Table of Contents

Pest Management Recommendations for Field Crops

This bulletin is divided into three sections - disease and nematode control, insect control, and weed control. The recommendations are listed according to crop and then pest. In the table of recommendations given under each crop, the pesticide recommendations are given in units (pints, pounds, and so forth) of commercial products. In most cases, the amount of active ingredient to be applied is given. This information will be useful if the pesticide is commercially available at different concentrations. If a pesticide concentration differs from that recommended, determine the amount of a given formulation you need to use to apply the pesticide at the recommended rate. For example, if the recommended rate is 1 pound of active ingredient, then you should use 2 pounds of a 50 percent, wettable-powder formulation. If the formulation is a liquid, you must know the pounds of active ingredient per gallon to make this calculation.

To the best of our knowledge, all recommended rates in this publication are in accordance with those on the product labels. However, if there is disagreement between recommendations in this bulletin and what is stated on the label, always follow the label directions.

Pay particular attention to the columns Time limit: Days before harvest and Remarks. If you have any questions about a recommendation given in this bulletin, consult your county Extension agent.

Disclaimer:

When trade names are included, no discrimination against similar products is intended. Mention of trademarks in this publication does not constitute an endorsement by Maryland Cooperative Extension.

Guide to Abbreviations

A	=	acre
AS	=	aqueous solution or suspension
DF	=	dry flowable
DG	=	dispersible granule
E, EC	=	emulsifiable concentrate
F, FL, L	=	flowable liquid
G	=	granular
LC	=	liquid concentrate
S	=	solution
SP	=	soluble powder
W, WP	=	wettable powder
WDG	=	water-dispersible granule

Other formulations also may be registered.

Use Pesticides Correctly and Safely

A.E. Brown
Extension pesticide coordinator
Department of Entomology
University of Maryland, College Park

A pesticide is any chemical used to control a pest. Pests may be such organisms as insects, plant-disease agents, weeds, nematodes, and others. Therefore, insecticides, fungicides, and herbicides are all types of pesticides. When used carefully, pesticides can provide great benefits; but since they are designed to be toxic, they also can present risks to users and consumers when used improperly.

Classification Status

Pesticides that are not considered likely to harm humans or the environment when used according to label directions are classified for general use and may be purchased and applied by anyone. However, commercial applicators must obtain a business license from the Maryland Department of Agriculture to apply any pesticide commercially. The U.S. Environmental Protection Agency (EPA) has determined that some pesticides may pose a threat even when used according to label directions; these materials are classified for restricted use. Pesticides may be classified for restricted use if they are highly toxic; they have a history of accidents; they may cause oncogenic effects (tumors), teratogenic effects (birth defects), fetotoxic effects (harm to a developing fetus), or re-pro-ductive effects (such as a lowered sperm count); they can leach into ground water; or, they can harm wildlife. To assist you in understanding why a particular pesticide has been classified for restricted use, and to help you understand what precautions you should take to prevent adverse effects, reasons for restriction are identified in the table "Environmental and health effects of pesticides," which is found at the end of this section. Restricted-use products may be purchased and applied only by a trained, certified pesticide applicator or under the supervision of one. Consult your county Extension agent for information about certification.

Read and Follow the Label

Your best guide to the correct and safe use of any pesticide is the product label. Pesticide labels contain such important and pertinent information as the brand or trade name, the amount of active ingredient, directions for use, environmental hazards, what to do in the case of an accident, and storage and disposal directions.

An important feature of pesticide labels is that they are required by law to carry certain signal words that indicate their relative hazard to humans. Highly toxic pesticides must carry the signal word danger along with the word poison and the skull-and-crossbones symbol. The approximate amount of a highly toxic pesticide needed to kill the average person is a taste to a teaspoon. In the case of moderately toxic pesticides, the required signal word on the label is warning with the approximate lethal dose being a teaspoon to an ounce. Those pesticides that are designated to be of low toxicity or comparatively free from danger will carry the signal word caution, and an ounce to more than a pint is the approximate amount needed to kill the average person. Acute toxicity information provided in the table on the following pages is based on animal studies with technical-grade material. Be aware that a formulated product can be either more or less toxic than the technical-grade material. Check the signal word on the label of the product you will be using to be sure.

Reducing Risks to Pesticide Handlers and Field Workers

Risk depends on both toxicity (how poisonous a chemical is) and exposure. Reducing exposure to a minimum reduces risk. The use of protective clothing and equipment is one of the best means to reduce exposure. Maryland Cooperative Extension recommends long pants, a long-sleeved shirt, and socks and shoes as the minimum outfit that a person should wear whenever handling pesticides. If special protective clothing is required, the pesticide label must bear a statement identifying the appropriate gear. However, it is wise to wear extra-protective clothing even if it is not required. A hat will protect your scalp, ears, and eyes (all very absorbent parts of the body) from inadvertent contact with spray drift. Gloves, goggles, face masks, respirators, coveralls, and boots are required when mixing, loading, and applying some pesticides. Gloves or boots should be made of rubber or neoprene, never leather. Leather absorbs chemicals very easily and cannot be decontaminated. Also make sure that belts, hat bands, and other protective gear are not leather.

Organophosphate and carbamate insecticides inhibit cholinesterase, an enzyme in the body that is necessary for proper nerve function. Applicators frequently using these insecticides should have their cholinesterase levels monitored before the spray season begins to establish a baseline reading and continue regular monitoring throughout the season. Organophosphate and carbamate insecticides recommended in this bulletin are identified in the table "Environmental and health effects of pesticides" found at the end of this section. Check with your county Extension agent for information on cholinesterase testing.

On January 1, 1995, the U.S. Environmental Protection Agency (EPA) fully implemented a comprehensive set of standards to protect workers in nurseries, greenhouses, forests, and related structures, as well as on farms. This regulation is called the Worker Protection Standard or WPS. The regulation covers pesticide applicators, mixer/loaders, and workers who perform tasks in treated areas of these operations and, thus, may be exposed to pesticide residues. Owners, leaseholders, and operators of these establishments, and their contractors, supervisors, and workers are subject to enforcement actions.

The elements of these safety standards include requirements for training handlers and workers, notification of pesticide applications, the use of specific protective equipment, establishment of specific reentry periods, requirements for decontamination procedures, and assignment of emergency duties. More information on WPS is available from your county Extension office. Know and follow all requirements under the standard.

Reducing Risks to the Environment

Besides posing risks to the applicator, pesticides also can harm the environment when misused or when used without properly considering the site of application or storage. Be aware of sensitive organisms (fish, birds, and other wildlife) and areas (streams, wells, bare ground areas, and adjacent land uses) in making your decisions about the safest chemical to choose for a particular job. The table "Environmental and health effects of pesticides," found at the end of this section, includes notes on specific chemicals' toxicity to wildlife, ground water contamination potential, phytotoxicity (ability to cause plant injury), and other factors to consider. The pesticide label also provides such information.

Reducing Risks to Consumers

Although degradation of pesticide residues in and on the plant occurs with time, small amounts of pesticide will often remain at harvest. The EPA determines safe levels of residues that can remain at harvest and establishes a tolerance or legally allowable level for each pesticide on each commodity for which it is registered. The tolerance is usually in the range of 0.1 to 10 parts of the pesticide per million parts (ppm) of the crop. You must check the pesticide label for the required waiting period between application and harvest, which is identified on the label and in this bulletin as days to harvest or the preharvest interval (PHI). You also must make sure that the proper dose is applied at the correct time. Using a higher dose than the label states could result in illegal and possibly harmful levels of residue at harvest.

Proper Application

In addition to and in conjunction with information provided on the pesticide label, we offer the following suggestions to assist you in carrying out an effective and spray-saving operation:

- If you are in doubt about the use of or need for a pesticide on a crop, contact your county Extension agent for advice or assistance.
- Do not use a pesticide on a crop or for a pest not listed on the label.
- Do not use any pesticide at a rate higher than that recommended or specified on the label. Overdosing is expensive and illegal.
- Make sure your sprayer is calibrated properly.
- Wear a protective mask or clothing if the label so directs.
- Do not spray when temperatures are over 85°F or under high wind conditions. Avoid spray drift on people, animals, and nearby crops.
- Spray in the late afternoon or evening to avoid killing honeybees and other pollinating insects.
- Cover the foliage uniformly with spray, but do not use excessive amounts of water. Too much water can weaken the potency of a finished spray.
- Never harvest a crop sooner than the indicated time interval (limit) between the last spraying and harvest.
- In the case of accidental poisoning, contact your physician or call the nearest Poison Control Center. See the listing on the back cover of this bulletin.

Proper Storage

Improper storage of pesticides can lead to accidental poisonings, contamination of the environment, and deterioration of the chemicals themselves. The storage building should be fireproof, with good lighting and ventilation, and an exhaust fan. The building must be posted with appropriate warning signs and should be kept locked at all times. The storage area must be separate from living, working, and eating areas. Shelves should be sturdy. Metal shelves are easiest to clean if there is a spill; wooden shelves should be lined with absorbent paper. All pesticides should be stored in their original containers. If the label becomes damaged or unreadable, contact your dealer for a copy to attach to the container. Store herbicides separately from other pesticides, fertilizers, and other materials to prevent cross-contamination, which could lead to plant injury. To delay chemical breakdown, keep pesticides out of direct sunlight and do not allow them to freeze. Most pesticides have a storage life of about 2 years under good conditions. Have first aid and spill cleanup materials handy.

Proper Disposal

There are few environmentally safe ways to dispose of leftover or unwanted pesticides. The safest and least expensive way is to use them according to label directions. Empty containers still contain small amounts of pesticides and must be

disposed of properly to avoid accidents or environmental contamination. When using liquid pesticides, fill the container one-quarter full with diluent, replace the closure or plug, rotate the container, and add the rinsate to the spray tank. Repeat this procedure two more times, then puncture the top and bottom of the container to prevent reuse. When using dry formulations, carefully empty the contents of the container into the tank, then cut both ends to help remove any remaining pesticide and to prevent reuse. Containers of both liquid and dry formulations can

Recordkeeping

Federal and state laws require keeping records of pesticide use. This is a recordkeeping requirement, not a record reporting requirement. Access to records will be granted only through the U.S. Secretary of Agriculture, the state agency responsible for reinforcing pesticide laws, or a health professional. The laws vary and the requirements differ for private and commercial certified applicators in the states covered by these recommendations. However, all applicators in these states will fulfill the various legal requirements by keeping the information listed below. Fill in a standard form similar to the following one to be sure you get all the necessary data for each application. In addition to meeting the requirements, keeping records of pesticide use is a wise precaution. Records can establish proof of proper pesticide use in damage suits, provide information to trace residue or damage problems, and allow you to compare the results obtained from different pesticides. The more information on record, the more useful the records will be to you. More information on recordkeeping is available from your county Extension office.

Pesticide Application Record

Name and address of certified applicator: _____

Name and address of applicator (if different than above): _____

Name of owner or tenant of property: _____

Location of application site: _____

Date of application: _____

Time of application: _____

Wind direction: _____

Estimated wind velocity: _____

Other weather conditions: _____

Common name of pesticide	Formulation	EPA registration number	Rate
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Total amount of pesticide used: _____

Rate and concentration of pesticide used: _____

Type of equipment used: _____

Target pest: _____

Crop, site, or commodity treated: _____

Acreage, size, or number of plants treated: _____

Comments: _____

_____

_____

_____

Field Map

Environmental and health effects of pesticides

Environmental and health effects of pesticides - fungicides and/or nematicides

Fungicide and/or nematicide	Trade name	Classification [a]	Toxicity to Mammals			Remarks
			Oral LD_{50} [b]	Acute oral	Acute dermal	
1,3-dichloropropene (1,3-D)	Telone, Telone II	R1,3,5	250	Moderate	Moderate	Probable human carcinogen. Causes severe eye damage through contact. May cause lung, liver, and kidney damage, and respiratory system irritation through prolonged contact. May cause allergic skin reaction.
Aldicarb	Temik	R4	1	High	High	Carbamate insecticide/nematicide. Extremely toxic to mammals. Has the potential to leach into groundwater.
Azoxystrobin	Quadris	G	>5,000	Low	Moderate	May cause mild irritation following eye contact.
Bordeaux mixture	Bordeaux mixture	G	NA	Very low	Very low	
Captan	Rival, Captan	G	8,400	Very low	Very low	Causes irreversible eye damage through direct contact. May cause allergic skin reaction. May cause eye irritation. Toxic to fish.
Carboxin	Vitavax	G	3,820	Low	Very low	
Chlorothalonil	Bravo	G	10,000	Very low	Very low	May irritate eyes. Very toxic to fish and other marine organisms.
Difenoconazole	Dividend	G	1,453	Low	Low	Toxic to fish. Practically nontoxic to birds, honeybees, and earthworms.
Ethoprop	Mocap	R2	34	High	High	Organophosphate insecticide/nematicide. Highly toxic to birds; toxic to fish, other aquatic invertebrates, and other wildlife.
Fenamiphos	Nemacur	R1,2,3,9	5	High	High	Organophosphate insecticide/nematicide. Causes irreversible eye damage through direct contact. Toxic to fish and wildlife.

Environmental and health effects of pesticides - fungicides and/or nematicides (continued)

Fungicide and/or nematicide	Trade name	Classification [a]	Toxicity to Mammals			Remarks
			Oral LD_{50} [b]	Acute oral	Acute dermal	
Ferbam	Carbamate	G	>5,000	Low	Low	May cause irritation of eyes, nose, throat, and skin. Toxic to fish; nontoxic to bees.
Fludioxonil	Maxim	G	>5,000	Very low	Very low	Highly toxic to fish.
Imazalil	Flo-Pro IMZ	G	320	Moderate	Low	
Mancozeb	Dithane, Penncozeb, Manzate	G	4,500	Low	Very low	May cause irritation of throat, nose, eyes, and skin. Toxic to fish; slightly toxic to birds.
Mefenoxam	Ridomil Gold, Apron XL	G	669	Moderate	Low	May cause substantial but temporary skin and eye irritation. Subject to developing resistant strains of fungi. Corrosive.
Metalaxyl	Allegiance, Apron, Ridomil	G	669	Low	Low	Relatively nontoxic to fish.
Oxamyl	Vydate	R1,3,9	5	High	Low	Carbamate insecticide/nematicide. Contains methanol; may be fatal or cause blindness if swallowed. Highly toxic to bees; toxic to birds, fish, other aquatic invertebrates, and other wildlife. Has the potential to leach into groundwater.
PCNB	Terraclor, Rival	G	1,200	Low	Low	
Propiconazole	Tilt	G	1,517	Low	NA	Causes eye irritation. May cause skin sensitization reactions. Toxic to fish.
Pyraclostrobin	Headline	G	200	Moderate	Low	May cause skin irritation and substantial but temporary eye injury. Toxic to fish and aquatic invertebrates. Has a potential for runoff for several months or more after application.
Streptomycin sulfate	Agri-Strep	G	9,000	Very low	NA	May cause allergic skin reaction.

Environmental and health effects of pesticides - fungicides and/or nematicides (continued)

Fungicide and/or nematicide	Trade name	Classification [a]	Toxicity to Mammals			Remarks
			Oral LD_{50} [b]	Acute oral	Acute dermal	
Tebuconazole	Folicur, Raxil	G	4,000	Low	Very low	
Terbufos	Counter	R1,2,9	4	High	High	Organophosphate insecticide/nematicide. Toxic to birds, fish, and other wildlife.
Thiabendazole	Mertect, Rival	G	3,100	Low	Low	Slightly toxic to fish.
Thiophanate methyl	Topsin-M	G	7,500	Very low	NA	Causes moderate eye irritation. Toxic to fish.
Thiram	Thiram	G	780	Low	Very low	Avoid alcohol before and after use because alcohol increases the toxic effects of Thiram.
Triadimefon	Bayleton	G	363	Moderate	Very low	Toxic to fish.
Triadimenol	Baytan	G	689	Low	Very low	Toxic to fish.
Trifloxystrobin	Stratego	G	>2,000	Low	Low	Direct contact can cause substantial but temporary eye injury. Toxic to fish and aquatic invertebrates.

[a] G refers to general use, R refers to restricted use. Reasons for restrictions are as follows: R1 = acute oral toxicity; R2 = acute dermal toxicity; R3 = acute inhalation toxicity; R4 = accident history; R5 = ability to cause tumors (oncogenicity); R6 = ability to cause birth defects (teratogenicity); R7 = fetotoxicity; R8 = reproductive effects (not applicable to pesticides recommended in this publication at this time); R9 = effects on birds; R10 = effects on fish or other aquatic life; R11 = effects on terrestrial wildlife; R12 = groundwater contamination potential; R13 = hazardous to nontarget plants; R14 = worker exposure concerns.

[b] Based on technical product.

NA— means not available.

Environmental and health effects of pesticides - herbicides

Herbicide [a]	Trade name	Classification [b]	Toxicity to Mammals: Oral LD_{50} [c]	Toxicity to Mammals: Acute oral	Toxicity to Mammals: Acute dermal	Remarks
2,4-D	2,4-D LVE OSA	G	375	Moderate	Low	May cause skin and eye irritation. Has the potential to leach into groundwater. Low volatility esters may become volatile at 90°F and above. Do not apply near desired plants. Application equipment must be cleaned with special materials before applying other pesticides.
2,4-DB	Butoxone, Butyrac	G	1,960	Low	Low	May cause skin and eye irritation. Toxic to fish.
Acetochlor	Degree, Harness, TopNotch	R5	2,690	Low	Low	Highly toxic to fish and aquatic plants; moderately toxic to aquatic invertebrates; slightly toxic to birds. Acetochlor has the potential to contaminate ground and surface water.
Acifluorfen-sodium	Ultra Blazer	G	1,300	Low	Moderate	Rain or irrigation within 6 hours after application will reduce efficacy. Irritating to eyes and skin.
Alachlor	Lasso Micro-Tech	R5	930	Low	Very low	Can cause eye and skin irritation. Has been detected in ground and surface water.
Ametryn	Evik	G	1,405	Low	Very low	Moves vertically and laterally due to high water solubility. Do not apply near desired plants.
Atrazine	Aatrex and others	R12,14	1,780	Low	Very low	Residues may remain in the soil for over 1 year. Has been detected in drinking water samples. Moves vertically and laterally with water. Do not apply near desired plants. A buffer area is required between atrazine application sites and surface water. Mixing/loading set backs are 50 feet from surface water. Application set backs are 200 feet from lakes or reservoirs or 66 feet from points where field surface water enters a perennial or intermittent stream.

Environmental and health effects of pesticides - herbicides (continued)

Herbicide [a]	Trade name	Classification [b]	Toxicity to Mammals: Oral LD_{50} [c]	Toxicity to Mammals: Acute oral	Toxicity to Mammals: Acute dermal	Remarks
Benefin	Balan	G	>7,000	Very low	Low	
Bentazon	Basagran	G	1,100	Low	Low	May cause eye and skin irritation.
Bromoxynil	Buctril, Brominal	G	190	Moderate	Low	Mild eye and skin irritation. Toxic to fish. Nonvolatile.
Carfentrazone-ethyl	Aim	G	5,143	Very low	Low	
Chlorimuron-ethyl	Classic	G	>4,000	Low	Low	May cause eye and skin irritation. Sensitive rotational crops include corn and sorghum.
Chlorsulfuron	Glean	G	3,053	Low	Low	
Clethodim	Select	G	2,920	Low	Low	
Clomazone	Command	G	1,369	Low	Low	May cause eye and skin irritation. Relatively nontoxic to fish. Foliar contact or vapors may cause chlorosis (light spotting) to sensitive plants.
Clopyralid	Stinger	G	>5,000	Low	Low	May cause eye damage, skin irritation.
Cloransulam-methyl	FirstRate	G	>5,000	Very low	Low	May cause eye irritation. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination. Under some conditions, may have a high potential for runoff for several weeks postapplication.
Dicamba	Banvel/Clarity	G	1,040	Low	Low	Relatively mobile in the soil.
Dicamba + diflufenzopyr (sodium salt)	Distinct or Overdrive	G		Low	Very low	Causes moderate eye irritation. Prolonged or frequent skin contact may cause allergic reaction in some individuals. Use of this product in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination.

Environmental and health effects of pesticides - herbicides (continued)

Herbicide [a]	Trade name	Classification [b]	Toxicity to Mammals: Oral LD_{50} [c]	Toxicity to Mammals: Acute oral	Toxicity to Mammals: Acute dermal	Remarks
Diclofop methyl	Hoelon	R5	563	Low	Very low	May cause eye and skin irritation. Toxic to fish. Cool temperatures and wet soil may induce plant injury.
Diclosulam	Strongarm	G	>5,000	Very low	Low	Moderate eye irritation. Use in areas where soils are permeable, especially where the water table is shallow, may result in groundwater contamination. Under some conditions, may have high potential for runoff.
Diflufenzopyr + dicamba (sodium salt)	Distinct or Overdrive	G		Low	Very low	Causes moderate eye irritation. Prolonged or frequent skin contact may cause allergic reaction in some individuals. Use of this product in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination.
Dimethenamid-p	Outlook	G	695	Low	Low	May cause substantial but temporary eye injury. Dimethenamid-p has properties that may result in contamination of groundwater. Application in areas where soils are permeable or coarse and groundwater is near the surface could result in groundwater contamination.
Diuron	Karmex	G	1,017	Low	Very low	May cause eye and skin irritation. Do not use on light, sandy soils.
Ethafluralin	Sonalan	G	>10,000	Low	NA	May cause eye and skin irritation.
Fenoxaprop-ethyl	Acclaim	G	3,310	Low	Low	Toxic to fish.
Fluazifop-P-butyl	Fusilade	G	2,451	Low	Low	May cause eye irritation.

Environmental and health effects of pesticides - herbicides (continued)

Herbicide [a]	Trade name	Classification [b]	Toxicity to Mammals: Oral LD_{50} [c]	Toxicity to Mammals: Acute oral	Toxicity to Mammals: Acute dermal	Remarks
Flufenacet	Define	G	371	Moderate	Low	Prolonged or frequently repeated skin contact may cause allergic reaction in some individuals.
Flumetsulam	Python	G	>5,000	Low	Low	Relatively nontoxic to bees. Broadstrike has the potential to contaminate groundwater.
Flumiclorac	Resource	G	3,200	Low	Low	
Flumioxazin	Valor	G	>5,000	Low	Moderate	Toxic to nontarget plants and aquatic invertebrates.
Fomesafen	Reflex, Flexstar	G	1,500	Low	NA	May cause eye and skin irritation.
Glufosinate-ammonium	Liberty	G	1,620	Low	Low	Relatively nontoxic to fish.
Glyphosate	Roundup Weather Max, Touchdown Total, and others	G	4,900	Low	Very low	May cause skin and eye irritation. Do not use or store in galvanized or unlined steel spray equipment. Glyphosate will react with the metal to produce a highly combustible gas. Avoid spraying the foliage of any desirable plant. Low toxicity to fish and wildlife.
Halosulfuron-methyl	Permit or Sandea	G	1,287	Low	Very low	May cause slight eye irritation.
Hexazinone	Velpar	G	1,690	Low	NA	Irritating to the eyes. Relatively nontoxic to fish and wildlife. Do not use near desirable plants.
Imazamox	Raptor					
Imazapyr + imazethapyr	Lightning	NA	>5,000	Very low	Low	May cause substantial but temporary eye injury. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination.
Imazaquin	Scepter	G	5,000	Low	Low	May cause skin irritation.

Environmental and health effects of pesticides - herbicides (continued)

Herbicide [a]	Trade name	Classification [b]	Toxicity to Mammals: Oral LD_{50} [c]	Toxicity to Mammals: Acute oral	Toxicity to Mammals: Acute dermal	Remarks
Imazethapyr	Pursuit	G	>5,000	Very low	Low	May cause eye and skin irritation.
Imazethapyr + imazapyr	Lightning	NA	>5,000	Very low	Low	
Isopropalin	Paarlan	G	>5,000	Very low	NA	Strongly adsorbed by the soil and resistant to leaching by water. Do not plant any other food or feed crops in treated soil for 1 year after application.
Isoxaflutole	Balance	R13	>5,000	Very low	Low	
Lactofen	Cobra	G	>5,000	Very low	Low	May cause eye and skin irritation.
Linuron	Lorox, Linex and others	G	1,500	Low	Low	May irritate eyes, nose, throat, and skin. Moderately toxic to fish, shellfish, and wild birds. Crop injury may result on sandy soils or soils containing less than 1 percent organic matter.
MCPA	Rhomene	G	700	Low	Low	May be irritating to eyes and skin. Nonvolatile. Do not use the same machinery to apply other pesticides after using MCPA.
Mesotrione	Callisto	G	>5,000	Low	Low	Prolonged or frequently repeated skin contact may cause allergic reaction in some individuals. This product has a high potential for runoff for several weeks after application.
Metribuzin	Sencor	G	1,100	Low	Very low	High potential for leaching into ground-water. Do not use on sandy or sandy loam soils containing less than 2 percent organic matter. Moderately toxic to birds and fresh water invertebrates. May result in surface water contamination through runoff.
Metsulfuron-methyl	Cimarron	G	>5,000	Low	Low	May cause eye and skin irritation.
Napropamide	Devrinol	G	>500	Low	Very low	Toxic to fish.

Environmental and health effects of pesticides - herbicides (continued)

Herbicide [a]	Trade name	Classification [b]	Toxicity to Mammals: Oral LD_{50} [c]	Toxicity to Mammals: Acute oral	Toxicity to Mammals: Acute dermal	Remarks
Naptalam	Alanap	G	>5,000	Very low	Low	Causes eye irritation. May cause crop injury when applied to soils low in organic matter, low in clay content, or with a pH of 9 or above.
Nicosulfuron	Accent	G	>5,000	Low	Low	May cause slight eye irritation. Do not use within 7 days of an organophosphate foliar insecticide application.
Paraquat	Gramoxone Inteon	R1,4	20	High	Moderate	Very toxic to humans, especially when ingested or inhaled. Moderately toxic to marine species. Immediately inactivated when in contact with soil. Nonvolatile.
Pebulate	Tillam	G	921	Low	Low	
Pendimethalin	Prowl	G	1,250	Low	Very low	Resists leaching. Toxic to fish.
Picloram	Tordon	R13	8,200	Very Low	Low	Hazard to nontarget plants, crop and noncrop.
Primisulfuron-methyl	Beacon	G	>5,050	Low	Low	May cause slight eye irritation.
Pronamide	Kerb	R5	5,620	Very low	Very low	Mildly irritating to eyes and skin.
Propachlor	Ramrod	G	710	Low	Moderate	Moderately irritating to eyes. Toxic to fish.
Prosulfuron	Peak	G	986	Low	Low	
Pyridate	Tough	G	2,000	Low	Low	May cause eye and skin irritation.
Quizalofop-P-ethyl	Assure II or Targa	G	1,182	Low	Low	May cause eye and skin irritation. Highly toxic to freshwater fish.
Rimsulfuron	Matrix	G	>5,000	Very low	Low	May cause eye irritation.
Sethoxydim	Poast, Poast Plus	G	3,200	Low	Very low	Causes eye and skin irritation.
Simazine	Princep	G	>5,000	Very low	Low	May cause slight eye and skin irritation. Low toxicity to fish and wildlife.

Environmental and health effects of pesticides - herbicides (continued)

Herbicide [a]	Trade name	Classification [b]	Toxicity to Mammals: Oral LD_{50} [c]	Toxicity to Mammals: Acute oral	Toxicity to Mammals: Acute dermal	Remarks
s-metolachlor	Dual II Magnum/Cinch	G	1,200	Low	Very low	Dangerous when inhaled. May cause eye and skin irritation. Has potential for ground and surface water contamination due to slow degradation and ease of leaching. Toxic to fish.
Sodium chlorate	Defol	G	1,200	Low	Low	Somewhat irritating to eyes, skin, and mucous membranes.
Sulfentrazone	Authority, Spartan	G	2,000	Low	Low	May cause slight skin irritation.
Tebuthiuron	Spike	G	640	Low	Low	Low toxicity to fish and wildlife. Vertical leaching in soil is slow; no lateral movement has been observed.
Terbacil	Sinbar	G	>5,000 <7,500	Very low	Very low	May irritate eyes, nose, throat, and skin. Do not use on sandy soils or soils containing less than 1 percent organic matter.
Thifensulfuron-methyl	Harmony GT XP	G	>5,000	Very low	Low	May cause slight eye and skin irritation.
Tribenuron-methyl	Express	G	>5,000	Low	Low	May cause eye and skin irritation.
Triclopyr	Garlon or Remedy	G	630	Low	Low	Irritating to eyes and skin. Toxic to fish. See listings for Crossbow in Pasture section.
Trifluralin	Treflan and others	G	3,900	Low	Very low	Toxic to fish.

[a] For trade names of herbicide mixtures, see page 2-2

[b] G refers to general use, R refers to restricted use. Reasons for restrictions are as follows: R1 = acute oral toxicity; R2 = acute dermal toxicity; R3 = acute inhalation toxicity; R4 = accident history; R5 = ability to cause tumors (oncogenicity); R6 = ability to cause birth defects (teratogenicity); R7 = fetotoxicity; R8 = reproductive effects (not applicable to pesticides recommended in this publication at this time); R9 = effects on birds; R10 = effects on fish or other aquatic life; R11 = effects on terrestrial wildlife; R12 = groundwater contamination potential; R13 = hazardous to nontarget plants; R14 = worker exposure concerns.

[c] Based on technical product.

NA— means not available.

Environmental and health effects of pesticides - insecticides

Insecticide	Trade name	Classification [a]	Toxicity to Mammals: Oral LD_{50} [b]	Toxicity to Mammals: Acute oral	Toxicity to Mammals: Acute dermal	Remarks
Acephate	Orthene	G	361	Moderate	Moderate	Organophosphate. Toxic to bees; moderately toxic to birds; relatively nontoxic to fish.
Azinphos-methyl	Guthion	R3,4,9,10,11	11	High	Moderate	Organophosphate. Moderately toxic to birds; highly toxic to bees, fish, and other wildlife.
Bacillus thuringiensis	Dipel Agree Biobit Crymax Deliver Xentari Javelin	G	NA	Very low	Very low	Protein toxin from a soil bacterium. Very low toxicity to mammals, fish, birds, and bees.
Carbaryl	Sevin	G	500	Low	Low	Carbamate. Very low to low toxicity to birds and fish; highly toxic to bees.
Carbofuran	Furadan	R1,2,3,9	8	High	High	Carbamate. Highly toxic to birds, fish, and bees. Do not mix with alkaline pesticides.
Chlorpyrifos	Dursban Lorsban	R9,10	163	Moderate	Moderate	Organophosphate. Toxic to fish, crustaceans, and bees; moderately toxic to birds. Incompatible with alkaline materials.
Chlorpyrifos-methyl	Reldan	G	1,000	Low	Low	Organophosphate. Toxic to fish.
Clothianidin	Poncho 250 Poncho 1250	G	>5,000 mg/kg	>5,000 mg/kg	>2.628 mg/L/4 hrs	Neonicotinoid. Toxic to aquatic invertebrates.
Cyfluthrin	Baythroid Tempo	R10	826	Low	Low	Pyrethroid. Eye irritant. Toxic to fish.
DDVP (dichlorvos)	Vapona	G	80	Moderate	Moderate	Organophosphate.
Diazinon	Diazinon	G	76	Moderate	Moderate	Organophosphate. Moderately toxic to birds; highly toxic to fish and bees.
Dimethoate	Cygon	G	235	Moderate	Moderate	Organophosphate. Highly toxic to birds.

Environmental and health effects of pesticides - insecticides (continued)

Insecticide	Trade name	Classification [a]	Toxicity to Mammals: Oral LD_{50} [b]	Toxicity to Mammals: Acute oral	Toxicity to Mammals: Acute dermal	Remarks
Disulfoton	Disyston	R2,3	2	High	High	Organophosphate. Toxic to fish, bees, and birds. Plant injury may result when used with certain preemergence herbicides.
Endosulfan	Phaser Thiodan	G	160	Moderate	Moderate	Chlorinated hydrocarbon. Toxic to fish and birds.
Esfenvalerate	Asana	R10	450	Moderate	Low	Pyrethroid. Can cause eye and skin irritation. Highly toxic to fish, other aquatic organisms, and bees. Incompatible with alkaline materials.
Ethoprop	Mocap	R2	62	Moderate	High	Organophosate. Toxic to wildlife and fish; moderately toxic to birds.
Fensulfothion	Dasanit	R2,3	2	High	High	Organophosphate. Highly toxic to birds; toxic to fish and bees. Incompatible with alkaline materials.
Fipronil	Regent 80WG	R9,10	336	Moderate	Moderate	Fiprole. May cause allergic reaction and/or eye irritation. Toxic to estuarine invertebrates.
Fonofos	Dyfonate	R2	16	High	High	Organophosphate. Toxic to fish and wildlife; moderately toxic to birds.
Gamma-cyhalothrin	Proaxis	R10	>2,500	Low	Low	Pyrethroid. Toxic to fish. Causes moderate eye and skin irritation.
Imidacloprid	Admire Provado Gaucho	G	4,143	Low	Very low	Neonicotinoid. Highly toxic to bees and aquatic invertebrates.
Indoxacarb	Steward	G	751	Low	Very low	Oxadiazine. Causes moderate eye irritation. Prolonged or frequent skin contact may cause allergic reaction in some individuals. Toxic to mammals, fish, birds, and invertebrates. Highly toxic to bees.
Lambdacyhalothrin	Warrior	R10	56	Moderate	Low	Pyrethroid. Toxic to fish.

Environmental and health effects of pesticides - insecticides (continued)

Insecticide	Trade name	Classification [a]	Toxicity to Mammals: Oral LD_{50} [b]	Toxicity to Mammals: Acute oral	Toxicity to Mammals: Acute dermal	Remarks
Lindane	Lindane	R5	88	Moderate	Moderate	Chlorinated hydrocarbon. Highly toxic to fish and bees; moderately toxic to birds. Phytotoxic if used at excessive rates.
Malathion	Cythion	G	1,000	Low	Low	Organophosphate. Low toxicity to birds; highly toxic to fish and bees. Incompatible with alkaline materials.
Metaldehyde	Metaldehyde bait	G	630	Low	NA	Molluscicide.
Methobyl	Lannate Nudrin	R4,11	17	High	Moderate	Organophosphate. Toxic to bees; low toxicity to birds.
Methoprene	Diacon	G	>34,600	Low	Low	Insect growth regulator.
Microencapsulated methyl parathion	Penncap-M	R2,4,9,11	270	Moderate	Low	Organophosphate. Highly toxic to birds, fish, and bees.
Oxamyl	Vydate	R1,3,9	5	High	Moderate	Carbamate. Highly toxic to birds, fish, and bees.
Permethrin	Ambush Pounce	R5,10	4,000	Low	Low	Pyrethroid. Can cause eye and skin irritation. Highly toxic to fish, other aquatic organisms, and bees.
Phorate	Thimet	R1,2,9,10,11	1	High	High	Organophosphate. Toxic to bees; moderately toxic to birds. Incompatible with alkaline materials.
Phosmet	Imidan	G	147	Moderate	Low	Organophosphate. Toxic to fish, bees, and wildlife; moderately toxic to birds. Incompatible with alkaline materials.
Pirimiphos-methyl	Actellic	G	>2,000	Low	Low	Organophosphate. Toxic to birds, fish, and bees.
Pymetrozine	Fulfill	G	>5,000	Very low	Low	Pyridine azomethine

Environmental and health effects of pesticides - insecticides (continued)

Insecticide	Trade name	Classification [a]	Toxicity to Mammals: Oral LD_{50} [b]	Toxicity to Mammals: Acute oral	Toxicity to Mammals: Acute dermal	Remarks
Spinosad	Tracer	G	5,000	Very low	Very low	May cause slight eye irritation. Highly toxic to bees and mollusks.
Tefluthrin	Force	R14	22	High	NA	Pyrethroid. Can cause eye and skin irritation. Probable high toxicity to fish, other aquatic organisms, and bees; conditionally registered until toxicity to fish and other aquatic organisms is further assessed.
Terbufos	Counter	R1,2,9	4	High	High	Organophosphate. Highly toxic to birds, fish, and wildlife.
Thiamethoxam	Platinum Actara Cruiser	G	>5000	Very low	Low	Neonicotinoid. Causes moderate eye irritation. Toxic to fish and aquatic invertebrates.
Thiodicarb	Larvin	G	66	Moderate	Low	Carbamate. Moderate toxicity to bees. Do not add to water with a pH of less than 3.0 or above 8.5.
Tralomethrin	Scout	R10	1,250	Low	Low	Pyrethroid. Highly toxic to fish and bees.
Zeta--cypermethrin	Mustang	R10	234	Moderate	Moderate	Pyrethroid. Causes moderate eye irritation. May cause sensitization reaction in some individuals. Extremely toxic to fish and aquatic organisms. Highly toxic to bees.

[a] G refers to general use, R refers to restricted use. Reasons for restrictions are as follows: R1 = acute oral toxicity; R2 = acute dermal toxicity; R3 = acute inhalation toxicity; R4 = accident history; R5 = ability to cause tumors (oncogenicity); R6 = ability to cause birth defects (teratogenicity); R7 = fetotoxicity; R8 = reproductive effects (not applicable to pesticides recommended in this publication at this time); R9 = effects on birds; R10 = effects on fish or other aquatic life; R11 = effects on terrestrial wildlife; R12 = groundwater contamination potential; R13 = hazardous to nontarget plants; R14 = worker exposure concerns.

[b] Based on technical product.

NA— means not available.

Weed Control in Field Crops

R.L. Ritter, Extension weed control specialist,
Department of Natural Resource Sciences and Landscape Architecture,
University of Maryland, College Park

E.S. Hagood and H.P. Wilson
Virginia Polytechnic Institute and State University

W.S. Curran, Pennsylvania State University

B.A. Majek, Rutgers University, New Jersey

M. Van Gessel, University of Delaware

R.S. Chandran, West Virginia University

Chemical Weed Control in Field Crops

Herbicides are useful tools in most weed management programs. They should be used to supplement, not supplant, other methods or tools available. These other tools include good cultural practices, such as proper fertilization and liming, to give the crop a "head start," and crop rotation and proper cultivation, which are essential for a total weed management program. The following are definitions of terms you will find in this and similar publications on herbicides:

1. **Early preplant (EPP)**
   The herbicide is applied to the soil before planting. Generally used in no-till to control existing vegetation and provide early residual control.

2. **Preplant incorporated (PPI)**
   The herbicide is applied to the soil after plowing but before planting and mixed with the top few inches of soil with different incorporation implements.

3. **Preemergence (PRE)**
   The herbicide is applied after the crop is planted but before it emerges from the ground. Soil moisture, light rainfall, or shallow cultivation may be necessary to obtain good weed control with many preemergence herbicides.

4. **Postemergence (POST)**
   The herbicide is applied to the foliage of weeds after the crop has emerged.

5. **Surfactant**
   This is a surface-active agent that reduces the surface tension, thus permitting a more uniform application and spreading the herbicide solution evenly on the plant foliage or ground. Many terms designate particular surface activities, such as adjuvant, detergent, emulsifier, spreader, sticker, and wetting agent.

Most of the herbicides recommended in this publication are selective. At the recommended rate of application, they will selectively control or injure weeds but will not seriously damage the crop in which these weeds are growing. In using most selective herbicides, you should carefully follow the recommended rate of application because higher rates may severely injure or kill the crop. You must accept the responsibility if you use a herbicide in a manner other than that directed on the label. Read the label on the container and follow the directions.

The precision required for herbicide application is greater than for many other farm tasks. Three factors govern the rate of application: pressure, nozzle size, and ground speed. Contact your county Extension office for related publications.

Use Rate

The recommended use rates of herbicides generally vary with soil texture and organic matter content. The herbicide rates given in this section will refer only to three soil texture groups: coarse, medium, and fine. The following is a list of soil textures included in these three soil texture groups.

Soil textures

Soil texture group	Soil texture
Coarse	Sand, loamy sand, sandy loam
Medium	Loam, silt loam, silt, sand clay loam
Fine	Silty clay loam, clay loam, sandy clay, silty clay, clay

Refer to this table to determine the soil texture group for the soil you want to treat. Low rates of herbicides generally are used on coarse soils low in organic matter, while high rates generally are used on fine soils high in organic matter. Consult the label for the proper herbicide rate for your soils.

Development of Herbicide Resistant Weeds

Herbicide resistant weed populations may result through repeated use of herbicides with similar modes of action (see table on Guide to Single Active Ingredient Herbicides). Crop rotation, herbicide rotation or tank-mixing herbicides with different modes of action will help reduce buildup of herbicide resistant weeds.

Guide to prepackaged mixes

Product Name	Prepackaged mix ingredients	Formulation ratio	Manufacturer
Axiom 68DF	Define + metribuzin	0.544 + 0.136 lb ai/lb product	Bayer
Basis 75DF	Matrix + Harmony GT	0.5 + 0.25 lb ai/lb product	DuPont
Bicep II Magnum 5.5L	Dual II Magnum + atrazine	2.4 + 3.1 lb/gal	Syngenta
Bicep Lite II Magnum 6L	Dual II Magnum + atrazine	3.33 + 2.67 lb/gal	Syngenta
Boundary 6.5EC	Dual II Magnum + metribuzin	5.25 + 1.25 lb/gal	Syngenta
Buctril-Atrazine 3L [a]	Buctril + atrazine	1.0 + 2.0 lb/gal	Bayer
Bullet 4L	Lasso MT + atrazine	2.5 + 1.5 lb/gal	Monsanto
Camix 3.67L	Dual II Magnum/Cinch + Callisto	3.34 + 0.334 lb/gal	Syngenta
Canopy EX 29.5DF	Classic + Express	0.227 + 0.068 lb ai/lb product	DuPont
Celebrity Plus 70DF	Distinct + Accent	0.424 + 0.106 lb ai/lb product	BASF
Cinch ATZ 5.5L	Dual II Magnum/Cinch + atrazine	2.4 + 3.1 lb/gal	DuPont
Crossbow 3L	Remedy + 2,4-D	1.0 + 2.0 lb/gal	Dow AgroSciences
Curtail 2.4L [a]	Stinger + 2,4-D amine	0.4 + 2.0 lb/gal	Dow AgroSciences
Degree Xtra 4EC	Harness + atrazine	2.7 + 1.34 lb/gal	Monsanto
Distinct 70DF/Overdrive 70DF	Banvel/Clarity + diflufenzopyr	0.5 + 0.2 lb ai/lb product	BASF
Equip 32WG	Option + idosulfuron	0.30 + 0.02 lb ai/lb product	Bayer
Exceed 57WG	Peak + Beacon	0.285 + 0.285 lb ai/lb product	Syngenta
Extreme 2.17DF	Pursuit + Roundup	0.17 + 2.0 lb/gal	BASF
Field Master 4.25L	Roundup + Harness + atrazine	0.75 + 2.0 + 1.5 lb/gal	Monsanto
Finesse 75DF	Glean + Ally	0.625 + 0.125 lb ai/lb product	DuPont
FulTime 4CS	TopNotch + atrazine	2.4 + 1.6 lb/gal	Dow AgroSciences
Fusion 2.56E	Fusilade 2000 + Whip	2.0 + 0.56 lb/gal	Syngenta
Gangster (co-pack)	Valor + FirstRate	0.51 + 0.84 lb ai/lb product	Valent

Guide to prepackaged mixes (continued)

Product Name	Prepackaged mix ingredients	Formulation ratio	Manufacturer
Grazon P+D 2.54L [a]	2,4-D + Tordon	2.0 + 0.54 lb/gal	Dow AgroSciences
Guardsman Max 5L	Outlook + atrazine	1.7 + 3.3 lb/gal	BASF
Guardsman Max Lite 5L	Outlook + atrazine	2.25 + 2.75 lb/gal	BASF
Harmony Extra XP 75DF	Harmony GT XP + Express	0.50 + 0.25 lb ai/lb product	DuPont
Harness Xtra 5.6L	Harness + atrazine	3.1 + 2.5 lb/gal	Monsanto
Hornet 78.5WDG	Python + Stinger	0.185 + 0.6 lb ai/lb product	Dow AgroSciences
Keystone 5.25SE	Acetochlor + atrazine	3.0 + 2.25 lb/gal	Dow AgroSciences
Keystone LA 5.5L	Acetochlor + atrazine	4.0 + 1.5 lb/gal	Dow AgroSciences
Laddok S12 5L	Basagran + atrazine	2.5+ 2.5 lb/gal	MicroFlo
Landmaster 3.1SL	Roundup + 2,4-D amine	1.2 + 1.9 lb/gal	Monsanto
Lariat 4L	Lasso EC + atrazine	2.5 + 1.5 lb/gal	Monsanto
Lexar 3.7SC	Dual II Magnum + Callisto + atrazine	1.74 + 0.224 + 1.74 lb/gal	Syngenta
Lightning 70DG	Pursuit + Arsenal	0.525 + 0.175 lb ai/lb product	BASF
Lumax 3.95SC	Dual II Magnum + Callisto + atrazine	2.68 + 0.268 + 1.0 lb/gal	Syngenta
Marksman 3.2L	Banvel/Clarity + atrazine	1.1 + 2.1 lb/gal	BASF
NorthStar 47.4WG	Beacon + Banvel/Clarity	0.075 + 0.4 lb/gal	Syngenta
PastureGard 2SL	Remedy + Vista	1.5 + 0.5 lb/gal	Dow AgroSciences
Radius 4L	Define + Balance	3.57 + 0.43 lb/gal	Bayer
Ready Master ATZ 4L	Roundup + atrazine	2.0 + 2.0 lb/gal	Monsanto
Redeem 3EC	Remedy + Stinger	2.25 + 0.75 lb/gal	Dow AgroSciences
Sequence 5.25SC	Glyphosate + s-metolachlor	2.25 + 3.0 lb/gal	Syngenta
Spirit 57WG	Beacon + Peak	0.4275 + 0.1425	Syngenta
Steadfast 75DF	Accent + Matrix	0.5 + 0.25 lb ai/lb product	DuPont
Steadfast ATZ 89WG	Accent + Matrix + atrazine	0.027 + 0.013 + 0.85 lb ai/lb product	DuPont
Stellar 3.1EC	Resource + Cobra	0.7 + 2.4 lb/gal	Valent
Storm 4S	Basagran + Blazer	2.67 + 1.33 lb/gal	UPI
Surmount 1.34SL	Tordon + Vista	0.67 + 0.67 lb/gal	Dow AgroSciences
Synchrony XP 28.4DF	Classic + Harmony GT XP	0.215 + 0.069 lb ai/lb product	DuPont
Yukon 67.5 WDG	Permit + dicamba	0.125 + 0.55 lb ai/lb product	Monsanto

[a] Products not targeted for major distribution in Delaware, Maryland, Virginia, and West Virginia.

Guide to single active ingredient herbicides

Trade Name	Common Name	Mode of Action	Manufacturer
Accent	Nicosulfuron	ALS Inhibitor	DuPont
Aim	Carfentrazone-ethyl	PPO Inhibitor	FMC
Arsenal	Imazapyr	ALS Inhibitor	BASF
Atrazine	Atrazine	Mobile Photosynthesis Inhibitor	Various
Authority	Sulfentrazone	PPO Inhibitor	FMC
Balan	Benefin	Seedling Root Inhibitor	Gowan
Balance	Isoxaflutole	Pigment Inhibitor or HPPD Inhibitor	Bayer
Banvel	Dicamba	Growth Regulator	MicroFlo
Basagran	Bentazon	Nonmobile Photosynthesis Inhibitor	MicroFlo
Beacon	Primisulfuron	ALS Inhibitor	Syngenta
Buctril	Bromoxynil	Nonmobile Photosynthesis Inhibitor	Bayer
Butyrac	2,4-DB	Growth Regulator	Albaugh
Cadre	Imazapyc	ALS Inhibitor	BASF
Callisto	Mesotrione	Pigment Inhibitor or HPPD Inhibitor	Syngenta
Cimarron	Metsulfuron-methyl	ALS Inhibitor	DuPont
Clarity	Dicamba	Growth Regulator	BASF
Classic	Chlorimuron-ethyl	ALS Inhibitor	DuPont
Cobra	Lactofen	Cell Membrane Disruptor	Valent
Command	Clomazone	Pigment Inhibitor	FMC
Define	Flufenacet	Seedling Shoot Inhibitor	Bayer
Degree	Acetochlor	Seedling Shoot Inhibitor	Monsanto
Devrinol	Napropamide	Seedling Shoot Inhibitor	UPI
Distinct/Overdrive	Dicamba + diflufenzopyr	Growth Regulator	BASF
Dual II Magnum/Cinch	S-metolachlor	Seedling Shoot Inhibitor	Syngenta/DuPont
Evik	Ametryn	Mobile Photosynthesis Inhibitor	Syngenta
Express [a]	Tribenuron-methyl	ALS Inhibitor	DuPont
FirstRate	Cloransulam-methyl	ALS Inhibitor	Dow AgroSciences
Flexstar	Fomesafen	Cell Membrane Disruptor	Syngenta
Fusilade DX	Fluazifop-P-butyl	Lipid Synthesis Inhibitor	Syngenta
Glean [a]	Chlorsulfuron	ALS Inhibitor	DuPont
Gramoxone Inteon	Paraquat	Cell Membrane Disruptor	Syngenta
Gramoxone Max	Paraquat	Cell Membrane Disruptor	Syngenta
Harmony GT XP	Thifensulfuron-methyl	ALS Inhibitor	DuPont
Harness	Acetochlor	Seedling Shoot Inhibitor	Monsanto
Hoelon	Diclofop-methyl	Lipid Synthesis Inhibitor	Bayer
Kerb	Pronamide	Seedling Shoot Inhibitor	Dow AgroSciences

Guide to single active ingredient herbicides (continued)

Trade Name	Common Name	Mode of Action	Manufacturer
Lasso/MicroTech	Alachlor	Seedling Shoot Inhibitor	Monsanto
Liberty	Glufosinate-ammonium	EPSP Inhibitor	Bayer
Linex	Linuron	Mobile Photosynthesis Inhibitor	Griffen
Matrix	Rimsulfuron	ALS Inhibitor	DuPont
MCPA	MCPA	Growth Regulator	Various
Option	Foramsulfuron	ALS Inhibitor	Bayer
Osprey	Mesosulfuron-methyl	ALS Inhibitor	Bayer
Outlook	Dimethenamid-P	Seedling Shoot Inhibitor	BASF
Peak	Prosulfuron	ALS Inhibitor	Syngenta
Pendimax	Pendimethalin	Seedling Root Inhibitor	Dow AgroSciences
Permit/Sandea	Halosulfuron-methyl	ALS Inhibitor	Gowan
Poast	Sethoxydim	Lipid Synthesis Inhibitor	MicroFlo
Poast Plus	Sethoxydim (with surfactant)	Lipid Synthesis Inhibitor	MicroFlo
Princep	Simazine	Mobile Photosynthesis Inhibitor	Syngenta
Prowl or other labeled formulations	Pendimethalin	Seedling Root Inhibitor	BASF
Pursuit	Imazethapyr	ALS Inhibitor	BASF
Python	Flumetsulam	ALS Inhibitor	Dow AgroSciences
Raptor	Imazamox	ALS Inhibitor	BASF
Reflex	Fomesafen	Cell Membrane Disruptor	Syngenta
Remedy	Triclopyr	Growth Regulator	Dow AgroSciences
Resource	Flumiclorac	PPO Inhibitor	Valent
Roundup or other labeled formulations	Glyphosate	EPSP Inhibitor	Various
Scepter	Imazaquin	ALS Inhibitor	BASF
Select	Clethodim	Lipid Synthesis Inhibitor	Valent
Sencor	Metribuzin	Mobile Photosynthesis Inhibitor	Bayer
Sinbar	Terbacil	Mobile Photosynthesis Inhibitor	DuPont
Sonalan	Ethalfluralin	Seedling Root Inhibitor	Dow AgroSciences
Spartan	Sulfentrazone	PPO Inhibitor	FMC
Spike	Tebuthiuron	Mobile Photosynthesis Inhibitor	Dow AgroSciences
Stinger	Clopyralid	Growth Regulator	Dow AgroSciences
Strongarm	Diclosulam	ALS Inhibitor	Dow AgroSciences
Targa	Quizalofop-P-ethyl	Lipid Synthesis Inhibitor	Gowan
Tillam	Pebulate	Seedling Shoot Inhibitor	Monterey Chemical
Topnotch	Acetochlor	Seedling Shoot Inhibitor	Dow AgroSciences
Touchdown Total	Glyphosate	EPSP Inhibitor	Syngenta
Tough EC	Pyridate	Nonmobile Photosynthesis Inhibitor	Syngenta

Guide to single active ingredient herbicides (continued)

Trade Name	Common Name	Mode of Action	Manufacturer
Treflan or other labeled formulations	Trifluralin	Seedling Root Inhibitor	Dow AgroSciences
Ultra Blazer	Acifluorfen-sodium	Cell Membrane Disruptor	UPI
Valor	Flumioxazin	PPO Inhibitor	Valent
Velpar	Hexazinone	Mobile Photosynthesis Inhibitor	DuPont

[a] Products not targeted for major distribution in Delaware, Maryland, New Jersey, Pennsylvania, Virginia, or West Virginia.

Rain-free requirements following application of postemergence herbicides [a]

Herbicide	Time (Hours)	Herbicide	Time (Hours)	Herbicide	Time (Hours)
2,4-D amine	6-8	FirstRate	2	Ready Master ATZ [b]	4-6
2,4-D ester	1-2	Flexstar	1	Redeem	Not specified
2,4-DB	6	Fusilade DX	1	Reflex	1
Accent	4-6	Fusion	1	Remedy	Not specified
Aim	1	Gramoxone Inteon	0.25-0.5	Resource	1
Atrazine	4	Gramoxone Max	0.5	Roundup Weather Max	0 - 1
Banvel/Clarity	2	Grazon P + D	Not specified	Scepter	1
Basagran	8	Harmony Extra	3	Select	1
Basis	4	Harmony GT XP	1	Shotgun	6
Beacon	4	Hoelon	4-6	Spirit	4
Buctril	0.17	Hornet	6	Steadfast	4
Callisto	1	Laddok S-12	8	Stellar	1
Celebrity Plus	4	Liberty	4	Stinger	6-8
Cimarron	4	Lightning	1	Storm	8
Classic	1	Marksman	4	Synchrony XP	1
Cobra	0.5	Northstar	4	Targa	1
Crossbow	Not specified	Option	2	Touchdown Total [b]	0 - 1
Distinct/Overdrive	4	Osprey	4	Tough	1-2
Equip	2	Peak	4	Typhoon	1
Exceed	4	Permit	4	Ultra Blazer	6
Extreme	1	Poast Plus/Poast	1	Yukon	4
Field Master	2	Pursuit	1		
Finesse	6	Raptor	1		

[a] Taken from product labels.

[b] Heavy rainfall soon after application may reduce level of control.

Glyphosate and glyphosate-type products

Product	Manufacturer	Active ingredient/Acid equivalent (adjuvants in formulation)	Apply to Roundup Ready crops
Acquire	BASF	4 lb ai/3 lb ae (some additives)	soybean
Credit	NuFarm	4 lb ai/3 lb ae (some additives)	soybean
Durango	Dow AgroSciences	5.4 lb ai/4.0 lb ae (some additives)	soybean, corn
Extreme (Roundup + Pursuit)	BASF	2 lb ai/gal + 2.17 lb ai/gal	soybean
Gly Star Original	Albaugh	4 lb ai/3 lb ae (some additives)	soybean, corn
Gly Star Plus	Albaugh	4 lb ai/3 lb ae (some additives)	soybean, corn
Gly-Flo	MicroFlo	4 lb ai/3 lb ae (some additives)	soybean
Glyphomax XRT	Dow AgroSciences	5.4 lb ai/4 lb ae (some additives)	soybean, corn
Glyphos	Cheminova	4 lb ai/3 lb ae (some additives)	soybean
Glyphos X-tra	Cheminova	4 lb ai/3 lb ae (adjuvants included)	soybean
Honcho, Rascal, Silhouette, Rattler, Buccaneer, Mirage	Various	4 lb ai/3 lb ae (some additives)	soybean
Ranger	Monsanto	2.7 lb ai/2 lb ae (some additives)	no
ReadyMaster ATZ (Roundup + Atrazine)	Monsanto	2.02 lb ai/gal + 2.0 lb ai/gal (some adjuvant)	corn
Rodeo	Monsanto	5.4 lb ai/4 lb ae (no additives)	no
Roundup Original	Monsanto	4 lb ai/3 lb ae (some adjuvants)	soybean, corn
Roundup Original MAX	Monsanto	5.5 lb ai/4.5 ae (some adjuvants)	soybean, corn, alfalfa
Roundup UltraMax	Monsanto	5 lb ai/3.68 lb ae (TranSorb adjuvants)	soybean, corn
Roundup Weather MAX	Monsanto	5.5 lb ai/4.5 lb ae (TranSorb adjuvants)	soybean, corn
StrikeOut Extra	Libertas Now, Inc.	4 lb ai/3 lb ae (adjuvants included)	soybean, corn

Glyphosate and glyphosate-type products (continued)

Product	Manufacturer	Active ingredient/Acid equivalent (adjuvants in formulation)	Apply to Roundup Ready crops
StrikeOut UL	Libertas Now, Inc.	4 lb ai/3 lb ae (some additives)	soybean, corn
Touchdown HiTech	Syngenta	5.0 lb ai/5.0 lb ae (No - have to add)	soybean, corn
Touchdown Total	Syngenta	4.17 lb ai/4.17 lb ae (adjuvants included)	soybean, corn

Weed Control in Corn

Uncontrolled weeds continue to be a major limiting factor in Delmarva corn production. To be successful in controlling weeds in corn, the weed control program must be well planned and well executed. Consideration should be given to cultural, mechanical, and chemical methods of weed control with reference to specific weed infestations. The major elements of a successful weed control program in corn are summarized below.

Weed Control Program

Weed identification.

The first step in an effective weed control program is proper weed identification. Only by knowing the exact identities and relative infestations of weeds on a field-by-field basis can the proper weed control strategy be developed. Continued use of the same program, or use of reduced tillage practices, can result in changes in weed infestations. Keep an accurate field record of the weeds in each field on a yearly basis, and use this record to plan your weed control program.

Cultural control.

Several aspects of cultural weed control should be considered in planning a corn weed control program. These include weed-free seed, cover crops, and crop rotation. Crop rotation is a valuable tool in our corn/soybean rotations because perennial broadleaf weeds that cannot be controlled in soybeans can be effectively controlled in corn. Take advantage of this opportunity to control these tough weeds with mechanical methods and herbicides.

Mechanical control.

Mechanical weed control is still one of our most useful weed control tools. Both primary tillage and cultivation should be considered for specific weed problems. Perennial broadleaf weeds are an increasing problem in no-till corn production. In some cases, these weeds cannot be controlled without tillage to disrupt underground perennial parts. The use of the moldboard plow is an effective method of control and, for some weeds, represents the only practical method of control.

Herbicidal control.

Many options are available in terms of herbicidal control of weeds in corn. Both preplant incorporated and preemergence combinations are available that offer broad spectrum weed control. Preplant incorporated treatments ensure activation of the herbicide and minimize the risk of crop injury. Preemergence treatments require rainfall for activation, but offer good weed control when rainfall occurs within the first 2 weeks after application. Consider postemergence and directed postemergence applications. These are some of our strongest options in corn weed control. Identify the weed and select the herbicide program that best fits your specific weed infestation.

The following tables give general ratings of relative herbicidal activity. Activity varies with weather conditions, soil type, and application method. Under nonoptimal conditions, activity may be less than indicated.

Corn herbicides and their restrictions

Trade name	Common name	Manufacturer	Restricted-use pesticide [1]	Water quality advisory [2]	Worker Reentry (hours) [3]
2,4-D amine 4S	2,4-D amine	several	—	—	48
2,4-D LVE 4E	2,4-D LVE	several	—	—	12
AAtrex, Atrazine 4L/90DF	atrazine	Syngenta, others	yes	yes	12
Accent 75DF	nicosulfuron	DuPont	—	—	4
Aim 40DF	carfentrazone-ethyl	FMC	—	—	12
Axiom 68DF	flufenacet + metribuzin	Bayer	—	yes	12
Balance Pro 4L	isoxaflutole	Bayer	yes	yes	12
Banvel 4S	dicamba	MicroFlo	—	Yes	24
Basagran 4S	bentazon	MicroFlo	—	Yes	48
Basis 75DF	rimsulfuron + thifensulfuron	DuPont	—	—	4
Beacon 75DF	primisulfuron	Syngenta	—	—	12
Bicep II Magnum 5.5L	s-metolachlor + atrazine + safener	Syngenta	yes	yes	24
Bicep Lite II Magnum 6L	s-metolachlor + atrazine + safener	Syngenta	yes	yes	24
Buctril + atrazine 3L	bromoxynil + atrazine	Bayer	Yes	Yes	24
Buctril 4E	bromoxynil	Bayer	—	—	12
Bullet 4ME	alachlor + atrazine	Monsanto	yes	yes	12
Callisto 4L	mesotrione	Syngenta	no	yes	12
Camix 3.67L	s-metolachlor + mesotrione	Syngenta	no	yes	24
Celebrity Plus	nicosulfuron + dicamba + diflufenzopyr	BASF	—	yes	12
Cinch 7.64E	s-metolachlor + safener	DuPont	No	Yes	24
Cinch ATZ 5.5L	s-metolachlor + atrazine + safener	DuPont	Yes	Yes	12
Clarity 4S	dicamba	BASF	—	yes	24
Define 60DF	flufenacet	Bayer	no	yes	12
Degree 3.8ME	acetochlor	Monsanto	yes	yes	12
Degree Xtra 4.04ME	acetochlor + atrazine	Monsanto	yes	yes	12
Dual II Magnum/Cinch 7.64E	s-metolachlor + safener	Syngenta	no	yes	24
Equip 32WG	foramsulfuron + iodosulfuron	Bayer	No	Yes	12
Evik 80W	ametryn	Syngenta	—	—	12
Exceed 57WG	prosulfuron + primisulfuron	Syngenta	—	—	12
Field Master 4.25SE	glyphosate + acetochlor + atrazine	Monsanto	yes	yes	12
FulTime 4CS/EC	acetochlor + atrazine + safener	Dow AgroSciences	yes	yes	12
Gramoxone Inteon (harvest aid)	paraquat	Syngenta	Yes	—	24
Gramoxone Inteon (preemergence)	paraquat	Syngenta	Yes	—	12
Guardsman Max 5FL	atrazine + dimethenamid-p	BASF	yes	yes	12
Guardsman Max Lite 5FL	atrazine + dimethenamid-p	BASF	yes	yes	12

Corn herbicides and their restrictions (continued)

Trade name	Common name	Manufacturer	Restricted-use pesticide [1]	Water quality advisory [2]	Worker Reentry (hours) [3]
Harmony Extra XP 75DF	thifensulfuron + tribenuron	DuPont	—	—	12
Harmony GT XP 75DF	thifensulfuron	DuPont	No	No	4
Harness 7E	acetochlor + safener	Monsanto	yes	yes	12
Harness Xtra 5.6/6L	acetochlor + atrazine	Monsanto	yes	yes	12
Hornet 78.5WG	flumetsulam + clopyralid	Dow AgroSciences	—	Yes	48
Keystone 5L	acetochlor + atrazine	Dow AgroSciences	yes	yes	12
Keystone LA 5.5L	acetochlor + atrazine	Dow AgroSciences	yes	yes	12
Laddok S-12	bentazon + atrazine	BASF	yes	yes	48
Lariat 4E	alachlor + atrazine	Monsanto	yes	yes	12
Lasso 4E	alachlor	Monsanto	yes	yes	12
Lexar 3.7SC	atrazine+mesotrione+s-metolachlor	Syngenta	Yes	Yes	24
Liberty 1.67L [5]	glufosinate	Bayer	—	—	12
Lightning 70DG [4]	imazethapyr + imazapyr	BASF	—	yes	12
Linex 50DF, 4L	linuron	Griffen	—	—	24
Lumax 3.95SC	atrazine + mesotrione + s-metolachlor	Syngenta	Yes	Yes	24
Marksman 3.2L	dicamba + atrazine	BASF	Yes	Yes	24
MicroTech 4ME	alachlor	Monsanto	yes	yes	12
NorthStar 51.4WG	primisulfuron + dicamba	Syngenta	—	—	12
Option 35WDG	foramsulfuron	Bayer	no	yes	12
Outlook 6EC	dimethenamid-p	BASF	—	yes	12
Permit/Sandea 75WG	halosulfuron	Goean	—	—	12
Princep, Simazine, 4L/90DF	simazine	Syngenta, others	—	yes	12
Prowl 3.3E, H2O	pendimethalin	BASF	—	—	24
Pursuit 2S [4]	imazethapyr	BASF	—	—	4
Python 80WDG	flumetsulam	Dow AgroSciences	—	yes	12
Radius 4L	isoxaflutole + flufenacet	Bayer	Yes	Yes	12
Ready Master ATZ 4FL	glyphosate + atrazine	Monsanto	yes	yes	12
Resource 0.86E	flumiclorac	Valent	—	—	12
Roundup Weather Max 5.5S and other labeled formulations	glyphosate	Monsanto, others	—	—	4-12
Sencor 75DF/4L	metribuzin	Bayer	—	yes	12
Spirit 57WG	primisulfuron + prosulfuron	Syngenta	—	—	12
Steadfast 75DF	nicosulfuron + rimsulfuron	DuPont	no	no	4
Steadfast ATZ	nicosulfuron + rimsulfuron + atrazine	DuPont	Yes	Yes	12
Stinger 3S	clopyralid	Dow AgroSciences	—	yes	12
Topnotch 3.2CS	acetochlor + safener	Dow AgroSciences	yes	yes	12
Touchdown Total and Hi-Tech	glyphosate	Syngenta	—	—	12

Corn herbicides and their restrictions (continued)

Trade name	Common name	Manufacturer	Restricted-use pesticide [1]	Water quality advisory [2]	Worker Reentry (hours) [3]
Tough 3.75E	pyridate	Syngenta	—	—	12
Yukon 67.5WDG	halosulfuron + dicamba	Monsanto	no	yes	12

1 Only licensed applicators may purchase and apply restricted-use pesticides.

2 These herbicides have properties that may result in ground or surface water contamination. Do not apply them in areas where soils are permeable or coarse and ground water is near the surface. Practices should be followed to minimize the potential for dissolved runoff and/or runoff erosion. See the herbicide label for specific restrictions.

3 If soil-applied products are injected or incorporated at application time, under certain circumstances the Worker Protection Standard allows workers to enter the treated area if they will have no contact with anything that has been treated. Personal protective equipment is required for early entry to treated areas if contact with treated soil, plants, or water is involved.

4 For use only on Clearfield corn hybrids.

5 For use only on glufosinate-resistant corn hybrids.

Corn - relative effectiveness of "burndown" for no-till corn estabishment [a,b]

Treatment	Grasses and broadleaf weeds in crop stubble (0-3 inches)	Grasses and broadleaf weeds in crop stubble (> 3 inches)	Annual ryegrass and annual weeds	Orchardgrass sod and annual weeds	Rye cover and annual weeds	Volunteer small grains and annual weeds
2,4-D and then Gramoxone Inteon (10-14 days later)	G	G	P	P-F	G	F
Atrazine (1.0-2.0 lb) + Gramoxone Inteon	G	F-G	F	F	G	G
Banvel/Clarity and then Gramoxone Inteon (10-14 days later) (c)	G	G	P	P-F	G	F
Glyphosate (4.0 lb ai/bal) formulation (1.0 qt/acre) or equivalent as labeled	G	F-G	F-G	P	F-G	F
Glyphosate (4.0 lb ai/gal) formulation (1.0 qt/acre) or equivalent as labeled + 2,4-D	G	G	F-G	P	F-G	F
Glyphosate (4.0 lb ai/gal) formulation (1.0 qt/acre) or equivalent as labeled + Banvel/Clarity (c)	G	G	F-G	P	F-G	F
Glyphosate (4.0 lb ai/gal) formulation (2.0 - 3.0 qt/acre) or equivalent as labeled	G	G	G	F-G	G	G
Gramoxone Inteon	G	F-G	P	P-F	G	F
Gramoxone Inteon + 2,4-D	G	G	P	P-F	G	F
Gramoxone Inteon + Banvel/Clarity (c)	G	G	P	P-F	G	F
Gramoxone Inteon and then Gramoxone Inteon (10-14 days later)	G	G	P-F	G	G	G

Corn - relative effectiveness of "burndown" for no-till corn establishment [a,b] (continued)

Treatment	Alfalfa and annual weeds	Clover and annual weeds	Fescue sod and annual weeds	Horseweed [d] and other annual weeds	Perennial, broadleaf weeds and annuals
2,4-D and then Gramoxone Inteon (10-14 days later)	F	G	P-F	G	F-G
Atrazine (1.0-2.0 lb) + Gramoxone Inteon	P	F	F	F	P-F
Banvel/Clarity and then Gramoxone Inteon (10-14 days later) (c)	G	G	P-F	G	F-G
Glyphosate (4.0 lb ai/bal) formulation (1.0 qt/acre) or equivalent as labeled	P-F	F	P	F-G	F
Glyphosate (4.0 lb ai/gal) formulation (1.0 qt/acre) or equivalent as labeled + 2,4-D	F	G	P	G	F-G
Glyphosate (4.0 lb ai/gal) formulation (1.0 qt/acre) or equivalent as labeled + Banvel/Clarity (c)	G	G	P	G	F-G
Glyphosate (4.0 lb ai/gal) formulation (2.0 - 3.0 qt/acre) or equivalent as labeled	G	G	G	G	F-G
Gramoxone Inteon	P-F	F	F	F	P-F
Gramoxone Inteon + 2,4-D	F	F-G	P-F	F-G	F
Gramoxone Inteon + Banvel/Clarity (c)	F-G	F-G	P-F	F-G	F
Gramoxone Inteon and then Gramoxone Inteon (10-14 days later)	F	F-G	G	F-G	F

[a] G (Good) = 80-100 percent control; F (Fair) = 60-80 percent control; P (Poor) = 20-60 percent control; N (None) = < 20 percent control; and NR = not recommended.

[b] These treatments are rated only for control of vegetation existing at the time of no-till corn establishment. Add residual herbicides as required for the specific infestation.

[c] Use Banvel/Clarity only on soil types for which the preemergence use of this product is permitted by label.

[d] Some horseweed biotypes have not been controlled by glyphosate. Alternative burndown programs should be considered in fields with a history of one or more annual applications of glyphosate.

Relative effectiveness of herbicides for corn [a]

[a] Legend - based on adequate moisture, good growing conditions, and proper herbicide application

E = Excellent (>90% control)
G = Good (80-90% control)
F = Fair (60-80% control)
P = Poor (20-60% control)
G-E = Good to Excellent
F-G = Fair to Good
P-F = Poor to Fair
N = None (<20% control)

	Barnyardgrass	Bermudagrass	Broadleaf signalgrass	Crabgrass	Fall panicum	Foxtails	Goosegrass	Johnsongrass (seedling)	Johnsongrass (rhizome)	Quackgrass	Sandbur	Shattercane	Texas panicum	Yellow nutsedge
Preplant incorporated														
Atrazine	F-G	N	P	F-G	N	F	F	N	N	P-F	P	N	N	N
Dual II Magnum/Cinch	G-E	N	F-G	G-E	G-E	E	E	P	N	N	F	P	P	F-G
Dual II Magnum/Cinch + Atrazine	G-E	N	F-G	G-E	G-E	E	E	P	N	P-F	F	P	P	F-G
Dual II Magnum/Cinch + Atrazine + Princep	G-E	N	F-G	G-E	G-E	E	E	P	N	P-F	F	P	P	F-G
Outlook	G-E	N	F-G	G	G-E	G-E	G	P	N	N	F	P	P	F
Outlook + Atrazine	G-E	N	F-G	G	G-E	G-E	G	P	N	P-F	F	P	P	F
Outlook + Atrazine + Princep	G-E	N	F-G	G	G-E	G-E	G	P	N	P-F	F	P	P	F
Princep	G	N	P	F-G	F	F-G	F-G	P	N	P	-	P	P	P
Preemergence														
Atrazine	F	N	P	P-F	P	F	F	N	N	P-F	P	P	P	P
Atrazine + Princep	F-G	N	P	F-G	F	F-G	F-G	P	N	P-F	P	P	-	P
Axiom	G	N	F-G	G	G	G	G	P	N	N	P	N	P	P
Basis	G	N	N	P	G	G	P	N	N	N	P	N	-	N
Callisto	N	N	P	F	N	P	N	N	N	N	N	N	N	P
Define	G-E	N	F-G	G-E	E	E	E	P	N	N	F-G	P-F	P-F	P-F
Define + Atrazine	G-E	N	F-G	G-E	E	E	E	P	N	P-F	F	P	P	P-F
Dual II Magnum/Cinch	G-E	N	F-G	G-E	G-E	E	E	P	N	N	F	P	P	F
Dual II Magnum/Cinch + Atrazine	G-E	N	F-G	G-E	G-E	E	E	P	N	P-F	F	P	P	F
Dual II Magnum/Cinch + Atrazine + Princep	G-E	N	F-G	G-E	G-E	E	E	P	N	P-F	F	P	P	F
Harness/Degree	G-E	N	F-G	G-E	E	E	E	P	N	N	F	P	P	F
Harness/Degree + Atrazine	G	N	F-G	G-E	E	E	E	P	N	P-F	F	P	P	F
Harness/Degree + Atrazine + Princep	G	N	F-G	G-E	E	E	E	P	N	P-F	F	P	P	F
Hornet	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Keystone	G-E	N	F-G	G-E	E	E	E	P	N	P-F	F	P	P	F

Relative effectiveness of herbicides for corn [a] (continued)

	Barnyardgrass	Bermudagrass	Broadleaf signalgrass	Crabgrass	Fall panicum	Foxtails	Goosegrass	Johnsongrass (seedling)	Johnsongrass (rhizome)	Quackgrass	Sandbur	Shattercane	Texas panicum	Yellow nutsedge
Lexar	G-E	N	F-G	G-E	G-E	E	E	P	N	N	F	P	P	F
Lumax	G-E	N	F-G	G-E	G-E	E	E	P	N	N	F	P	P	F
MicroTech	G-E	N	F-G	F-G	E	E	E	P	N	N	F	P	P	P
MicroTech + Atrazine	G-E	N	F-G	F-G	E	E	E	P	N	P-F	F	P	P	P
MicroTech + Atrazine + Princep	G-E	N	F-G	F-G	E	E	E	P	N	P-F	F	P	P	P
Outlook	G-E	N	F-G	G	G	G	G	P	N	N	P-F	P	P	F
Outlook + Atrazine	G-E	N	F-G	G	G	G	G	P	N	P-F	P-F	P	P	F
Outlook + Atrazine + Princep	G-E	N	F-G	G	G	G	G	P	N	P-F	P-F	P	P	F
Princep	F-G	N	P	F-G	G	G	F-G	P	N	F	-	P	P	P
Prowl	G-E	N	F-G	F	F-G	G	F	F	N	N	F	F	P-F	N
Python	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Topnotch	G-E	N	F-G	G-E	E	E	E	P	N	N	F	P	P	F
Topnotch + Atrazine	G-E	N	F-G	G-E	E	E	E	P	N	P-F	F	P	P	F
Topnotch + Atrazine + Princep	G-E	N	F-G	G-E	E	E	E	P	N	P-F	F	P	P	F
Postemergence														
2,4-D	N	N	N	N	N	N	N	N	N	N	N	N	N	N
2,4-D + Banvel/Clarity	N	N	N	N	N	N	N	N	P	N	N	N	N	N
Accent	G-E	N	G-E	P-F	G	G	P	E	G-E	G-E	G	E	G	P
Aim	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Atrazine + Oil	F	N	F	P-F	P	F	G	P	N	F-G	-	P	P	P-F
Banvel/Clarity	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Basagran	N	N	N	N	N	N	N	N	N	N	N	N	N	F
Basis	F-G	N	F-G	P-F	G	G	P	F-G	F	-	F	F-G	F	P-F
Beacon	P	N	P	P	F	F-G	P	E	G	G	-	E	P	P
Brominal or Buctril	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Callisto	G	N	P	F-G	P	P	P	P	N	-	-	P	P	F
Celebrity Plus	G-E	N	G-E	P-F	G	G	P	E	G-E	G-E	G	E	G	P
Distinct	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Equip	F	N	F-G	F	F	F	F	F-G	F-G	G	F	G	F	-
Evik (b)	G	N	G	F-G	F-G	F-G	G	P-F	N	-	-	F	G	P
Exceed	P	N	N	P	P	P-F	N	P-F	N	P-F	-	P-F	N	P
Field Master	E	G	E	E	G-E	E	E	E	G	G-E	E	G	G	P-F

Relative effectiveness of herbicides for corn [a] (continued)

	Barnyardgrass	Bermudagrass	Broadleaf signalgrass	Crabgrass	Fall panicum	Foxtails	Goosegrass	Johnsongrass (seedling)	Johnsongrass (rhizome)	Quackgrass	Sandbur	Shattercane	Texas panicum	Yellow nutsedge
Glyphosate (Roundup Weather Max, Touchdown Total and others)	E	G	E	E	G-E	E	E	E	F-G	E	E	E	F-G	F-G
Gramoxone Inteon (b)	G	N	F	G	G	G	G	G	N	P	G	G	F	F
Harmony GT XP	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Hornet	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Laddok S-12	F	N	P	P-F	P	F	F	P	N	F	-	F	P	P-F
Liberty	F-G	N	F	F	F-G	F-G	P	F-G	N	F	F-G	F-G	F-G	P
Lightning	G	N	F-G	P-F	P-F	G	P	G	F	F-G	-	G	P-F	F-G
Linex (b)	F	N	F-G	F	F	F	F	P-F	N	N	-	P-F	F	P
Marksman	N	N	P	P	N	P	F	N	N	F	-	N	-	P
NorthStar	P	N	P	P	F	F-G	P	E	G	G	-	E	P	P
Option	F-G	N	G	P-F	G	G	G	G	G	G	G	G	G	F
Permit/Sandea	N	N	N	N	N	N	N	N	N	N	N	N	N	E
Prowl + Atrazine	F-G	N	F	F-G	P	F	G	P-F	N	F	-	P	P	F
Resource	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Spirit	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Steadfast	G-E	N	G-E	P-F	G	G-E	P	E	G-E	G-E	G	E	G	P
Steadfast ATZ	G-E	N	G-E	P-F	G	G-E	P	E	G-E	G-E	G	E	G	P
Stinger	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Tough	N	N	N	N	N	N	N	N	N	N	N	N	N	F

[b] Post-directed

Relative effectiveness of herbicides for corn [a] (continued)

[a] Legend - based on adequate moisture, good growing conditions, and proper herbicide application

E = Excellent (>90% control)
G = Good (80-90% control)
F = Fair (60-80% control)
P = Poor (20-60% control)
G-E = Good to Excellent
F-G = Fair to Good
P-F = Poor to Fair
N = None (<20% control)

	Eastern black nightshade	Burcucumber	Cocklebur	Jimsonweed	Lambsquarters (common)	TR-Lambsquarters	Morningglory (annual spp)	Pigweed	TR-Pigweed	Common ragweed	Giant ragweed	Sicklepod	Smartweed	Spurred anoda	Prickly sida or teaweed	Tropic croton	Velvetleaf
Preplant incorporated																	
Atrazine	E	F	G	G	G	N	G	G	N	G	G	G	G	G	G	G	G
Dual II Magnum/Cinch	F	N	N	N	P-F	P-F	N	G	G	P	N	N	P	N	P	N	N
Dual II Magnum/Cinch + Atrazine	E	F	G	G	G	P-F	G	G	G	G	G	G	G	G	G	G	G
Dual II Magnum/Cinch + Atrazine + Princep	E	F	G	G	G	P-F	G	G	G	G	G	G	G	G	G	G	G
Outlook	F	N	N	N	P	P	N	G	G	P	N	N	P	N	P	N	N
Outlook + Atrazine	E	F	G	G	G	P	G	G	G	G	G	G	G	G	G	G	G
Outlook + Atrazine + Princep	E	F	G	G	G	P	G	G	G	G	G	G	G	G	G	G	G
Princep	G-E	F	G	G	G	N	G	G	N	G	F	G	G	F-G	F-G	F-G	F-G
Preemergence																	
Atrazine	E	P-F	G	E	E	N	F-G	E	N	G-E	F-G	G	G	F-G	G	G	F-G
Atrazine + Princep	E	F	G	E	E	N	G	E	N	E	G	G	G	F-G	G	G	G
Axiom	P	N	N	N	P-F	P-F	N	P-F	P-F	P	N	N	N	N	N	N	N
Basis	N	N	P	P	F-G	F-G	N	G	G	N	N	-	P	P	-	-	P
Callisto	P	-	P-F	F	G	G	F	F-G	F-G	P	-	-	-	-	N	N	-
Define	P-F	N	N	N	P-F	P-F	N	G	G	P	N	N	P	N	P-F	N	N
Define + Atrazine	E	F	G	E	E	P-F	G	E	G	E	G	G	G	G	G	G	G
Dual II Magnum/Cinch	F	N	N	N	P	P	N	G	G	P	N	N	P	N	P	N	N
Dual II Magnum/Cinch + Atrazine	E	F	G	E	E	P	G	E	G	E	G	G	G	G	G	G	G
Dual II Magnum/Cinch + Atrazine + Princep	E	F	G	E	E	P	G	E	G	E	G	G	G	G	G	G	G
Harness/Degree	F	N	N	N	F	F	N	F-G	F-G	P	N	N	P	-	P	N	N
Harness/Degree + Atrazine	E	F	G	E	E	F	G	E	G	E	G	G	G	G	G	G	G
Harness/Degree + Atrazine + Princep	E	F	G	E	E	F	G	E	G	E	G	G	G	G	G	G	G
Hornet	P-F	P	F-G	F-G	F-G	G	P	E	E	P	P	F-G	E	F	F-G	-	G

Relative effectiveness of herbicides for corn [a] (continued)

	Eastern black nightshade	Burcucumber	Cocklebur	Jimsonweed	Lambsquarters (common)	TR-Lambsquarters	Morningglory (annual spp)	Pigweed	TR-Pigweed	Common ragweed	Giant ragweed	Sicklepod	Smartweed	Spurred anoda	Prickly sida or teaweed	Tropic croton	Velvetleaf
Keystone	E	F	G	E	E	P-F	G	E	G	E	G	G	G	G	G	G	G
Lexar	G-E	P-F	G	E	E	E	G	E	E	E	G	G	G	G	G	G	E
Lumax	G-E	P-F	F	G-E	E	E	F-G	E	E	F-G	F	P-F	F-G	P-F	F-G	-	F-G
MicroTech	F-G	N	N	N	P	P	N	G	G	P	N	N	P	N	P	N	N
MicroTech + Atrazine	E	F	G	E	E	P	G	E	G	E	G	G	G	G	G	G	G
MicroTech + Atrazine + Princep	E	F	G	E	E	P	G	E	G	E	G	G	G	G	G	G	G
Outlook	F	N	N	N	P	P	N	G	G	P	N	N	P	N	P	N	N
Outlook + Atrazine	E	F	G	E	E	P	G	E	G	E	G	G	G	G	G	G	G
Outlook + Atrazine + Princep	E	F	G	E	E	P	G	E	G	E	G	G	G	G	G	G	G
Princep	G-E	F	G	G-E	E	N	G	E	N	E	F	G-E	E	F-G	F-G	F-G	F-G
Prowl	N	N	N	N	F-G	F-G	P	F-G	F-G	P	N	N	P	N	P	P	F
Python	P-F	P	F-G	F-G	G	G	P	G	G	P	P	F-G	E	F	F-G	-	G
Topnotch	F	N	N	N	F	F	N	F-G	F-G	P	N	N	P	-	P	N	N
Topnotch + Atrazine	E	F	G	E	E	F	G	E	F-G	E	G	G	G	G	G	G	G
Topnotch + Atrazine + Princep	E	F	G	E	E	F	G	E	F-G	E	G	G	G	G	G	G	G
Postemergence																	
2,4-D	F	P	G-E	E	E	E	E	E	E	E	E	F-G	F-G	-	G	G	F-G
2,4-D + Banvel/Clarity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Accent	N	F-G	P	F	P	P	F	G-E	G-E	P	P	F	F-G	-	P	-	P
Aim	G	N	N	N	F-G	F-G	F	G	G	P	N	-	-	-	-	-	E
Atrazine + Oil	G-E	F-G	G-E	E	E	N	G-E	E	N	G-E	G	G	E	-	G	F-G	F-G
Banvel/Clarity	E	F	E	E	E	E	E	E	E	G-E	G-E	G-E	E	-	G	G	G
Basagran	P	P	G-E	E	P-F	P-F	P	P	P	F-G	P-F	P	G-E	F	F-G	F	F-G
Basis	N	N	F	P-F	G	G	P	G-E	G-E	P	N	P	G	-	N	-	G
Beacon	P-F	G	F-G	F-G	F-G	F-G	F	G-E	G-E	G-E	G	F	F-G	-	F	-	F-G
Brominal or Buctril	G-E	F-G	F-G	F-G	G	G	F	P	P	F-G	F-G	N	F-G	-	P	G	F-G
Callisto	G	-	F-G	G	E	E	F-G	G-E	G-E	F	-	-	-	F-G	P	-	G-E
Celebrity Plus	E	F-G	E	E	E	E	E	E	E	G-E	G-E	G-E	E	-	G	G	F-G
Distinct	E	F-G	E	E	E	E	E	E	E	G-E	G-E	G-E	E	-	G	G	G
Equip	F	F-G	F	F	P-F	P-F	P-F	E	E	F-G	F-G	P-F	F	-	-	-	P
Evik (b)	G	F	E	E	E	E	F-G	G	G	G-E	F-G	F-G	F-G	-	G	F-G	F-G
Exceed	G	G	G	G	P-F	P-F	P-F	G-E	G-E	G-E	G-E	G	G-E	-	P	-	F-G

Relative effectiveness of herbicides for corn [a] (continued)

	Eastern black nightshade	Burcucumber	Cocklebur	Jimsonweed	Lambsquarters (common)	TR-Lambsquarters	Morningglory (annual spp)	Pigweed	TR-Pigweed	Common ragweed	Giant ragweed	Sicklepod	Smartweed	Spurred anoda	Prickly sida or teaweed	Tropic croton	Velvetleaf
Field Master	F-G	E	E	E	F-G	F-G	G	E	E	F-G	G	F-G	F-G	F	F-G	G	F-G
Glyphosate (Roundup Weather Max, Touchdown Total and others)	F-G	E	E	E	F-G	F-G	F-G	E	E	F-G	G	F-G	F-G	F-G	F	F-G	G
Gramoxone Inteon (b)	G	G	G	G	G	G	F-G	G	G	G	F-G	G	F-G	G	G	G	G
Harmony GT XP	P	P-F	F	P	E	E	P	E	E	P	P	P	G	P	P	P	F-G
Hornet	P	N	G	G	P-F	P-F	F	F	F	G	F-G	-	F-G	-	N	-	G
Laddok S-12	F-G	P	G-E	E	F-G	P-F	P-F	F	P	F-G	F-G	P-F	F-G	-	F-G	-	F-G
Liberty	G	G	G-E	G-E	F-G	F-G	G-E	G	G	G-E	G	G-E	F	-	F-G	-	G
Lightning	G-E	P	G-E	G-E	P-F	P-F	P-F	E	E	P-F	P	F	G	-	G	-	F
Linex (b)	P-F	F	G	G	G	G	F-G	G	G	G	G	G	F-G	G	G	-	F-G
Marksman	E	G	E	E	E	E	G-E	E	E	G-E	G-E	G-E	E	-	G	G	G
NorthStar	E	F-G	E	E	E	E	E	E	E	G-E	G-E	G	E	-	G	G	G
Option	F	F-G	F	F	P-F	P-F	P	E	E	F-G	P-F	-	-	-	-	-	P
Permit/Sandea	P	P	G-E	G	P	P	F	G-E	G-E	G-E	F-G	P-F	F-G		N		G
Prowl + Atrazine	G-E	F-G	G-E	E	E	N	G-E	E	N	G-E	G	G	E	-	G	F-G	G
Resource	F-G	F-G	P	P	P	P	P	F	F	P	P	N	P	-	N	-	E
Spirit	F	F-G	F-G	F-G	P-F	P-F	P-F	G-E	G-E	G-E	G	F	F-G	-	P	-	F-G
Steadfast	N	F-G	P	P-F	P	P	P	G-E	G-E	P	P	P	F-G	-	P	-	P
Steadfast ATZ	G	F-G	F-G	F-G	F-G	F	F	G	G	P	N	P	G	-	N	-	G
Stinger	F	N	G-E	G	P	P	N	P	P	E	G-E	-	F	-	-	-	P
Tough	G	P	F-G	F-G	G-E	G-E	N	G-E	G-E	P	P-F	-	P	-	-	-	P-F

[b] Post-directed

Corn - Grazing and forage restrictions for corn herbicides [a]

Corn Herbicide	Graze	Silage/Grain
	Days after treatment	
2,4-D	7	7
Accent	30	30
Aim	no restrictions	no restrictions
Atrazine	21	21
Axiom	do not graze	-
Banvel/Clarity or Marksman	> milk stage	>milk stage
Basagran	12	12
Basis	30	30
Beacon	30	45/80
Buctril	30	30
Callisto	not specified	not specified
Celebrity Plus	do not graze	32/72
Define	150	150
Degree	-	-/-
Distinct	do not graze	32/72
Dual II Magnum/Cinch	30	30
Equip	45	45/70
Evik	30	30
Exceed	30	40/80
Gramoxone Inteon	not specified	not specified
Gramoxone Inteon (post-directed)	do not graze	do not feed
Harmony GT XP	30	30
Harness	21	21
Hornet [f]	45	85
Keystone	not specified	not specified
Laddok	21	21

Corn - Grazing and forage restrictions for corn herbicides [a]

Corn Herbicide	Graze	Silage/Grain
	Days after treatment	
Lexar	45	60
Liberty [b]	do not graze	60/70
Lightning [c]	45	45
Lumax	45	45
MicroTech	21	21
NorthStar	30	45/60
Option	45	45/70
Outlook	40	40
Permit/Sandea	30	30
Princep	do not graze	-
Prowl	75	75
Prowl H2O	21	21
Pursuit [c]	45	45
Python	do not graze	85
Ready Master ATZ [d]	-	50/-
Resource	28	28
Roundup Weather Max [e]	0	50/7
Roundup Weather Max (spot treatment)	14	14
Spirit	30	40/60
Steadfast	30	30
Steadfast ATZ	30	30
Stinger	40	40
Touchdown Total or Hi-Tech	not specified	not specified
Tough	68	68
Yukon	30	30

[a] The herbicides listed in this table restrict grazing or foraging (silage) intervals for treated corn.

[b] For use only with Liberty-Link/GR corn hybrids.

[c] For use only with Clearfield corn hybrids.

[d] Do not graze, harvest of feed corn forage or silage following a sequential in-crop application of this product followed by Roundup Weather Max herbicide on Roundup Ready corn.

[e] Do not graze or use for silage if sequential applications are made.

[f] A 45 day interval for forage or silage if application is made before corn is 20" tall or V6 growth stage. An 85 day interval for corn harvested for grain, regardless of application timing.

Corn-atrazine use recommendations and precautions

Preemergence [a]

On highly erodible soils (as defined by the U.S. Soil conservation Service)

- Fields where more than 30 percent of the soil is covered with plant residue at planting: Apply a maximum of 2.0 pounds of active ingredient of atrazine per acre as a broadcast spray.
- Fields where less than 30 percent of the soil is covered with plant residue at planting: Apply a maximum of 1.6 pounds of active ingredient of atrazine per acre as a broadcast spray.

On soils that are not highly erodible

- Apply a maximum of 2.0 pounds of active ingredient of atrazine per acre as a broadcast spray.

Postemergence

- If no atrazine was applied prior to crop emergence, use a maximum rate of 2.0 pounds of active ingredient of atrazine per acre.
- If a preemergence application was made in the same calendar year, the combined preemergence and postemergence applications may not exceed 2.5 pounds of active ingredient of atrazine per acre.

Safety Precautions

- Do not mix, load, or apply atrazine within 50 feet of drinking-water wells, livestock-water wells, agricultural-drainage wells, irrigation wells, abandoned wells, or sinkholes.
- Do not mix or load atrazine within 50 feet of intermittent streams, perennial streams, rivers, lakes, or reservoirs.
- Do not apply atrazine within 200 feet of lakes or reservoirs.
- Do not apply atrazine within a 66-foot arc measured from points where surface water runoff enters intermittent streams, perennial streams, or rivers.

[a] The total amount of atrazine applied preemergence and postemergence combined in 1 calendar year may not exceed 2.5 pounds of active ingredient of atrazine per acre.

IR/IT Corn Statement

Lightning, Pursuit and Scepter are IMI or IMI-containing package-mixes. These herbicides can only be used on IR (imidazolinone-resistant) or IT (imidazolinone-tolerant) corn varieties such as Clearfield or severe injury will result. These hybrids are also recommended when a risk of Pursuit or Scepter carryover makes the planting of standard varieties impractical. Continuous use of a herbicide or herbicides with a single site of action encourages the development of resistant weeds. The use of IMI herbicides in corn is not recommended due to the increased risk of weed resistance development.

Corn Herbicide Rotation Restrictions

The following table summarizes the crop rotation restrictions after certain corn herbicide applications have been made. Consult the label if two or more of these materials are applied in the same season. This list is not a substitute for the herbicide label.

Corn - Herbicide rotation restrictions

Rotational crops (month after application) [a] -- Alfalfa to Pumpkins

Herbicide	Alfalfa	Cabbage	Cotton	Cucumbers	Field corn	Grain sorghum	Lima beans	Muskmelon	Onions	Peas	Peppers	Pumpkins
2,4-D	3	3	3	3	NR	3	3	3	3	3	3	3
Accent	10	10 [b]	10	10 [b]	NR	10 [b]	10 [b]	10 [b]	10 [b]	10	10 [b]	10 [b]
Aim	12	12	NR	12	NR	NR	12	12	1	12	12	12
Atrazine	SY	SY	12	SY	NR	NR	SY	SY	SY	SY	SY	SY
Axiom	12	12	12	12	NR	12	12	12	18	SY	SY	SY
Banvel	AH	AH	AH	AH	NR	NR	AH	AH	AH	AH	AH	AH
Basagran	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Basis (p)	10	18	10	18	NR	10	18	18	18	8	18	18
Beacon	8	18	8	18	0.5 [f]	8	18	18	18	8	18	18
Brominal	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY
Buctril	1	1	1	1	1	1	1	1	1	1	1	1
Callisto	NY	18	NY	18	NR	NY	18	18	18	18	18	18
Celebrity Plus	10	10 [n]	10	10 [n]	0.25	10 [b]	10 [n]	10 [n]	10 [n]	10	10 [n]	10 [n]
Clarity	4	4	4	4	NR	NR	4	4	4	4	4	4
Define	12	4	4	12	NR	12	12	12	12	18	4	18
Degree	SY	SY	SY	SY	NR	NY	SY	SY	SY	SY	SY	SY
Degree Xtra	SY	SY	SY	SY	NR	NY	SY	SY	SY	SY	SY	SY
Distinct	1	1	1	1	0.25	1	1	1	1	1	1	1
Dual II Magnum/Cinch	4	NY	NR	SY	NR	NR	NR	SY	SY	NR	NY	12
Equip	18	18	8	18	15 days	8	18	18	18	18	18	18
Evik	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY
Exceed	18	10 [m]	10 [m]	18	1 [f]	10	18	18	18	10	18	18
Field Master	SY	SY	SY	SY	NR	NR	SY	SY	SY	SY	SY	SY
Glyphosate (Roundup Weather Max, Touchdown Total+ others)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Gramoxone Inteon	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Harmony GT XP	1.5	1.5	1.5	1.5	NR	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Harness	SY	SY	SY	SY	NR	NY	SY	SY	SY	SY	SY	SY
Hornet	10.5	26 [g]	18	26 [g]	NR	12	10.5	26 [g]	26 [g]	10.5	26 [g]	26 [g]

Corn - Herbicide rotation restrictions (continued)

Rotational crops (month after application) [a] -- Alfalfa to Pumpkins

Herbicide	Alfalfa	Cabbage	Cotton	Cucumbers	Field corn	Grain sorghum	Lima beans	Muskmelon	Onions	Peas	Peppers	Pumpkins
Laddok	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY
Lexar	18	18	NY	18	NR	NY	18	18	18	18	18	18
Liberty	4	4	4	4	NR	2.5	4	4	4	4	4	4
Lightning	9.5	40 g	18	40 g	8.5 f	18	40 g	40 g	40 g	9.5	40 g	40 g
Linex/Lorox	4	4	4	4	NR	4	4	4	4	4	4	4
Lumax	18	18	NY	18	NR	NY	18	18	18	18	18	18
Marksman	SY	SY	24	SY	NR	NR	SY	SY	SY	SY	SY	SY
MicroTech	AH	NY	NY	NY	NR	NR	NR	NY	NY	NY	NY	NY
NorthStar	8	18	8	18	0.5 f	8	8	18	18	8	18	18
Option	2	2	2	2	7 days	2	2	2	2	2	2	2
Outlook	NY	NY	NY	NY	NR	NR	NY	NY	NY	NY	NY	NY
Permit/Sandea	9	15	4	9	1 f	2	NY	NY	18	9	10	9
Princep	SY	SY	SY	SY	NR	SY	SY	SY	SY	SY	SY	SY
Prowl	NY	NY	NR	NY	NR o	NY	NR	NY	NY	NY	NY	NY
Python	4	26	18	26	NR	12	4	26 g	26 g	4	26 g	26 g
Ready Master ATZ	SY	SY	SY	SY	NR	NY	SY	SY	SY	SY	SY	SY
Resource	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Sencor	4	12	8	12	4	12	12	12	18	8	12	12
Spirit	18	10	10	18	1f	10	18	18	18	10	18	18
Steadfast	12	10 n	10	10 n	NR	10 n	10 n	10 n	10 n	10	10 n	10 n
Stinger	10.5	18	18	18	NR	10.5	18	18	10.5	18	18	18
Tough	1	1	1	1	NR	1	1	1	1	1	1	1
Yukon	9	15	4	9	1	2	9	9	18	9	10	9

[a] AH = after harvest; NL = not listed on label; NR = no restriction; NY = next year; SY = second year following application.

[b] 18 months with a soil pH ³ 7.5.

[c] 20 days per pint.

[d] 30 days per pint if rainfall is greater than 30 inches.

[e] See current 2,4-D label.

[f] Clearfield corn can be planted anytime.

[g] And successful field bioassay.

[h] In New Jersey, Delaware, Maryland, Pennsylvania only.

[i] In New Jersey, Delaware, Maryland, Pennsylvania only, transplants only.

[j] 18 months if less than 2 percent organic material and 15 inches of rain.

[k] Merit, Carnival, and Sweet Success are 15 months.

[l] Only following 0.38 ounces per acre.

[m] In New Jersey and Pennsylvania 18 months for cabbage, cotton, tobacco, tomatoes. STS soybeans-10 months.

[n] 18 months with a soil pH >6.5.

[o] Plant below herbicide zone.

[p] If Basis rates > 0.33 oz/acre-alfalfa, peas + sorghum-18 months; snap beans, soybeans-10 months.

Corn - Herbicide rotation restrictions (continued)

Rotational crops (month after application) [a] -- Snap beans to Winter wheat

Herbicide	Snap beans	Soybeans	Squash	Sweet corn	Tobacco	Tomatoes	Water-melon	White potatoes	Winter barley	Winter rye	Winter wheat
2,4-D	3	0.25-1 [e]	3	NR	NY	3	3	3	3	3	3
Accent	10	0.5	10 [b]	10 [k]	10 [b]	10 [b]	10 [b]	10 [b]	4	4	4
Aim	12	NR	12	NR	12	12	12	1	NR	NR	NR
Atrazine	SY	NY	SY	NR	SY	SY	SY	SY	NY	NY	NY
Axiom	SY	NR	12	12	12	12	12	1	12	12	12
Banvel	AH	1 [d]	AH	AH	NY	AH	AH	AH	1 [c]	1 [c]	1 [c]
Basagran	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Basis p	8	0.5	18	10	18	1	18	NR	4	4	4
Beacon	18	8	18	8	8	18	18	18	3	3	3
Brominal	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY
Buctril	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY
Callisto	18	NY	18	NY	NY	18	18	NY	4	4	4
Celebrity Plus	10	4	10 [n]	10 [k]	10 [n]	10 [n]	10 [n]	10 [n]	4	4	4
Clarity	4	0.5-1	4	4	4	4	4	4	AH	AH	AH
Define	18	NR	18	18	18	18	18	18	12	12	12
Degree	SY	NY	SY	NY	NY	SY	SY	SY	SY	SY	AH
Degree Xtra	SY	NY	SY	NY	NY	SY	SY	SY	SY	SY	AH
Distinct	1	1	1	1	1	1	1	1	1	1	1
Dual II Magnum/Cinch	NR	NR	12	NR	NY	6	12	NR	4.5	4.5	4.5
Equip	18	8	18	18	18	18	18	18	18	18	2
Evik	NY	NY	NY	NY	NY	NY	NY	NY	AH	AH	AH
Exceed	10	10 [m]	18	3	10 [m]	10 [m]	18	18	3	3	3
Field Master	SY	NY	SY	NY	SY	SY	SY	SY	NY	NY	NY
Glyphosate (Roundup Weather Max, Touchdown Total+ others)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Gramoxone Inteon	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Harmony GT XP	1.5	NR	1.5	1.5	1.5	1.5	1.5	1.5	NR	1.5	NR
Harness	SY	NY	SY	NY	NY	SY	SY	SY	SY	SY	AH
Hornet	26 [g]	10.5	26 [g]	18	18	26 [g]	26 [g]	18	4	4	4

Corn - Herbicide rotation restrictions (continued)

Rotational crops (month after application) [a] -- Snap beans to Winter wheat

Herbicide	Snap beans	Soybeans	Squash	Sweet corn	Tobacco	Tomatoes	Water-melon	White potatoes	Winter barley	Winter rye	Winter wheat
Laddok	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY
Lexar	18	NY	18	NY	18	18	18	18	NY	NY	NY
Liberty	4	NR	4	4	4	4	4	4	2.5	2.5	2.5
Lightning	9.5	9	40 g	18	9.5	40 g	40 g	26	9.5	4	4
Linex/Lorox	4	NR	4	4	4	4	4	NR	4	4	4
Lumax	18	NY	18	NY	18	18	18	18	18	4.5	4.5
Marksman	NY	NY	SY	NR	SY	SY	SY	SY	10	10	10
MicroTech	NY	NR	NY	NR	NY	NY	NY	NY	AH	AH	AH
NorthStar	8	8	18	8	8	18	18	8	3	3	3
Option	2	14 days	2	2	2	2	2	2	2	2	2
Outlook	NY	NR	NR	NR	NY	NY	NY	NY	4	4	4
Permit/Sandea	9	9	9	3	NY	8	NY	9	2	2	2
Princep	SY	SY	SY	NR	SY	SY	SY	SY	SY	SY	SY
Prowl	NR	NR	NY	NY	NR	NY	NY	NR	4	NY	4
Python	26 g	NR	26 g	18	9	26 g	26 g	12	4	4	4
Ready Master ATZ	SY	NY	SY	NY	SY	SY	SY	SY	SY	SY	SY
Resource	NR	NR	NR	NR	NR	NR	NR	NR	4	4	4
Sencor	12	4	12	12	12	4	12	4	8	12	8
Spirit	10	10	18	8	10	10	18	10	3	3	3
Steadfast	10	0.5	10 n	10	10 n	10 n	10 n	10 n	4	4	4
Stinger	18	10.5	18	10.5	18	18	18	18	NR	NR	NR
Tough	1	1	1	1	1	1	1	1	1	1	1
Yukon	9	9	9	3	-	8	9	9	2	2	2

a AH = after harvest; NL = not listed on label; NR = no restriction; NY = next year; SY = second year following application.

b 18 months with a soil pH ³ 7.5.

c 20 days per pint.

d 30 days per pint if rainfall is greater than 30 inches.

e See current 2,4-D label.

f Clearfield corn can be planted anytime.

g And successful field bioassay.

h In New Jersey, Delaware, Maryland, Pennsylvania only.

i In New Jersey, Delaware, Maryland, Pennsylvania only, transplants only.

j 18 months if less than 2 percent organic material and 15 inches of rain.

k Merit, Carnival, and Sweet Success are 15 months.

l Only following 0.38 ounces per acre.

m In New Jersey and Pennsylvania 18 months for cabbage, cotton, tobacco, tomatoes. STS soybeans-10 months.

n 18 months with a soil pH >6.5.

o Plant below herbicide zone.

p If Basis rates > 0.33 oz/acre-alfalfa, peas + sorghum-18 months; snap beans, soybeans-10 months.

Approved tank-mixes for soil-applied herbicides in corn [a]

■ = approved tank-mixes. See individual labels for specific mixtures that may be prohibited and for specific application rate and timing information.

	Axiom	Atrazine	Banvel/Clarity	Callisto	Define	Dual II Magnum / Cinch	Harness/Degree	Hornet	Linex/ Lorox	Marksman	MicroTech	Outlook	Prowl	Pursuit [b]	Pursuit Plus [b]	Python [c]	Simazine	Topnotch
Atrazine	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Banvel/Clarity	■	■			■	■	■	■	■		■	■	■	■	■		■	■
Callisto	■	■				■	■					■						■
Define		■	■					■		■			■			■		
Dual II Magnum/Cinch		■	■	■				■	■	■			■	■	■	■	■	
Harness/Degree		■	■	■				■		■			■	■	■		■	
MicroTech		■	■						■	■			■	■	■		■	
Outlook		■	■	■				■					■	■	■	■	■	
Prowl	■	■	■		■	■	■	■		■	■	■		■	■			■
Pursuit [b]		■	■			■	■				■	■	■					■
Python [c]	■	■			■	■						■						
Simazine		■	■			■	■				■	■			■			■
Topnotch		■	■										■	■	■		■	

MIXES

Axiom		■	■	■				■		■			■			■		
Bicep II Magnum/Cinch ATZ		■	■	■				■	■				■	■	■	■	■	
Bullet		■	■						■	■			■	■	■		■	
Degree Xtra			■					■		■			■	■		■	■	
FulTime		■	■	■				■	■	■			■	■		■		
Guardsman Max		■	■	■				■		■			■	■		■	■	
Harness Extra		■	■	■				■		■			■	■		■	■	
Hornet [c]	■	■	■		■	■	■					■						■
Keystone		■	■					■		■			■			■	■	
Lexar		■															■	
Lumax		■															■	
Marksman	■	■			■	■	■				■	■	■		■			■

NOTE: Unless specifically prohibited on product lables, other tank-mix combinations may be appropriate for use.

a Roundup Weather Max, Touchdown IQ, Gramoxone Max, or 2,4-D may be tank-mixed with many of these products for increased burndown in conservation silage systems. See burndown herbicide section for more information about these potential tank-mix partners.

b For use only on Clearfield corn hybrids.

c Tank-mixing Hornet or Python WDG with other herbicides is allowed; however, no partners are stated on the product labels. When tank-mixing, read and follow the product labels for important information on herbicide use.

Corn—no-till or conventional tillage—postemergence

Maximum corn and weed size for broadcast applications of chloroacetamide and other herbicides.
For use when weather conditions preclude use of standard preemergence program.

Herbicides	Maximum Corn Size	Maximum Weed Size
Atrazine	12 inches	1.5 inches
Axiom, Define	before emergence	before emergence
Banvel/Clarity or Marksman + Dual II Magnum/Cinch or Lasso EC	3 inches	2-leaf grass
Banvel/Clarity or Marksman + Outlook	8 inches	1-inch grass
Bicep II Magnum/Cinch ATZ	5 inches	2-leaf
Bullet or MicroTech + atrazine	5 inches	2-leaf
Callisto	30 inches or 8-leaf stage	5 inches
Degree or Degree Xtra [a]	11 inches or by tank-mix partner	before emergence or by tank-mix partner
Dual II Magnum/Cinch	40 inches (post direct > 5 inches)	2-leaf
Dual II Magnum/Cinch + Banvel/Clarity	5 inches	3-inch pigweed
Dual II Magnum/Cinch + Marksman	3 inches	2-leaf
FulTime or Topnotch [b]	11 inches or by tank-mix partner	before emergence or by tank-mix partner
Guardsman Max	12 inches	1.5 inches
Harness or Harness Xtra [c]	11 inches or by tank-mix partner	before emergence or by tank-mix partner
Hornet	2 inches (soil applied)	before emergence
	20 inches (post)	6 inches
Keystone	11 inches or by tank-mix partner	before emergence or by tank-mix partner
Lexar	12 inches	5 inches
Lumax	5 inches	3 inches
Marksman	5-leaf or 8 inches	before emergence
Outlook	12 inches	before emergence
	layby 12-36 inches	
Princep	before emergence	before emergence
Prowl + Accent [d]	4-leaf	depends on weed (see Accent label)
Prowl + Beacon [d]	4-leaf	depends on weed (see Beacon label)
Prowl +Atrazine	12 inches	1 inch
Python	20 inches	before emergence or by tank-mix partner

[a] May be tank-mixed with Accent, Atrazine, Banvel or Clarity, Marksman, Permit, Princep, Prowl, or Pursuit (Clearfield corn).

[b] May be tank-mixed with a number of different products including Accent, Banvel or Clarity, Prowl, Pursuit (Clearfield-corn). See a herbicide label for specific information.

[c] May be tank-mixed with Accent, Atrazine (Harness), Banvel or Clarity, Marksman, Permit, or Pursuit (Clearfield-corn).

[d] Accent rate of 1/3 to 2/3 oz per acre and Beacon rate of 3/8 to 3/4 oz per acre.

Corn--no-till

Perennial sod: bluegrass, fescue, orchardgrass, ryegrass, and timothy

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Reduced triazine carryover and optimum control of virorous orchardgrass sods	Paraquat 0.5 lb + surfactant followed by paraquat 0.5 lb + surfactant 10-14 days later + residual herbicide treatments as required for specific infestations	Gramoxone Inteon 2.0 pt + surfactant as labeled followed by Gramoxone Inteon 2.0 pt + surfactant as labeled 10-14 days later + residual herbicide(s)	Use double paraquat (4.0 pints total) applications for vigorous orchardgrass stands where single applications have not been effective. Observe paraquat use instructions and precautions. Tank-mix with residual herbicides as listed below for the specific weed infestation. High triazine rates are not required for orchardgrass control where the double paraquat application is used.
Alternate method for control of tall fescue and orchardgrass sods	Glyphosate 1.0-3.0 lb + residual herbicide treatment as required for specific infestation	Roundup Weather Max 0.7-1.9 qt or Touchdown Total 0.75-2.2 qt or other labeled glyphosate formulation + surfactant as labeled + residual herbicides	For fescue control, apply 3.0 pound rate of Roundup Weather Max or Touchdown Total when most plants have reached the boot stage. For orchardgrass control, apply the 2.0 pound rate of Roundup Weather Max or Touchdown Total when most plants have reached the early boot to seedhead stage. 1.0 to 1.5 pounds of Roundup Weather Max or Touchdown Total can be used in 3 to 10 gallons of water for orchardgrass control when orchardgrass is a minimum of 12 inches tall. Use of atrazine with these treatments is recommended for optimum sod control.

Corn--no-till

Annual cover: barley, rye, wheat or no-till into existing crop stubble

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Control of annual weeds and annual cover crops	Paraquat 0.5-1.0 lb + surfactant	Gramoxone Inteon 2SL 2.0-4.0 pt + surfactant as labeled	Apply 2.0-2.5 pt/acre for weeds 1 to 3 inches tall; 2.5-3.0 pt/acre for weeds 3 to 6 inches tall; 3.0-4.0 pt/acre for weeds 6 inches tall. A nonionic surfactant is needed. Paraquat may not control weeds taller than 6 inches. Increase gallonage as density of stubble, crop residue, or weeds increases. Paraquat will not provide residual weed control. Residual herbicides can be tank-mixed with paraquat.
Control of annual weeds and annual cover crops and suppression or control of perennial weeds or covers	Glyphosate 0.5-5.0 lb	Roundup Weather Max 0.5-3.6 qt or Touchdown Total 0.4-3.6 qt or other labeled glyphosate formulation	Apply Roundup Weather Max as follows: 16 to 22 oz/acre for small annual weeds, <6 inches tall; 22 to 32 oz/acre for annual weeds > 6 inches tall. When using nitrogen solutions as the carrier, use rate may need to be increased. For Touchdown Total, rates are 0.7 -4.3 pt/acre for annual weeds < 6 inches tall; 1.5-5.8 pt/acre for annual weeds > 6 inches tall or under stress. Higher rates will control perennial species, but those species often are not present or susceptible at the time of planting. Residual herbicides can be tank-mixed with these products. Applications with fan-type nozzles generally have been more effective than with flood nozzles.

Corn--no-till

Annual cover: barley, rye, wheat or no-till into existing crop stubble (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Contact kill of barley, rye, and wheat cover crops and annuals, including barnyardgrass, crabgrass, foxtail (giant, green, and yellow), goosegrass, lambsquarters, morningglory spp., mustard, nightshade, panicum (fall), pigweed (redroot), purslane, ragweed, smartweed, spanishneedles, velvetleaf, and witchgrass	Nonselective Herbicide + the approved tank-mix: Atrazine 1.0-2.0 lb + simazine 1.0-2.0 lb	Nonselective Herbicide + the approved tank-mix: Atrazine 4L 1.0-2.0 qt or 90W 1.1-2.2 lb + Princep 4L 1.0-2.0 qt or 90W 1.1-2.2 lb	Apply in 35 to 45 gallons of water per acre 10 to 14 days before planting. Use paraquat 0.47 pound active ingredient on barley. Use a 1:2 atrazine to simazine ratio on heavily infested fall panicum fields. Do not plant any crop except those specified on the label the following year. Do not allow animals to graze treated forage. See precaution above on use of paraquat. Follow label for proper mixing procedures rate to soil texture, organic matter content of soil, and weed problem. Low volume broadcast applications are recommended with other glyphosate formulations for best results.
Barnyardgrass, beggarweed (Florida), carpetweed, crabgrass (large, smooth), foxtail (green, giant, yellow), galinsoga, goosegrass, johnsongrass (seedling), lambsquarters (common), panicum (fall), pigweed sp., purslane, pusley (Florida), signalgrass (broadleaf), spurge (spotted), witchgrass	Nonselective Herbicide + the approved tank-mix: Flufenacet 0.48-0.78 lb + metribuzin 0.12-0.2 lb + atrazine 1.2-2.0 lb	Nonselective Herbicide + the approved tank-mix: Axiom 68DF 14.0-23.0 oz + Atrazine 4L 1.2-2.0 qt or 90W 1.3-2.2 lb	Plant corn 1.0 to 1.5 inches deep. Can be applied up to 45 days preplant. Sequential applications are recommended when applied 30 to 45 days preplant, with 2/3 amount applied early and remaining 1/3 applied at planting. Axiom is not labeled for application to emerged corn plants.
Triazine-resistant and susceptible common lambsquarters and pigweeds	Nonselective Herbicide + Rimsulfuron 0.01-0.015 lb + thifensulfuron-methyl 0.005-0.0075 lb	Nonselective Herbicide + Basis 75WDG 0.33-0.5 oz	Can be applied from 7 days before planting up through the 4-leaf corn stage. If applying post, do not apply more than 0.33 ounce per acre. Generally utilized as a tank-mix partner with another herbicide or herbicide combination. Do not apply preemergence on coarse-textured soils with less than 1 percent organic matter. Always include a NIS or COC when making applications to emerged weeds. Use a minimum of 15 gpa spray solution.

Corn--no-till

Annual cover: barley, rye, wheat or no-till into existing crop stubble (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Pigweed, carpetweed, chickweed, crabgrass, jimsonweed, lambsquarters, nightshade, ragweed (common), smartweed, and velvetleaf	Nonselective Herbicide + the approved tank-mix: Mesotrione 0.188-0.24 lb or Mesotrione 0.188-0.24 lb and residual grass herbicide or Mesotrione 0.156-0.188 lb and residual grass herbicide and atrazine 1.2-2.0 lb	Nonselective Herbicide + the approved tank-mix: Callisto 4FL 6.0-7.7 oz or Callisto 4FL 6.0-7.7 oz and residual grass herbicide or Callisto 4FL 5.0-6.0 oz and residual grass herbicide and Atrazine 4FL 1.2-2.0 qt or 90W 1.3-2.2 lb	Callisto is a systemic preemergence and postemergence herbicide for the selective contact and residual control of broadleaf weeds in field corn. Callisto is not effective for the control of most grass weeds. Preemergence grass herbicides such as Axiom, Degree, Dual II Magnum/Cinch, Harness, Outlook, or Topnotch, or postemergence grass herbicide can be tank-mixed with Callisto to provide a broader spectrum of weed control. To broaden its broadleaf weed control ability, tank-mix atrazine with Callisto or utilize an atrazine containing product like Bicep II Magnum, Degree Xtra, Fultime, Harness Xtra, Keystone or Guardsman Max. Do not apply more than a total of 10.7 oz/acre of Callisto per season.
Barnyardgrass, carpetweed, crabgrass (large, smooth), foxtail (giant, green, yellow), goosegrass, johnsongrass (seedling), panicum (fall), purslane (common), and signalgrass	Nonselective Herbicide + the approved tank-mix: Flufenacet 0.6-0.79 lb + atrazine 1.0-2.0 lb	Nonselective Herbicide + the approved tank-mix: Define 60DF 16.0-21.0 oz + Atrazine 4L 1.0-2.0 qt or 90W 1.1-2.2 lb	Apply after planting and before corn emerges. In the event of a crop failure, corn or soybeans may be planted immediately after a Define application. Small grains may be seeded 12 months after a Define application. Adjust rate to soil texture and organic matter.

Corn--no-till

Annual cover: barley, rye, wheat or no-till into existing crop stubble (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Contact kill of barley, rye, and wheat cover crops; annual grasses, such as barnyardgrass, broadleaf signalgrass, browntop, crabgrass, crowfootgrass, field sandbur, foxtail millet, foxtail (bristly, giant, green, yellow), goosegrass, johnsongrass (seedling), nutsedge (yellow), panicum (fall, Texas), prairie cupgrass, red rice, red sprangletop, robust foxtail (purple and white), shattercane, wild millet, and witchgrass; and broadleaf weeds, such as beggarweed (Florida), carpetweed, cocklebur, galinsoga, groundcherry, jimsonweed, lambs-quarters, nightshade (black, hairy), pigweed, purslane, ragweed (common, giant), sida (prickly), smartweed sp., and velvetleaf	Nonselective Herbicide + the approved tank-mix: Acetochlor 1.54-2.4 lb + atrazine 1.25-2.0 lb	Nonselective Herbicide + the approved tank-mix: Degree 3.8EC 3.25-5.0 pt + Atrazine 4L 1.25-2.0 qt or 90DF 1.1 lb or use Degree Xtra 4EC 2.9-3.7 qt	See acetochlor restrictions on page 2-37. Use of the highest labeled rates should result in more consistent late-season annual grass control.
	Acetochlor 1.54-2.4 lb + atrazine 1.25-2.0 lb + simazine 1.0-1.5 lb	Degree 3.8EC 3.25-5.0 pt + Atrazine 4L 1.25-2.0 qt or 90W 1.39-2.2 lb + Princep 4L 1.0-1.5 qt or 90W 1.1-1.6 lb	

Corn--no-till

Annual cover: barley, rye, wheat or no-till into existing crop stubble (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Contact kill of barley, rye, and wheat cover crops and annuals, including barnyardgrass, carpetweed, cocklebur, crabgrass, foxtail (giant, green, yellow), goosegrass, lambsquarters, morningglory spp., nutsedge (yellow), panicum (fall), pigweed spp., purslane, pusley (Florida), ragweed, signalgrass, smartweed, and velvetleaf	Nonselective Herbicide + the approved tank-mix: s-metolachlor 0.95-1.6 lb + atrazine 1.2-2.0 lb	Nonselective Herbicide + the approved tank-mix: Dual II Magnum/Cinch 7.64EC 1.0-1.67 pt + Atrazine 4L 1.2-2.0 qt or 90W 1.3-2.2 lb or use Bicep II Magnum 5.5 FL/Cinch ATZ 5.5 FL 1.6-2.6 qt	Apply before, during, or after planting, but apply before the corn emerges. Adjust rates to soil texture and organic matter content of soil. Do not graze or feed forage to livestock or use for silage. Small grains may be seeded 4.5 months after s-metolachlor use. Do not graze or feed forage or fodder from small grains to livestock. Bicep Lite II Magnum may be available in certain parts of the region.
	pendimethalin 0.75-1.5 lb	Prowl 3.3EC 0.9-1.8 qt or Prowl H20 3.8 CS 0.8-1.6 qt	The addition of Prowl to this combination will aid in the control of triazine-resistant common lambsquarters and velvetleaf. Use of Prowl on coarse-textured soils with less than 1.5 percent organic matter is not recommended because of the likelihood of injury.
Contact kill of barley, rye, and wheat cover crops and annuals, including barnyardgrass, carpetweed, cocklebur, crabgrass, cupgrass (southwestern), foxtail millet, foxtail (giant, green, yellow), goosegrass, lambsquarters, morningglory spp., nutsedge (yellow), panicum (fall), pigweed spp., purslane, pusley (Florida), ragweed, sandbur, signalgrass, smartweed, velvetleaf, and witchgrass	Nonselective Herbicide + the approved tank-mix: s-metolachlor 0.95-1.6 lb + atrazine 0.6-1.0 lb + simazine 0.6-1.0 lb	Nonselective Herbicide + the approved tank-mix: Dual II Magnum/Cinch 7.64EC 1.0-1.67 pt + Atrazine 4L 0.6-1.0 qt or 90W 0.66-1.1 lb + Princep 4L 0.6-1.0 qt or 90W 0.66-1.1 lb	Apply in 10 to 40 gallons of water or fluid fertilizer with ground equipment in minimum tillage or no-tillage systems where corn is planted directly into a cover crop, stale seedbed, established sod, or previous crop residues. Adjust rates of atrazine, s-metolachlor, and simazine to soil texture, organic matter content of soil, and weed problem. Check labels for restrictions regarding planting of rotational cover crops. Note: s-metolachlor plus atrazine plus simazine may also be applied as Bicep II Magnum (atrazine plus s-metolachlor) plus Princep (simazine). Consult label for specific rates.

Corn--no-till

Annual cover: barley, rye, wheat or no-till into existing crop stubble (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Contact kill of barley, rye, and wheat cover crops; annual grasses, such as barnyardgrass, broadleaf signalgrass, browntop, crabgrass, crowfootgrass, field sandbur, foxtail millet, foxtail (bristly, giant, green, yellow), goosegrass, johnsongrass (seedling), nutsedge (yellow), panicum (fall, Texas), prairie cupgrass, red rice, red sprangletop, robust foxtail (purple and white), shattercane, wild millet and witchgrass; and broadleaf weeds, such as beggarweed (Florida), carpetweed, cocklebur, galinsoga, groundcherry, jimsonweed, lambsquarters, nightshade (black, hairy), pigweed, purslane, ragweed (common, giant), sida (prickly), smartweed sp., and velvetleaf	Nonselective Herbicide + the approved tank-mix: Acetochlor 1.53-2.4 lb + atrazine 1.25-2.0 lb	Nonselective Herbicide + the approved tank-mix: Harness 7EC 1.75-2.75 pt + Atrazine 4L 1.25-2.0 qt or 90W 1.39-2.22 lb or use Harness Xtra 5.6L 1.8-2.7 qt	See acetochlor restrictions on page 2-37. Use of the highest labeled rates should result in more consistent late-season annual grass control. Other acetochlor + atrazine prepackaged mixes are available such as Keystone and Keystone LA from Dow AgroSciences. Keystone use rate is 2.2 to 3.4 qt/acre. Field Master is a prepackage mixture of Roundup, Harness, and atrazine. Field Master use rates range from 3.5 to 5.0 quarts per acre. Additional Roundup may be needed for effective non-selective weed control.
Carpetweed, chickweed, clover (red), cocklebur, henbit, horseweed, jimsonweed, lambsquarters, morningglory, nightshade, pigweed, purslane, ragweed (common), sicklepod, sida (prickly), smartweed, spurred anoda, and velvetleaf	Nonselective Herbicide + Flumetsulam/clopyralid 0.196-0.245 lb or flumetsulam 0.04-0.07 lb	Nonselective Herbicide + Hornet 78.5WP 4.0-5.0 oz or Python 0.8-1.33 oz	Hornet and Python are approved for use with most grass herbicides, including Dual II Magnum/Cinch, Outlook, Harness, MicroTech, and Topnotch. Adequate soil moisture is required for optimum herbicidal activity. If using liquid fertilizer solution, water-soluble packets containing Hornet or Python should be premixed with water and added to the spray tank through 20- to 35-mesh screen. Soil insecticides should be applied in a band to avoid potential injury. Observe rotational restrictions on labels. Application to emerged Canada thistle will result in reduced late-season competition. Corn must be planted at least 1.5 inches deep, soil organic matter >1.5 percent, and soil temperature above 50 degrees F. If these three criteria are not met, injury may occur. To avoid crop injury, plant Clearfield corn hybrids.

Corn--no-till

Annual cover: barley, rye, wheat or no-till into existing crop stubble (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Contact kill of barley, rye, and wheat cover crops and residual control of annual grasses including barnyardgrass, crabgrass spp., fall panicum, foxtail spp., goosegrass, and witchgrass, and annual broadleaf weeds including jimsonweed, lambsquarters (including triazine-resistant species), morningglory spp. (suppression), nightshade, common ragweed, pigweed (including triazine-resistant), smartweed, velvetleaf, and yellow nutsedge	Nonselective Herbicide + approved tank-mix: Atrazine 1.3-1.5 lb + mesotrione 0.168-0.196 lb + s-metolachlor 1.3-1.5 lb	Nonselective Herbicide + approved tank-mix: Lexar 3.7FL 3.0-3.5 qt Approved tank-mixes with Lexar include the following: Atrazine 4L or 90W or Princep 4L or 90W	Lexar contains more atrazine but less s-metolachlor than Lumax. Use 3 qt/acre on soil with organic matter content less than 3% and 3.5 qt/acre on soil with organic matter content 3% or greater. Do not apply more than 14 days prior to planting or to field corn taller than 12 inches. Do not graze or feed forage from treated areas for 45 days following last application. Do not harvest forage, grain, or stover within 60 days after last application. Do not apply other mesotrione containing products (Callisto, Camix, or Lumax) to ground that has been treated the same season. Do not apply Lexar postemergence to corn that has received an at-plant application of Counter. Do not make a postemergence application of Lexar in a tank-mix with any organophosphate or carbamate insecticide. Do not make a postemergence application of any organophosphate or carbamate insecticide within 7 days before or 7 days after a Lexar application. If significant rainfall does not occur within 7 days after application, weed control may be decreased. Do not rotate to crops other than corn, cotton, small grains, sorghum or peanuts the spring following application of Lexar herbicide. If applied after June 1, do not rotate with crops other than corn or sorghum the next season.

Corn--no-till

Annual cover: barley, rye, wheat or no-till into existing crop stubble (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Contact kill of barley, rye, and wheat cover crops and residual control of annual grasses including barnyardgrass, crabgrass spp., fall panicum, foxtail spp., goosegrass, and witchgrass and annual broadleaf weeds including jimsonweed, lambsquarters (including triazine-resistant species), nightshade, common ragweed, pigweed (including triazine-resistant species), smartweed, and velvetleaf	Nonselective Herbicide + approved tank-mix: Atrazine 0.625-0.75 lb + mesotrione 0.168-0.2 lb + s-metolachlor 1.68-2.0 lb	Nonselective Herbicide + approved tank mix: Lumax 5.6FL 2.5-3.0 qt Approved tank-mixes for use with Lumax: Atrazine 4L or 90W or Princep 4L or 90W	Lumax contains less atrazine and more s-metolachlor than Lexar. Lumax can be applied 14 days prior to planting. Use the 2.5-qt rate on soils of less than 3.0% organic matter and the 3.0-qt rate on soils of greater than 3.0% organic matter. Unsatisfactory weed control may be observed if activation rainfall is not received within 7 days of application. Lumax contains a relatively low rate of atrazine. Broadleaf weed control can be significantly improved through use of additional atrazine. Lumax provides control of triazine-resistant pigweed and lambsquarters species. Do not rotate to crops other than corn (all types), cotton, soybeans, sorghum, or peanuts in the spring following application. Lumax can also be applied as an early postemergence treatment on corn up to 5 inches high. Early postemergence applications will not provide consistent control of emerged annual grasses. As directed on the Lumax label, do not apply to emerged corn if an at-planting application of Counter was made or severe corn injury may occur. Temporary corn injury may occur if an organophosphate insecticide other than Counter was used. Lorsban label allows for T-band or in-furrow application of Lorsban followed by postemergence application of Lumax. Do not apply Callisto, Camix, or Lexar to a field that has been treated with Lumax in the same season. If applied after June 1, do not rotate with crops other than corn or sorghum the next season. Winter wheat, barley, or rye may be planted 4.5 months following application. For most vegetables, the planting restriction is 18 months.

Corn--no-till

Annual cover: barley, rye, wheat or no-till into existing crop stubble (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Contact kill of barley, rye, and wheat cover crops and annuals, including barnyardgrass, carpetweed, cocklebur, crabgrass, foxtail (giant, green, yellow), goosegrass, jimsonweed, lambsquarters, nightshade (black), panicum (fall), pigweed spp., purslane, pusley (Florida), ragweed (common), signalgrass, smartweed, velvetleaf, and witchgrass	Nonselective Herbicide + approved tank-mix: Alachlor 2.5-3.0 lb + atrazine 1.0-2.0 lb	Nonselective Herbicide + approved tank-mix: MicroTech 2.5-3.0 qt + Atrazine 4L 1.0-2.0 qt or 90W 1.1-2.2 lb or use Bullet 2.5-4.5 qt	Apply 10 to 14 days before and up to the day of planting. Follow label for proper mixing procedures and adjust rate to soil texture, organic matter content of soil, and weed problem. This combination may be weak on crabgrass species and may not provide season-long control of other annual grasses.
Contact kill of barley, rye, and wheat cover crops and annuals, including barnyardgrass, carpetweed, cocklebur, crabgrass, foxtail (giant, green, yellow), goosegrass, lambsquarters, morningglory spp., nutsedge (yellow), panicum (fall), pigweed spp., purslane, pusley (Florida), ragweed, signalgrass, smartweed, and velvetleaf	Nonselective Herbicide + the approved tank-mix: Dimethenamid-p 0.66-0.98 lb + atrazine 1.2-2.0 lb	Nonselective Herbicide + the approved tank-mix: Outlook 6EC 14.0-21.0 oz + Atrazine 4L 1.2-2.0 qt or 90W 1.3-2.2 lb or use Guardsman Max 5L 3.0-4.6 pt	Apply before, during, or after planting but before corn emerges. Adjust rates to soil texture and organic matter content of soil. Small grains may be seeded 4 months after dimethenamid-p use. Late-season grass control may diminish in no-till conditions. Guardsman Max Lite may be available in certain regions.
	Dimethenamid-p 0.66-0.98 lb + atrazine 0.5-1.0 lb + simazine 0.5-1.0 lb	Outlook 6EC 14.0-21.0 oz + Atrazine 4L 0.5-1.0 qt or 90W 0.5-1.1 lb + Princep 4L 0.5-1.0 qt or 90W 0.5-1.1 lb	

Corn--no-till

Annual cover: barley, rye, wheat or no-till into existing crop stubble (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Contact kill of barley, rye, and wheat cover crops; annual grasses, such as barnyardgrass, broadleaf signalgrass, browntop, crabgrass, crowfootgrass, field sandbur, foxtail millet, foxtail (bristly, giant, green, yellow), goosegrass, johnsongrass (seedling), nutsedge (yellow), panicum (fall, Texas), prairie cupgrass, red rice, red sprangletop, robust foxtail (purple, white), shattercane, wild millet, and witchgrass; and broadleaf weeds, such as beggarweed (Florida), carpetweed, cocklebur, galinsoga, groundcherry, jimsonweed, lambsquarters, nightshade (black, hairy), pigweed, purslane, ragweed (common, giant), sida (prickly), smartweed sp., and velvetleaf	Nonselective Herbicide + the approved tank-mix: Acetochlor 1.6-2.4 lb + atrazine 1.0-2.0 lb	Nonselective Herbicide + the approved tank-mix: Topnotch 3.2CS 4.0-6.0 pt + Atrazine 4L 1.0-2.0 qt or 90W 1.1-2.2 lb or use FulTime 4CS 2.5-5.0 qt	See remarks on page 2-37 regarding all acetochlor-containing products. In no-till, use of the highest labeled rates of acetochlor and the addition of simazine where appropriate to rotational plans should result in more consistent late-season annual grass control. Other acetochlor + atrazine prepackaged mixes are available such as Keystone and Keystone LA from Dow AgroSciences. Keystone use rate is 2.2 to 3.4 qt/acre.
	Acetochlor 1.6-2.4 lb + atrazine 0.5-1.0 lb + simazine 0.5-1.0 lb	Topnotch 3.2CS 4.0-6.0 pt + Atrazine 4L 0.5-1.0 qt or 90W 0.5-1.1 lb + Princep 4L 0.5-1.0 qt or 90W 0.5-1.1 lb	

Acetochlor Products, Use Rates and Restrictions:

Single products:

Trade name	Rate per acre
Harness 7E	1.0-2.5 pt
Degree 3.8L	1.13-2.75 qt
Topnotch 3.2CS	2.0-3.75 qt

Premixes:

Trade name	Rate per acre
Degree Xtra 4.04L	2.9-3.7 qt
Field Master 4.25L	3.5-5.0 qt
Fultime 4CS	2.5-5.0 qt
Harness Xtra 6L	1.8-2.7 qt
Keystone 5.25SE	2.2-3.4 qt
Keystone LA 5.5SE	1.6-2.5 qt

Acetochlor use restrictions:

- Read the label for information concerning personal protective equipment.
- This product is toxic to fish. Avoid application and runoff to areas containing aquatic life.
- This chemical demonstrates the properties and characteristics associated with chemicals detected in ground water. Avoid permeable soils and minimize runoff.
- Do not apply to the following soils if ground water depth is 30 feet or less:
  - sands with less than 3 percent organic matter,
  - loamy sands with less than 2 percent organic matter, or
  - sandy loams with less than 1 percent organic matter.
- Observe restrictions on the label that concern mixing, loading, rinsing, and washing.
- Do not apply through irrigation equipment.
- Do not apply using aerial application equipment.
- Do not use acetochlor on any crop other than corn.

Corn--no-till

Annual cover: barley, rye, wheat or no-till into existing crop stubble (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Early preplant control of annual grasses	Simazine 1.0-1.5 lb	Princep 4L 1.0-1.5 qt or 90W 1.1-1.7 lb	Apply 2 to 4 weeks prior to corn planting. Rainfall is necessary for satisfactory control. Apply additional burndown and residual herbicides at planting as required.
Supplement to paraquat, glyphosate (Roundup Weather Max or Touchdown) or simazine early preplant, burndown treatments. For added control of hard-to-control annual broadleaf weeds present at no-till corn establishment, suppression of some perennial broadleaf species, and control of alfalfa and clovers	2,4-D 0.25-0.50 lb or Dicamba 0.25-0.375 lb	2,4-D 0.50-1.0 pt or Banvel/Clarity 0.50-0.75 pt	Add 2,4-D or dicamba to paraquat for added burndown of hard-to-control broadleaf weeds. Use the lower rate of 2,4-D on light, sandy soils and the higher rate only on heavy soils. Do not apply dicamba on light, sandy coastal plain soils as a preemergence treatment. Adjust dicamba rate to soil texture and organic matter content of soil as labeled. Use 2,4-D for added control or suppression of mustard spp., plantains, horseweed, and 2,4-D susceptible annual broadleaf weeds. Use dicamba for control or suppression of alfalfa, clovers, dock, and dicamba-susceptible annual broadleaf weeds.

Triazine-resistant weeds in no-till corn

For pigweed control, use a nonselective herbicide plus atrazine in combination with a chloroacetamide herbicide (alachlor, s-metolachlor, acetochlor, or dimethenamid-p). Simazine may also be included where required for late-season annual-grass control. The chloroacetamide herbicide will suppress or control initial triazine-resistant pigweed flushes, but in most years an early postemergence application of dicamba will be required for season-long control.

For control of triazine-resistant pigweed, common lambsquarters, and velvetleaf, use a nonselective herbicide in combination with flumetsulam (Python) or rimsulfuron plus thifensulfuron-methyl (Basis). With timely activation rainfall, these treatments can provide season-long control of these species without supplemental postemergence herbicide applications. Atrazine should generally be applied in combinations with flumetsulam for broad-spectrum weed control. A residual grass herbicide should be tank-mixed with Python or Basis for season-long grass control. Lexar or Lumax, blends of s-metolachlor + atrazine + mesotrione (Callisto) also provides excellent season-long control of triazine-resistant lambsquarters and pigweed species.

Corn--conventional tillage

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preplant incorporated Barnyardgrass, carpetweed, crabgrass (large, smooth), foxtail (giant, green, yellow), goosegrass, johnsongrass (seedling), panicum (fall), purslane (common), and signalgrass	Flufenacet 0.525-0.75 lb	Define 60DF 14.0-20.0 oz	Apply to the soil and incorporate into the top 2 inches of soil before planting, using a field cultivator, disk harrow, or similar implement. Read the label and adjust rate to soil texture and content of organic matter. In the event of a crop failure, corn or soybeans may be planted immediately after a Define application. Small grains may be seeded 12 months after a Define application.
Barnyardgrass, carpetweed, crabgrass, foxtail (giant, green, yellow), goosegrass, nutsedge (yellow), panicum (fall), pigweed, pusley (Florida), signalgrass, and witchgrass	s-metolachlor 0.95-1.6 lb	Dual II Magnum/Cinch 7.64EC 1.0-1.67 pt	Apply to the soil and incorporate into the top 2 inches within 14 days before planting, using a disk, harrow, rolling cultivator, or similar implement. Small grains may be planted 4.5 months following treatment. Do not graze or feed forage or fodder from small grains to livestock.
Above weeds and cocklebur, lambsquarters, jimsonweed, morningglory, nightshade (black), pigweed spp., purslane, ragweed, smartweed, and velvetleaf	s-metolachlor 0.76-1.6 lb + atrazine 1.0-2.0 lb	Dual II Magnum/Cinch 7.64EC 0.8-1.67 pt + Atrazine 4L 1.0-2.0 qt or 90W 1.1-2.2 lb or use Bicep II Magnum/Cinch ATZ 5.5FL 1.3-2.6 qt	Apply tank-mixture to the soil and incorporate into the top 2 inches of soil before planting using a disk, harrow, rolling cultivator, or similar implement. Read the label and adjust rate to soil texture and organic matter content of soil. See s-metolachlor restrictions above. Bicep Lite II Magnum may be available in certain parts of the region.

Corn--conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preplant incorporated (continued)			
Barnyardgrass, carpetweed, cocklebur, crabgrass, cupgrass (southwestern), foxtail millet, foxtail (giant, green, yellow), goosegrass, johnsongrass (seedling), lambsquarters, morningglory spp., nutsedge (yellow), panicum (fall), pigweed spp., purslane, pusley (Florida), ragweed, sandbur, signalgrass, smartweed, velvetleaf, volunteer sorghum, and witchgrass	s-metolachlor 0.76-1.6 lb + atrazine 0.5-1.0 lb + simazine 0.5-1.0 lb	Dual II Magnum/Cinch 7.64EC 0.8-1.67 pt + Atrazine 4L 0.5-1.0 qt or 90W 0.5-1.1 lb + Princep 4L 0.5-1.0 qt or 90W 0.5-1.1 lb	Apply the tank-mixture to the soil and incorporate into the top 2 inches of soil within 14 days before planting using a finishing disk, harrow, rolling cultivator, or similar implement capable of providing uniform 2-inch incorporation. If corn is to be planted on beds, apply and incorporate the tank-mixture after bed formation. Read the label and adjust rate to soil texture and organic matter content of soil. S-metolachlor plus atrazine plus simazine may also be applied as Bicep II Magnum or Cinch ATZ (atrazine plus s-metolachlor) plus Princep (simazine). Consult label for specific ratios.
Barnyardgrass, carpetweed, crabgrass, foxtail (giant, green, yellow), goosegrass, nutsedge (yellow), panicum (fall), pigweed spp., pusley (Florida), signalgrass, and witchgrass	Dimethenamid-p 0.66-0.98 lb	Outlook 6EC 14.0-21.0 oz	Apply to the soil and uniformly incorporate into top 2 inches within 14 days before planting using a field cultivator, disk harrow, or similar implement. Small grains may be planted 4 months following treatment.

Corn--conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preplant incorporated (continued)			
Previously listed weeds and cocklebur, jimsonweed, lambsquarters, morningglory spp., nightshade (black), pigweed, purslane, ragweed, smartweed, and velvetleaf	Dimethenamid-p 0.66-0.98 lb + atrazine 1.0-2.0 lb	Outlook 6EC 14-21 oz + Atrazine 4L 1.0-2.0 qt or 90W 1.1-2.2 lb or use Guardsman Max 6L 3.0-4.6 pt	Apply the tank-mixture to the soil and incorporate into top 2 inches of soil before planting using a field cultivator, disk harrow, or similar implement. Read the label and adjust rate to soil texture and organic matter content of soil. See dimethenamid-p restrictions in previous entry. Guardsman Max Lite may be available in certain regions.
	Dimethenamid-p 0.66-0.98 lb + atrazine 0.5-1.0 lb + simazine 0.5-1.0 lb	Outlook 6EC 14-21 oz + Atrazine 4L 0.5-1.0 qt or 90W 0.5-1.1 lb + Princep 4L 0.5-1.0 qt or 90W 0.5-1.1 lb	Apply the tank-mixture to the soil and incorporate into top 2 inches of soil within 14 days before planting using a finishing disk, harrow, field cultivator, or similar implement capable of providing uniform 2-inch incorporation. If corn is to be planted on beds, apply and incorporate the tank-mixture after bed formation. Read the label and adjust rate to soil texture and organic matter content of soil.
Preemergence			
Many annuals including lambsquarters, morningglory spp., mustards, nightshade, pigweed (redroot), pusley (Florida), velvetleaf, and witchgrass	Atrazine 1.5-2.0 lb	Atrazine 4L 1.5-2.0 qt or 90W 1.66-2.5 lb	Spray immediately after planting. Use lower rate on light soils. Shallow cultivation usually will improve weed control. Do not plant any crop except those specified on the label the following year. Do not apply more than 2.0 pounds of atrazine or simazine in any one year. Use a 1:2 ratio of atrazine to simazine on more severe annual grass problem areas.
Broadleaf weeds listed above for atrazine plus barnyardgrass, Brachiaria spp., crabgrass, foxtail (giant, green, yellow), goosegrass, lambsquarters, morningglory, mustards, nightshade, panicum (fall), pusley (Florida), ragweed, smartweed, spanishneedles, and witchgrass	Atrazine 1.0-1.5 lb + simazine 1.0-1.5 lb	Atrazine 4L 1.0-1.5 qt or 90W 1.1-1.6 lb + Princep 4L 1.0-1.5 qt or 90W 1.1-1.6 lb	

Corn--conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preemergence (continued)			
Barnyardgrass, beggarweed (Florida), carpetweed, crabgrass (large, smooth), foxtail (green, giant, yellow), galinsoga, goosegrass, johnsongrass (seedling), lambsquarters (common), panicum (fall), pigweed sp., purslane, pusley (Florida), signalgrass (broadleaf), spurge (spotted), witchgrass	Flufenacet 0.44-0.78 lb + metribuzin 0.11-0.2 lb + atrazine 1.2-2.0 lb	Axiom 68DF 13.0-23.0 oz + Atrazine 4L 1.2-2.0 qt or 90W 1.3-2.2 lb	Plant corn 1.0 to 1.5 inches deep. Axiom is not labeled for application to emerged corn plants.
Triazine-resistant and susceptible common lambsquarters and pigweeds	Rimsulfuron 0.01-0.015 lb + thifensulfuron-methyl 0.005-0.0075 lb	Basis 75WDG 0.33-0.5 oz	Can be applied from 7 days before planting up through the 4-leaf corn stage. If applying post, do not apply more than 0.33 ounces per acre. Generally utilized as a tank-mix partner with another herbicide or herbicide combination. Do not apply preemergence on coarse-textured soils with less than 1 percent organic matter. Always include a NIS or COC when making applications to emerged weeds. Use a minimum of 15 gpa spray solution.
Pigweed, carpetweed, chickweed, crabgrass, jimsonweed, lambsquarters, nightshade, ragweed (common), smartweed, and velvetleaf	Mesotrione 0.188-0.24 lb or Mesotrione 0.188-0.24 lb and residual grass herbicide or Mesotrione 0.156-0.188 lb and residual grass herbicide and atrazine 1.2-2.0 lb	Callisto 4FL 6.0-7.7 oz or Callisto 4FL 6.0-7.7 oz and residual grass herbicide or Callisto 4FL 5.0-6.0 oz and residual grass herbicide and Atrazine 4FL 1.2-2.0 qt or 90W 1.3-2.2 lb	Callisto is a systemic preemergence and postemergence herbicide for the selective contact and residual control of broadleaf weeds in field corn. Callisto is not effective for the control of most grass weeds. Preemergence grass herbicides such as Axiom, Degree, Dual II Magnum/Cinch, Harness, Outlook, or Topnotch, or postemergence grass herbicide can be tank-mixed with Callisto to provide a broader spectrum of weed control. To broaden its broadleaf weed control ability, tank-mix atrazine with Callisto or use an atrazine containing product such as Bicep II Magnum, Degree Xtra, Fultime, Harness Xtra, Keystone or Guardsman Max. Do not apply more than a total of 10.7 oz/acre of Callisto per season.

Corn--conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preemergence (continued)			
Barnyardgrass, carpetweed, crabgrass (large, smooth), foxtail (giant, green, yellow), goosegrass, johnsongrass (seedling), panicum (fall), purslane (common), and signalgrass	Flufenacet 0.525-0.75 lb + atrazine 1.0-2.0 lb	Define 60DF 14.0-20.0 oz + Atrazine 4L 1.0-2.0 qt or 90W 1.1-2.2 lb	Apply after planting and before corn emerges. Read the label and adjust rate to soil texture and content of organic matter. In the event of a crop failure, corn or soybeans may be planted immediately after a Define application. Small grains may be seeded 12 months after a Define application.
Annual grasses, such as barnyardgrass, broadleaf signalgrass, browntop, crabgrass, crowfootgrass, field sandbur, foxtail millet, foxtail (bristly, giant, green, yellow), goosegrass, johnsongrass (seedling), nutsedge (yellow), panicum (fall, Texas), prairie cupgrass, red rice, red sprangletop, robust foxtail (purple and white), shattercane, wild millet and witchgrass; and broadleaf weeds, such as beggarweed (Florida), carpetweed, cocklebur, galinsoga, roundcherry, jimsonweed, lambsquarters, nightshade (black, hairy), pigweed, purslane, ragweed (common, giant), sida (prickly), smartweed sp., and velvetleaf	Acetochlor 1.54-2.4 lb + atrazine 1.25-2.0 lb or	Degree 3.8EC 3.25-5.0 pt + Atrazine 4L 1.25-2.0 qt or 90W 1.39-2.2 lb or use Degree Xtra 4EC 2.9-3.7 qt	See acetochlor restrictions on page 2-37. Use of the highest labeled rates should result in more consistent late-season annual grass control.
	Acetochlor 1.54-2.4 lb + atrazine 1.25-2.0 lb + simazine 1.0-1.5 lb	Degree 3.8EC 3.25-5.0 pt + Atrazine 4L 1.25-2.0 qt or 90W 1.39-2.2 lb + Princep 4L 1.0-1.5 qt or 90W 1.1-1.6 lb	
Barnyardgrass, carpetweed, crabgrass, foxtail (giant, green, yellow), goosegrass, nutsedge (yellow), panicum (fall), pigweed spp., pusley (Florida), signalgrass, and witchgrass	s-metolachlor 0.95-1.6 lb	Dual II Magnum/Cinch 7.64EC 1.0-1.67 pt	Apply after planting and before corn emerges. Small grains may be seeded 4.5 months after treatment. Do not graze or feed forage or fodder from small grains to livestock. Adjust rate to soil texture.

Corn--conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preemergence (continued)			
Above weeds and cocklebur, jimsonweed, lambsquarters, morningglory spp., nightshade (black), ragweed, smartweed, and velvetleaf	s-metolachlor 0.76-1.6 lb + atrazine 1.0-2.0 lb	Dual II Magnum/Cinch 7.64EC 0.8-1.67 pt + Atrazine 4L 1.0-2.0 qt or 90W 1.1-2.2 lb or use Bicep II Magnum/Cinch ATZ 5.5 FL 1.3-2.6 qt	See above for respective herbicides. S-metolachlor plus atrazine (Bicep II Magnum or Cinch ATZ) may also be applied as an early postemergence treatment up to the time when weeds reach the 2-leaf stage and corn is no more than 5 inches high. Do not apply as an early postemergence treatment in fluid or fertilizer Bicep Lite II Magnum may be available in certain parts of the region.
Barnyardgrass, carpetweed, cocklebur, crabgrass, cupgrass (southwestern), foxtail (giant, green, yellow), johnsongrass (seedling), lambsquarters, morningglory spp., millet (foxtail), nutsedge (yellow), panicum (fall), pigweed spp., purslane, pusley (Florida), ragweed, sandbur, signalgrass, smartweed, velvetleaf, volunteer sorghum, and witchgrass	s-metolachlor 0.76-1.6 lb + atrazine 0.5-1.0 lb + simazine 0.5-1.0 lb	Dual II Magnum/Cinch 7.64EC 0.8-1.67 pt + Atrazine 4L 0.5-1.0 qt or 90W 0.5-1.1 lb + Princep 4L 0.5-1.0 qt or 90W 0.5-1.1 lb	Apply the tank-mixture during planting (behind the planter) or after planting but before weeds or corn emerge. Read the label and adjust rates to soil texture and organic matter content of soil. Check labels for instructions regarding planting of rotational crops. S-metolachlor plus atrazine plus simazine may also be applied as Bicep II Magnum or Cinch ATZ (atrazine plus s-metolachlor) plus Princep (simazine). Consult labels for specific ratios.
Annual grasses, such as barnyardgrass, broadleaf signalgrass, browntop, crabgrass, crowfootgrass, field sandbur, foxtail millet, foxtail (bristly, giant, green, yellow), goosegrass, johnsongrass (seedling), nutsedge (yellow), panicum (fall, Texas), prairie cupgrass, red rice, red sprangletop, robust foxtail (purple, white), shattercane, wild millet, and witchgrass; and broadleaf weeds, such as beggarweed (Florida), carpetweed, cocklebur, galinsoga, groundcherry, jimsonweed, lambsquarters, nightshade (black, hairy), pigweed, purslane, ragweed (common, giant), sida (prickly), smartweed sp., and velvetleaf	Acetochlor 1.53-2.4 lb + atrazine 1.25-2.0 lb	Harness 7EC 1.75-2.75 pt + Atrazine 4L 1.25-2.0 qt or 90W 1.4-2.2 lb or use Harness Xtra 5.6L 1.8-2.7 qt	See acetochlor use restrictions on page 2-37. Other formulations of acetochlor + atrazine are available such as Keystone and Keystone LA from Dow AgroSciences. Keystone use rate is 2.2 to 3.4 qt/acre.

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preemergence (continued)			
Carpetweed, chickweed, cocklebur, henbit, horseweed, jimsonweed, lambsquarters, morningglory, nightshade, pigweed, purslane, red clover, ragweed (common), sicklepod, sida (prickly), smartweed, spurred anoda, and velvetleaf	Flumetsulam/clopyralid 0.196-0.245 lb or Flumetsulam 0.04-0.07 lb	Hornet 78.5WDG 4.0-5.0 oz or Python 0.8-1.33 oz	If incorporating, uniformly incorporate the herbicide treatment into the top 2 to 3 inches of the final seedbed. Adequate soil moisture is required for optimum herbicidal activity. If adequate soil moisture is not received within 7 to 10 days after a surface-applied treatment, a shallow cultivation is recommended. If using in liquid fertilizer solution, water-soluble packets containing Hornet or Python should be premixed with water and added to the spray tank through a 20- to 35-mesh screen. Soil insecticides should be applied in a band to avoid potential injury. Observe the rotational restrictions on the label. Hornet and Python are approved for use with most grass herbicides, including Dual II Magnum/Cinch, Outlook, Harness, and MicroTech. Plant corn at least 1.5 inches deep, soil organic matter >1.5 percent, and soil temperature above 50 degrees F. If these three criteria are not met, injury may occur. To avoid crop injury, plant Clearfield corn hybrids.

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preemergence (continued)			
Residual control of annual grasses including barnyardgrass, crabgrass spp., fall panicum, foxtail spp., goosegrass, and witchgrass and annual broadleaf weeds including jimsonweed, lambsquarters (including triazine-resistant species), morningglory spp. (suppression), nightshade, common ragweed, pigweed (including triazine-resistant), smartweed, velvetleaf, and yellow nutsedge	Atrazine 1.3-1.5 lb + mesotrione 0.168-0.196 lb + s-metolachlor 1.3-1.5 lb	Lexar 3.7FL 3.0-3.5 qt Approved tank-mixes for use with Lexar: Atrazine 4L or 90W or Princep 4L or 90W	Lexar contains more atrazine but less s-metolachlor than Lumax. Use 3 qt/acre on soil with organic matter content less than 3% and 3.5 qt/acre on soil organic matter content 3% or greater. Do not apply more than 14 days prior to planting or to field corn taller than 12 inches. Do not graze or feed forage from treated areas for 45 days following last application. Do not harvest forage, grain, or stover within 60 days after last application. Do not apply other mesotrione containing products (Callisto, Camix, or Lumax) to ground that has been treated the same season. Do not apply Lexar postemergence to corn that has received an at-plant application of Counter. Do not make a postemergence application of Lexar in a tank-mix with any organophosphate or carbamate insecticide. Do not make a postemergence application or any organophosphate or carbamate insecticide within 7 days before or 7 days after a Lexar application. If significant rainfall does not occur within 7 days after application, weed control may be decreased. Do not rotate to crops other than corn, cotton, small grains, sorghum or peanuts the spring following application of Lexar herbicide. If applied after June 1, do not rotate with crops other than corn or sorghum the next season.

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preemergence (continued)			
Annual grasses such as barnyardgrass, crabgrass spp., fall panicum, foxtail spp., goosegrass, and witchgrass and annual broadleaf weeds including jimsonweed, lambsquarters (including triazine-resistant species), nightshade, common ragweed, pigweed (including triazine-resistant species), smartweed, and velvetleaf	Atrazine 0.625-0.75 lb + mesotrione 0.168-0.2 lb + s-metolachlor 1.68-2.0 lb	Lumax 5.6FL 2.5-3.0 qt Approved tank-mixes for use with Lumax: Atrazine 4L or 90W or Princep 4L or 90W	Lumax contains less atrazine and more s-metolachlor than Lexar. Lumax can be applied 14 days prior to planting. Use the 2.5-qt rate on soils of less than 3.0 percent organic matter and the 3.0-qt rate on soils of greater than 3.0 percent organic matter. Unsatisfactory weed control may result if activation rainfall is not received within 7 days of application. Lumax contains a relatively low rate of atrazine. Broadleaf weed control can be significantly improved through use of additional atrazine. Lumax provides control of triazine-resistant pigweed and lambsquarters species. Do not rotate to crops other than corn (all types), cotton, soybeans, sorghum, or peanuts in the spring following application. Lumax can also be applied as an early postemergence treatment on corn up to 5 inches high. Early postemergence applications will not provide consistent control of emerged annual grasses. As directed on the Lumax label, do not apply to emerged corn if an at-planting application of Counter was made or severe corn injury may occur. Temporary corn injury may occur if an organophosphate insecticide other than Counter was used. Lorsban label allows for T-band or in-furrow application of Lorsban followed by postemergence application of Lumax. Do not apply Callisto, Camix, or Lexar to a field that has been treated with Lumax in the same season. Winter wheat, barley, or rye may be planted 4.5 months following application. For most vegetables the planting restriction is 18 months.

Corn--conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preemergence (continued)			
Barnyardgrass, carpetweed, crabgrass, foxtail (giant, green, yellow), goosegrass, panicum (fall), pigweed spp., purslane, pusley (Florida), signalgrass, and witchgrass	Alachlor 2.0-3.25 lb	MicroTech 2.0-3.25 qt or other labeled alachlor formulation	Apply after planting and before crop or weeds emerge. Read label and adjust rate to soil texture and organic matter content of soil. Most effective on grasses; higher rate improves control of many broadleaf weeds.
Above weeds and jimsonweed, lambsquarters, nightshade (black), morningglory spp., mustards, ragweed, smartweed, and velvetleaf	Alachlor 1.5-3.0 lb + atrazine 1.0-1.6 lb	MicroTech 1.5-3.0 qt or other alachlor formulation + Atrazine 4L 1.0-1.6 qt or 90W 1.1-1.8 lb or use Bullet (prepackaged mix) 2.5-4.5 qt	Read label and adjust rate to soil or texture and organic matter content. See other remarks and precautions about the use of alachlor and atrazine separately. Alachlor and atrazine may be applied as a tank-mix and incorporated into top 2 inches of soil within 7 days before planting. Certain alachlor formulations may be applied as an early postemergence treatment up to the time when weeds reach the 2-leaf stage and corn is not more than 5 inches high. Do not apply as an early postemergence treatment in fluid fertilizer.
Barnyardgrass, carpetweed, crabgrass, foxtail (giant, green, yellow), goosegrass, nutsedge (yellow), panicum (fall), pigweed spp., pusley (Florida), signalgrass, and witchgrass	Dimethenamid-p 0.66-0.98 lb	Outlook 6EC 14.0-21.0 oz	Apply after planting but before corn emerges. Small grains may be seeded 4 months after treatment. Adjust rate to soil texture.

Corn--conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preemergence (continued) Above weeds and cocklebur, jimsonweed, lambsquarters, morningglory, nightshade (black), ragweed, smartweed, and velvetleaf	Dimethenamid-p 0.66-0.98 lb + atrazine 1.0-2.0 lb	Outlook 6EC 14.0-21.0 oz + Atrazine 4L 1.0-2.0 qt or 90W 1.1-2.2 lb or use Guardsman Max 5L 3.0-4.6 pt	See above for respective herbicides. Outlook plus atrazine also may be applied as an early postemergence treatment up to the time when weeds reach the 2-leaf stage and corn is no more than 8 inches tall. Do not apply as an early postemergence treatment in fluid fertilizer.
	Dimethenamid-p 0.66-0.98 lb + atrazine 0.5-1.0 lb + simazine 0.5-1.0 lb	Outlook 6EC 14.0-21.0 oz + Atrazine 4L 0.5-1.0 qt or 90W 0.5-1.1 lb + Princep 4L 0.5-1.0 lb or 90W 0.5-1.1 lb	See above for respective herbicide. Read the label, and adjust the rate to soil texture and organic matter content. Guardsman Max Lite is available in certain regions.
Barnyardgrass, carpetweed, crabgrass, foxtail (giant, green, yellow), goosegrass (suppression), johnsongrass (seedling), lambsquarters, panicum (fall, Texas), purslane, sandbur, signalgrass (suppression), velvetleaf (suppression)	Pendimethalin 0.75-1.5 lb	Prowl 3.3EC 0.9-1.8 qt or Prowl H2O 3.8CS 0.8-1.6 qt	In conventional tillage systems, plant into a seedbed that is firm and free of clods and trash. Use only where adequate tillage is practiced to provide good soil coverage of the corn seed. Plant at least 1.5 inches deep and completely cover with soil.

Corn--conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preemergence (continued) Annual grasses, such as barnyardgrass, broadleaf signalgrass, browntop, crabgrass, crowfootgrass, field sandbur, foxtail millet, foxtail (bristly, giant, green, yellow), goosegrass, johnsongrass (seedling), nutsedge (yellow), panicum (fall, Texas), prairie cupgrass, red rice, red sprangletop, robust foxtail (purple, white), shattercane, wild millet, and witchgrass; and broadleaf weeds, such as beggarweed (Florida), carpetweed, cocklebur, galinsoga, groundcherry, jimsonweed, lambsquarters, nightshade (black, hairy), pigweed, purslane, ragweed (common, giant), sida (prickly), smartweed sp., and velvetleaf	Acetochlor 0.8-2.4 lb + atrazine 1.0-2.0 lb	Topnotch 3.2CS 2.0-6.0 pt + Atrazine 4L 1.0-2.0 qt or 90W 1.1-2.2 lb or use FulTime 4CS 2.5-5.0qt	See remarks section for acetochlor on page 2-37. Other acetochlor + atrazine prepackaged mixes are available such as Keystone and Keystone LA from Dow AgroSciences. Keystone use rate is 2.2 to 3.4 qt/acre.
	Acetochlor 0.8-2.4 lb + atrazine 0.5-1.0 lb + simazine 0.5-1.0 lb	Topnotch 3.2CS 2.0-6.0 pt + Atrazine 4L 0.5-1.0 qt or 90W 0.5-1.1 lb + Princep 4L 0.5-1.0 qt or 90W 0.5-1.1 lb	

Post herbicide application restrictions for corn

Herbicide	Over-the-top application	Use of drop nozzles	Comments
2,4-D	<8" tall	0.5 pt-8" to 36" tall	
Accent	20" or 6 collars	20" to 36" or 10 collars	
Aim	Up to 8-leaf collar stage	20" to 36" tall or V6 to V10 stage	
Atrazine	12" tall		
Banvel or Clarity	1 pt-8" tall or 5 leaves; 0.5 pt-8" to 36" tall or 15 days before tassel emergence		Do not apply Banvel or Clarity near soybeans if corn is >24" tall or if soybeans are >10" tall or have begun to bloom
Basagran	No restrictions		
Basis	Spike to 4 leaves (or 2 collars) or 0.5" to 6" tall		Do not apply to corn >6" tall or having 3 collars
Beacon	4" to 20" tall (freestanding)	For splits, 20" tall to before tassel emergence	
Buctril	1 pt-emergence to tassel; 1.5 pt-4 leaves to tassel		Postemergence application before 3-leaf stage may result in corn leaf burn
Callisto	Up to 30" tall (or 8-leaf stage of corn)		
Celebrity Plus	4" to 24" tall (freestanding) or <6 collars (V6 stage)	When necessary	
Distinct	6 oz/acre from 4-10" corn and 4 oz/acre from 10-24" corn	24-36"	Do not make applications when corn is within 15 days of tassel emergence
Equip	Up to 12" or V4	12" to 36" up to V8	
Exceed	4" to 20" tall (or 6 collars)	>20" to 30" tall	
Harmony GT XP	2 to 6 leaves up to 12		Do not apply to corn >12
Hornet	Emergence up to 20" tall		
Liberty	Emergence to 24" tall or 7 collars (whichever comes first)	>20" to 36" tall	Apply to Liberty-Link or GR corn hybrids only
Lightning	Up to 20" tall	When necessary	Apply to Clearfield or IMI corn hybrids only
Marksman	Emergence to 5-leaf stage (or up to 8" tall)		
NorthStar	4" to 20" (or 6 collars)	>20" to 30" tall	
Option	Up to 16" or V5	16" to 36" up to V8	

Post herbicide application restrictions for corn (continued)

Herbicide	Over-the-top application	Use of drop nozzles	Comments
Permit/Sandea	Spike to 48	When necessary	If tank-mixed with 2,4-D, apply to corn up to 8
Resource	2-leaf to 10-leaf stage (collars must be visible)	When necessary to direct below corn leaves	
Roundup Weather Max	Up to 24" on Roundup Ready Corn and up to 30" on Roundup Ready Corn 2	24-30" with Roundup Ready corn and 30-48" with Roundup Ready Corn 2	Apply to Roundup-Ready hybrids only
Spirit	4" to 20" or 6 collars	20" to 24"	
Steadfast	Up to 20" or 6 collars		
Steadfast ATZ	Up to 12" or 7 collars		
Touchdown Total or HiTech	Emergence through V8 stage		Apply to Roundup-Ready hybrids only
Yukon	Spike through 36" tall	When necessary	

Approved tank-mixes for foliar-applied herbicides in corn[a]

■ = approved tank-mixes. See individual labels for specific mixtures that may be prohibited and for specific application rate timing, and adjuvant information.

	2-4,D	Accent	Aim	Atrazine	Banvel/Clarity	Basagran	Basis	Beacon	Buctril	Callisto	Celebrity Plus	Distinct	Exceed	Harmony GT XP	Hornet[c]	Laddok	Liberty[d]	Lightning	Marksman	NorthStar	Permit	Pursuit[b]	Resource	Roundup Weather Max[e]	Steadfast	Stinger[c]	Touchdown Total[e]	Tough
2-4,D			■					■	■				■			■		■			■		■				■	■
Accent			■	■	■	■		■	■		■	■	■						■	■	■		■					■
Aim	■	■		■	■		■	■					■		■		■	■	■	■	■			■				
Atrazine		■	■		■	■	■	■	■	■	■		■	■		■			■	■	■	■	■	■	■		■	■
Banvel/Clarity		■	■	■			■	■	■		■		■					■		■	■	■	■		■		■	■
Basagran		■		■																		■						
Basis			■	■	■														■				■				■	
Beacon	■	■	■	■	■				■				■						■		■		■					■
Buctril	■	■		■	■			■					■					■			■	■				■		
Callisto				■													■											
Celebrity Plus		■		■	■							■							■									
Distinct		■											■												■			
Equip				■	■			■				■	■		■				■	■	■							■
Exceed	■	■	■	■	■			■	■										■				■					■
Harmony GT				■																								
Hornet **c**			■																				■		■		■	
Laddok	■			■						■													■			■		
Liberty **d**			■							■													■					
Lightning	■		■		■				■														■				■	
Marksman		■	■	■			■	■			■		■							■	■	■	■		■	■	■	■
North Star		■	■	■	■														■				■					■
Option				■	■			■				■	■		■				■	■	■							■
Permit	■	■	■	■	■			■	■										■				■	■				
Pursuit **b**				■	■	■			■										■				■					
Resource	■	■		■	■		■	■	■				■		■	■	■	■	■	■	■	■		■		■		
Roundup Weather Max **e**			■	■																	■		■					
Steadfast				■	■							■			■				■							■		■
Stinger **c**									■							■			■				■		■			
Touchdown Total or HiTech **e**	■			■	■		■								■			■	■									
Tough	■			■	■			■					■						■	■	■							
Yukon		■		■				■																				

NOTE: Unless specifically prohibited on product lables, other tank-mix combinations may be appropriate for use.

a Certain PRE herbicides such as Dual, Frontier, Prowl, etc. may be applied as early POST applications in tank-mixes. See product label for additional information on timings, rates, tank-mix partners, etc.

b For use only on Clearfield corn hybrids.

c Tank-mixing Hornet or Stinger with other herbicides is allowed, however, no specific partners are stated on their product labels. When tank-mixing, read and follow the product labels for important information on herbicide use.

d Tank-mixing Liberty with other herbicides is allowed, however, no specific partners are stated on the label. Do not tank-mix with Basis or Sencor. Do not use with Pursuit on Clearfield hybrids. Do not use with Poast on SR hybrids. When tank-mixing, follow the label.

e Other glyphosate formulations may be labeled.

Corn - no-till or conventional tillage

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence Beggar ticks, bindweed, burdock, cocklebur, coffeeweed, carpetweed, galinsoga, horseweed, jimsonweed, lambsquarters, morningglory (annual), mustards, nightshade (black), pigweed spp., purslane (common), pusley (Florida), ragweed (common), sicklepod, smartweed, spanishneedles, sunflower, and velvetleaf	2,4-D 0.25-0.5 lb	2,4-D amine or LVE 0.5-1.0 pt of a 4.0 lb/gal formulation	Apply from the time that the corn emerges until layby. Do not cultivate for 10 days, or corn may break off. Small weeds are easier to kill; use higher rate for larger weeds. Grasses are not controlled. After corn is more than 10 inches tall, direct the spray below top of corn plant (use drop nozzles). Some 2,4-D formulations are available that contain greater than 4.0 lb ai/gallon. Consult label.
Weeds listed above for respective chemicals plus suppression of alfalfa, artichoke (Jerusalem), bindweeds, dock (curly), dogbane (hemp), horsenettle, milkweed (common, honeyvine), plantain (broadleaf), sorrel (red), and thistle (Canada)	2,4-D 0.125 lb + dicamba 0.25 lb	2,4-D amine 0.25 pt of a 4.0 lb/gal formulation + Banvel/Clarity 0.5 pt	Observe all precautions listed for respective chemicals. When corn is taller than 8 inches, direct spray beneath corn leaves and onto weeds.

Corn - no-till or conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Barnyardgrass, foxtail (giant, green, yellow), johnsongrass (seedling and rhizome), panicum (fall), pigweed, quackgrass, shattercane, and smartweed	Nicosulfuron 0.031 lb	Accent 75SP 0.66 oz + approved tank-mixes: Atrazine 0.75-1.5 qt or Banvel/Clarity 0.5-1.0 pt or Buctril 1.0-1.5 pt or Buctril + atrazine 1.5-3.0 pt or Callisto 1.5-3.0 oz or Marksman 2.0-3.5 pt	Prior to using Accent consider crop rotational plans. Consult label. Apply to corn prior to 11-leaf stage. Consult label when applying to corn that is under stress, treated with Counter insecticide, treated pre or post with other organophosphate insecticides or Basagran herbicide 7 days before Accent application, or a hybrid that is susceptible to MDMV or MCDV if johnsongrass is present. Always add a nonionic surfactant or crop oil concentrate when used alone. Tank-mixing with certain broadleaf herbicides other than atrazine may result in a reduction of annual grass control and an increase in crop injury. Consult Accent label for adjuvant recommendations for tank-mix combinations. A higher degree of johnsongrass control may be achieved with split applications, but do not exceed 1.33 ounces per acre in 1 year. Do not graze or feed forage or grain from treated areas to livestock within 30 days after application.
Lambsquarters (common), morningglory (ivyleaf, pitted), nightshade (black), pigweed (redroot), velvetleaf	Carfentrazone 0.008-0.016 lb	Aim 2EC 0.5-1.0 oz + approved tank-mixes: Atrazine 4L 1.0 pt or DF 9 oz or Banvel/Clarity 0.25-0.5 pt	Apply to corn up to 8-leaf collar stage and when weeds are generally 1 to 4 inches tall. Include a nonionic surfactant at 0.25% v/v. Tank-mixing with other herbicides increases weed control spectrum. Do not tank-mix with EC or formulated products or with COC as excessive injury may occur. When tank-mixing, make sure the Aim is mixed in the spray tank water first. Injury may vary with corn hybrids and environmental conditions.

Corn - no-till or conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Barnyardgrass, cocklebur, crabgrass, foxtail (giant, green, yellow), lambsquarters, morningglory spp., mustards, nightshade, pigweed, purslane, ragweed, and smartweed	Atrazine 2.0 lb + crop oil	Atrazine 4L 2.0 qt or 90W 2.2 lb + crop oil concentrate 1.0 qt	Use in a single broadcast spray before weeds exceed 1.5 inches in height. Use oil/atrazine in 20 gallons per acre. Do not include oil in atrazine sprays when corn is under stress from prolonged cold, wet weather, poor fertility, or other factors or when corn is wet and succulent from recent rainfall as crop injury may occur. Do not use oil in sprays when treating inbred lines or other breeding stock. Adding other pesticides, fertilizers, or other material to the oil-water emulsions may cause compatibility problems or crop injury. Follow instructions on the container for proper mixing and maintaining the emulsion in the spray tank.
Burcucumber, clovers, cocklebur, jimsonweed, lambsquarters, morningglory spp., mustards, nightshade (black, tall), pepperweed, pigweed spp., purslane, ragweed (giant), sida (prickly), smartweed, spurge (prostrate), and teaweed, velvetleaf, and Canada thistle suppression	Dicamba 0.25-0.5 lb	Banvel or Clarity 0.50-1.0 pt	Use the early postemergence rate (1.0 pint) as labeled for the specific soil type for corn up to the fifth leaf. For corn past the 5-leaf stage or 8 inches tall, use only Banvel or Clarity at the 0.25 pound (0.5 pint) rate. Apply Banvel or Clarity in this manner after weeds have emerged but before corn is 36 inches high or 15 days before tassel emergence. Best performance occurs when weeds are small. Drop nozzles may be used to increase coverage where corn leaves cover weeds. Do not graze or harvest for dairy or beef or feed before ensilage (milk) stage. Observe precautions to avoid drift to adjacent crops. Observe atrazine restrictions when using Marksman.
	Dicamba 0.26-0.47 lb + atrazine 0.52-0.94 lb	Marksman 3.2 FL 2.0-3.5 pt	

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Beggarticks, cocklebur, dayflower, jimsonweed, mustard (wild), nutsedge (yellow), ragweed, sida (prickly), smartweed, spurred anoda, sunflower (wild), thistle (Canada), and velvetleaf	Bentazon 0.75-1.0 lb + crop oil concentrate	Basagran 0.75-1.0 qt + crop oil concentrate 1.0 qt + approved tank-mixes: Atrazine 0.42-0.75 qt	Refer to label as the rate of application is dependent on leaf stage and height of weeds to be controlled. For Canada thistle and yellow nutsedge, follow with a second application in 7 to 10 days if needed. Cultivation within 10 to 14 days after application will improve control.
Barnyardgrass, foxtail spp., lambsquarters (common), mustard (wild), pigweed spp., smartweed spp., and velvetleaf	Rimsulfuron 0.01 lb + thifensulfuron-methyl 0.005 lb	Basis 75WDG 0.33 oz + approved tank-mixes: Atrazine 0.45-0.9 qt or Banvel/Clarity 0.25-0.50 pt or Marksman 1.0-2.0 pt	Apply to 1- to 2-inch tall grasses and 1- to 3-inch tall broadleaf weeds when corn is in the spike to 4-leaf stage. Applications of Basis must include a nonionic surfactant and an ammonium nitrogen fertilizer. Do not apply Basis to conventional or IT corn hybrids previously treated with Counter 15G. Applications of Basis to conventional or IT corn hybrids previously treated with other insecticides may also result in crop damage. There are no restrictions with regard to insecticides applied when an IR corn hybrid is planted. Do not tank-mix Basis with Basagran, Laddok, 2,4-D, Bladex, or other ALS-inhibiting herbicides, or with foliarly applied organophosphate or pyrethroid insecticides to avoid antagonism or crop injury.

Corn - no-till or conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Cocklebur, foxtail (giant, green, yellow), johnsongrass (seedling, rhizome), jimsonweed, lambsquarters, panicum (fall), pigweed, quackgrass, ragweed, shattercane, smartweed, and velvetleaf	Primisulfuron-methyl 0.018-0.036 lb	Beacon 75WDG 0.38-0.76 oz + approved tank-mixes: 2,4-D 0.25-0.75 pt or Accent 0.33 oz or Atrazine 1.0-1.5 qt or Banvel/Clarity 0.125-0.5 pt or Buctril 0.5-1.0 pt or Resource 0.25 pt or Marksman 1.0-2.0 pt	Consult county Extension office or seed corn dealer for listing of corn hybrids susceptible to Beacon applications. Apply when free-standing corn height is between 4 and 20 inches. Beacon can be applied to corn from 20 inches tall up to tassel emergence by postdirecting. Do not apply to corn that is under stress, treated with Counter insecticide, or in tank-mixes with other pesticides, unless recommended on the label. Do apply an organophosphate insecticide within 10 days before or after Beacon application. Do not apply to hybrids susceptible to MDMV or MCDV if johnsongrass is present in field. Always add a nonionic surfactant or crop oil concentrate when sprayed alone. Tank-mixing with other broadleaf herbicides may result in a reduction of grass control and an increase in crop injury. Use only nonionic surfactant at 1 quart per 100 gallons when tank-mixing. A higher degree of johnsongrass control may be achieved with split (0.38 ounce + 0.38 ounce) applications, but do not exceed 0.76 ounces per acre in 1 year. Do not graze or feed forage from Beacon-treated corn to livestock within 30 days after application. Consult label for rotational restrictions.

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Buckwheat (wild), cocklebur, jimsonweed, lambsquarters, morningglory spp., mustard (wild), nightshade spp., ragweed (common, giant), smartweed spp., and velvetleaf	Bromoxynil 0.25-0.375 lb	Buctril 2E 1.0-1.5 pt + approved tank-mixes: 2,4-D 0.125-0.5 pt or Accent 0.67 oz or Atrazine 0.5-1.5 qt or Banvel/Clarity 0.125-0.5 pt or Beacon 0.38-0.75 oz or Exceed 0.5-1.0 oz or Permit 0.3-0.67 oz or Stinger 0.3-0 67 pt	Apply as an early postemergence treatment to small weeds in corn from the 4- to 8-leaf stage. Adjust rate to weed size as specified by label. This treatment is nonvolatile and is appropriate to situations where the proximity of susceptible crops prohibits the use of 2,4-D or dicamba.

Corn - no-till or conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Pigweed, carpetweed, chickweed, crabgrass, jimsonweed, lambsquarters, nightshade, ragweed (giant) smartweed, velvetleaf, cocklebur, and nutsedge (yellow)	Mesotrione 0.094 lb or Mesotrione 0.094 lb and atrazine 0.25-0.5 lb	Callisto 4FL 3.0 oz or Callisto 4FL 3.0 oz and Atrazine 4L 0.25-0.5 qt or 90W 0.28-0.56 lb Other approved tank-mixes: Dual II Magnum Bicep II Magnum Accent Basagran Basis Steadfast Steadfast ATZ	Callisto is a systemic preemergence and postemergence herbicide for the selective contact and residual control of broadleaf weeds in field corn. Callisto is not effective for the control of most grass weeds. Postemegence grass herbicide can be tank-mixed with Callisto to provide a broader spectrum of weed control. To broaden its broadleaf weed control ability, tank-mix atrazine with Callisto. Always add crop oil concentrate at a rate of 1% v/v. Always add spray grade UAN (28- 0-0) at 2.5% v/v or ammonium sulfate at 8.5 lb/100 gallons spray solution. Do not apply postemergence if the corn was treated with Counter or Lorsban. Lorsban applied in a T-Band is okay. Do not tank-mix and apply with any organophosphate or carbamate insecticide. Do not apply an organophosphate or carbamate insecticide within 7 days before or 7 days after a Callisto application. Do not cultivate corn within 7 days before or after a Callisto application. Do not apply Callisto in a tank-mix with emulsifiable concentrate grass herbicides. Do not use methylated seed oil. Do not apply more than a total of 10.7 oz/acre of Callisto per season. Tank mixtures with atrazine at 0.25-0.5 lb ai/acre have provided more consistent overall weed control. When applying with atrazine, limit applications to 12 inch corn. Do not apply Calliston to a field that has alrady been treated with Lumax, Camix, or Lexar in the same season.

Corn - no-till or conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Barnyardgrass, foxtails (giant, green, yellow), johnsongrass (seedling), panicum (fall, Texas), ryegrass (annual), sandbur (field), signalgrass (broadleaf), shattercane, quackgrass, burcucumber, carpetweed, chickweed, cocklebur, jimsonweed, lambsquarters, marestail, morningglory spp., nightshade (black), pigweed spp., ragweed (common and giant), sicklepod, sida (prickly), smartweed, and velvetleaf	Nicosulfuron 0.031 lb + sodium salt of dicamba 0.178 lb + diflufenzopyr	Celebrity Plus 70DF 4.8 oz	Do not use where Counter was applied in-furrow. Temporary injury may also result when applied over top of corn that had Dyfonate, Lorsban, or Thimet applied. Apply to corn from 4 to 24 inches tall. Use in a minimum of 10 gpa. Applications must include a nonionic surfactant (0.25 to 0.5 percent v/v) and an ammonium nitrogen fertilizer (ex., 1 to 2 quarts of 28-0-0).Do not apply more than 9.4 ounces per acre per season.
Burcucumber, carpetweed, cocklebur, jimsonweed, lambsquarters, marestail, morningglory spp., nightshade (black), pigweed spp., ragweed (common, giant), sicklepod, sida (prickly), smartweed, velvetleaf, and suppression of perennial broadleaf weeds such as alfalfa, bindweed, clover, dandelion, dock, dogbane, horsenettle, milkweed spp., pokeweed, and thistles	Sodium salt of dicamba 0.175-0.263 lb + diflufenzopyr	Distinct 70DF 4.0-6.0 oz	Apply Distinct up to 6 ounces per acre from 4- to 10-inch-tall corn. Apply 4 ounces per acre from 10- to 24-inch-tall corn. Do not exceed a total of 10 ounces per acre per season. Adjuvants must be used. Use a nonionic surfactant at 0.25 percent v/v plus 5 quarts per acre of UAN (28 to 34 percent nitrogen) per 100 gallons of water. Distinct contains dicamba, the same active ingredient in Banvel and Clarity. Distinct is not recommended for use in tank-mixes with other PGR herbicides that contain dicamba, 2,4-D, or clopyralid. Distinct may be applied to corn 24-36" tall at 4 oz/acre when using drop nozzles. Do not make applications when corn is within 15 days of tassel emergence.

Corn - no-till or conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Barnyardgrass, foxtail spp., goosegrass, johnsongrass, fescue, orchardgrass, fall panicum, quackgrass, Italian ryegrass, shattercane, witchgrass, volunteer cereals, burcucumber, Canada thistle, jimsonweed, lambsquarters, marestail, morningglory spp., pigweed spp., ragweed (common, giant), smartweed and velvetleaf	Foramsulfuron 0.28 lb + Iodosulfuron-methyl 0.002 lb	Equip 32 WDG 1.5 oz + approved tank-mixes: Atrazine Banvel/Clarity Distinct Marksman Tough	Apply to young, actively growing weeds when corn is 0 - 12" tall or from emergence to the V4 growth stage. Drop nozzles can be used for corn from 12" to 36" or V4 to V8 growth stages. Apply in combination with methylated or ethylated seed oil with a minimum of 10% emulsifier and with nitrogen fertilizer. Use 1.5 pt/acre seed oil and 1.5 to 2.0 quarts/acre UAN or 1.5 to 3.0 pounds/acre AMS. May be tank-mixed with many residual or postemergence herbicides for increased specrum of weed control Consult label. An application of Equip is not recommended for use in the same season as Counter, Dyfonate or Thimet.
Barnyardgrass, carpetweed, cocklebur, crabgrass, foxtail (giant, green, yellow), galinsoga, goosegrass, lambsquarters, morningglory spp., nutsedge, panicum (fall), pigweed spp., purslane, pusley (Florida), ragweed (common), sesbania, shattercane, sicklepod, sida (prickly), signalgrass, smartweed, and velvetleaf	Ametryn 1.6-2.0 lb + surfactant	Evik 80W 2.0-2.5 lb + surfactant as labeled	Apply as a single-directed spray in 25 gallons of water after corn is at least 15 inches high and weeds up to 5 inches high. Thoroughly cover weed foliage without contacting upper leaves or whorl of corn as such contact causes crop injury. Use wetting agent suggested by manufacturer. Do not plant to other crops not on the label within 4 months after treatment. Use gauge wheels or leaf lifter equipment to prevent corn leaf contact with spray. Provide continuous agitation in tank. Apply in a minimum of 20 gallons of water or nonpressure nitrogen solution. Do not harvest, graze, or feed forage to livestock until 30 days after application. Do not apply if temperatures are low. Do not plant any rotational crop other than small grains until the following year. Do not apply within 3 weeks of tasseling.

Corn - no-till or conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Anoda (spurred), bindweed, burcucumber, cocklebur, jimsonweed, johnsongrass (seedling), lambsquarters, morningglory, nightshade, pigweed, quackgrass, ragweed (common, giant), shattercane, sicklepod, sida (prickly), smartweed, thistle (Canada), and velvetleaf	Prosulfuron/primisulfuron-methyl 0.036 lb	Exceed 57WG 1.0 oz + approved tank-mixes: 2,4-D 0.25-0.5 pt or Accent 0.3-0.5 oz or Atrazine 0.75-1.5 qt or Banvel/Clarity 0.125-0.5 pt or Beacon 0.19-0.38 oz or Buctril 0.5-1.0 pt or Marksman 1.0-2.0 pt or Tough 1.0-2.0 pt	Do not apply to corn under severe environmental stress. Do not apply to corn treated with Counter 15G (any application) or Counter 20CR applied in-furrow. If an IR corn hybrid is planted, the above restrictions do not apply. Apply Exceed postemergence to corn when corn plants are 4 to 30 inches tall. Applications made after the corn is 24 inches tall should be postdirected. Do not apply aerially. The use of a crop oil concentrate or nonionic surfactant is recommended. Consult the label for rotational restrictions.
Contact kill of emerged annual weeds in corn	Paraquat 0.25 - 0.50 lb + surfactant	Gramoxone Inteon 1.0-2.0 pt + surfactant as labeled	Apply as a directed spray when corn plants are at least 10 inches high. Do not allow spray to contact more than the lower 3 inches of the corn plant. For corn greater than 20" tall, spray no higher than the lower 1/3 of the corn stalks. Corn leaves sprayed will be injured. Follow label for proper mixing procedures.

Corn - no-till or conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Lambsquarters (common), mustard (wild), pigweed sp., smartweed sp., velvetleaf	Thifensulfuron 0.004 lb	Harmony GT XP 75DF 1/12 oz	Apply to corn 2 to 6 leaf (1 to 4 collars) or up to approximately 12 inches tall. Do not apply to field corn taller than 12 inches or 4 collars, whichever is more restrictive. Do not apply to standard hybrids or IT corn hybrids if previously treated with Counter 15G or 20CR. Applications to standard hybrids or IT corn hybrids treated with other insecticides may also result in crop damage. There are no restrictions with regard to insecticides if an IR corn hybrid is planted. Always add either a nonionic surfactant (0.25 percent v/v) or crop oil concentrate (1.0 percent v/v) plus either ammonium nitrogen solution such as 28 percent UAN (2-4 qt/acre) or spray grade ammonium sulfate (2-4 lb/acre).
Anoda (spurred), cocklebur, jimsonweed, morningglory (suppression), nightshade (suppression), purslane, ragweed (common), sicklepod, sida (prickly), smartweed, thistle (Canada, suppression), and velvetleaf	Flumetsulam/clopyralid 0.098 - 0.245 lb	Hornet 78.5 WDG 2.0 - 5.0 oz	Application may be applied broadcast over the top of field corn up to 20 inches tall. Apply when broadleaf weeds are 2 to 8 inches in height. Do not apply if rainfall is expected within 6 hours. Do not apply within 85 days of harvest. Include a nonionic surfactant at 0.25 percent v/v. Reduced weed control may result if applied to weeds under severe stress. If cultivating, delay for 10 days after application. Follow rotational restrictions with subsequent crops. Hornet may be tank-mixed with other postemergence herbicides unless the other product label prohibits it.

Corn - no-till or conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Cocklebur, lambsquarters pigweed (redroot), ragweed (common, giant), smartweed, and velvetleaf	Bentazon plus atrazine prepackaged mix 1.0-1.5 lb + crop oil concentrate	Laddok S-12 1.33-2.33 pt + crop oil concentrate 1.0 qt + approved tank-mixes: 2,4-D 2.7-4.0 oz or Atrazine 0.5 qt	Apply in a minimum of 20 gallons of water and a minimum of 40 pounds per square inch using hollow cone or flat fan nozzles only. Crop oil concentrate should always be added to the spray solution. Apply when weeds are small and when the crop is in the 1- to 5-leaf stage. Carefully observe maximum weed growth stages on the label. Observe atrazine restrictions when using Laddok.
Control of many annual broadleaf weeds and control or suppression of some annual grasses in conventional and no-till corn production systems and suppression of many perennial weeds	Glufosinate-ammonium 0.31-0.37 lb	Liberty 1.67L 1.5-1.75 pt	**For use on hybrids designated Liberty-Link or GR.** Good coverage with Liberty is required for acceptable control. Liberty may be applied from emergence until corn is 24 inches tall or until corn has eight developed collars. Adjust application rates for individual weed species and weed size as directed by the label. A repeat application of Liberty or repeat applications with the appropriate residual herbicides will be needed to control weeds that have not emerged at the time of application. Liberty is a postemergence herbicide with no residual soil activity and may be applied as the only herbicide in the program, alone following preemergence herbicides, or mixed with other postemergence herbicides listed on the label. The addition of ammonium sulfate and/or atrazine with Liberty herbicide has improved broadleaf weed control. Can be tank-mixed with approved postemergence herbicides except Sencor and Basis.

Corn - no-till or conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Anoda (spurred), artichoke (Jerusalem), wild buckwheat, carpetweed, common cocklebur, field bindweed (suppression), jimsonweed, knotweed, lambsquarters, honeyvine milkweed, morningglory (entireleaf, ivyleaf, pitted, tall, smallflower), mustard spp., nightshade (eastern black, black), nutsedge (suppression), pigweed, (palmer, prostrate, redroot, smooth, spiny), common ragweed (suppression), giant ragweed, sicklepod, prickly sida, smartweed, spurge (prostrate, spotted), sunflower, velvetleaf, Canada thistle (suppression), barnyardgrass, crabgrass (large, smooth), foxtail (giant, green, yellow), goosegrass, johnsongrass (seedling, rhizome), panicum (fall), quackgrass, field sandbur, shattercane, witchgrass	Imazethapyr 0.042 lb + imazapyr 0.014 lb	Lightning 70DG at 1.28 oz + approved tank-mixes: 2,4-D or Banvel/Clarity or Buctril or Clarity or Outlook or Prowl	**Apply to IMI (Clearfield) corn only. Use only with IR (IMI-resistant) or IT (IMI-tolerant) hybrids.** Lightning should be applied to small weeds, usually no larger than 3 inches tall. Lightning requires the addition of an adjuvant and liquid fertilizer. There are no soil-insecticide restrictions with IR hybrids. For IT hybrids, do not use Counter 15G in-furrow. May use Counter 15G or Thimet in banded applications. May use Counter 20CR in-furrow or banded. Lightning can carry over and cause injury to some rotational crops; be sure to check rotational restrictions.
Barnyardgrass, carpetweed, cocklebur, crabgrass, foxtail (giant, green, yellow), galinsoga, goosegrass, lambsquarters, morningglory spp., panicum (fall), pigweed spp., purslane, pusley (Florida), ragweed (common), sesbania, sicklepod, sida (prickly), smartweed, and velvetleaf	Linuron 0.63-1.5 lb + surfactant	Linex DF 1.25-3.0 lb or 4L 1.25-3.0 pt + surfactant as labeled	Apply as a single-directed spray in 25 gallons of water after corn is at least 15 inches high and weeds are up to 5 inches high. Thoroughly cover weed foliage without contacting upper leaves or whorl of corn as such contact causes crop injury. Use wetting agent suggested by manufacturer. Do not plant to other crops not on the label within 4 months after treatment. Use gauge wheels or leaf lifter equipment to prevent corn leaf contact with spray. Provide continuous agitation in tank.

Corn - no-till or conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Alfalfa, bindweed, burcucumber, cocklebur, dandelion, dogbane, horsenettle, horseweed, jimsonweed, lambsquarters, morningglory spp., nightshade (black), pigweed spp., ragweed (common, giant), sicklepod, sida (prickly), thistles (suppression), velvetleaf, johnsongrass (seedling), quackgrass, ryegrass (annual), and shattercane	Primisulfuron 0.075 lb + sodium salt of dicamba 0.125 lb	NorthStar 51.4 WDG 5 oz	NorthStar can be broadcast from 4- to 20-inch corn. From 20- to 36-inch tall corn, apply as directed spray. Do not apply if Counter was used. Do not make a foliar post or soil application of any OP insecticide within 10 days before or 7 days after a NorthStar application.
Barnyardgrass, burcucumber, cocklebur, foxtail (giant, green, yellow), goosegrass, jimsonweed, johnsongrass (rhizome, seedling), nightshade, panicum (fall, Texas), pigweed, quackgrass, ragweed (common), shattercane, velvetleaf, volunteer cereals	Foramsulfuron 0.03-0.04 lb	Option 35WDG 1.5-1.75 oz + approved tank-mixes: Atrazine or Banvel, Clarity, Distinct or Marksman or NorthStar	Apply when corn is 0-16 inches tall. Use drop nozzles when corn is 16-36 inches tall. Methylated or ethylated seed oil, with 10% emulsifier or greater, in combination with nitrogen fertilizer is the recommended adjuvant system at 1.5 pt/acre + 1.5-2.0 qt/acre. Do not apply by air. Do not apply more than twice per season. Do not use if Counter, Dyfonate, or Thimet were applied. Do not apply foliar applications of an OP insecticide within 7 days of an Option application.

Corn - no-till or conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Cocklebur, nutsedge (yellow, purple), pigweed, pokeweed, ragweed (common, giant), sunflower, and velvetleaf	Halosulfuron-methyl 0.032-0.063 lb	Permit/Sandea 75WG 0.6-1.3 oz + approved tank-mixes: 2,4-D 0.25-0.5 pt or Accent 0.66 oz or Atrazine 0.74-1.5 qt or Banvel/Clarity 0.125-0.5 pt or Beacon 0.76 oz or Buctril 0.5-1.0 pt or Buctril/Atrazine 1-2.5 pt or Harmony GT 75DF 1/12 oz or Marksman 0.5-2.0 pt	Do not apply to corn under severe environmental stress. Do not apply aerially. Permit alone can be applied over-the-top or with drop nozzles from the spike through layby stage of field corn. The use of a crop oil concentrate or nonionic surfactant is recommended-consult label. Consult label for rotational restrictions. When used exclusively with Pioneer IR field corn hybrids, Permit may be soil applied at the rate of 1.3 to 2.0 ounces per acre.
Barnyardgrass, cocklebur, crabgrass, foxtail (giant, green, yellow), goosegrass, jimsonweed, johnsongrass from seed, lambsquarters, morningglory spp., mustards, nightshade (black), panicum (fall), pigweed spp., ragweed, signalgrass, and velvetleaf	Pendimethalin 0.75-1.5 lb	Prowl 3.33 EC 0.9-1.89 qt or Prowl H2O 3.8 CS 0.8 - 1.6 qt + approved tank-mixes: Accent 0.33-0.67 oz or Atrazine 1.0-2.0 qt or Banvel/Clarity 0.5-0.75 pt or Beacon 0.38-0.76 oz or Buctril 1.5-2 pt or Marksman 2-3.5 pt	Refer to the labels for rate of application for different soil types and organic matter content of soil, and for mixing procedures. Some injury can occur if seed is not well covered with soil. Apply as early postemergence treatments in water until corn reaches the 4-leaf stage and weeds are less than 1 inch high. These combinations are particularly effective as early postemergence treatments for velvetleaf control.

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Control of many annual grasses and broadleaf weeds and suppression of many perennial weeds as well	Glyphosate 0.75-1.0 lb + atrazine 0.75-1.0 lb	Ready Master ATZ 1.5-2.0 qt	Apply this product postemergence to Roundup Ready corn from seedling emergence until the corn reaches 12 inches in height. A single in-crop application must not exceed 2 quarts per acre. The addition of adjuvants, micronutrients, or liquid fertilizers is not recommended. Ready Master ATZ can be tank-mixed with Harness, MicroTech, Partner, or atrazine. Tank mixtures of Ready-Master ATZ with Harness must be applied before the corn is 11 inches tall while tank mixtures with MicroTech or Partner must be applied before the corn exceeds 5 inches in height. If adding atrazine, a maximum of 2 pounds of active ingredient may be applied postemergence if no atrazine was applied prior to corn emergence.
Velvetleaf	Flumiclorac 0.027-0.04 lb + crop oil concentrate	Resource 4-6 oz + crop oil concentrate 1.0 pt + approved tank-mixes: 2,4-D 0.5-1.0 pt or Accent 0.33-1.0 oz or Atrazine 0.5-1.25 qt or Banvel/Clarity 0.5 pt	Apply as a broadcast over-the-top postemergence spray to 5- to 6-leaf velvetleaf and to corn that is in the 2- to 10-leaf stage. As a directed spray using drop nozzles, Resource may be applied at 8 ounces per acre. Resource has activity against several other weeds when they are in the 2- to 3-leaf stage including lambsquarters, common ragweed, and smooth pigweed. See table on page 2-43 for other approved tank-mixes.

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Control of many annual grasses and broadleaf weeds and suppression of many perennial weeds as well	Glyphosate 0.7-0.9 lb	Roundup Weather Max 4L 16-22 oz + approved tank-mixes: Atrazine or Bullet or Degree or Degree Extra or Harness or Harness Extra or MicroTech or Permit	**Apply Roundup Ultra Max to corn hybrids designated as Roundup-Ready.** Apply from emergence to V-8 (8-leaf collar) or 30 inches, whichever comes first. Single in-crop applications of this product are not to exceed 22 oz/acre. Sequential in-crop applications from emergence through V-8 stage or 30 inches must not exceed a total of 44 oz/acre per growing season. A full rate preemergence herbicide program followed by one application of Roundup Weather Max may provide better weed control under heavy weed pressure than one timely application. This product can be applied preharvest, up to 22 oz/acre, after maximum kernal fill is complete and the crop is physiologically mature (black layer formation) until 7 days before harvest. Combined total per year for all applications may not exceed 5.3 qt/acre. Allow a minimum of 50 days between application of this product and harvest of corn forage and 7 days between application and harvest of corn grain. Allow a minimum of 10 days between in-crop applications. In 2004/2005, Roundup Ready Corn 2 varieties will be available. These new varieties will allow up to a maximum in-crop single application of 32 oz/acre and a maximum in-crop total application of 2 qt/acre. Applications can be made to these new hybrids up to 48" tall corn, with drop nozzles required from 30-48" tall corn. Other glyphosate formulations are available.

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Barnyardgrass, crabgrass (large), foxtail (giant, green, yellow), johnsongrass (seedling), panicum (fall, Texas), quackgrass, ryegrass (Italian), field sandbur, shattercane, broadleaf signalgrass, jimsonweed, mustard sp., pigweed, smartweed	Nicosulfuron 0.023 lb and rimsulfuron 0.012 lb	Steadfast 75DF 0.75 oz + approved tank-mixes: Atrazine 90DF 0.25-2.0 lb or Callisto 4FL 1.5-3.0 oz or Clarity 4L 2.0-4.0 oz or Distinct 70DF 2.0-4.0 oz or Hornet 85.6DF 1.6-2.4 oz or Marksman 3.2FL 1.0 pt or Permit 75WG 0.66 oz or Stinger 3SL 2.0-4.0 oz	Apply Steadfast to corn that is up to 20 inches tall. Applications of Steadfast must include either a crop oil concentrate at 1 percent v/v or a nonionic surfactant at 0.25 to 0.5 percent v/v. In addition, an ammonoum nitrogen fertilizer is required. Use a high-quality liquid nitrogen fertilizer such as 28-0-0 at a rate of 2 qt/acre, or use spray grade ammonium sulfate at a rate of 2 lb/acre. Do not apply Steadfast with Basagran, Laddok 2,4-D, or foliar-applied organophosphates such as Lorsban. To avoid crop injury or antagonism, apply these products at least 7 days before or 3 days after the application of Steadfast.
Barnyardgrass, broadleaf signalgrass, Canada thistle (suppression), common cocklebur, common lambsquarters (except triazine-resistant), common milkweed (suppression), common pokeweed (suppression), eastern black nightshade, field sandbur, hemp dogbane (suppression), Italian ryegrass, jimsonweed, johnsongrass (seedling, rhizome), large crabgrass, morninglories, panicum (fall, Texas), Pennsylvania smartweed, pigweed (redroot, smooth), quackgrass, ragweed (common, giant), shattercane, sunflower, velvetleaf, volunteer cereals, nutsedge (suppression)	Nicosulfuron 0.024 lb and rimsulfuron 0.011 lb and atrazine 0.75 lb	Steadfast ATZ 89.3 WDG 14.0 oz + approved tank-mixes: atrazine 90DF 4.0-20 oz or Banvel/Clarity 2.0-4.0 oz or Marksman 8.0-16 oz or Distinct 1.0-2.0 oz or Callisto 1.5-3.0 oz or Hornet WDG 2.0-3.0 oz	Apply to corn that is up to 12 inches tall. Applications of Steadfast ATZ must include either a crop oil concentrate or a nonionic surfactant. In addition, an ammonium nitrogen fertilizer must be used. Steadfast ATZ may be tank-mixed with a pyrethroid or carbamate insecticide. However, post applications followoing an at planting application of numerous organophosphate insecticides such as Counter is prohibited. Do not tank-mix Steadfast ATZ with Basagran, Laddok, 2,4-D, foliar applied organophosphate insecticides, or with other ALS inhibiting herbicides unless specifically mentioned on the label.

Corn - no-till or conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Canada thistle	Clopyralid 0.09-0.25 lb	Stinger 0.25-0.67 pt	Apply after corn emergence through 24-inch tall corn. The addition of an adjuvant is not necessary. Apply when a majority of the thistles are 6 to 8 inches tall.
Control of many annual grasses and broadleaf weeds and suppression of many perennial weeds as well	Glyphosate 1.0-2.0.0 lb	Touchdown Total 24-48 oz + approved tank-mixes: most approved preemergence herbicides and several postemergence herbicides	**Apply Touchdown Total to corn hybrids designated as Roundup-Ready.** Apply from emergence to V-8 (8-leaf collar) or 30 inches, whichever comes first. Single in-crop applications of this product are not to exceed 24 oz/acre. Sequential in-crop applications from emergence through V-8 stage or 30 inches must not exceed 48 oz/acre per growing season. A full rate preemergence herbicide program followed by one application of Touchdown Total may provide better weed control under heavy weed pressure than one timely application. This product can be applied preharvest, up to 24 oz/acre, after maximum kernal fill is complete and the crop is physiologically mature (black layer formation) until 7 days before harvest. Combined total per year for all applications may not exceed 3.6 qt/acre. Allow a minimum of 50 days between application of this product and harvest of corn forage and 7 days between application and harvest of corn grain. Allow a minimum of 10 days between in-crop applications. Touchdown Total is available in a non-surfactant containing product called Touchdown HiTech. Other glyphosate formulations are available.

Corn - no-till or conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Cocklebur, jimsonweed, lambsquarters, nightshades, pigweed, ragweed, and velvetleaf	Pyridate 0.5-1.0 lb	Tough 5EC 0.8-1.6 pt + approved tank-mixes: 2, 4-D 0.5-1.0 pt or Accent 0.66 oz or Atrazine 0.75-1.5 qt or Banvel/Clarity 0.5-1.0 pt or Exceed 1.0 oz or Marksman 2.0-3.5 pt or Permit 0.6-1.3 oz	Tough is most effective on small, actively growing broadleaf weeds in the 1- to 4-leaf stage. The addition of atrazine or an approved adjuvant will provide broader spectrum control.
Cocklebur, jimsonweed, lambsquarters, morningglory, nightshade, nutsedge, pigweed, pokeweed, ragweed, smartweed, velvetleaf, and suppression of horsenettle, milkweed, and Canada thistle	Halosulfuron-methyl 0.02-0.04 lb + Sodium salt of dicamba 0.09-0.18 lb	Yukon 67.5WDG 4.0-8.0 oz + approved tank-mixes: atrazine 1.5-3.0 pt or Accent 0.66 oz	A nonionic surfactant or crop oil concentrate should be used. Use 0.25-0.5% nonionic surfactant or 1% v/v crop oil concentrate. When used alone, Yukon can be applied over the top or with crop nozzles from the spike through 36-inch-tall corn. Yukon can be applied 2 times a season with a total application not to exceed 8.0 oz/acre. Allow at least 2 weeks between applications.

Corn - no-till or conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Spot treatment			
Johnsongrass, as well as other annual and perennial grasses and broadleaf weeds	Glyphosate 1.0-3.0 lb	Roundup Weather Max 0.7-2.2 qt	Use an effective johnsongrass seedling control herbicide on corn and soybeans. In annual cropping systems, apply 1.0 to 1.75 pounds of this product per acre. Apply 1.0 pound of this product in 3 to 10 gallons of water per acre. Use 1.75 pounds of this product when applying 10 to 30 gallons of water per acre. In noncrop, or areas where annual tillage is not practiced (no-till), apply 1.75 to 2.5 pounds of this product in 10 to 30 gallons of water per acre. For best results, apply when most plants have reached the boot-to-head stage of growth or in the fall prior to frost. Allow 7 or more days after application before tillage. Do not tank-mix with residual herbicides when using the 1.0 pound per acre rate. In corn, for spot treatments, apply prior to silking. Do not treat more than 10 percent of the total field area to be harvested. Other glyphosate formulations are available.
Johnsongrass, as well as other annual and perennial grasses and broadleaf weeds	Glyphosate 1.0-3.0 lb	Touchdown Total 0.7-2.2 qt	In annual cropping systems, apply 1.0 to 3.0 qt/acre. For best results, apply when most plants have reached the boot-to-head stage of growth or in the fall prior to frost. Use 0.7 to 1.4 qt/acre for annual tillage systems. Use 1.4-2.2 qt/acre on no-till acres. Allow 3 to 7 days before tillage. In corn, spot application must be made prior to corn silking. A non-surfactant containing formulation of Touchdown Total is available under the trade name Touchdown HiTech. Other glyphosate formulations are available.

Corn - no-till or conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Harvest aids Morningglory spp. and other broadleaf weeds	2,4-D 0.5-1.0 lb	2,4-D amine 1.0-2.0 pt of a 4.0 lb/gal formulation that is labeled for harvest -aid use	Apply after hard-dough or denting stage. Do not forage or feed corn fodder for 7 days following application.
	Sodium chlorate	Defol 6 1.0 gal	Apply at least 14 days before harvesting on clear days with temperatures above 70 degrees F. Do not graze treated fields or feed fodder or forage within 14 days of application. Desiccation of morningglory and other vines may be erratic.
	Paraquat 0.3-0.5 lb	Gramoxone Inteon 2L 1.2-2.0 pt	Make one application at least 7 days prior to harvest after corn is mature and the black layer has formed. Apply in a minimum of 5.0 gal/acre by air and 20 gal/acre by ground. Use a nonionic surfactant containing at least 75% surface active agent at 0.25% v/v. A maximum of 2.0 pt/acre can be used. Drought stressed plants, especially broadleaf weeds can be difficult to kill and desiccation may not be complete.
	Glyphosate up to 3.0 lb	Roundup Weather Max Apply up to 2.0 qt/acre by ground and 44 oz/acre by air	Apply at 35 percent grain moisture or less. Ensure that maximum kernel fill is complete and the corn is mature (black layer formed). Allow at least 7 days between application and harvest. Apply with extreme caution because spray drift can be very damaging to trees, shrubs, and lawns at this time of year. For Roundup-Ready corn, the maximum amount of this product that can be applied after maximum kernal fill is complete and the crop is physiologically mature (black layer formation) until 7 days before harvest is 22 ounces per acre. Other glyphosate formulations are available.

Corn - no-till or conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Harvest aids (continued)	Glyphosate up to 3.0 lb	Touchdown Total Apply up to 2.2 qt/acre by ground and up to 24 oz/acre by air	Apply at 35 percent grain moisture or less. Ensure that maximum kernel fill is complete and the corn is mature (black layer formed). Allow at least 7 days between application and harvest. Apply with extreme caution because spray drift can be very damaging to trees, shrubs, and lawns at this time of year. With Roundup-Ready corn, the preharvest application is limited to 24 oz/acre until 7 days before harvest. A non-surfactant containing formulation of Touchdown Total is available under the trade name Touchdown HiTech. Other glyphosate formulations are available.
Postharvest fall weed control			
Alfalfa, artichoke (Jerusalem), bindweeds, dock (curly), dogbane (hemp), horsenettle, milkweed (common, honeyvine), plantains, pokeweed, sorrel (red), and thistle (Canada)	Dicamba 1.0-2.0 lb + surfactant or crop oil concentrate	Banvel or Clarity 2.0-4.0 pt + surfactant 1.0 qt/100 gal or crop oil concentrate 1.0 gal/100 gal	Apply after corn harvest and prior to frost to actively growing weeds. Results are best when weeds are at or beyond the full-bloom stage. Allow 10 or more days after application before tillage or mowing. Fall-seeded small grains are restricted to 30 days after application per pint of dicamba used.
Weeds listed above for Banvel and garlic (wild)	Dicamba 0.5-2.0 lb + 2,4-D ester 0.5-3.0 lb + surfactant or crop oil concentrate	Banvel or Clarity 1.0-4.0 pt + 2,4-D ester 1.0-6.0 pt + surfactant 1.0 qt/100 gal or crop oil concentrate 1.0 gal/100 gal	See the above remarks for Banvel/Clarity. Fall-seeded small grains are restricted to the following year for 2,4-D applications.

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postharvest fall weed control (continued)			
Docks and garlic (wild)	Thifensulfuron-methyl and Tribenuron-methyl 0.023-0.028 lb + crop oil concentrate or surfactant	Harmony Extra XP 0.5-0.6 oz + crop oil concentrate 1.0 gal/100 gal or surfactant 1.0 qt/100 gal	Best results are obtained when applications are made to young, actively growing weeds. Always premix Harmony Extra with water before adding it to the spray tank. Sequential treatments may be applied provided the total amount of Harmony Extra applied during one fallow cropland season does not exceed 1.0 ounce per acre. Harmony Extra must be applied at least 45 days prior to planting corn, cotton, rice, grain sorghum, or soybeans. All other crops require a 60-day planting restriction.
		approved tank-mixes: Banvel or Clarity or 2,4-D	Use of these tank-mixes will improve spectrum of perennial weed control.
Alfalfa, artichoke (Jerusalem), bermudagrass, bindweed (field), dock (curly), dogbane (hemp), horsenettle, johnsongrass, milkweed (common), muhly (wirestem), ryegrass (perennial), and thistle (Canada)	Glyphosate 1.0-5.0 lb + surfactant	Roundup Weather Max 0.7-3.6 qt or Touchdown Total 0.75-3.75 qt	Apply after corn harvest and prior to frost to actively growing weeds. Results are best when weeds are at or beyond the full-bloom stage. Allow 7 or more days after application before tillage or mowing. Do not harvest or feed treated vegetation for 8 weeks following application. A non-surfactant containing formulation of Touchdown total is available under the trade name Touchdown HiTech. Other glyphosate formulations are available.

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postharvest fall weed control (continued)			
Improved spectrum of control for perennial broadleaf weeds	Glyphosate 1.0-5.0 lb + dicamba 0.5-2.0 lb	Roundup Weather Max 0.7-3.6 qt or Touchdown Total 0.75-3.75 qt + Banvel or Clarity 1.0-4.0 pt	See previous remarks for Roundup Ultra Max. Fall-seeded small grains can follow dicamba applications (30 days per pint of dicamba applied). Small grains are restricted to the following year for 2,4-D applications. Do not harvest or feed treated vegetation for 8 weeks following application. A non-surfactant formulation of Touchdown Total is available under the trade trade name Touchdown HiTech. Other glyphosate formulations are available.
	Glyphosate 1.0-5.0 lb + 2,4-D ester 0.5-3.0 lb	Roundup Weather Max 0.7-3.6 qt or Touchdown Total 0.75-3.75 qt + 2,4-D ester 1.0-6.0 pt	

Weed Control in Forage Crops

Legume seedlings are relatively slow growing, whereas weeds often have a rapid initial growth period. Thus, in new seedlings, weeds compete strongly with the legume seedlings for light, moisture, and nutrients. Severe reduction or loss of stands may result. Several preplant incorporated treatments are available that offer good annual grass control and some broadleaf weed control at establishment. In addition, postemergence treatments available for use on new stands give good broadleaf weed control. Once a stand is established, weeds may continue to reduce yields and impair quality of the forage. Both residual-type herbicides and postemergence herbicides are available for use in established forage stands. Most are recommended for fall or spring dormant application. Pick the treatment that best suits the specific weed infestation, and carefully follow label directions in terms of timing and rates of application.

Spray volumes for forage areas should be 20 to 30 gallons per acre. Lower volumes will also work but increase the risk of spray drift.

Alfalfa

The following table illustrates the susceptibility of common alfalfa weeds to recommended herbicides. Herbicide application timings include establishment, seedling stands, fall or spring dormant, and postcutting. Note that four treatments may be used either in seedling stands or as fall or spring treatments in established stands.

Relative effectiveness of herbicides for alfalfa [a]

Legend - based on adequate moisture, good growing conditions, and proper herbicide application

G = Good (80-100% control)
F = Fair (60-80% control)
P = Poor (20-60% control)
F-G = Fair to Good
P-F = Poor to Fair
N = None (<20% control)

	Barnyardgrass	Bermudagrass	Cheat	Crabgrass	Fescue, tall (est.)	Foxtails	Goosegrass	Johnsongrass (seed)	Nutsedge (yellow)	Orchardgrass (est.)	Panicum (fall)	Quackgrass
Establishment												
2 x Gramoxone Inteon (b)	G	P-F	G	G	G	G	G	G	P	G	G	F
Balan	G	P	G	G	N	G	G	F	P	N	G	P
Eptam	G	F	G	G	N	G	G	G	G	N	G	F
Glyphosate (c)	G	G	G	G	G	G	G	G	F-G	G	G	G
Seedling stand and fall/spring dormant												
2,4-DB	N	N	N	N	N	N	N	N	N	N	N	N
Buctril	N	N	N	N	N	N	N	N	N	N	N	N
Kerb	F	P	G	F	G	F	F	P	N	G	F	G
Pursuit	F-G	N	N	F-G	N	G	F	G	P-F	N	F	P-F
Raptor	F-G	N	G	F-G	P	G	P	F-G	P-F	P	F-G	P
Postemergence												
Poast or Post Plus	G	G	P-F	G	P	G	G	G	N	F-G	G	F-G
Pursuit	F-G	N	N	F-G	N	G	F	G	P-F	N	F	P-F
Raptor	F-G	N	G	F-G	P	G	P	F-G	P-F	P	F-G	P
Select	G	G	G	G	F	G	G	G	N	G	G	F-G
Fall/spring dormant												
Gramoxone Inteon	-	P	G	N	F	N	N	N	P	F	N	F
Karmex	-	P	P-F	F	F	F	F	P-F	N	F	P-F	P-F
MCPA	-	N	N	N	N	N	N	N	N	N	N	N
Pursuit	-	N	N	F-G	N	G	F	G	P-F	N	F	P-F
Raptor	F-G	N	G	F-G	P	G	P	F-G	P-F	P	F-G	P
Sencor	-	P	G	P-F	P-F	P-F	P-F	P	N	P	P-F	P
Sinbar	-	P-F	G	P-F	F	P-F	P-F	P	P	F	P-F	F
Velpar	-	N	G	P-F	F	P-F	P-F	P	P	F	P-F	P-F

Relative effectiveness of herbicides for alfalfa [a] (continued)

	Barnyardgrass	Bermudagrass	Cheat	Crabgrass	Fescue, tall (est.)	Foxtails	Goosegrass	Johnsongrass (seed)	Nutsedge (yellow)	Orchardgrass (est.)	Panicum (fall)	Quackgrass
Postcutting												
Gramoxone Inteon	-	P-F	G	G	F	G	G	G	P-F	F	G	F
Pursuit	-	N	N	F-G	N	G	F	G	P-F	N	F	P-F
Raptor	F-G	N	G	F-G	P	G	P	F-G	P-F	P	F-G	P
Sinbar	-	P-F	G	G	F	G	G	G	P-F	F	G	F
Velpar	-	P-F	F-G	P-F	F	P-F	P-F	P	P	F-G	P-F	F

[a] The susceptibility ratings listed in this table assume correct rates and timings of herbicide application for the normal growth habit of each species. In some instances, ratings are lower than might be obtained if the recommended time of herbicide application and the time of weed presence or optimum susceptibility coincided.

[b] 2 x Gramoxone Inteon refers to susceptibility of weeds when sequential (two) applications of Gramoxone Inteon are used.

[c] Roundup Weather Max, Touchdown, and other labeled glyphosate formulations

Relative effectiveness of herbicides for alfalfa [a] (continued)

Legend - based on adequate moisture, good growing conditions, and proper herbicide application

G = Good (80-100% control)
F = Fair (60-80% control)
P = Poor (20-60% control)
F-G = Fair to Good
P-F = Poor to Fair
N = None (<20% control)

	Amaranth (spiny)	Chickweed (common)	Dandelion (est.)	Dock spp. (est.)	Dock spp. (seedling)	Dogbane (hemp)	Henbit	Horsenettle	Horseweed	Knawel or German moss	Lambsquarters (common)	Lettuce (prickly)	Milkweed spp.	Mustard spp.
Establishment														
2 x Gramoxone Inteon (b)	G	G	P	P	G	P	G	F	P	F-G	G	F	P	G
Balan	G	F	N	N	N	N	P-F	N	P	P-F	G	N	N	P
Eptam	G	F	N	N	N	N	G	N	P	P	G	N	N	P
Glyphosate (c)	G	G	G	F-G	G	G	G	F-G	G	F-G	G	G	F-G	G
Seedling stand and fall/spring dormant														
2,4-DB	G	N	P-F	P	G	N	N	N	F-G	N	G	F	N	G

Relative effectiveness of herbicides for alfalfa [a] (continued)

	Amaranth (spiny)	Chickweed (common)	Dandelion (est.)	Dock spp. (est.)	Dock spp. (seedling)	Dogbane (hemp)	Henbit	Horsenettle	Horseweed	Knawel or German moss	Lambsquarters (common)	Lettuce (prickly)	Milkweed spp.	Mustard spp.
Buctril	F	P	N	N	P	N	F-G	N	P-F	G	G	P-F	N	G
Kerb	N	G	P	F	F	N	F	N	P	P	P	P	N	P
Pursuit	F-G	F	P-F	P	P-F	N	F	N	N	N	P	N	N	G
Raptor	G	G	F-G	P	P-F	N	-	-	N	N	P	N	N	G
Postemergence														
Poast or Post Plus	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Pursuit	F-G	F	P-F	P	P-F	N	F	N	N	N	P	N	N	G
Raptor	G	G	F-G	P	P-F	N	-	-	N	N	P	N	N	G
Select	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Fall/spring dormant														
Gramoxone Inteon	N	G	P	P-F	G	N	G	P	P	F-G	N	F	N	F
Karmex	F-G	G	P	P-F	F	N	F	P-F	F	F-G	F-G	F	N	G
MCPA	P	N	F-G	P-F	G	N	N	N	F-G	N	P	F	N	G
Pursuit	F-G	F	P-F	P	P-F	N	F	N	N	N	P	N	N	G
Raptor	G	G	F-G	P	P-F	N	-	-	N	N	P	N	N	G
Sencor	P	G	F-G	F	F	N	G	P-F	P	F	P	F	N	G
Sinbar	F-G	G	F	P-F	F	P	G	P-F	F	F	F-G	F	P	G
Velpar	F-G	G	F-G	P-F	F	P	G	P-F	F	F	F-G	F	P	G
Postcutting														
Gramoxone Inteon	G	G	P-F	P-F	G	P	G	P	P	F	G	F	P	G
Pursuit	F-G	F	P-F	P	P-F	N	F	N	N	N	P	N	N	G
Raptor	G	G	F-G	P	P-F	N	-	-	N	N	P	N	N	G
Sinbar	G	G	F	F	G	P	G	P-F	F-G	F	G	F	P	G
Velpar	F-G	G	F-G	P-F	F	P	F-G	P-F	F	F	F-G	F-G	P	G

[a] The susceptibility ratings listed in this table assume correct rates and timings of herbicide application for the normal growth habit of each species. In some instances, ratings are lower than might be obtained if the recommended time of herbicide application and the time of weed presence or optimum susceptibility coincided.

[b] 2 x Gramoxone Inteon refers to susceptibility of weeds when sequential (two) applications of Gramoxone Inteon are used.

[c] Roundup Weather Max, Touchdown, and other labeled glyphosate formulations

Relative effectiveness of herbicides for alfalfa [a] (continued)

Legend - based on adequate moisture, good growing conditions, and proper herbicide application

G = Good (80-100% control)
F = Fair (60-80% control)
P = Poor (20-60% control)
F-G = Fair to Good
P-F = Poor to Fair
N = None (<20% control)

	Eastern black nightshade	Pennycress spp.	Pepperweed spp.	Pigweed	Plantain spp.	Ragweed (common)	Shepherdspurse	Smartweed	Speedwell	Thistle (bull)	Thistle (Canada)	Thistle (musk)	Thistle (plumeless)	Yellowrocket
Establishment														
2 x Gramoxone Inteon (b)	G	G	G	G	P	G	G	F-G	G	F	P	F	F	F
Balan	P-F	P	P	G	N	N	P	P	P	N	N	N	N	P
Eptam	G	P	P	G	N	P	P	P	P	N	N	N	N	P
Glyphosate (c)	G	G	G	G	F-G	G	G	G	G	G	F-G	G	G	G
Seedling stand and fall/spring dormant														
2,4-DB	G	G	G	G	F-G	F	G	P	P	F-G	N	F-G	F-G	G
Buctril	G	G	G	F	N	F	G	G	P	P-F	P	P-F	P-F	F
Kerb	P	F	P	N	F	N	F	P	P	P	N	P	P	P-F
Pursuit	F-G	G	G	F-G	N	F-G	G	F-G	P-F	N	P	N	N	G
Raptor	F-G	G	G	G	P	F	G	F-G	F	P-F	P-F	P-F	P-F	G
Postemergence														
Poast or Post Plus	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Pursuit	F-G	G	G	F-G	N	F-G	G	F-G	P-F	N	P	N	N	G
Raptor	F-G	G	G	G	P	F	G	F-G	F	P-F	P-F	P-F	P-F	G
Select	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Fall/spring dormant														
Gramoxone Inteon	P	F	F	N	P-F	N	F	N	G	F	P	F	F	P-F
Karmex	P-F	G	G	F-G	P-F	F-G	G	F	F-G	P-F	P	P-F	P-F	G
MCPA	P	G	G	P	G	P	G	P	P	G	P	G	G	G
Pursuit	F-G	G	G	F-G	N	F-G	G	F-G	P-F	N	P	N	N	G
Raptor	F-G	G	G	G	P	F	G	F-G	F	P-F	P-F	P-F	P-F	G
Sencor	P	G	G	P	G	P	G	P	F-G	F	P	F	F	G
Sinbar	F	G	G	F-G	F-G	F-G	G	F-G	G	P-F	P	PF	P-F	G
Velpar	F	G	G	F-G	F-G	F-G	G	F-G	G	P-F	P	P-F	P-F	G

Relative effectiveness of herbicides for alfalfa [a] (continued)

	Eastern black nightshade	Pennycress spp.	Pepperweed spp.	Pigweed	Plantain spp.	Ragweed (common)	Shepherdspurse	Smartweed	Speedwell	Thistle (bull)	Thistle (Canada)	Thistle (musk)	Thistle (plumeless)	Yellowrocket
Postcutting														
Gramoxone Inteon	G	G	G	G	G	G	G	G	G	F	P-F	F	F	F
Pursuit	F-G	G	G	F-G	N	F-G	G	F-G	P-F	N	P-F	N	N	G
Raptor	F-G	G	G	G	P	F	G	F-G	F	P-F	P-F	P-F	P-F	G
Sinbar	G	G	G	G	G	G	G	G	G	F	P	F	F	F-G
Velpar	F	G	G	F-G	F-G	F-G	G	F-G	G	P-F	P	P-F	P-F	G

[a] The susceptibility ratings listed in this table assume correct rates and timings of herbicide application for the normal growth habit of each species. In some instances, ratings are lower than might be obtained if the recommended time of herbicide application and the time of weed presence or optimum susceptibility coincided.

[b] 2 x Gramoxone Inteon refers to susceptibility of weeds when sequential (two) applications of Gramoxone Inteon are used.

[c] Roundup Weather Max, Touchdown, and other labeled glyphosate formulations

Alfalfa - grazing, feeding, and harvesting restrictions

Herbicide	Type of restriction	Length of restriction	Comments
2,4-DB (Butyrac)	Grazing or feeding	60 days 30 days	Seedling alfalfa. Established alfalfa.
Buctril	Grazing or harvest	30 days 60 days	After spring application. After fall application.
Gramoxone Inteon	Grazing Grazing or harvest	42 days 30 days	Fall or spring dormant application. Between cutting application.
Karmex	Grazing or harvest	none	Do not replant treated areas to any crop within 2 years of application.
Kerb	Grazing or harvest	120 days	Fall or dormant application.
Poast or Poast Plus	Forage (grazing) Hay (harvest)	7 days 14 days	On the label, forage refers to green, undried alfalfa. Hay is dried alfalfa.
Pursuit	Grazing or harvest	30 days	Do not feed, graze, or harvest within 30 days after application.
Raptor	Cutting or feeding	20 days	Wait at least 20 days between application and cutting or feeding of alfalfa forage or hay.
Roundup Weather Max or Touchdown or other labeled glyphosate formulation	Preharvest Spot treatment	36 hours 14 days	These products may be used in declining alfalfa stands or any stand of alfalfa where crop destruction is acceptable. The treated crop and weeds can be harvested and fed to livestock after 36 hours. Allow a minimum of 36 hours between application and harvest. Only one application to an existing stand of alfalfa per year. Do not apply more than 44 oz/acre of Roundup Weather Max or 1.5 pt/acre of Touchdown Total, or 1.25 pt/acre of Touchdown HiTech. Do not treat more than 1/10 of any acre at one time. Remove domestic livestock before application and wait 14 days after application before grazing livestock or harvesting.
Select	Grazing, feeding, or harvest	15 days	If tank-mixing with 2,4-DB, restriction is 60 days.
Sencor	Grazing or harvest	28 days	Dormant application.
Sinbar	Grazing or harvest	none	Do not replant treated areas to any crop within 2 years of application.
Velpar	Grazing or feeding	30 days	Plant only corn 12 months following application of Velpar.

Alfalfa, ladino clover and red clover

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preplant Annual grasses and broadleaf weeds, including barnyardgrass, bluegrass (annual), carpetweed, chickweed, crabgrass, foxtail (giant, green, yellow), goosegrass, johnsongrass from seed, lambsquarters, panicum (fall), pigweed, purslane, pusley (Florida), sandbur, and ryegrass (annual)	Benefin 1.2-1.5 lb	Balan 60DF 2.0-2.5 qt	Apply to clean, dry soil surface no more than 10 weeks before plant- ing. Incorporate within 4 to 8 hours with a disk set to cut 4 to 6 inches and operated in two different directions at 4 to 6 miles per hour, or with power takeoff driven equipment, set to cut 2 to 3 inches deep once over. See label, and adjust rate to soil texture.
Orchardgrass and fescue sods, control of annual weeds, alfalfa establishment, and suppression of perennial broadleaf weeds	Paraquat 0.625-1.0 lb + surfactant	Gramoxone Inteon 2.5-4.0 pt + surfactant as specified by label	Use this chemical for no-till establishment of alfalfa into perennial grass sods. Two applications utilizing 1.5 pints followed in 10 to 14 days by an additional 1.0 pint will generally be required for complete sod kill.
Bahiagrass, bermudagrass, bindweed (field), bluegrass (annual, Kentucky), blueweed (Texas), brome (downy), canarygrass (reed), cattail, crabgrass, dallisgrass, dock (curly), dogbane (hemp), fescues, fleabane, foxtail (giant, green, yellow), guineagrass, johnsongrass, kochia, lambsquarters (common), lettuce (prickly), milkweed, muhly (wirestem), mullein (common), napiergrass, nightshade (silverleaf), orchardgrass, panicums, paragrass, pigweed (redroot, smooth), ragweed (common, giant), quackgrass, sandbur, shattercane, smartweed (Pennsylvania, swamp), spanishneedles, thistle (Canada, Russian), torpedograss, vaseygrass, velvetleaf, and volunteer wheat	Glyphosate 0.5-5.0 lb	Roundup Weather Max 0.5-2.9 qt or Touchdown Total 0.35-3.6 qt or other labeled glyphosate formulation	Use glyphosate for control of emerged vegetation before the establishment of alfalfa in conventional systems or when overseeded into a cover crop. When overseeding alfalfa, glyphosate must be applied before planting a labeled cover crop. Avoid contact of spray with foliage, green stems or fruit of desirable crops, plants, trees, or other vegetation since severe damage or destruction may result. Repeated treatments may be necessary to control weeds regenerating from underground parts or seed. Repeat treatments must be made before the crop emerges. Do not feed or forage treated vegetation within 8 weeks after application. Low volume broadcast applications are recommended with some formulations for best results. Touchdown Total is also available as a non-surfactant containing formulation called Touchdown HiTech.

Alfalfa, ladino clover and red clover (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence			
Cocklebur, dock seedlings (curly), fanweed, filaree, lambsquarters, lettuce (prickly), morningglory spp., mustards, nightshade, pennycress, pigweed, ragweed (common), shepherdspurse, smartweed, and thistle (bull, curled, musk)	2,4-DB 0.5-1.5 lb	2,4-DB (Butyrac and others) 2.0-6.0 pt	Apply when weeds are actively growing and no more than 3 inches high or rosettes less than 3 inches across. May be applied either to seedling legumes (when seedling plants have two to four trifoliate leaves) or to established stands (in late fall or early winter) for best control. Fields should not be grazed or harvested for forage within 30 days on established stands after application. Do not apply if temperature is expected above 90°F or to fall below 40°F during or shortly after treatment.
Knawel or German moss, lambsquarters (common), mustard spp., nightshade spp., and suppression of some other winter annuals	Bromoxynil 0.25-0.375 lb	Buctril 2EC 1.0-1.5 pt	Apply when weed seedlings are actively growing, but do not exceed 4-leaf stage or 2 inches in height. Do not apply to seedling alfalfa with less than two trifoliate leaves.
Bluegrass (annual, perennial),cheat, chickweed, oats (wild), orchardgrass, quackgrass, ryegrass, sorrel (red), and volunteer grains	Pronamide 0.5-1.5 lb	Kerb 50W 1.0-3.0 lb	Use on established plantings or on new plantings after legume has reached trifoliate stage. Apply during fall or early winter and before winter freeze-up. Apply when soil temperature is 50°F or less. Remove or disperse trash or crop residue before treatment. Rainfall is necessary to move it into the root zone where it is absorbed. Avoid drift to nontarget areas. Do not graze or harvest for forage within 120 days of treatment.

Alfalfa - established

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence			
Bluegrass, brome (downy, smooth), chickweed, henbit, and suppression of perennial grasses, including orchardgrass and timothy	Paraquat 0.5-0.75 lb + surfactant	Gramoxone Inteon 2.0-3.0 pt + surfactant as specified by label	Apply as a broadcast application in 20 to 60 gallons of water per acre using ground equipment. Use higher rate for kill or suppression of harder-to-control weeds and grasses, such as the perennial species. Do not apply if fall regrowth following the last fall cutting is more than 6 inches high. Apply to well-established stands (at least 1 year old) after the last fall cutting when the crop is dormant or before spring growth reaches 2 inches. Alfalfa foliage present at the time of application will be burned, which may reduce the yield of the first cutting. Weeds and grasses should be succulent and growing at the time of application. Do not graze, cut, or harvest within 42 days of application. Do not apply more than once per season. Apply 1.0 to 2.0 pt on fall seeded, newly established stands less than 1 year old—dormant. Do not harvest within 60 days of application. Applications to alfalfa that is not dormant, or has broken dormancy, may result in stand and/or yield reductions.

Alfalfa - established (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Annual grasses and broadleaf weeds and suppression of perennial plants	Paraquat 0.25 lb + surfactant	Gramoxone Inteon 1.0 pt + surfactant as specified by label	Alternate method: postharvest application. Apply in 20 to 60 gallons of water by ground equipment immediately after alfalfa has been harvested. Do not treat more than 5 days after cutting. Foliage present at application will be burned. Do not graze, cut, or harvest within 30 days of application. Make one to three applications per year as required. These sprays may be applied in addition to a dormant application. May be used on stands less than 1 year old where weeds threaten stand loss. First year alfalfa stands and yields may be reduced if alfalfa is allowed to regrow more than 2 inches. For first-year alfalfa, do not apply more than twice during the first growing season.
Chickweed, corn gromwell, corn spurry, dogfennel, knawel or German moss, lettuce (prickly), mustards (wild-including Calepina sp.), pennycress, and shepherdspurse	Diuron 1.2-1.6 lb	Karmex 80DF 1.5-2.0 lb	Apply in March or early April when alfalfa is dormant and before it begins growth in the spring. Treat only stands established for 1 year or more. Do not apply to alfalfa/grass mixtures or to alfalfa with unusually shallow root penetration (such as shallow hard pans) or on sandy soils with less than 1 percent organic matter content. Do not replant treated areas to any crop within 2 years unless otherwise directed.
Many broadleaf weeds including burdock, Calepina sp., dandelion, goatsbeard, mustards, pennycress, pepperweed, plantain, shepherdspurse, thistles (curled, musk), and yellowrocket	MCPA 0.5 lb	MCPA 1.0 pt	Apply after frost when alfalfa is defoliated and dormant. Stand losses may result if sprayed when not completely dormant. Temperatures at the time of spraying should be above 40°F. May be used on mixtures with orchardgrass if established 1 year.

Alfalfa - established (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Barnyardgrass, bermudagrass, crabgrass, foxtail (giant, green, yellow), johnsongrass, panicum (fall), quackgrass, ryegrass (annual), shattercane, witchgrass, volunteer small grains, and corn	Sethoxydim 0.19-0.47 lb + crop oil concentrate	Poast 1.0-2.5 pt or Poast Plus 1.5-3.75 pt + crop oil concentrate 2.0 pt or Dash 2.0 pt	Apply to actively growing grasses at the size and rate indicated on the label for the individual grass species. Always add crop oil concentrate to the spray solution. A second application is required for complete control of perennial grass species. Do not apply sethoxydim within 7 days of feeding, grazing, or harvesting forage, or within 14 days of feeding or harvesting hay. Can be tank-mixed with 2,4-D but also observe feeding, grazing, and harvesting restrictions.
Barnyardgrass, bedstraw, chickweed spp., cocklebur, crabgrass spp., foxtail spp., henbit, jimsonweed, johnsongrass (seedling), knotweed, mallow spp., morningglory spp., mustard spp., nightshade spp., pennycress, pepperweed, pigweed spp., radish (wild), ragweed spp., shattercane, shepherdspurse, signalgrass (broadleaf), smartweed spp., spurge spp., velvetleaf, yellowrocket, and suppression of johnsongrass (rhizome)	Imathezapyr 0.047-0.095 lb	Pursuit 2L 3.0-6.0 oz	Apply postemergence to seedling or established alfalfa. Apply in the fall or spring to dormant alfalfa, before regrowth reaches 3 inches, or between cuttings. Make applications when weeds are no larger than 1 to 3 inches or when rosettes are less than 3 inches in diameter. Apply in 10 or more gallons of water per acre in combination with an approved nonionic surfactant or crop oil concentrate. Do not apply to seedling alfalfa before the crop has two fully expanded trifoliate leaves. Consult the label and adjust rate for the specific weed infestation. Rates of 4.0 to 6.0 ounces per acre are generally required for broad spectrum weed control. May be applied to alfalfa/grass mixtures after the establishment year. Do not apply to last year alfalfa to avoid rotational restrictions.

Alfalfa - established (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Bromegrass, cereals (barley, oat, wheat), chickweed (common), cocklebur, crabgrass (large), foxtail (giant, green, yellow), lambsquarters, jimsonweed, morningglory, mustard, nightshade, pennycress, pigweed, ryegrass, shattercane, shepardspurse, smartweed, and velvetleaf	Imazamox 0.031-0.047 lb	Raptor 1AS 4.0-6.0 oz	For seedling alfalfa, apply Raptor when the seedling alfalfa is in the second trifoliate stage or larger and when the majority of the weeds are 1–3 inches high. A temporary reduction in growth may occur. Raptor can be applied to established alfalfa in fall, winter, or spring to dormant or semi-dormant alfalfa, or between cuttings. Apply when the weeds are actively growing and before they exceed a height of 3 inches. Wait at least 20 days between application and cutting or using alfalfa forage or hay as feed. Apply a maximum of 6 ounces per season. Postemergence applications of Raptor require the addition of an adjuvant and a nitrogen fertilizer solution. For dormant applications, better control is achieved when air temperature is above 50 degrees F at time of application.

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Various annual and perennial grasses and broadleaf weeds	Glyphosate 0.75-1.5 lb ae	Roundup Original Max 22.0 - 44.0 oz	**For use only on Roundup Ready alfalfa** Apply after alfalfa seeding from emergence up to the 4 trifoliate leaf stage. If needed, a sequential postemergence application may be made after the 5th trifoliate leaf stage up to 5 days before cutting. The combined total per year for all in-crop applications must not exceed 4.1 quarts per acre. Remove domestic livestock before application and wait a minimum of 5 days after last application before grazing, or cutting and feeding of alfalfa forage and hay. Note - up to 10% of the seedlings may not contain a Roundup Ready gene and will not survive after the first application of this product. To eliminate the undesirable effects of stand gaps created by the loss of plants not containing a Roundup Ready gene, a single application of at least 22 oz/acre should be applied at or before the 3 to 4 trifoliate leaf stage.

Alfalfa - established (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Various annual and perennial grasses and broadleaf weeds	Glyphosate 0.75-1.5 lb ae	Roundup Original Max 22.0 to 44.0 oz	**For use only on Roundup Ready alfalfa** In established stands, apply up to 44 oz per acre per cutting up to 5 days before cutting. See remarks above for use in seedling alfalfa. Apply to annual weeds less than 4 inches tall. For perennial weed control, best results apply in the fall prior to a killing frost. Any single over-the-top application should not exceed 44 oz/acre. Sequential applications should be at least 7 days apart. The combined total for all in-crop applications must not exceed 4.1 qt/acre. Remove domestic livestock before application and wait a minimum of 5 days after last application before grazing, or cutting and feeding of alfalfa forage and hay.
Barnyardgrass, bermudagrass, bluegrass (annual), crabgrass, foxtail (giant, green, yellow), goosegrass, johnsongrass (seedling), panicum (fall, Texas), quackgrass, shattercane, volunteer corn, cereals, and tall fescue	Clethodim 0.094-0.125 lb + crop oil concentrate	Select 2EC 6.0-8.0 oz + crop oil concentrate 2.0 pt	May be applied to seedling or established alfalfa. Do not apply within 15 days of grazing, feeding, or harvesting (cutting) alfalfa for forage or hay. Can be tank-mixed with 2,4-DB, but a 60-day feeding, grazing, and harvesting restriction must be observed. Will control tall fescue at 8.0 oz/acre.
Chickweed	Metribuzin 0.25-0.375 lb	Sencor 4F 0.25-0.375 qt or DF 0.33-0.5 lb	Use lower rates for chickweed control only.

Alfalfa - established (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Chickweed, deadnettle, henbit, and pepperweed	Metribuzin 0.375-0.5 lb	Sencor 4F 0.75-1.0 pt or Sencor DF 0.5-0.66 lb	Treat only dormant established stands. Stands planted in the spring that are less than 1 year old at time of application may be treated up to 1.0 pint or 0.66 pound per acre after alfalfa growth ceases in the fall. If established orchardgrass is interplanted with alfalfa, use a maximum of 1.0 pint or 0.66 pound per acre. If newly seeded orchardgrass is interplanted with alfalfa, use a maximum of 0.75 pint or 0.5 pound per acre.
Bluegrass, brome (smooth), cheat, chickweed, cockle (white), dandelion, deadnettle, henbit, oats (wild), pepperweed, shepherdspurse, and suppression of dock	Metribuzin 0.375-1.0	Sencor 4F 0.375-1.0 qt or DF 0.5-1.3 lb	Make a single application in the fall after alfalfa becomes dormant or in the spring before new growth starts. Stands planted in the spring that are less than 1 year old at the time of application may be treated with a maximum of 0.66 pound of Sencor DF per acre after alfalfa growing ceases in the fall. Do not graze or harvest within 28 days after application. This chemical can be utilized on alfalfa/grass mixtures.
Chickweed	Terbacil 0.26-0.4 lb	Sinbar 80W 0.33-0.5 lb	Apply to new seedings after plants have developed three trifoliate leaves or to established stands. These lower rates are useful primarily for chickweed control during the dormant season in stands less than 1 year old.

Alfalfa - established (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)			
Barley (wild), brome (downy), chickweed, crabgrass, foxtail (giant, green, yellow), henbit, horseweed, lambsquarters, lettuce (prickly), mustard, pepperweed, ryegrass, shepherdspurse, and yellowrocket	Terbacil 0.4-1.2 lb	Sinbar 80W 0.5-1.5 lb	Treat only stands established 1 year or more. Make a single application in the fall after plants are dormant, in the spring before new growth exceeds 2 inches, or after cutting following hay removal. For semidormant and nondormant varieties, apply in the fall after last cutting or in the spring before new growth exceeds 2 inches. Do not use on seedling alfalfa, alfalfa grass mixtures, or other mixed stands. Do not apply on snow-covered or frozen ground as injury to the crop may result. Do not replant to any crop within 2 years of last application.
Bluegrass (annual), chickweed (common), crabgrass, dandelion (common), fiddleneck, fleabane, foxtail (giant, green, yellow), groundsel, lambsquarters, lettuce (prickly), mustard spp., pennycress, plantain (broadleaf), pigweed spp., shepherdspurse, speedwell, sweetclover, and yellowrocket	Hexazinone 0.45-1.35 lb	Velpar 90W 0.5-1.5 lb	Apply as a postemergence treatment to established stands of alfalfa in the fall or winter after alfalfa becomes dormant, or in the spring before new growth begins, or after cutting following hay removal. Use the lower rate on coarse-textured soils and the higher rate on fine-textured soils. Apply in a minimum of 20 gallons of water per acre when weeds are 2 inches high or less for best results. Corn may be planted 12 months after application. Do not let livestock graze or eat treated forage within 30 days following application.

Alfalfa - established (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Spot treatment			
Alfalfa and clover only	Glyphosate 0.5-4.0 lb	Roundup Weather Max 0.4-2.9 qt or Touchdown Total 0.35-2.8 qt or other labeled glyphosate formulation	Glyphosate can be used in alfalfa and clover as a spot treatment application. Apply in areas where the movement of domestic livestock can be controlled. No more than one-tenth of any acre should be treated at one time. Remove domestic livestock before application and wait 14 days after application before grazing livestock or harvesting. May also be applied at a rate of 1.0-2.0 percent, glyphosate : water. Touchdown Total is available as a non-surfactant containing formulation under the trade name Touchdown HiTech.
Preharvest			
Alfalfa	Glyphosate up to 1.9 lb depending upon formulation	Roundup Weather Max 1.4 qt or Touchdown Total 1.5 pt or other labeled glyphosate formulation	Glyphosate can be used in declining alflafa stands or any stand of alfalfa where crop destruction is acceptable. This application will severely injure or destroy the stand of alfalfa. This product will control annual and perennial weeds including quackgrass, when applied prior to harvest of alfalfa. The treated crop and weeds can be harvested and fed to livestonck after 36 hours. Allow a minimum of 36 hours between application and harvest. Application can be made at any time of the year. Make only one application to an existing stand of alfalfa per year. Applications greater than 1.4 qt/acre of Roundup Weather Max or 1.5 pt/acre of Touchdown Total will require an 8 week waiting period between application and grazing or harvesting.

Pasture

Spray volumes for pasture areas should be 20 to 30 gallons per acre with ground sprayers. Lower volumes also will work, but risk of spray drift increases. Aerial application of lower volumes also may be used.

Musk and curled thistles are major problems in western Virginia and Maryland and continue to spread eastward. These plants are considered biennials, but some plants actually may germinate in the spring and flower in the late summer. Such plants would be annuals. In the spring, susceptible crop and ornamental plants are actively growing and will be damaged if spray drift reaches them.

The 2,4-D used for thistle control has little residual activity in the soil. Weeds reinfest areas where thistles are killed in the fall. This results in plants that bloom and produce seed the next summer. Based on this, spring may be the best time to control thistles. At the same time, controlling thistles in the spring is hazardous to the growth of desirable plants.

Rates of application are stated in pounds of acid equivalent (AE) per acre. Amine, low-volatile ester (LVE), and oil-soluble amine (OSA) formulations for various weed situations are suggested. Various formulations containing from 2 to 6 pounds acid equivalent per gallon are available. Usually, higher acid equivalents per gallon are more economical. The following table will aid in converting pounds per acre to liquid volumes necessary to supply the amount of the weed killer suggested. It is important to have the correct amount of herbicide.

Equivalency rates

AE (lb/gal on label)	Pints of given formulation necessary to supply the following rates per acre					
	1/4 lb	1/2 lb	1 lb	2 lb	3 lb	4 lb
2	1	2	4	8	12	16
3	2/3	1 1/3	2 2/3	5 1/3	8	10 2/3
4	1/2	1	2	4	6	8
6	1/3	2/3	1 1/3	2 2/3	4	5 1/3

Relative effectiveness of herbicides for pasture

Legend - based on adequate moisture, good growing conditions, and proper herbicide application

G = Good (80-100% control)
F = Fair (60-80% control)
P = Poor (20-60% control)
F-G = Fair to Good
P-F = Poor to Fair
N = None (<20% control)

Treatment and Rate (pounds of active ingredient per acre)	Amaranth, spiny	Aster spp.	Bedstraw spp.	Bindweed (field)	Bindweed (hedge)	Blackberry spp.	Brackenfern	Burdock spp.	Buttercup spp.	Campion (bladder)	Carrot (wild)	Chamomile (mayweed)	Chickweed (common)	Chickweed (mouse-ear)	Chicory	Clover (hop)	Clover spp.	Cockle (corn)	Cocklebur
2,4-D 2.0	G	G	P	F	G	P	P	G	G	P	G	P	P	P	G	P	P	F	G
2,4-D 1.0-1.5	F-G	G	P	F	G	P	P	G	G	P	G	P	P	P	G	P	P	F	G
2,4-D + dicamba 0.75-1.5 + 0.25-0.50	G	G	P [c]	F	G	P-F	P [c]	G	G	G	G	G	G	P-F [c]	G	P [c]	F-G	G	G
2,4-D + Picloram (Grazon P + D) 0.75 + 0.20	P	G	-	P	-	G	-	G	G	P	G	-	-	-	G	G	-	-	G
2,4-D + Picloram (Grazon P + D) 0.50 + 0.14	P	F	-	P	-	G	-	G	G	P	G	-	-	-	G	G	-	-	G
2,4-D + Picloram (Grazon P + D) 0.70 + 0.23	G	G	-	G	-	F	-	G	G	F	G	-	-	-	G	G	-	-	G

Relative effectiveness of herbicides for pasture (continued)

Treatment and Rate (pounds of active ingredient per acre)	Amaranth, spiny	Aster spp.	Bedstraw spp.	Bindweed (field)	Bindweed (hedge)	Blackberry spp.	Brackenfern	Burdock spp.	Buttercup spp.	Campion (bladder)	Carrot (wild)	Chamomile (mayweed)	Chickweed (common)	Chickweed (mouse-ear)	Chicory	Clover (hop)	Clover spp.	Cockle (corn)	Cocklebur
Cimarron (a)	G					F-G			F-G			G	G						
Crossbow (b)	G	G	F-G	F	G	F-G	P	G	G	P	G	F	F	F-G	G	F-G	F-G	F-G	G
Dicamba (Banvel or Clarity) 2.0	G	G	P-F	G	G	P-F	P-F	G	G	G	G	G	G	G	F-G	P-F	G	G	G
Dicamba (Banvel or Clarity) 1.0	G	G	P	F-G	G	P	P	F	F-G	G	G	G	G	F-G	F	P	G	G	G
Dicamba (Banvel or Clarity) 0.50	G	F-G	N	P-F	F-G	N	N	F	F	F-G	F	F-G	F-G	P-F	P	N	F-G	G	G
Dicamba (Banvel or Clarity) 0.25	F-G	F	N	P	F	N	N	P-F	P	F	P-F	F	F	P	P	N	P-F	G	G
Overdrive 0.35	G	G	N	P-F	F-G	F	N	F	F	F-G	F	F-G	F-G	P-F	P	N	F-G	G	G
Surmount	F-G	G	G	G	-	G	-	-	G	F	P	-	G	G	-	-	G	-	G
Triclopyr + clopyralid (Redeem) 0.42 + 0.14	P	G	-	G	-	F	-	G	G	P	G	-	-	-	G	G	-	-	G

Treatment and Rate (pounds of active ingredient per acre)	Cowcockle	Daisy spp.	Dandelion (est.)	Dewberry spp.	Dock spp. (est.)	Dogbane (hemp)	Dogfennel	Evening-primrose	Fleabane spp.	Garlic (wild)	Goldenrod spp.	Hawkweed spp.	Henbit	Honeysuckle spp.	Horsenettle	Horseweed	Jimsonweed	Knapweed (spotted)	Knawel or German moss
2,4-D 2.0	F	G	G	P	F	P	G	G	G	G	G	G	F	P	P	G	G	F-G	P
2,4-D 1.0-1.5	F	G	G	P	F	P	G	G	G	F-G	G	G	P	P	P	G	G	F	P
2,4-D + dicamba 0.75-1.5 + 0.25-0.50	G	G	G	P-F [c]	G	F	G	G	G	G	G	G	G	P [c]	G	G	G	G	G
2,4-D + Picloram (Grazon P + D) 0.75 + 0.20	-	G	G	-	G	F	F	-	G	-	G	F	G	G	G	G	F-G	G	-
2,4-D + Picloram (Grazon P + D) 0.50 + 0.14	-	G	G	-	G	F	P	-	F	-	F	P	F	F	F-G	G	F	G	-
2,4-D + Picloram (Grazon P + D) 0.70 + 0.23	G	G	G	-	G	P	G	-	G	-	G	F	G	F	G	G	G	G	-
Cimarron (a)					G					G			G			F-G			
Crossbow (b)	F-G	G	G	F-G	F-G	F-G	G	G	G	F-G	G	G	G	F-G	F	G	G	F-G	P-F
Dicamba (Banvel or Clarity) 2.0	G	G	G	P-F	F-G	F-G	G	G	G	G	F-G	F-G	G	P-F	F-G	G	G	G	G
Dicamba (Banvel or Clarity) 1.0	G	G	F-G	P	F	F	F-G	G	G	G	F	F	G	P	F	G	G	G	G
Dicamba (Banvel or Clarity) 0.50	G	F-G	F	N	P-F	P-F	F	F	F-G	F	P	P	F-G	N	P-F	F-G	G	F	G
Dicamba (Banvel or Clarity) 0.25	G	F	P	N	P-F	P-F	P	P-F	F	P	P	P	P-F	N	P-F	F	G	P-F	G
Overdrive 0.35	G	F-G	F-G	F	P-F	P-F	F	F	F-G	F	P	P	F-G	F	F	F-G	G	F	G
Surmount	-	G	G	G	G	G	G	-	G	N	F-G	-	F-G	-	G	G	F-G	-	-
Triclopyr + clopyralid (Redeem) 0.42 + 0.14	F	G	G	-	G	P	G	-	G	-	F	P	F	F	G	G	G	G	-

Relative effectiveness of herbicides for pasture (continued)

Treatment and Rate (pounds of active ingredient per acre)	Knotweed (prostrate)	Kudzu	Lambsquarters (common)	Lettuce (wild)	Mallow (common)	Milkweed spp.	Mullein (common)	Multiflora rose	Mustard spp.	Nightshade (black)	Onion (wild)	Pennycress spp.	Pepperweed spp.	Persimmon (common)	Pigweed spp.	Plantain spp.	Poison-hemlock	Poison-ivy, poison-oak	Pokeweed
2,4-D 2.0	F	P	G	G	F	P	P	P	G	P-F	G	G	G	P	G	G	G	P	P
2,4-D 1.0-1.5	F	P	G	G	F	P	P	P	G	P-F	F-G	G	G	P	F-G	G	F	P	P
2,4-D + dicamba 0.75-1.5 + 0.25-0.50	G	P [c]	G	G	F-G	F	P	P-F [c]	G	F-G	G	G	G	G	G	G	G	G	P [c]
2,4-D + Picloram (Grazon P + D) 0.75 + 0.20	-	G	G	G	-	F	G	G	F	F	-	-	-	F	F	G	G	G	F
2,4-D + Picloram (Grazon P + D) 0.50 + 0.14	-	G	G	G	-	P	F	F-G	P	P	-	-	-	F	P	G	G	G	P
2,4-D + Picloram (Grazon P + D) 0.70 + 0.23	-	G	G	G	-	P	G	F	F	G	-	-	-	G	G	G	G	F	P
Cimarron (a)							F-G	F-G			G				G				
Crossbow (b)	F	P-F	G	G	F	F	P	F-G	G	P-F	F-G	G	G	P	G	G	F-G	F	F-G
Dicamba (Banvel or Clarity) 2.0	G	P-F	G	G	G	F-G	P	F	G	G	G	G	G	F-G	G	G	P-F	F-G	P-F
Dicamba (Banvel or Clarity) 1.0	G	P	G	G	G	F	P	P	G	G	G	G	G	P-F	G	F-G	P	P-F	P
Dicamba (Banvel or Clarity) 0.50	G	N	G	F-G	F-G	P-F	P	N	F-G	F-G	F	F-G	F-G	P	G	F	N	P	N
Dicamba (Banvel or Clarity) 0.25	G	N	G	F	F	P-F	N	N	F	F	P	F	F	P	F-G	P	N	P	N
Overdrive 0.35	G	N	G	F-G	F-G	F	P	P	F-G	F-G	F	F-G	F-G	P	G	F	P	P	P-F
Surmount	-	-	G	-	G	F-G	-	G	P	G	N	G	-	G	G	G	-	-	P
Triclopyr + clopyralid (Redeem) 0.42 + 0.14	-	G	G	G	-	P	G	P	F	G	-	-	-	F	G	G	G	F	P

Treatment and Rate (pounds of active ingredient per acre)	Ragweed (common)	Ragweed (giant)	Shepherdspurse	Sneezeweed (bitter)	Sorrel spp.	Spurge (prostrate)	Stickweed (perennial composite)	Sumac spp.	Sunflower spp.	Teasel spp.	Thistle (bull)	Thistle (Canada)	Thistle (musk)	Thistle (plumeless)	Trumpet-creeper	Velvetleaf	Waterhemlock (spotted)	Woodsorrel spp.	Yellowrocket
2,4-D 2.0	G	F	F-G	G	P	P	G	P	F-G	P-F	G	F	G	G	P	F-G	G	P	G
2,4-D 1.0-1.5	F-G	F	F-G	F-G	P	P	G	P	F-G	P-F	F-G	F	G	F-G	P	F-G	F	P	G
2,4-D + dicamba 0.75-1.5 + 0.25-0.50	G	G	G	G	G	G	G	P [c]	G	G	G	F	G	G	P-F [c]	G	G	P-F [c]	G
2,4-D + Picloram (Grazon P + D) 0.75 + 0.20	G	G	-	G	-	-	G	F	G	G	G	G	G	G	F	G	-	-	-
2,4-D + Picloram (Grazon P + D) 0.50 + 0.14	G	G	-	G	-	-	F	P	G	F	G	F	G	G	P	F	-	-	-
2,4-D + Picloram (Grazon P + D) 0.70 + 0.23	G	G	-	G	G	-	G	G	G	G	G	G	G	G	P	G	-	-	-
Cimarron (a)												F	F-G						
Crossbow (b)	G	F-G	F-G	F-G	F-G	P	G	F-G	F-G	P-F	G	F-G	G	G	P-F	F-G	F-G	F-G	G

Relative effectiveness of herbicides for pasture (continued)

Treatment and Rate (pounds of active ingredient per acre)	Ragweed (common)	Ragweed (giant)	Shepherdspurse	Sneezeweed (bitter)	Sorrel spp.	Spurge (prostrate)	Stickweed (perennial composite)	Sumac spp.	Sunflower spp.	Teasel spp.	Thistle (bull)	Thistle (Canada)	Thistle (musk)	Thistle (plumeless)	Trumpet-creeper	Velvetleaf	Waterhemlock (spotted)	Woodsorrel spp.	Yellowrocket
Dicamba (Banvel or Clarity) 2.0	G	G	G	G	G	G	G	P-F	G	G	G	F-G	G	G	F-G	G	P-F	G	G
Dicamba (Banvel or Clarity) 1.0	G	G	G	G	G	G	G	P	G	G	G	F	G	G	F	G	P	P-F	G
Dicamba (Banvel or Clarity) 0.50	G	G	F-G	F-G	F-G	F-G	F-G	N	G	F	F	P-F	F	F	P	G	N	P	F-G
Dicamba (Banvel or Clarity) 0.25	F-G	F-G	F	F	F	F	P-F	N	G	P-F	P-F	P	P-F	P-F	P	G	N	P	F
Overdrive 0.35	G	G	F-G	F-G	F-G	F-G	F-G	P	G	F	F	F	F	F	P	G	P	P	F-G
Surmount	G	G	P	G	-	-	G	G	G	-	G	F	G	G	-	G	-	-	P
Triclopyr + clopyralid (Redeem) 0.42 + 0.14	G	G	-	G	G	-	G	G	G	G	G	G	G	G	P	G	-	-	-

[a] Cimarron is characterized by high specificity, in other words, excellent activity on a relatively small number of weeds as indicated on the table. Cimarron is especially useful for multiflora rose control where drift from other pasture herbicides could be a problem.

[b] Crossbow's rate range is from 1 to 4 qut/acre for general broadleaf weed control and 1.5 to 4 gal/acre for woody brush species in pastures. Consult the label for recommended use rates for individual weed species.

[c] Better control of these species may be obtained by using higher rates of 2,4-D plus dicamba. Consult the label for use rates and precautions.

Pasture - grazing and haying restrictions for grass forage and pasture herbicides

Herbicide	Type of animal	Interval between application and grazing	Interval between application and haying	Comments
2,4-D amine	Dairy	7 days	30 days	2,4-D labels vary. See specific label of product used.
2,4-D ester	All	7 days	30 days	2,4-D labels vary. See specific label of product used.
Banvel or Clarity	Lactating dairy	7 days if < 1.0 pt 21 days if 1.0-2.0 pt 40 days if 2.0-4.0 pt 60 days if 4.0-16.0 pt	37 days if < 1.0 pt 51 days if 1.0-2.0 pt 70 days if 2.0-4.0 pt 90 days if 4.0-16.0 pt	No waiting period between treatment and grazing for nonlactating animals. Remove meat animals from treated areas 30 days prior to slaughter.
Cimarron	All	None	None	A field bioassay must be completed before rotating to any crop or grass species/variety not listed in the label's Rotation Interval Table, or if the soil pH is not in the specified range, or if the rate applied is not specified in the table.

Pasture - grazing and haying restrictions for grass forage and pasture herbicides (continued)

Herbicide	Type of animal	Interval between application and grazing	Interval between application and haying	Comments
Crossbow	Lactating dairy Other livestock	< 2.0 gal/A-14 days > 2.0 gal/A-do not graze until next seas < 2.0 gal/A-none > 2.0 gal/A-14 days [a]	Harvest next season Harvest next season 7 days 14 days	Remove meat animals from treated areas 3 days prior to slaughter.
Grazon P + D	Dairy Other	7 days 0 days	30 days 30 days	Remove meat animals from treated areas at least 3 days prior to slaughter.
Overdrive	All	None	None	No grazing or haying restrictions.
PastureGard	Lactating Dairy Other	Next season None	14 days 14 days	Withdraw livestock from treated areas at least 3 days prior to slaughter.
Redeem	Lactating dairy Other livestock	14 days none	Harvest next season 7 days	Withdraw animals at least 3 days prior to slaughter.
Roundup Weather Max or Touchdown or other labeled glyphosate formulation	All	Spot-14 days Renovate-8 weeks	Spot-14 days Renovate-8 weeks	Use as spot treatment. Do not treat more than 0.10 of any acre. Leaves no soil residue.
Spike 20P	All	< 20 lb/A-none >20 lb/A-1 year	1 year 1 year	Leaves soil residue up to 2 years.
Stinger	All	None	None	Do not use hay or straw from treated areas for compost or mulch on susceptible broad-leaved crops.
Surmount	Lactating Dairy Other	14 days None	7 days 7 days	Withdraw livestock from treated areas at least 3 days prior to slaughter.

[a] Less than 25 percent treated, no grazing restriction.

Rotational crop restrictions for pasture herbicides

Pesticide	Rotational crops (month after application)								
	Alfalfa or Clover	Corn	Cotton	Forage Grasses	Grain Sorghum	Peanuts	Small Grains	Soybeans	Other Crops
2,4-D	NS [c]	NR	NS [c]	NS [c]	NR	NS [c]	NS [c]	0.25-1 [e]	NS [c]
Banvel or Clarity	AH [b]	NR	AH [b]	NR	NR	AH [b]	NR	AH [b]	AH [b]
Cimarron	12	- [d]	- [f]	6-18	- [f]	- [f]	- [f]	- [d]	- [f]
Crossbow	NS [c]	NS [c]	NS [c]	1	NS [c]	NS [c]	NS [c]	NS [c]	NS [c]
Grazon P + D	- [g]	- [g]	- [g]	- [g]	- [g]	- [g]	- [g]	- [g]	- [g]
Overdrive	1	1	1	1	1	1	1	1	1
PastureGard	4	4	4	0	4	4	0	4	4
Redeem	NS [f]	NS [f]	NS [f]	0	NS [f]	NS [f]	NS [f]	0	NS [f]
Stinger	10.5	NR	18	12	10.5	18	NR	12	12-18 [d]
Surmount	12 [g]	12 [g]	12 [g]	0	0	12 [g]	0	12 [g]	12 [g]

[a] 34 months unless a field bioassay is conducted. Consult label for instructions. These restrictions were obtained from the old Ally label. Reference the Cimarron label for current rotational restrictions.

[b] After normal harvesting of the crop to which Banvel was applied.

[c] Next growing season.

[d] Consult label.

[e] See soybean weed control section for preplant intervals for 2,4-D rates and formulations.

[f] Do not plant broadleaf crops until an adequate sensitive bioassay shows that clopyralid is no longer detectable in the soil.

[g] For use in permanent grass pasture. Do not plant to other crops until picloram residues are no longer detectable as indicated by an adequately sensitive bioassay or chemical test.

Permanent Pasture

Weed Problem	Chemical rate per acre	Product per acre [a]	Remarks
Corn chamomile, corncockle, cowcockle, knawel or German moss, knotweed, mayweed, ragweed, sheepsorrel, sorrel (red), spurge (prostate), and sunflower	Dicamba 0.25 lb	Banvel or Clarity 0.5 pt	Use as a postemergence application. Apply when weeds are actively growing. Clover will be killed. Do not apply near desirable trees or plants or in location where chemicals may be washed or moved into contact with their roots. Do not graze meat animals in treated fields within 30 days before slaughter.
Bladder campion, chickweed, croton, dock (curly), ragweed (giant), ragwort, sesbania, shepherdspurse, velvetleaf, and wormwood	Dicamba 0.5 lb	Banvel or Clarity 1.0 pt	Do not graze dairy animals on treated areas within 7 days if 0.5 pound per acre is applied; 21 days if 1.0 pound per acre is applied; 40 days if 2.0 pounds per acre are applied; or 60 days if 8.0 pounds per acre are applied.
Aster, clover, garlic (wild), goldenrod, knapweed (spotted), mallow, onion (wild), teasel, and thistle (sow)	Dicamba 1.0 lb	Banvel or Clarity 1.0 qt	Observe dosage rates and days of delay between treatment and harvesting for hay: 37 days if 0.5 pound per acre is applied; 51 days if 1.0 pound per acre is applied; 70 days if 2.0 pounds per acre are applied; 90 days if 8.0 pounds per acre are applied.
Blueweed or viper's bugloss, buckbrush or coralberry, carrot (wild), chicory, cottonwood seedlings, eveningprimrose, groundsel, knapweed (spotted), nightshade, poison-ivy, ragwort (tansy), sorrel (wood), stinging nettle, thistle (musk), trumpetcreeper, and yarrow	Dicamba 2.0 lb	Banvel or Clarity 2.0 qt	Use as a postemergence application. Apply when weeds are actively growing. Clover will be killed. Do not apply near desirable trees or plants or in locations where chemicals may be washed or moved into contact with their roots. Do not graze meat animals in treated fields within 30 days before slaughter.
Hawthorn, juniper, kudzu, multiflora rose, sumac, and other woody species	Dicamba 1.0-2.0 lb or Dicamba 1.0 lb + 2,4-D 2.0 lb	Banvel or Clarity 1.0-2.0 qt or Banvel or Clarity 1.0 qt + 2,4-D 2.0 qt	Consult the table on page 2-99 and the product labels for grazing and haying restrictions.

Permanent Pasture (continued)

Weed Problem	Chemical rate per acre	Product per acre [a]	Remarks
Dewberry, dock (curly), horsenettle (sandbrier), persimmon, poison-ivy, and many other weeds listed above for 2,4-D	Dicamba 0.25-0.5 lb + 2,4-D amine 0.75-1.5 lb	Banvel or Clarity 4L 0.5-1.0 pt + 2,4-D amine 1.5-3.0 pt	Spray when horsenettle blooming begins. All legumes will be killed. Repeat treatment on regrowth in the second year. Do not graze dairy animals on treated areas within 7 days after application. Do not graze meat animals on treated areas within 30 days of slaughter. Do not harvest for dry hay within 37 days of treatment. Make ground application only using 10 to 20 gallons of water per acre.
Blackberry, buttercup, chickweed (common), dock (curly), garlic, geranium (Carolina), henbit, marestail, mayweed, mullein (common), multiflora rose, pigweed, sneezeweed (bitter), and thistle (musk)	Metsulfuron-methyl 0.004-0.04 oz + surfacant	Cimarron 60 DF 0.1-1.0 oz + surfactant	Apply as a broadcast spray from early spring to late summer as indicated by the label for the specific weed to be controlled. For multiflora rose control, apply the 0.5-ounce rate in the spring soon after plants are fully leafed. Do not apply the 0.5-ounce rate to fescue or timothy unless temporary discoloration of the forage is acceptable. Applications of Cimarron and liquid nitrogen will discolor many species of grass pasture. Applications of Cimarron to timothy and fescue should be made after green-up. Timothy and fescue should be a minimum of 6 inches tall and actively growing at application. Do not use more than 0.4 oz/acre, do tank-mix Cimarron with 2,4-D, and only use a nonionic surfactant to minimize injury to fescue and timothy. Application under other conditions may result in crop discoloration and/or stunting. Multiflora rose, blackberry, and Canada thistle may also be controlled via spot treatment using 1.0 ounce of Cimarron in 100 gallons of water. Cimarron has no grazing restrictions. Carefully observe precautions regarding rotational crops. A co-pack of Cimarron plus 2,4-D plus Banvel is available under the trade name Cimarron Max. See label for use rate.

Permanent Pasture (continued)

Weed Problem	Chemical rate per acre	Product per acre [a]	Remarks
Burdock, carrot (wild), cocklebur, dandelion, goldenrod, ironweed, lambsquarters, marshelder, oxalis, pigweed (spiny amaranth), plantains, ragweed, sunflower, thistle (Canada), and vetch	2,4-D + triclopyr (prepackaged mix) 0.75-1.5 lb	Crossbow 1.0-2.0 qt	Apply when weeds and brush are actively growing. Apply in a manner to avoid drift or other contact with nearby susceptible vegetation. Use lower rates for general weed control and control of more susceptible woody species. When using 2.0 gallons or less per acre, do not graze or harvest green forage from treated area for lactating dairy animals until 14 days after treatment. When using more than 2.0 and up to 4.0 gallons, do not graze or harvest green forage for lactating dairy animals until next growing season. When grazing or harvesting green forage for other livestock and using 2.0 gallons or less, no grazing restrictions apply. When using more than 2.0 and up to 4.0 gallons, do not graze or harvest green forage from treated area for other livestock until 14 days after treatment. Do not harvest hay from treated area for lactating dairy animals until next growing season. When using 2.0 gallons or less per acre, do not harvest hay for other livestock until 7 days after treatment. When using more than 2.0 gallons per acre, do not harvest hay for other livestock until 14 days after treatment. Withdraw livestock from grazing treated grass or consumption of treated hay at least 3 days before slaughter. This restriction applies to grazing during the season following treatment or hay harvested during the season following treatment.

Permanent Pasture (continued)

Weed Problem	Chemical rate per acre	Product per acre [a]	Remarks
Alder, ash, aspen, birch, blackberry, blackgum, cherry, elderberry, hawthorn, hazel, maples, multiflora rose, oak, pigweed (spiny amaranth), pine, salmonberry, sumac, sweetgum, tamarack, and willow	2,4-D + triclopyr (prepackaged mix) 1.5-4.5 lb	Crossbow 2.0-6.0 qt	Apply when weeds and brush are actively growing. Apply in a manner to avoid drift or other contact with nearby susceptible vegetation. Use lower rates for general weed control and control of more susceptible woody species. See comments above regarding grazing, haying, and slaughter restrictions.

Permanent Pasture (continued)

Weed Problem	Chemical rate per acre	Product per acre [a]	Remarks
Many difficult to control annual, biennial, and perennial broadleaf weed species, including mugwort, prickly pear cactus, horsenettle, and suppression of bladder campion.	Picloram + 2,4-D 0.32-2.54 lb	Grazon P+D 1.0-8.0 pt	**FOR USE IN CERTAIN COUNTIES IN VIRGINIA AND WEST VIRGINIA.** For use only in permanent pastures. The distribution of Grazon P + D will be further restricted within Virginia due to the picloram content of the product and sensitivity of certain broadleaf crops. Recommended for use only in the VA counties of Albemarle, Alleghany, Amelia, Amherst, Appomattox, Augusta, Bath, Bedford, Botetourt, Buckingham, Carroll, Chesterfield, Clarke, Craig, Culpeper, Cumberland, Fairfax, Fauquier, Floyd, Fluvanna, Frederick, Giles, Goochland, Greene, Highland, Loudon, Louisa, Madison, Montgomery, Nelson, Orange, Page, Powhatan, Prince William, Pulaski, Rappahannock, Roanoke, Rockbridge, Rockingham, Shenandoah, Spotsylvania, Stafford, Warren, and Wythe. Do not allow spray to contact crops or other desirable broadleaf plants. Do not apply in residential areas or near ornamental trees and shrubs. Desirable trees and ornamentals can be affected via movement of the herbicide in soil and subsequent root uptake. Do not rotate to crops intended for food or feed use other than detectable by an adequately sensitive bioassay. Do not contaminate water intended for irrigation or domestic purposes. Bladder Campion suppression can be achieved with a 3.0 to 4.0 pt/acre use rate.

Permanent Pasture (continued)

Weed Problem	Chemical rate per acre	Product per acre [a]	Remarks
Annual and perennial weeds including aster, buttercup, burdock, carrot (wild), chicory, crane's bill, daisy, dandelion, dock seedlings, dogfennel, elderberry, evening-primrose, fleabane, knapweed (spotted), goatsbeard, goldenrod, hawkweed, horseweed, lettuce (wild), mustards, parsnip (wild), pepperweed, pennycress, plantains, and thistle (musk)	2,4-D 1.0-1.5 lb	LVE, OSA, or amine	Apply when weeds are actively growing. Use lower rates on annuals and biennials and higher rates for perennials.
Bitterweed	2,4-D 1.5 lb	LVE, OSA, or amine	Apply when bitterweed reaches about 3 inches high.
Thistle (bull and curled)	2,4-D 1.5 lb	LVE, OSA, or amine	Spray thistles when in rosette stage and actively growing, either in late fall or early spring.
Pigweed (spiny) and ragweed	2,4-D 1.0-1.5 lb	LVE, OSA, or amine	Apply in early summer when weeds first reach 2 to 4 inches in height. Usually one application is sufficient. Occasionally more seed will germinate. Repeat treatment if needed.
Coralberry or devil's shoestring	2,4-D 2.0 lb	LVE or OSA	Clip in winter. Spray when weed is about 1 inch high (early May) and actively growing. Be prepared to spot-treat in the second year.
Dwarflarkspur and hemlock (water)	2,4-D 2.0 lb	LVE, OSA, or amine	Apply in the bud to early bloom stage. See 2,4-D above.
Garlic (wild) or onion (wild)	2,4-D 1.5-2.0 lb or Dicamba 1.0 lb	LVE or Banvel/Clarity 1.0 qt	Spray late in fall and during February or early March with mid-day temperatures of 60°F or above. Repeat twice annually for 3 to 4 years. Do not graze dicamba-treated areas for 21 days after treatment.

Permanent Pasture (continued)

Weed Problem	Chemical rate per acre	Product per acre [a]	Remarks
Alfalfa, bindweed (field, hedge), burcucumber, burdock, buttercup, carpetweed, chickweed (common), clover (white), cocklebur, croton, dandelion, dock (broadleaf, curly), dogbane, dogfennel, eveningprimrose (common, cutleaf), fleabane, goldenrod, henbit, horsenettle, jimsonweed, knotweed, lambsquarters (common), lespedeza, lettuce (prickly), mallow, milkweed (climbing, common), morningglory, mustard, nightshade, pigweed, plantain, pokeweed, purslane, ragweed (common, giant), shepherdspurse, smartweed, sowthistle, thistle (bull, Canada, musk, plumeless), velvetleaf, waterhemp, vetch (hairy), yarrow (common)	Sodium salt of dicamba 0.175-0.35 lb + diflufenzopyr	Overdrive 70DF 4.0-8.0 oz	Use 4.0-8.0 oz of Overdrive per acre. Use higher rates when treating large annual and biennial weeds or when treating perennial weeds. A maximum of 10 oz of Overdrive can be applied per season per treated acre in noncropland sites. A maximum of 8 oz of Overdrive can be applied per season per treated acre in pasture, hay, and rangeland sites. The addition of a nonionic surfactant or methylated seed oil is recommended. Overdrive can be tank-mixed with other products - see label. Do not plant any crops within 30 days after the last application. Pasture and rangeland grass treated with Overdrive can be grazed or harvested for livestock feed immediately after application.
Herbaceous broadleaf weeds including black medic, burdock, chickweed, chickory, cinquefoil spp., clover spp., cocklebur, common purslane, curly dock, cutleaf evening primrose, dogfennel, hemp dogbane, ironweed, lambsquarters, lespedeza, maypop, morningglory spp., pigweed spp., plantain spp., prickly lettuce, ragweed spp., vetch, yarrow, wild violet, and others. Woody broadleaf weeds including blackberry, hawthorn, locust spp., multiflora rose, poison ivy, poison oak, privet, sumac, yucca, and others	Triclopyr + fluroxypyr 0.5-2.0 lb	PastureGard 2.0-8.0 pt	**FOR USE ONLY IN VIRGINIA AND WEST VIRGINIA.** For use only in permanent pastures. Do not apply where drift may be a problem due to proximity of sensitive crops or other broadleaf species. Do not apply to alfalfa, clover, or other desirable broadleaf species unless injury to or loss of these species is acceptable. Do not apply directly to water. Do not allow runoff of surfact water to reach desirable species on adjacent areas. Do not reseed pasture grasses for 3 weeks following application, or apply to new seedlings until pasture grass species are well established. Do not rotate within 120 days of application to any crop except grass species, wheat, barley, or oats.

Permanent Pasture (continued)

Weed Problem	Chemical rate per acre	Product per acre [a]	Remarks
Chickweed, clover species, cocklebur, dandelion, henbit, vetch, burdock, cornflower, horseweed, jimsonweed, lambsquarters, prickly lettuce, nightshade spp., Virginia pepperweed, plantain spp., common ragweed, shepherdspurse, red sorrel, sheep sorrel, ironweed, bitter sneezeweed, thistle, (bull, musk, plumeless, Canada), knapweed, and mugwort	Tricolpyr + clopyralid 0.563-1.5 lb/A	Redeem 3L 1.5-4.0 pts/acre	Apply to actively growing weeds in a minimum of 10 gallons per acre. Extreme conditions including cold and drought prior to or following application may reduce effectiveness. Lower use rates are generally effective for annual weed species, but higher rates are required for perennial species. Use a nonionic surfactant at manufacturer's recommended rate for all applications. Do not apply this product to or allow spray drift to contact vegetables, ornamentals, susceptible broadleaf crops, or other desirable nontarget plants. Do not graze or feed harvested forage to lactating dairy animals for 14 days after treatment.

Permanent Pasture (continued)

Weed Problem	Chemical rate per acre	Product per acre [a]	Remarks
Spot treatment of undesirable woody vegetation including alder, cherry, multiflora rose, oak spp., pine, elm, locust, maple, sumac, spruce	Tebuthiuron 2.0-4.0 lb	Spike 40P 5.0-10.0 lb	Spike is for nonselective soil sterilant activity as a spot treatment on individual woody plants. Consult label for rates for individual species and for application procedures for individual formulations. Do not use Spike 40P in any area where desirable species are in the vicinity of plants to be eliminated. Both grasses and broadleaf plants in treated spots will be killed. If treated area is to be used for grazing or haying, do not apply more than 5.0 pounds per acre of Spike 40P in areas receiving 20 inches or less average annual rainfall or more than 10 pounds per acre of Spike 40P in areas receiving more than 20 inches average rainfall. Do not cut hay for livestock feed for 1 year after a Spike 40P treatment. Spike 40P may injure or suppress certain herbaceous vegetation in the treated area. Therefore, do not apply where such injury cannot be tolerated. Injury to most herbaceous perennial plants is reduced if Spike 40P is applied when vegetation is dormant. Do not apply Spike 40P to any portion of a ditchbank that will come into contact with water as movement of Spike 40P in water may result in injury or death to nontarget vegetation. Do not apply on ditches used to transport irrigation or potable water. Do not apply Spike 40P more than once per year.
Artichoke (Jerusalem), burdock (common), chamomile, clover, cocklebur, cornflower, dandelion, dock (curly), dogfennel, groundsel (common), horseweed, lettuce (prickly), nightshade (many), ragweed (common, giant), thistle (Canada, musk), and vetch	Clopyralid 0.125-0.5 lb	Stinger 0.33-1.33 pt	Apply to actively growing weeds. Do not apply aerially. Grasses are tolerant. New grass seedlings may be injured until established. There are no grazing restrictions. Avoid drift into sensitive crops. See section on rotational restrictions.

Permanent Pasture (continued)

Weed Problem	Chemical rate per acre	Product per acre [a]	Remarks
Herbaceous broadleaf weeds including biennial thistle spp., chickweed, clover spp., cocklebur, croton spp., curly dock, dogfennel, field bindweed, goldenrod, groundsel, hemp dogbane, horsenettle, horseweed (marestail), knotweed, lambsquarters, morningglory spp., nightshade spp., pigweed, ragweed spp., yarrow, white cockle, and many others. Woody broadleaf weeds including blackberry, eastern red cedar, hawthorn, locust spp., multiflora rose, pricklypear, sumac spp., and others	Picloram + fluroxypyr 0.26-1.0 lb	Surmount 1.5-6.0 pt	**FOR USE ONLY IN VIRGINIA AND WEST VIRGINIA.** For use only in permanent pastures. The distribution of Surmount will be further restricted within Virginia and West Virginia due to the picloram content of the product and sensitivity of certain broadleaf plants. Do not apply where drift or runoff may be a problem due to proximity of sensitive crops or other broadleaf species. Do not apply in residential areas or near ornamental trees or shrubs. Do not apply directly to water, or allow drift, application, sprayer cleanup, or runoff to contaminate water used for irrigation or domentic purposes. Do not rotate within 12 months of application to any crop except permanent grass pasture, grasses for hay or silage, barley, oats, wheat, or grain sorghum. After 12 months, rotate to other crops only after an adequately senstive bioassay indicates no risk of crop injury.

[a] Do not graze dairy animals on 2,4-D sprayed areas for 7 days after spraying. Observe grazing restrictions specific to the rate of Banvel/Clarity applied. If poisonous plants are present, keep animals out until plants turn brown. Spray when the temperature is predicted to be 60°F or above during the day. Do not use on newly seeded areas until the grass is well established.

Pasture Renovation

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Suppression of competition by emerged sod and undesirable emerged broadleaf weeds and grasses	Paraquat 0.25-0.5 lb + surfactant	Gramoxone Inteon 1.0-2.0 pt + surfactant as specified by label	Graze area close, apply in spring or early summer after growth begins, before or at time of seeding grasses, alfalfa, clover, or birdsfoot trefoil. Do not graze in treated areas until newly planted seedlings are 3 to 6 inches high for seedling grasses and forage legumes, 18 inches high for sudangrass, and 24 inches high for sorghum-sudan. Do not pasture or mow bermudagrass for hay until 40 days after treatment.
Control of existing sods and undesirable emerged broadleaf weeds and grasses	Glyphosate 0.5-5.0 lb	Roundup Weather Max 0.5-3.1 qt or Touchdown Total 0.35-3.5 qt or other labeled glyphosate formulation	Apply prior to planting forage grasses and legumes. Remove domestic livestock before application and wait 8 weeks after application before grazing or harvesting. Touchdown Total is available in a non-surfactant containing formulation called Touchdown HiTech.

Weed Control in Grain Sorghum

There are excellent herbicide combinations for weed control in both conventional and no-till sorghum. The best combinations include Dual or Lasso combined with atrazine, but the sorghum seed must be properly protected with seed treatments of Concep or Screen when using these control materials. If untreated seed is to be used, then Ramrod and atrazine or atrazine alone are the only choices. Consult the "relative effectiveness tables" listed in the Weed Control in Corn section for efficacy information on many of the sorghum herbicides.

Sorghum - no-till

Weed Problem	Crop [a]	Chemical rate per acre	Product per acre	Remarks
Cover crops, including perennial sods, annual weeds and top kill, and suppression of perennial weeds	G,F	Paraquat 0.5-1.0 lb + surfactant	Gramoxone Inteon 2.0-4.0 pt + surfactant as labeled	Use 2.0-2.5 pints per acre for weeds 1 to 3 inches, use 2.5-3.0 pints per acre for weeds 3 to 6 inches, and use 3.0 to 4.0 pints per acre for weeds over 6 inches. Weeds 6 inches or taller may not be controlled. Always use a nonionic surfactant. Uniform coverage is important for good kill. Use lower rates for rye cover crop. Must be accompanied by preemergence residual herbicides.

Sorghum - no-till (continued)

Weed Problem	Crop [a]	Chemical rate per acre	Product per acre	Remarks
Annual weeds, cover crops, perennial sods and suppression of perennial weeds, such as quackgrass and thistle (Canada)	G,F	Glyphosate 0.5-5.0 lb	Roundup Weather Max 0.5-3.1 qt or Touchdown Total 0.35-3.5 qt or other labeled glyphosate formulation	Apply before crop emergence. Use 1.0 to 1.5 pounds for control of annual cover crops and emerged annual grass and broadleaf weeds. Use 2.0 to 3.0 pounds for emerged perennial weeds. At normal application dates in no-till systems, perennial weeds may not be at the proper stage of growth for control. Since glyphosate is slower acting than paraquat in killing vegetation, its use may result in greater soil moisture loss. Uniform coverage is important. Rainfall within 1 hour may reduce effectiveness. This chemical must be accompanied by residual herbicides for season-long grass and broadleaf weed control. Touchdown Total is available in a non-surfactant containing formulation called Touchdown HiTech.

[a] G=grain sorghum; F=forage sorghum

Sorghum - no-till or conventional

Weed Problem	Crop [a]	Chemical rate per acre	Product per acre	Remarks
Preemergence				
Barnyardgrass, crabgrass, cupgrass (southwestern), foxtail (giant, green, yellow), lambsquarters, morningglory spp., nutsedge (yellow), panicum (browntop, fall), pigweed, purslane, rice (red), signalgrass, and witchgrass. Also carpetweed, cocklebur, goosegrass, pusley (Florida), smartweed, and velvetleaf	G,F	s-metolachlor 0.95-1.6 lb + atrazine 1.2-1.6 lb	Dual II Magnum/Cinch 7.64EC 1.0-1.67 pt + Atrazine 4L 1.2-1.6 qt or 90W 1.3-1.8 lb or use Bicep II Magnum 5.5FL 1.6-2.1 qt	**Use only if the sorghum seed has been treated by the seed company with Screen or Concep.** Apply to the oil and incorporate into the top 2 inches of soil within 14 days before planting using a finishing disk, harrow, rolling cultivator, or similar implement capable of providing uniform 2-inch incorporation. Preemergence applications may be made at planting (behind the planter) or after planting, but applications should not be made before weeds or crops emerge. Do not use with atrazine on coarse soils or on soils with less than 1 percent organic matter. Observe precautions on the label.

Sorghum - no-till or conventional (continued)

Weed Problem	Crop [a]	Chemical rate per acre	Product per acre	Remarks
Preemergence (continued)				
Barnyardgrass, crabgrass, foxtail (giant, green, yellow), cupgrass (southwestern), lambsquarters, morningglory spp., nutsedge (yellow), panicum (browntop, fall), pigweed, purslane, rice (red), signalgrass, and witchgrass. Also carpetweed, cocklebur, goosegrass, pusley (Florida), smartweed, and velvetleaf	G	Alachlor 2.0-3.0 lb + atrazine 1.0-1.75 lb	MicroTech 2.0-3.0 qt + Atrazine 4L 1.0-1.75 qt or 90W 1.1-1.9 lb or use Bullet 3.0-4.0 qt	**Use only if the sorghum seed has been treated by the seed company with Screen or Concep.** Apply to the soil and incorporate into the top 1 to 2 inches of soil within 7 days before planting, using a finishing disk, harrow, rolling cultivator, or similar implement capable of providing uniform 2-inch incorporation. Preemergence applications may be made at planting (behind the planter) or after planting, but application should be made before weeds or crops emerge. Do not use with atrazine on coarse soils or on soils with less than 1.0-percent organic matter. Observe precautions on the label.
Barnyardgrass, carpetweed, cocklebur, crabgrass, foxtail, goosegrass, jimsonweed, lambsquarters, morningglory, nutsedge, panicum, pigweed spp., ragweed, smartweed, and velvetleaf	G,F	Dimethenamid-p 0.66-0.98 lb + atrazine 0.75-2.0 lb	Outlook 6EC 14.0-21.0 oz + Atrazine 4L 0.75-2.0 qt or 90W 0.8-2.2 lb or use Guardsman Max 3.0-4.6 pt	**Use only if the sorghum seed has been treated by the seed company with Screen or Concep.** Can be applied preplant incorporated, preemergence, or postemergence to grain sorghum up to 12 inches tall. Under high soil moisture and/or cool conditions, Outlook may cause temporary stunting or leaf wrapping. Sorghum will normally outgrow these symptoms in 10 to 14 days. Sorghum forage may be grazed or fed to livestock at 60 or more days after application. Grain and fodder may be harvested and fed at 80 or more days after application.

Sorghum - no-till or conventional (continued)

Weed Problem	Crop [a]	Chemical rate per acre	Product per acre	Remarks
Postemergence				
Cocklebur, coffeeweed, galinsoga, horseweed, jimsonweed, lambsquarters, morningglory spp., mustards, nightshade (black), pigweed, poorjoe, pusley (Florida), ragweed, sicklepod, spanishneedles, sunflower, and velvetleaf	G	2,4-D 0.25-0.5 lb	2,4-D amine 0.5-1.0 pt of a 4.0 lb/gal formulation	Apply after crop reaches 6 inches tall but before it reaches 15 inches tall and prior to the boot stage. A directed spray is desirable if crop is over 8 inches tall. Do not apply during boot to early dough stage. Hybrids are varied in susceptibility to 2,4-D. Treat only those known to be tolerant. Some 2,4-D formulations are available that contain greater than 4.0 lb ai/gallon. Consult label.
Barnyardgrass, cocklebur, crabgrass, foxtail (giant, green, yellow), lambsquarters, morningglory spp., nightshade (black), pigweed (redroot), purslane, pusley	G,F	Atrazine 1.2 lb	Atrazine 4L 2.4 pt or 90W 1.3 lb	Use postemergence when sorghum is up to 12 inches tall. Adjust rate to soil texture and organic matter content. Do not graze or feed forage from treated areas for 21 days after treatment. For postemergence applications, add crop oil concentrate at the rate of 1.0 gallon per 100 gallons. Heavy rains immediately after treatment may result in crop injury. If applied after June 10, do not plant any crop in treated areas except corn or sorghum the following year. This treatment is weak on fall panicum. Refer to label for additional instructions.
Clovers, cocklebur, jimsonweed, lambsquarters, morningglory (ivyleaf, tall), mustards, nightshade (black), pepperweed, pigweeds, purslane, sida (prickly) or teaweed, ragweeds, smartweed, spurge (prostrate), sunflower (common), and velvetleaf. Suppression of alfalfa, artichoke (Jerusalem), bindweeds, dock (curly), dogbane (hemp), horsenettle, milkweed (common, honeyvine), plantain (broadleaf), sorrel (red), and thistle (Canada)	G	Dicamba 0.25 lb or Dicamba 0.20-0.26 lb + atrazine 0.39-0.52 lb	Banvel or Clarity 0.5 pt or Marksman 3.2FL 1.5-2.0 pt	Apply after weeds have emerged and are actively growing. Apply after sorghum is in the 3-leaf stage but before sorghum is 15 (Banvel or Clarity) or 12 (Marksman) inches tall. Drop nozzles should be used if the crop is taller than 8 inches. Do not graze or feed treated sorghum, forage, or silage prior to mature grain stage. Do not apply to sorghum grown for seed production. Observe precautions to avoid drift to adjacent crops. Observe atrazine restrictions when using Marksman.

Sorghum - no-till or conventional (continued)

Weed Problem	Crop [a]	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)				
Beggarticks, cocklebur, dayflower, jimsonweed, mustard (wild), nutsedge (yellow), ragweed, sida (prickly), smartweed, spurred anoda, sunflower (wild), thistle (Canada), and velvetleaf	G,F	Bentazon 0.75-1.0 lb + crop oil concentrate	Basagran 0.75-1.0 qt + crop oil concentrate 1.0 qt	Refer to label as the rate of application is dependent on leaf stage and height of weeds to be controlled. For Canada thistle and yellow nutsedge, only one application can be made in sorghum; therefore, control may be partial or inconsistent
Buckwheat (wild), cocklebur, jimsonweed, lambsquarters, morningglory spp., mustard (wild), nightshade spp., ragweed (common, giant), smartweed spp., and velvetleaf	G,F	Bromoxynil 0.25-0.375 lb	Buctril 2E 1.0-1.5 pt or Buctril/atrazine package mix 1.5-3.0 pt	Apply as an early postemergence treatment to small weeds. Adjust rate to weed and crop size as specified by label. This treatment is nonvolatile and is appropriate for situations where the proximity of susceptible crops prohibits the use of 2,4-D or dicamba.
Cocklebur, lambsquarters, pigweed (redroot), ragweed (common, giant), smartweed, and velvetleaf	G,F	Bentazon + atrazine prepackaged mix 1.0-1.5 lb + crop oil concentrate	Laddok S-12 2.0-3.5 pt + crop oil concentrate 1.0 qt	Apply in a minimum of 20 gallons of water and a minimum of 40 pounds per square inch using hollow cone or flat fan nozzles only. Crop oil concentrate should always be added to the spray solution. Apply when weeds are small and when the crop is in the 1- to 5-leaf stage. Carefully observe maximum weed growth stages on the label. Observe atrazine restrictions when using Laddok.
Barnyardgrass, carpetweed, cocklebur, crabgrass, foxtail (giant, green, yellow), goosegrass, lambsquarters, mustard, morningglory spp., pigweed, panicum (fall), purslane, pusley (Florida), ragweed, sida (prickly), teaweed, smartweed, and velvetleaf	G,F	Linuron 0.5-1.0 lb	Linex 50 DF 1.0-2.0 lb or 4L 1.0-2.0 pt	Apply as directed spray only. Consult label for rates relative to crop and weed height. Do not spray unless the crop to weed height differential will allow spray to contact weeds without contacting upper leaves or whorl of sorghum. Do not graze or feed plants to livestock within 3 months after postemergence application.

Sorghum - no-till or conventional (continued)

Weed Problem	Crop [a]	Chemical rate per acre	Product per acre	Remarks
Postemergence (continued)				
Bindweed, cocklebur, jimsonweed, lambsquarters, morningglory (suppression), mustards, pigweed, ragweeds, smartweed, and velvetleaf	G	Prosulfuron 0.027-0.036 lb	Peak 57DF 0.75-1.0 oz + approved tank-mixes: Banvel or Clarity 0.125-0.5 pt or 2,4-D 0.25-0.5 pt or Atrazine 0.5-1.0 qt or Buctril 0.5-1.0 pt or Marksman 1.0-2.0 pt	Peak may be applied postemergence to sorghum between 5 and 30 inches in height. Do not apply to sorghum under stress. Use crop oil concentrate or nonionic surfactant. When tank-mixing, consult label for proper additive. Peak can interact with certain organophosphate insecticides. Consult label.
Cocklebur, nutsedge, pigweed, pokeweed, ragweed (common, giant), sunflower, and velvetleaf	G,F	Halosulfuron-methyl 0.032 lb	Permit/Sandea 75WG 0.66 oz + approved tank-mixes: Atrazine 0.75-1.5 qt or Banvel or Clarity 0.25-0.5 pt or Buctril 0.5-1.0 pt or 2,4-D 0.25-0.5 pt	Do not apply to sorghum under severe environmental stress. Do not apply aerially. Permit alone can be applied from the 2-leaf through the layby stage (before grain head emergence). The use of a nonionic surfactant is recommended consult label. Consult label for rotational restrictions.
Cocklebur, jimsonweed, lambsquarters, morningglory, nightshade, nutsedge, pigweed, pokeweed, ragweed, smartweed, velvetleaf, and suppression of horsenettle, milkweed, and Canada thistle	G,F	Halosulfuron-methyl 0.02-0.03 lb + Sodium salt of dicamba 0.09-0.135 lb	Yukon 67.5WDG 4.0-6.0 oz + approved tank-mixes: atrazine 1.5-3.0 pt	Use a nonionic surfactant or crop oil concentrate. Use 0.25–0.5% nonionic surfactant or 1% v/v crop oil concentrate. When used alone, Yukon can be applied over the top from the 2-leaf stage through 15-inch-tall sorghum. Use drop nozzles if sorghum is taller than 8 inches. Crop injury will be minimized if the spray solution does not contact leaves or the whorl. Apply Yukon in a single application with the total application rate not to exceed 6 ounces. Do not graze or feed treated sorghum forage or silage prior to mature grain stage.

Sorghum - no-till or conventional (continued)

Weed Problem	Crop [a]	Chemical rate per acre	Product per acre	Remarks
Harvest aids				
Harvest aid and to reduce the moisture content of grain prior to harvest	G	Sodium chlorate	Defol 6 0.75-1.0 gal	Desiccation of morningglory and other vines may be erratic.
		Glyphosate up to 2.0 lb	Roundup Weather Max 1.4 qt or Touchdown Total 1.4 qt or other labeled glyphosate formulation	Apply at 30 percent grain moisture or less. Allow at least 7 days between application and harvest. Apply with extreme caution because spray drift at this time of year can be very damaging to trees, shrubs, and lawns. Touchdown Total is available as a non-surfactant containing formulation called Touchdown HiTech.

[a] G=grain sorghum; F=forage sorghum

Weed Control in Small Grains

Small grains - barley, oats, rye and wheat

Weed Problem	Chemical rate per acre	Product per acre	Treatment time	Remarks
Contact kill of most annual weeds for no-till plantings	Paraquat 0.5-1.0 lb + surfactant	Gramoxone Inteon 2.0-4.0 pt + surfactant as labeled	No-till establishment	Use 2.0-2.5 pints per acre for weeds 1 to 3 inches, use 2.5-3.0 pints per acre for weeds 3 to 6 inches, and use 3.0-4.0 pints per acre for weeds over 6 inches. Weeds 6 inches or taller may not be controlled. Apply after planting but before emergence of the small grain. Use 20 to 60 gallons of diluted spray per acre. As the density of the crop residue increases, the spray gallonage should increase to ensure complete coverage and kill. Use the higher rate if existing vegetation is dense, cool temperatures exist, or drought conditions are prevalent.
Kill of most annual weeds for no-till plantings	Glyphosate 0.5-5.0 lb	Roundup Weather Max 0.5-3.1 qt or Touchdown Total 0.35-3.5 qt or other labeled glyphosate formulation	No-till establishment	See label for specific use instructions. The low rate can be used when small winter annuals are present and less than 2 inches high. Increase rate on larger weeds. Application with fan-type nozzles is preferred. The lower rate is more effective in 3 to 10 gallons per acre. The higher rates can be used in controlling certain perennials if their stage of growth and condition match glyphosate's labeling. Touchdown Total is available in a non-surfactant formulation called Touchdown HiTech.

Small grains - barley, oats, rye and wheat (continued)

Weed Problem	Chemical rate per acre	Product per acre	Treatment time	Remarks
Corn chamomile, corn gromwell, cowcockle, knawel or German moss, mayweed, mustard (wild), pennycress (field), pepperweed, radish (wild), shepherdspurse, yellowrocket. Weak in control of chickweed and henbit	Bromoxynil 0.375-0.5 lb	Buctril 1.5-2.0 pt	Postemergence fall or spring	Destroy all weed seedlings before seeding small grains. Look for weeds as soon as small grains start to germinate. Apply after small grain is beyond 2-leaf stage and weed seedlings have no more than three to four leaves or rosettes 1.5 inches across. Best results can be expected with flat fan nozzles using a minimum of 30 pounds per square inch and 10 gallons per acre. With flood nozzles, use a minimum of 20 gallons of water per acre and 30 gallons per square inch. Use higher rate for cowcockle, henbit, chickweed, and wild mustard control. Poor control has resulted when applied to larger weeds. Thorough weed coverage is necessary for effective control. Do not apply if small grains form a canopy, during or after boot stage, or when crop is under stress from lack of moisture. Do not graze treated fields for 30 days after application. May be applied with fluid fertilizer.

Small grains - barley, oats, rye and wheat not seeded to legumes

Weed Problem	Chemical rate per acre	Product per acre	Treatment time	Remarks
Burdock, buttercup (bulbous), chicory, cornflower or bachelor's buttons, dandelion, dock (curly) seedlings, fanweed, fleabane, goatsbeard, henbit, lettuce (prickly), meadow campion or ragged-robin, mustard (black, wild), pennycress, plantain, poppy (corn), primrose, radish (wild), rock cress, shepherdspurse, smartweed, thistle (blessed), turnip (wild), vetch (hairy), and suppression of garlic, onions (wild), and thistles	2,4-D amine 0.25-0.5 lb	2,4-D amine 0.5-1.0 pt (various brands 4.0 lb/gal)	Postemergence spring	Spray 2,4-D when grain is 4 to 8 inches high or after tillering but before jointing. Spraying small grain too early or after jointing can result in reduced yields and uneven ripening. The higher rates of 2,4-D increase the risk of grain injury. Use production practices favorable to maximum crop competition. Do not graze dairy animals or feed forage within 14 days of treatment. Always premix 2,4-D amine with water before mixing with liquid fertilizer. Oats may be injured, use low rate.
Most winter annual broadleaf weeds as listed for 2,4-D amine. Better suppression of perennials, especially garlic and onion (wild)	2,4-D low volatile ester 0.25-0.5 lb	2,4-D low volatile ester 0.5-1.0 pt (various brands 4.0 lb/gal)	Postemergence spring	Spray 2,4-D when grain is 4 to 8 inches high or after tillering but before jointing. Caution: Vapors and drifts are injurious to tomato, tobacco, and many ornamentals. Underseeded legumes usually are killed. Use higher rates to prevent garlic aerial bulbet formation. Cannot control garlic in oats without injuring oats. Best results if daytime temperature is 50°F or higher for 5 to 7 days following treatment. For best results, do not apply with liquid nitrogen solution, because the proper time of application of each differs. Uniform coverage is important.
Most winter annual weeds listed for 2,4-D amine and bromoxynil, especially good on knawel or German moss	2,4-D amine or low volatile ester 0.25-0.5 lb + bromoxynil 0.25-0.375 lb	2,4-D amine or low volatile ester 0.5-1.0 pt (various brands 4.0 lb/gal) + Buctril 1.0-1.5 pt	Postemergence spring	See remarks for 2,4-D and bromoxynil.

Small grains - barley, oats, rye and wheat not seeded to legumes (continued)

Weed Problem	Chemical rate per acre	Product per acre	Treatment time	Remarks
Chickweed (suppression), cutleaf eveningprimrose, henbit (suppression), mustards, thistle (Canada) (suppression), and wild garlic	Prosulfuron 0.009-0.018 lb	Peak 57DF 0.25-0.5 oz + approved tank-mixes: Banvel or Clarity 0.13-0.25 pt or Buctril 0.75-1.5 pt or 2,4-D 0.5-0.75 pt	Postemergence fall	Apply Peak postemergence from the 3-leaf stage to before the second node is detectable in stem elongation (Feekes' Growth Stage 7). Add a nonionic surfactant to all applications. Do not apply more than 1.0 ounce of Peak per acre during the cropping season. Do not apply to a crop under stress. Consult label for interactions with organophosphate insecticides and recrop intervals. There is a 10-month rotational restriction to planting soybeans. Peak can be applied to small grains to be harvested for forage. Do not harvest, graze, or plant corn within 30 days of application.
Harvest aids Use for previous weeds listed for 2,4-D amine	2,4-D amine 0.5-1.0 lb	2,4-D amine 1.0-2.0 pt (various brands 4.0 lb/gal)	Postemergence spring	2,4-D amine can be applied from dough stage to harvest as a harvest aid when weeds threaten to interfere with harvest operations. Do not use treated straw for livestock feed.

Small grains - fall-seeded barley, oats, and wheat

Weed Problem	Chemical rate per acre	Product per acre	Treatment time	Remarks
Many annual broadleaf weeds including chamomile/mayweed, common chickweed (suppression), curly dock, knawel, mustard spp, wild garlic, and several other species	Thifensulfuron 0.023-0.028 lb	Harmony GT XP 0.5-0.6 oz	Postemergence	For best results, apply in water with 0.25 to 0.5 percent v/v nonionic surfactant. Consult label for more information about certain hard-to-control species, including wild garlic, wild radish, and others. May be tank-mixed with 2,4-D, Banvel/Clarity, Buctril, and several others including several grain herbicides registered for wheat. Harmony GT XP may be mixed with several insecticides or fungicides but do not mix with Malathion. Refer to label for mixing instructions with respect to use of nitrogen fertilizer carriers or surfactants. Plant wheat, barley, oat, soybean, and corn anytime after Harmony GT XP application. Plant any other crop 45 days after Harmony GT XP application. For wheat and barley, make applications after the crop is in the 2-leaf stage, but before the flag leaf is visible. Apply after 3-leaf-stage on spring oats but before jointing. Do not graze or feed forage or hay from treated areas to livestock. Harvested straw may be used for bedding and/or feed.

Small grains - fall-seeded barley and wheat

Weed Problem	Chemical rate per acre	Product per acre	Treatment time	Remarks
Chickweed, cress (mouse-ear), dogfennel, garlic (wild), geranium (Carolina), knawel or German moss, mustard spp., shepherdspurse, swinecress, and suppression of cutleaf evening primrose, henbit, lettuce (prickly), radish (wild), and thistle (Canada)	Thifensulfuron-methyl and Tribenuron-methyl 0.014-0.028 lb + surfactant or liquid nitrogen fertilizer	Harmony Extra XP 0.3-0.6 oz + surfactant (1.0 qt/100 gal) or liquid nitrogen fertilizer	Postemergence	Best results obtained when applications are made to young, actively growing weeds. Annual broadleaf weeds should be past the cotyledon stage, actively growing, and less than 4" tall or wide. Wild garlic plants should be less than 12" tall with 2" to 4" of new growth. Make applications after the crop is in the second leaf stage, but before the flag leaf is visible. Delay applications until weeds have emerged. Do not graze or feed forage or hay from treated areas to livestock. Harvested straw may be used for bedding or feed. Do not plant any crop other than wheat or barley for 45 days after application. Always premix Harmony Extra XP in water before adding to spray tank. Refer to the chart below for mixing instructions with respect to liquid-nitrogen carriers, surfactants, and combinations.
		Approved combinations: tank-mix with 2,4-D or Banvel/Clarity		Use for improved control of vetch, wild radish, and other difficult-to-control species.

Small grains - Harmony Extra adjuvant recommendations for barley and wheat

Carrier	Situation	Rate of surfactant per 100 gallons
Water	Normal	1 qt
Nitrogen diluted with water	Normal	1/2-l pt
Nitrogen	Garlic over 8 inches	1/2 pt
Nitrogen	Garlic less than 8 inches	None
Nitrogen	With 0.5 pt 2,4-D	None
Water	With 0.5 pt 2,4-D	1 pt

Weed Problem	Chemical rate per acre	Product per acre	Treatment time	Remarks
Spot treatment in wheat and barley Kills most annual weeds for no-till planting.	Glyphosate 0.5-5.0 lb	Roundup Weather Max 0.5-3.1 qt or Touchdown Total 0.35-3.5 qt or other labeled glyphosate formulation	Preharvest	Use the low rate for annual weeds up to 6 inches tall and higher rates for weeds taller than 6 inches. Applications with fan-type nozzles generally have been more effective than with flood nozzles. Apply up to 14 days before forage and hay harvest; and up to 8 weeks before grain and straw harvest. Do not treat more than 10 percent of the total field to be harvested. Touchdown Total is available as a non-surfactant containing formulation called Touchdown HiTech.

Small grains - fall-seeded barley and wheat (continued)

Weed Problem	Chemical rate per acre	Product per acre	Treatment time	Remarks
Harvest aid for wheat and barley				
Control of annual grasses and broadleaf weeds and suppression of perennial weeds, including field bindweed, quackgrass, and thistle (Canada) to facilitate harvest	Glyphosate 0.5-1.0 lb	Roundup Weather Max 0.4-0.7 qt or Touchdown Total 0.7 to 1.5 pt or other labeled glyphosate formulation	Preharvest	Glyphosate controls annual and perennial weeds at the rates and timings listed on the label. Make applications after the hard-dough stage of grain (30 percent moisture) and at least 7 days prior to harvest. Glyphosate may be applied with ground or aerial equipment. For control of quackgrass or suppression of Canada thistle, apply 1.0 pound of glyphosate. For suppression of field bindweed, apply 0.5 to 1.0 pound of glyphosate with 1.0 to 2.0 pints of 2,4-D. Do not apply more than 1.0 pound of glyphosate per acre for preharvest use. Do not apply to wheat grown for seed. Touchdown Total is available as a non-surfactant containing formulation called Touchdown HiTech.

Small grains - fall-seeded barley

Weed Problem	Chemical rate per acre	Product per acre	Treatment time	Remarks
Many winter annual broadleaf weeds, same as for Small grains-fall-seeded wheat	Dicamba 0.125 lb	Banvel 0.25 pt or Clarity 0.125-0.25 pt	Postemergence spring	Apply after grain is fully tillered but before jointing. Observe precautions on label.
Many winter annual broadleaf weeds, same as for Small grains-fall-seeded wheat	Dicamba 0.06-0.125 lb + 2,4-D amine or ester 0.25 lb	Banvel 0.13-0.25 pt or Clarity 0.13-0.25 pt + 2,4-D amine or ester 0.5 pt (various brands 4.0 lb/gal)	Postemergence spring	Apply after grain is fully tillered but before jointing. Observe precautions on label.
Ryegrass (annual)	Diclofop-methyl 0.5-1.0 lb	Hoelon 1.3-2.66 pt	Postemergence	Hoelon is labeled for the following winter barley varieties: Milton, Boone, Molly Bloom, Wysor, Nomini, Anson, Mulligan, Henry, Pennco, and Sussex. Crop damage may result when applied to other varieties. However, work in Virginia has shown additional barley varieties exhibit excellent tolerance to Hoelon. If Hoelon is applied too early (1- to 2-leaf stage) severe injury to barley may occur. Do not apply preemergence. Do not apply with crop oil concentrate, nor mix with broadleaf herbicides other than Buctril. Do not apply with liquid fertilizers. See wheat section for more information.
Ryegrass (annual) and some winter annual weeds, but not chickweed	Diclofop-methyl 0.75-1.0 lb + bromoxynil 0.25-0.375 lb	Hoelon 2.0-2.66 pt + Buctril 1.0-1.5 pt	Postemergence	Refer to comments on Hoelon under Small grains-fall-seeded wheat and fall-seeded barley.

Small grains - fall and spring-seeded oats

Weed Problem	Chemical rate per acre	Product per acre	Treatment time	Remarks
Many winter annual broadleaf weeds, same as under Small grains-fall-seeded wheat	Dicamba 0.125 lb	Banvel 0.25 pt or Clarity 0.13-0.25 pt	Postemergence	Apply after grain is fully tillered but before jointing for fall-seeded oats. Applications to spring-seeded oats must be made before the oats exceed the 5-leaf stage. Observe precautions on label.
Many winter annual broadleaf weeds and wild garlic as listed under small grains, and fall-seeded wheat and barley sections	Thifensulfuron-methyl 0.15-0.20 oz + Tribenuron-methyl 0.08-0.11 oz	Harmony Extra XP 0.3-0.4 oz + surfactant 0.25% or liquid nitrogen fertilizer	Postemergence	See comments under small grains and fall-seeded wheat and barley section. Consider using tank-mixes with 2,4-D, Buctril, Banvel, or Clarity for improved control.

Small grains - fall-seeded wheat

Weed Problem	Chemical rate per acre	Product per acre	Treatment time	Remarks
Burdock, buttercup (bulbous), chicory, cornflower or bachelor's buttons, dandelion, dock (curly) seedlings, fanweed, fleabane, goatsbeard, henbit, lettuce (prickly), meadow campion or ragged robin, mustard (black, wild), pennycress, plantain, poppy (corn), primrose, radish (wild), rock cress, shepherdspurse, smartweed, thistle (blessed), turnip (wild), vetch (hairy), and suppression of garlic, onions (wild), and thistles	2,4-D amine 0.25-0.75 lb	2,4-D amine 0.5-1.5 pt (various brands 4.0 lb/gal)	Postemergence spring	Spray 2,4-D when grain is 4 to 8 inches high or after tillering but before jointing. Spraying small grain too early or after jointing can result in reduced yields and uneven ripening. The higher rates of 2,4-D increase the risk of grain injury. Use production practices favorable to maximum crop competition. Do not graze dairy animals or feed forage within 14 days of treatment. Always premix 2,4-D amine with water before mixing with liquid fertilizer.

Small grains - fall-seeded wheat (continued)

Weed Problem	Chemical rate per acre	Product per acre	Treatment time	Remarks
Corn chamomile, corncockle, cowcockle, dandelion, dogfennel, goatsbeard, knawel or German moss, mayweed, and smartweed, weak on chickweed	Dicamba 0.125 lb	Banvel 0.25 pt or Clarity 0.125-0.25 pt	Postemergence spring	See label for grazing restrictions. Apply after grain is fully tillered but before jointing.
Above weeds listed for dicamba and 2,4-D	Dicamba 0.06-0.125 lb + 2,4-D amine or ester 0.25-0.375 lb	Banvel 0.13-0.25 pt or Clarity 0.13-0.25 pt + 2,4-D amine or ester 0.5-0.75 pt (various brands 4.0 lb/gal)	Postemergence spring	Good general treatment for broadleaf control. Controls wider spectrum of weeds than either herbicide alone. Apply after grain is fully tillered but before jointing.
Many winter annual broadleaf weeds	Dicamba 0.06-0.125 lb + bromoxynil 0.25-0.375 lb	Banvel 0.13-0.25 or Clarity 0.13-0.25 pt + Buctril 1.0-1.5 pt	Postemergence spring	Apply after grain is fully tillered but before jointing. Observe label precautions.
Previous weeds listed for 2,4-D and dicamba and for improved performance against the following difficult-to-control weeds: fiddleneck, garlic (wild), gromwell, henbit, and onion (wild)	Dicamba 0.125 lb + 2,4-D amine 0.5-1.0 lb or Dicamba 0.125 lb + 2,4-D ester 0.5-0.75 lb	Banvel 0.25 pt or Clarity 0.25 pt + 2,4-D amine 1.0-2.0 pt (various brands 4.0 lb/gal) or Banvel 0.25 pt or Clarity 0.13-0.25 pt + 2,4-D ester 1.0-1.5 pt (various brands 4.0 lb/gal)	Postemergence spring	Apply after grain is fully tillered but before jointing. This combination gives better control of more weeds than either chemical alone. This is only labeled on fall-seeded wheat, not barley, oats, or rye. Do not use unless possible crop injury will be tolerated.

Small grains - fall-seeded wheat (continued)

Weed Problem	Chemical rate per acre	Product per acre	Treatment time	Remarks
Annual ryegrass	Diclofop-methyl 0.5-1.0 lb	Hoelon 1.33-2.66 pt	Postemergence	Hoelon will not control broadleaf weeds. It is slow acting in controlling ryegrass. Hoelon can be applied preemergence at 2.0 to 2.66 pints per acre in Delaware, Maryland, Virginia, and West Virginia. For postemergence control, apply Hoelon to wheat before the first node (jointing) develops. Do not apply to ryegrass past the 5-leaf/2-tiller stage. Post applications are permitted in Delaware, Maryland, Virginia, and West Virginia. The use of 1.0 pint to 1.0 quart of crop oil concentrate per acre may be helpful, but do not use when conditions are cool and wet. Do not tank-mix Hoelon with any broadleaf herbicides in Delaware, Maryland, or Virginia as reduced annual ryegrass may occur. Broadleaf herbicides can be applied 5 days after Hoelon is applied. Hoelon is labeled for use with numerous fungicides. Hoelon is labeled to be tank-mixed with liquid nitrogen (28 to 32 percent), but do not use less than 2.0 pints of Hoelon per acre. Hoelon-resistant annual ryegrass has been confirmed in Delaware, Maryland, New Jersey, and Virginia.
Annual ryegrass and some winter annual weeds, but not chickweed	Diclofop-methyl 0.75-1.0 lb + bromoxynil 0.25-0.375 lb	Hoelon 2.0-2.66 pt + Buctril 1.0-1.5 pt	Postemergence	See previous remarks concerning Hoelon. Do not apply other broadleaf herbicides within 1 week of a Hoelon application.

Small grains - fall-seeded wheat (continued)

Weed Problem	Chemical rate per acre	Product per acre	Treatment time	Remarks
Bluegrass (annual, roughstalk), bromegrass spp., bulbous oatgrass, chickweed (common), mustard spp., shepherdspurse	Sulfosulfuron 0.031 lb	Maverick 0.67 oz	Postemergence fall or spring depending on species	For best control of brome species, apply to actively growing weeds in fall. Bulbous oatgrass is best controlled by fall applications. Many mustard species may be controlled by spring or fall applications of Maverick. Applications should contain 0.5 percent nonionic surfactant by volume (2 qt/100 gallons). Maverick is most effective when applied in water versus liquid fertilizers or nitrogen. pH of spray solutions should be between 6.0 and 8.0 (see label). For best control of brome species, apply Maverick to 2- to 3-leaf brome. Rotation crops may be injured by Maverick. If soil pH is <6.5 you can rotate to STS soybeans within 3 months of application, or 5 months for non-STS soybeans. If soil pH runs above 6.5, a 12 month rotational restriction is in effect for soybeans. No other crop other than wheat can be planted sooner than 3 months after application. For all other crops, a field bioassy must be performed no sooner than 3 months after application. Wheat forage may be grazed immediately after application. Do not harvest wheat for hay within 30 days of application and do not harvest wheat for grain or straw within 55 days of application. If soybeans are planted, use STS varieties. Corn may be planted the year

Small grains - fall-seeded wheat (continued)

Weed Problem	Chemical rate per acre	Product per acre	Treatment time	Remarks
				following wheat. One year after application, other crops may be grown if, in a bioassay, that crop is not injured (see label).

Small grains - fall-seeded wheat (continued)

Weed Problem	Chemical rate per acre	Product per acre	Treatment time	Remarks
Bluegrass (annual and roughstalk), bromegrass spp. (suppression), common chickweed (suppression), henbit (suppression), ryegrass (annual/Italian)	Mesosulfuron-methyl 0.013 lb	Osprey 4.75 oz	Postemergence - late fall, winter, or early spring	Osprey will be targeted primarily in our region for control of Hoelon-resistant Italian ryegrass. Applications should be made to small weeds 1-leaf to the 2-tiller stage. Applications may be made only to wheat from emergence up to the jointing stage. The current label requires the addition of either a methylated seed oil (MSO) at 1.3 to 1.5 pt/acre or a basic blend type of adjuvant. A basic blend adjuvant includes a non-ionic surfactant (NIS) or MSO and a nitrogen source. Use 0.8 to 1.6 pt/acre of the basic blend surfactant. When a MSO or basic blend adjuvant are used, ammonium nitrogen or ammonium sulfate fertilizer are not recommended. When using a tank-mix partner that restricts the addition of a MSO or basic blend, use a NIS at 0.5% v/v with ammonium nitrogen fertilizer. Use a spray grade quality urea ammonium nitrogen fertilizer at 1 to 2 qt/acre or ammonium sulfate ferrtilizer at 1.5 to 3.0 lb/acre. The preferred carrier for Osprey is water. If utilizing liquid nitrogen as the carrier, limit it to no more than 15% of the spray solution. Do not use liquid fertilizers without a non-ionic surfactant at 0.25% v/v. Due to the activity of fertilizer on the crop, temporary injury may result when liquid nitrogen is used as a spray carrier. Do not make topdress applications

Small grains - fall-seeded wheat (continued)

Weed Problem	Chemical rate per acre	Product per acre	Treatment time	Remarks
				of ammonium nitrogen fertilizer within 14 days following an Osprey application or severe injury may occur. Do not apply Osprey to barley or oats as damage will be severe and recovery may not occur. Harmony Extra XP and Harmony GT XP can be tank-mixed with Osprey. Banvel nor 2,4-D are labeled for use with Osprey. Do not apply Osprey within 30 days of harvesting wheat forage, and 60 days for hay, grain and straw. Soybeans can be planted within 90 days of application. Most vegetable crops would have a 10 month rotational restriction.

Weed Control in Soybeans

Soybean herbicides and their restrictions

Trade name	Common name	Manufacturer	Restricted-use pesticide [1]	Water quality advisory [2]	Worker Reentry (hours) [3]
2,4-D amine 4S	2,4-D amine	several	-	-	48
2,4-D LVE 4E	2,4-D LVE	several	-	-	12
2,4-DB	2,4-DB	several	-	Yes	48
Authority 75DF	sulfentrazone	FMC	-	Yes	12
Axiom 68DF	flufenacet + metribuzin	Bayer	-	yes	12
Basagran 4S	bentazon	MicroFlo	-	Yes	48
Boundary 6.5EC	s-metolachlor + metribuzin	Syngenta	-	Yes	12
Canopy EX 29.5DF	chlorimuron + tribenuron	DuPont	-	Yes	12
Classic 25DF	chlorimuron	DuPont	-	-	12
Cobra 2E	lactofen	Valent	-	-	12
Command 3ME	clomazone	FMC	-	-	12
Dual II Magnum/Cinch 7.64	s-metolachlor	Syngenta	-	Yes	24
Extreme 2.17FL	imazethapyr + glyphosate	BASF	-	yes	48
FirstRate 84WDG	cloransulam-methyl	Dow AgroSciences/ Monsanto	-	Yes	12
Fusilade DX 2E	fluazifop	Syngenta	-	-	12
Fusion 2.56E	fluazifop + fenoxaprop	Syngenta	-	-	24
Gangster (co-pack)	flumioxazin + chloransulam-methyl	Valent	No	Yes	12
Gauntlet (co-pack)	sulfentrazone + cloransulam	FMC/ Dow AgroSciences	-	yes	12
Gramoxone Inteon 2L	paraquat	Syngenta	Yes	Yes	12
Harmony GT XP 75DF	thifensulfuron	DuPont	Yes	Yes	12/4
Lasso 4E	alachlor	Monsanto	yes	yes	12
Liberty 1.67L [4]	glufosinate	Bayer	-	-	12
Linex 50DF or 4L	linuron	DuPont	-	-	24
MicroTech 4ME	alachlor	Monsanto	yes	yes	12
Outlook 6EC	dimethenamid-p	BASF	-	yes	12
Poast 1.5E	sethoxydim	BASF	-	-	12
Poast Plus 1E	sethoxydim	BASF	-	-	12
Prowl 3.3EC/Prowl H2O 3.8CS	pendimethalin	BASF	-	Yes	24
Pursuit 2S	imazethapyr	BASF	-	-	4
Python 80WDG	flumetsulam	Dow AgroSciences	-	yes	12
Raptor 1S	imazamox	BASF	-	-	4
Reflex 2E/Flexstar 1.88E	fomesafen	Syngenta	-	yes	24

Soybean herbicides and their restrictions (continued)

Trade name	Common name	Manufacturer	Restricted-use pesticide [1]	Water quality advisory [2]	Worker Reentry (hours) [3]
Resource 0.86EC	flumiclorac	Valent	-	-	12
Roundup Weather Max 5.5L or other labeled formulations [5]	glyphosate	Monsanto	-	-	12
Scepter 1.5S/70DG	imazaquin	BASF	-	yes	12
Select 2E	clethodim	Valent	-	-	24
Sencor 75DF/4L	metribuzin	Bayer	-	yes	12
Sequence	glyphosate + s-metolachlor	Syngenta	No	Yes	24
Sonalan 3E	ethalfluralin	Dow AgroSciences	-	-	24
Stellar 3.1EC	flumiclorac + lactofen	Valent	-	-	12
Storm 4S	acifluorfen + bentazon	UPI	-	Yes	48
Synchrony XP 28.4DF	chlorimuron + thifensulfuron	DuPont	-	-	12
Targa 0.88E	quizalofop	Gowan	-	-	12
Touchdown Total 4.17AE/Touchdown HiTech 5AE [5]	glyphosate	Syngenta	-	Yes	12
Treflan	trifluralin	Dow AgroSciences, others	-	-	12
Ultra Blazer 2S	acifluorfen	UPI	-	Yes	48
Valor	flumioxazin	Valent	-	-	12

1 Only licensed applicators may purchase and apply restricted-use pesticides.

2 These herbicides have properties that may result in ground or surface water contamination. Do not apply them in areas where soils are permeable or coarse and groundwater is near the surface. Practices should be followed to minimize the potential for dissolved runoff and/or runoff erosion. See the herbicide label for specific restrictions.

3 If soil-applied products are injected or incorporated at application time, under certain circumstances the Worker Protection Standard allows workers to enter the treated area if they will have no contact with anything that has been treated. Personal protective equipment is required for early entry to treated areas if contact with treated soil, plants, or water is involved.

4 For use on Liberty Link soybean varieties only.

5 May be applied over-the-top on Roundup-Ready soybean varieties only.

6 For use on STS soybean varieties only.

Relative effectiveness of herbicides for soybeans

Legend - based on adequate moisture, good growing conditions, and proper herbicide application

E = Excellent (>90% control)
G = Good (80-90% control)
F = Fair (60-80% control)
P = Poor (20-60% control)

G-E = Good to Excellent
F-G = Fair to Good
P-F = Poor to Fair
N = None (<20% control)

	Barnyardgrass	Bermudagrass	Broadleaf signalgrass	Crabgrass	Fall panicum	Foxtails	Goosegrass	Johnsongrass (seedling)	Johnsongrass (rhizome)	Quackgrass	Sandbur	Shattercane	Texas panicum	Yellow nutsedge
Preplant incorporated														
Command	F-G	P	G-E	F-G	E	E	E	P	N	P	G-E	P	G	N
Command + Sencor	F-G	P	G-E	F-G	E	E	E	P	N	P	G-E	P	G	N
Dual II Magnum/Cinch	G-E	N	F-G	E	G-E	E	E	P	N	N	F	P	P	F-G
Dual II Magnum/Cinch + Sencor	G-E	N	F-G	E	G-E	G	E	P	N	N	F	P	P	F-G
MicroTech	G-E	N	F-G	F-G	E	E	E	P	N	N	F	P	P	F
MicroTech + Sencor	G-E	N	F-G	F-G	E	E	E	P	N	N	F	P	P	F
Prowl	E	P	G	F	G	E	G-E	G	P	P	G	G	G	N
Prowl + Sencor	E	P	G	F	G	E	G-E	G	P	N	G	G	G	N
Python	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Scepter	P	N	N	P	P	F	P	F	N	N	N	P	N	P
Scepter + Dual II Magnum/Cinch	G-E	N	F-G	G	G-E	E	E	N	N	N	F	P	P	G
Scepter + MicroTech	G-E	N	F-G	G	E	E	E	F	N	N	F	P	P	F-G
Scepter + Prowl	E	P	G	G	G	E	G-E	G	P	P	G	G	G	P
Scepter + Treflan	E	P	G	G	G	E	E	G	P	P	G	G	G	P
Sencor	P-F	N	P-F	P-F	P-F	P-F	F	P	N	N	P	P	N	N
Treflan	E	P	G	G	G	E	E	G	P	P	G	G	G	N
Treflan + Sencor	E	P	G	G	G	E	E	G	P	P	G	G	G	N
Preemergence														
Axiom	G	N	F-G	G	G	G	G	P	N	N	P	N	P	P
Dual II Magnum/Cinch	G-E	N	F-G	G-E	G-E	E	E	P	N	N	F	P	P	F
Dual II Magnum/Cinch + Linex	G-E	N	F-G	G-E	G-E	E	E	P	N	N	F	P	P	F
Dual II Magnum/Cinch + Sencor	G-E	N	F-G	G-E	G-E	E	E	P	N	N	F	P	P	F
FirstRate/Amplify	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Linex	F	N	P	F	F	F	F	P	N	N	F	P	N	N
MicroTech	G-E	N	F-G	F-G	E	E	E	P	N	N	F	P	P	P
MicroTech + Linex	G-E	N	F-G	F-G	E	E	E	P	N	N	F	P	P	P

Relative effectiveness of herbicides for soybeans (continued)

	Barnyardgrass	Bermudagrass	Broadleaf signalgrass	Crabgrass	Fall panicum	Foxtails	Goosegrass	Johnsongrass (seedling)	Johnsongrass (rhizome)	Quackgrass	Sandbur	Shattercane	Texas panicum	Yellow nutsedge
MicroTech + Sencor	G-E	N	F-G	F-G	E	E	E	P	N	N	F	P	P	P
Outlook	G-E	N	G	G	G	G-E	G	P	N	N	P-F	P	P	F
Outlook + Linex	G-E	N	F-G	G	G	G-E	G	P	N	N	P-F	P	P	F
Outlook + Scepter	G-E	N	F-G	G	G	G-E	G	P	N	N	P-F	P	P	F
Outlook + Sencor	G-E	N	F-G	G	G	G-E	G	P	N	N	P-F	P	P	F
Prowl	G-E	N	F-G	F	F-G	G	F	F	N	N	F	F	P-F	N
Prowl + Linex	G-E	N	F-G	F	F-G	G	F	F	N	N	F	F	P-F	N
Prowl + Sencor	G-E	N	F-G	F	F-G	G	F	F	N	N	F	F	P-F	N
Python	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Scepter	P	N	N	P	P	P-F	P	P-F	N	N	N	P	N	P
Scepter + Dual II Magnum/Cinch	G-E	N	F-G	G-E	G	E	E	P	N	N	F	P	P	F-G
Scepter + MicroTech	G-E	N	F-G	F-G	E	E	E	P	N	N	F	P	P	F
Scepter + Prowl	G-E	N	F-G	F	F-G	G	F	F	N	N	F	F	P-F	P
Sencor	P-F	N	P-F	P-F	P-F	P-F	P-F	P	N	N	P	P	N	N
Valor	P	N	P	P	P	P	P	N	N	N	N	N	P	N
Postemergence														
Basagran	N	N	N	N	N	N	N	N	N	N	N	N	N	F
Classic	N	N	N	P	P	P	N	P	N	N	N	P	N	P-F
Cobra	N	N	N	N	N	N	N	N	N	N	N	N	N	N
FirstRate	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Flexstar	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Fusilade DX	E	G	G	F-G	E	E	G	E	G-E	G	G	E	G	N
Fusion	E	F-G	G	G	E	E	G	E	G	G	G	E	G	N
Harmony GT XP	N	N	N	N	N	N	N	N	N	N	N	N	N	P
Poast, Poast Plus	E	F-G	G	G-E	E	E	G-E	E	G	G	G	G	G	N
Pursuit	F	N	F-G	F-G	F	F-G	P	G	P-F	N	P-F	G	P-F	P
Reflex	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Resource	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Roundup Weather Max [a]	E	G	E	E	G-E	E	E	E	G	G-E	E	G	G	P-F
Scepter	N	N	N	P	P	P	P	P	N	N	N	P	N	P-F
Select	E	G-E	G-E	E	E	E	G	E	G-E	G-E	G	E	G	N
Stellar	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Storm	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Synchrony XP	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Relative effectiveness of herbicides for soybeans (continued)

	Barnyardgrass	Bermudagrass	Broadleaf signalgrass	Crabgrass	Fall panicum	Foxtails	Goosegrass	Johnsongrass (seedling)	Johnsongrass (rhizome)	Quackgrass	Sandbur	Shattercane	Texas panicum	Yellow nutsedge
Targa	G-E	G	G	F-G	E	G	G	E	G-E	G	G	E	G	N
Touchdown Total/Touchdown HiTech [a]	E	G	E	E	G-E	E	E	E	G	G-E	E	G	G	P-F
Typhoon	E	G	G	F-G	E	E	G	E	G-E	G	G	E	G	N
Ultra Blazer	N	N	N	N	P	P	N	P	N	N	N	P	N	N

Relative effectiveness of herbicides for soybeans (continued)

Legend - based on adequate moisture, good growing conditions, and proper herbicide application

E = Excellent (>90% control)
G = Good (80-90% control)
F = Fair (60-80% control)
P = Poor (20-60% control)
G-E = Good to Excellent
F-G = Fair to Good
P-F = Poor to Fair
N = None (<20% control)

	Eastern black nightshade	Burcucumber	Cocklebur	Jimsonweed	Lambsquarters (common)	Morningglory (annual spp)	Pigweed	Common ragweed	Giant ragweed	Sicklepod	Smartweed	Spurred anoda	Prickly sida or teaweed	Tropic croton	Velvetleaf
Preplant incorporated															
Command	P	P	P	F-G	G	N	P-F	F	P-F	P	F-G	E	F-G	G	E
Command + Sencor	P-F	P	F	F-G	G	P-F	E	G	P-F	F-G	G	E	G-E	F-G	E
Dual II Magnum/Cinch	F	N	N	N	P-F	N	G	P	N	N	P	N	P	N	N
Dual II Magnum/Cinch + Sencor	F	P	F	F	G	P-F	E	G	P	F-G	G	F	G	F-G	F-G
MicroTech	F-G	N	N	N	P-F	N	G	P	N	N	P	F	P	N	N
MicroTech + Sencor	F-G	P	F	F	G	P-F	E	G	P	F-G	G	F	G	F-G	F-G
Prowl	N	N	N	N	G-E	P	G	N	N	N	P	N	N	P	F
Prowl + Sencor	P	N	F	F	G-E	P-F	E	G	P	F-G	G	F	G	F-G	F
Python	P-F	P	F-G	F-G	G-E	P	E	P	P	F-G	E	F	F-G	-	G

Relative effectiveness of herbicides for soybeans (continued)

	Eastern black nightshade	Burcucumber	Cocklebur	Jimsonweed	Lambsquarters (common)	Morningglory (annual spp)	Pigweed	Common ragweed	Giant ragweed	Sicklepod	Smartweed	Spurred anoda	Prickly sida or teaweed	Tropic croton	Velvetleaf
Scepter	F-G	F-G	E	F-G	G	F	E	F-G	F	F-G	F-G	P-F	G	P	F-G
Scepter + Dual II Magnum/Cinch	F-G	F-G	E	F-G	G	F	E	F-G	F	F-G	F-G	P-F	G	P	F-G
Scepter + MicroTech	F-G	F-G	E	F-G	G	F	E	F-G	F	F-G	F-G	P-F	G	P	F-G
Scepter + Prowl	F-G	F-G	E	F-G	G-E	F	E	F-G	F	F-G	F-G	P-F	G	P	F-G
Scepter + Treflan	F-G	F-G	E	F-G	G	F	E	F-G	F	F-G	F-G	P-F	G	P	F-G
Sencor	P	P	F	F	G	P-F	E	G	P	F-G	G	F	G	F-G	F-G
Treflan	N	N	N	N	G	P	G	N	N	N	P	N	N	P	N
Treflan + Sencor	P	P	F	F	G	P-F	E	G	P	F-G	G	F	G	F-G	F
Preemergence															
Axiom	P	N	N	N	P-F	N	P-F	P	N	N	N	N	N	N	N
Dual II Magnum/Cinch	F	N	N	N	P-F	N	G	P	N	N	P	N	P	N	N
Dual II Magnum/Cinch + Linex	F	P	P-F	P-F	G	P-F	E	G	P	P-F	G	P	F-G	F-G	F
Dual II Magnum/Cinch + Sencor	F	P	F	F	G	P-F	E	G	P	F-G	G	F	G	F-G	F-G
FirstRate/Amplify	N	P	G	G	E	G	P	G	F-G	N	G	G	N	N	G
Linex	P	P	P-F	P-F	G-E	P-F	E	G	P	P-F	G	P	F-G	P	F
MicroTech	F-G	N	N	N	P-F	N	G	P	N	N	P	N	P	N	N
MicroTech + Linex	F-G	P	P-F	P-F	G-E	P-F	E	G	P	P-F	G	P	F-G	P	F
MicroTech + Sencor	F-G	P	F	F	G-E	P-F	E	G	P	F-G	G	F	G	F-G	F-G
Outlook	F	N	N	N	P	N	G	P	N	N	P	N	P	N	N
Outlook + Linex	F	P	P-F	P-F	G	P-F	E	G	P	P-F	G	P	F-G	P	F
Outlook + Scepter	F	P-F	F-G	F-G	F-G	P	E	F-G	P	F-G	F-G	P	F-G	P	P-F
Outlook + Sencor	F	P	F	F	G	P-F	E	G	P	F-G	G	F	G	F-G	F-G
Prowl	N	N	N	N	F-G	P	G	P	N	N	P	N	P	P	F
Prowl + Linex	P	P	P-F	P-F	G-E	P-F	E	G	P	P-F	G	P	F-G	P	F
Prowl + Sencor	P	P	F	F	G-E	P-F	E	G	P	F-G	G	F	G	P	F-G
Python	P-F	P	F-G	F-G	G-E	P	E	P	P	F-G	E	F	F-G	-	G
Scepter	P-F	P-F	F-G	F-G	F-G	P-F	E	P-F	P	F-G	F-G	P	F-G	P	P-F
Scepter + Dual II Magnum/Cinch	F	P-F	F-G	F-G	F-G	P	E	P-F	P	F-G	F-G	P	F-G	P	P-F
Scepter + MicroTech	F-G	P-F	F-G	F-G	F-G	P	E	P-F	P	F-G	F-G	P	F-G	P	P-F
Scepter + Prowl	P-F	P-F	F-G	F-G	F-G	P	E	P-F	P	F-G	F-G	P	F-G	P	P-F
Sencor	P	P	F	F	G-E	P-F	E	G	P	F-G	G	F	G	F-G	F-G
Valor	G	N	N	F-G	G	F-G	G	N	N	N	P	F-G	G	F-G	P

Relative effectiveness of herbicides for soybeans (continued)

	Eastern black nightshade	Burcucumber	Cocklebur	Jimsonweed	Lambsquarters (common)	Morningglory (annual spp)	Pigweed	Common ragweed	Giant ragweed	Sicklepod	Smartweed	Spurred anoda	Prickly sida or teaweed	Tropic croton	Velvetleaf
Postemergence															
Basagran	P	P	G-E	E	P-F	P [b]	P	F-G	P-F	P	G-E	F	F	F	G
Classic	P	G	E	E	P	P-F [b]	E	F	G-E	F-G	F-G	N	P	P	P-F
Cobra	F-G	F-G	F [b]	E	P	P-F [b]	E	E	G	P	P	P-F	F	F-G	F-G
FirstRate	N	F	E	E	N	G	P	G-E	G	P	G	P	P		F-G
Flexstar	F-G	F	F [b]	E	F	F-G [b]	E	E	G-E	P-F	F	P-F	N	F	P-F
Fusilade DX	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Fusion	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Harmony GT XP	N	P-F	F	P	E	P	E	-	N	P	G	N	P	P	G
Poast, Poast Plus	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Pursuit	F-G	P-F	E	G	P	F-G	E	P-F	F	P	F-G	F	P	P	F-G
Reflex	F-G	F	F [b]	G	P	F-G [b]	E	E	G	P-F	F	P	P	F-G	P
Resource	P	F	P	P	F	F	F	P	P	N	P	P	N	P	E
Roundup Weather Max [a]	F-G	E	E	E	F-G	F-G	E	F-G	G	F-G	F-G	F	F-G	G	F-G
Scepter	P	P	E	F	N	P	E	P	P	F	P	N	P	P	P
Select	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Stellar	F	P-F	P-F	F-G	P-F	F	F-G	F-G	P-F	N	P	P	N	P	E
Storm	F-G	P-F	G	E	P	F-G [b]	F	F-G	P-F	P	G	F	F	P	F-G
Synchrony XP	N	G	E	E	E	F	E	F	F-G	F-G	G	N	P	P	G
Targa	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Touchdown Total/Touchdown HiTech [a]	F-G	E	E	E	F-G	F-G	E	F-G	G	F-G	F-G	F	F-G	G	F-G
Typhoon	F-G	F	F [b]	G	P	F-G [b]	E	E	G	P-F	F	P	P	F-G	P
Ultra Blazer	F-G	F	F [b]	E	P-F	G-E	E	E	F-G	P	G	P	N	F-G	P

[a] Other formulations of glyphosate are available.

[b] indicates species for which control can be improved by the addition of 2 fl oz of 2,4-DB.

Soybean Herbicide Rotational Restrictions

The herbicides listed below, when used in soybeans, may influence the ability to rotate crops in a normal fashion. Labeled rotational intervals are as follows but may be influenced by many factors, such as the addition of other residual herbicides, soil type and soil pH. Do not use these herbicides unless all rotational restrictions are understood. Consult the label for a different time interval if two or more of these materials are applied in the same season. This list is not a substitute for the label!

Rotational crops (months after application) - Alfalfa to Peppers

Herbicide	Alfalfa	Cabbage	Cotton	Cucum-bers	Field Corn	Grain Sorghum	Lima Beans	Musk-melon	Onions	Peas	Peppers
Authority	12	18	18	18	10	10	30	30	30	30	30
Axiom	12	SY	SY	SY	NR	12	12	12	18	12	12
Basagran	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Boundary	4.5	12	8	12	8	12	12	12	18	8	12
Canopy EX	12	18	9	18	9	9	30	30	30	9	30
Classic (a)	12	18	9	18	9	9	30	30	30	9	30
Cobra	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Command (a)	16	9 [b]	NR [a]	9	9	9	9	9	12	9	NR
Dual II Magnum/Cinch	4	NY	NR	SY	NR	NR	NR	SY	SY	NR	12
Extreme	4	40	18	18	8.5 [b]	18	NR	40	40	4	40 [b]
FirstRate/Amplify (a)	9	30 [d]	9	30 [d]	9	9	9	30 [d]	30 [d]	9	30 [d]
Flexstar	18	18	10	18	10	18	10	18	18	10	18
Fusilade DX/Fusion	NR	NR	NR	NR	2	2	NR	NR	NR	NR	NR
Gauntlet	12	30 [d]	18	30 [d]	10	10	30	30 [d]	30 [d]	30	30
Harmony Extra XP	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Harmony GT XP	1.5	1.5	1.5	1.5	NR	1.5	1.5	1.5	1.5	1.5	1.5
Linex/Lorox	4	4	4	4	4	4	4	4	4	4	4
MicroTech	AH	NY	NY	NY	NR	NR	NR	NY	NY	NY	NY
Outlook	NY	NY	NY	NY	NR	NR	NY	NY	NY	NY	NY
Poast Plus/Poast	NR	NR	NR	NR	AH	AH	NR	NR	NR	NR	NR
Prowl	NY	NY	NR	NY	NR	NY	NR	NY	NY	NY	NY
Pursuit (a)	4	40	18	40	8.5 [c]	18	NR	40	40	4	40 [b]
Python	4	26	18	26	NR	12	4 [d]	26 [d]	26 [d]	4	26 [d]
Raptor	3	9	9	9	8.5	9	NR	9	9	NR	9
Reflex	18	18	10	18	10	18	10	18	18	10	18
Resource	1	1	1	1	NR	1	1	1	1	1	1
Roundup Weather Max (j)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Scepter (a)	18	18	18	18	9.5 [a,c]	11	11	18	18	18	18
Select	NR	1	NR	1	1	1	1	1	NR	1	1
Sencor	4	12	8	12	4	12	12	12	18	8	12
Sonalan	AH	AH	AH	AH	AH	AH	AH	AH	AH	AH	AH
Stellar	1	1	1	1	NR	1	1	1	1	1	1
Storm	AH	AH	AH	AH	AH	AH	AH	AH	18	AH	AH
Synchrony XP	10	18	10 [h]	18	10	12	18	18	18	12	18
Targa	4	4	NR	4	4	4	4	4	4	4	4

Rotational crops (months after application) - Alfalfa to Peppers (continued)

Herbicide	Alfalfa	Cabbage	Cotton	Cucum-bers	Field Corn	Grain Sorghum	Lima Beans	Musk-melon	Onions	Peas	Peppers
Touchdown Total/ Touchdown HiTech (j)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Treflan	NR	NR	5	NR	5	5	NR	5	5	NR	NR [b]
Ultra Blazer	AH	AH	NY	AH	AH	AH	AH	AH	18	AH	AH
Valor	12 [d]	12 [d]	2	12 [d]	2	2	12 [d]	12 [d]	12 [d]	12 [d]	12 [d]

Key: AH = After Harvest; B- Bioassay; NL - Not Listed; NR - No Restriction; NY - Next Year; SY - Second Year following application.

[a] Read the label for additional restrictions due to rate, rainfall, soil, pH, application rate and so forth.

[b] Transplanted.

[c] Corn hybrids, which are classified as tolerant (IT) or resistant (IR) to Scepter and/or other imidazolinone herbicides (for example, Pursuit), may be planted the spring of the year following the Scepter or Pursuit application regardless of rainfall or time interval from chemical treatment to corn planting.

[d] Plus successful field bioassay.

[e] Treated seed.

[f] 30 months in Pennsylvania.

[g] 12 months in Pennsylvania.

[h] In Virginia: alfalfa-9 months, cotton-8 months, field corn-8 months.

[i] Plant below herbicide zone.

[j] Other formulations of glyphosate are available.

Rotational crops (months after application) - Pumpkins to Winter wheat (continued)

Herbicide	Pumpkins	Snap beans	Soybeans	Squash	Sweet corn	Tobacco	Tomatoes	Water melon	White potatoes	Winter barley	Winter rye	Winter wheat
Authority	18	30	NR	30	18	NR	30	18	30	4	4	4
Axiom	12	12	-	12	12	12	12	12	1	12	12	12
Basagran	NR	NR	-	NR	NR	NR	NR	NR	NR	NR	NR	NR
Boundary	12	12	NR	12	8	12	12	12	8	4.5	12	4.5
Canopy EX	18	9	NR	30	18	9 [b]	9 [b]	18	30	3	3	3
Classic (a)	18	9	-	30	18	9	9	18	30	3	3	3
Cobra	NR	NR	-	NR	NR	NR	NR	NR	NR	NR	NR	NR
Command (a)	NR	9	-	9	9	NR	9 [b]	12	9	12	12	12
Dual II Magnum/Cinch	SY	NR	-	SY	NR	NY	6	SY	NR	4.5	4.5	4.5
Extreme	40 [d]	4	NR	40 [d]	18	9.5	26 [b]	26	26	9.5	4	3
FirstRate/Amplify (a)	30 [d]	9	-	30 [d]	18	30 [d]	30 [d]	30 [d]	18	30 [d]	30 [d]	3
Flexstar	18	10	-	18	10	18	18	18	18	4	4	4
Fusilade DX/Fusion	NR	NR	-	NR	2	NR	NR	NR	NR	2	2	2
Gauntlet	30 [d]	30	NR	30 [d]	18	30	30 [d]	30 [d]	30 [d]	12	12	4
Harmony Extra XP	1.5	1.5	-	1.5	1.5	1.5	1.5	1.5	1.5	NR	1.5	NR
Harmony GT XP	1.5	1.5	NR	1.5	1.5	1.5	1.5	1.5	1.5	NR	1.5	NR
Linex/Lorox	4	4	-	4	4	4	4	4	4	4	4	4
MicroTech	NY	NY	-	NR	NR	NY	NY	NY	NY	AH	AH	AH

Rotational crops (months after application) - Pumpkins to Winter wheat (continued)

Herbicide	Pumpkins	Snap beans	Soybeans	Squash	Sweet corn	Tobacco	Tomatoes	Water melon	White potatoes	Winter barley	Winter rye	Winter wheat
Outlook	NY	NY	NR	NY	NY	NY	NY	NY	NY	4	4	4
Poast Plus/Poast	NR	NR	-	NR	NR	NR	NR	NR	NR	NR	NR	NR
Prowl	NY	NR	-	NY	NY	NR	NY	NY	NR	4	NY	4
Pursuit (a)	40 [d]	4	NR	40 [d]	18	9.5	40 [b]	40	26	9.5	4	4
Python	26 [d]	4 [d]	-	26 [d]	18	9	26 [d]	26 [d]	12	4	4	4
Raptor	9	NR	NR	9	8.5	9	9	9	9	4	4	3
Reflex	18	10	-	18	10	18	18	18	18	4	4	4
Resource	1	1	-	1	1	1	1	1	1	4	4	4
Roundup Weather Max (j)	NR	NR	-	NR	NR	NR	NR	NR	NR	NR	NR	NR
Scepter (a)	18	11	-	18	18	9.5	18	18	18	11	18	3
Select	1	1	-	1	1	1	1	1	1	1	1	1
Sencor	12	12	-	12	4	12	4	12	12	4	12	4
Sonalan	AH	AH	-	AH	AH	AH	AH	AH	AH	AH	AH	AH
Stellar	1	1	-	1	1	1	1	1	1	4	4	4
Storm	AH	AH	-	AH	AH	AH	AH	AH	18	AH	AH	AH
Synchrony XP	18	12	NR	18	18	10 [b]	10 [b]	18	18	4	4	4
Targa	4	NR	-	4	4	4	4	4	4	4	4	4
Touchdown Total/ Touchdown HiTech (j)	NR	NR	-	NR	NR	NR	NR	NR	NR	NR	NR	NR
Treflan	5	NR	-	5	5	5	NR [b]	5	NR	NR	NR	NR
Ultra Blazer	AH	AH	NR	AH	AH	AH	AH	AH	AH	AH	AH	AH
Valor	12 [d]	12 [d]	NR	12 [d]	4	2	12 [d]	12 [d]	12 [d]	4	4	2

Key: AH = After Harvest; B- Bioassay; NL - Not Listed; NR - No Restriction; NY - Next Year; SY - Second Year following application.

[a] Read the label for additional restrictions due to rate, rainfall, soil, pH, application rate and so forth.

[b] Transplanted.

[c] Corn hybrids, which are classified as tolerant (IT) or resistant (IR) to Scepter and/or other imidazolinone herbicides (for example, Pursuit), may be planted the spring of the year following the Scepter or Pursuit application regardless of rainfall or time interval from chemical treatment to corn planting.

[d] Plus successful field bioassay.

[e] Treated seed.

[f] 30 months in Pennsylvania.

[g] 12 months in Pennsylvania.

[h] In Virginia: alfalfa-9 months, cotton-8 months, field corn-8 months.

[i] Plant below herbicide zone.

[j] Other formulations of glyphosate are available.

Soybeans--postemergence overtop broadleaf herbicide rate chart [a]

Weed	Maximum leaf number [b]	Basagran (pints)	Classic (ounces)	Cobra (ounces)	FirstRate (ounces)	Flexstar (pints)	Harmony GT XP (ounces)	Pursuit (ounces)	Raptor (ounces)
Balloonvine	2	1.5	- [c]	12.5	-	1.25	-	-	-
	4	1.5-2.0	-	12.5	-	1.5	-	-	-
	6	2.0	-	-	-	-	-	-	-
Beggarweed (Florida)	2	-	0.50	12.5	-	-	-	-	-
	3	-	0.50	-	-	-	-	-	-
	4	-	0.67	-	-	-	-	-	-
	6	-	0.75	-	-	-	-	-	-
Burcucumber	3	-	0.67 [d,e]	12.5	-	-	0.08	-	-
	4	-	0.75 [d,e]	12.5	-	-	0.08	-	-
Cocklebur	2	1.0-1.5	0.5	12.5	0.3	1.0	0.08 [d]	4.0	5.0
	4	1.0-1.5	0.5	12.5	0.3	1.0	0.08 [d]	4.0	5.0
	5	1.5	0.5	12.5	0.3	1.25	0.08 [d]	4.0	5.0
	6	1.5-2.0	0.5	12.5	0.3	1.25	0.08 [d]	4.0	5.0
	8	2.0	0.67	-	0.3	1.5	-	4.0	5.0
	10	2.0	0.75	-	-	-	-	-	-
Cowpea	1	-	0.67 [d,e]	-	-	-	-	-	-
	3	-	0.67 [d,e]	-	-	-	-	-	-
	4	-	0.75 [d,e]	-	-	-	-	-	-
Crotalaria	4	-	-	-	-	1.0-1.25	-	-	-
	6	-	-	-	-	1.0-1.25	-	-	-
Croton (tropic)	1	1.5	-	12.5	-	1.0-1.25	-	-	-
	2	1.5-2.0	-	12.5	-	1.0-1.25	-	-	-
	4	2.0	-	12.5	-	1.0-1.25	-	-	-
	6	-	-	-	-	1.5	-	-	-
Jimsonweed	4	1.5	0.5	12.5	0.3	1.0	0.08 [d]	4.0	5.0
	5	1.5	0.67	-	-	1.0	0.08 [d]	-	5.0
	6	1.5-2.0	0.75	-	-	1.0	-	-	5.0
	8	2.0	-	-	-	1.25-1.5	-	-	-
	10	2.0	-	-	-	-	-	-	-
	12	-	-	-	-	-	-	-	-
Lambsquarters	2	2.0 [g,I]	-	-	-	-	0.08	4.0	5.0
	3	2.0 [g,I]	-	-	-	-	0.08	-	5.0
	4	2.0 [g,I]	-	-	-	-	0.08	-	5.0
	6	2.0 [g,I]	-	-	-	-	0.08	-	-
	8	2.0 [g,I]	-	-	-	-	0.08	-	-

Soybeans--postemergence overtop broadleaf herbicide rate chart [a] (continued)

Weed	Maximum leaf number [b]	Basagran (pints)	Classic (ounces)	Cobra (ounces)	FirstRate (ounces)	Flexstar (pints)	Harmony GT XP (ounces)	Pursuit (ounces)	Raptor (ounces)
Morningglory (entireleaf)	2	1.5 [j]	0 50 [e]	12.5 [g]	0.3	1.0	-	4.0	5.0
	3	1.5 [j]	0.67 [e]	-	0.3	1.0	-	-	5.0
	4	1.5 [j]	0.75 [e]	-	0.3	1.25	-	-	5.0
Morningglory (ivyleaf)	2	1.5 [j]	0.50 [e]	12.5 [g]	0.3	1.0	-	4.0	5.0
	3	1.5 [j]	0.75 [e]	-	0.3	1.0	-	-	5.0
	4	1.5 [j]	-	-	0.3	1.25	-	-	5.0
Morningglory (pitted)	2	1.5 [j]	0.50 [e]	12.5 [g]	0.3	1.0	-	4.0	-
	3	1.5 [j]	0.67	12.5 [g]	0.3	1.0	-	-	-
	4	1.5 [j]	0.75	12.5 [g]	0.3	1.0	-	-	-
	8	-	-	-	-	-	-	-	-
Morningglory (tall)	2	1.5 [j]	0.50 [e]	12.5 [g]	0.3	1.0	-	4.0	5.0
	3	1.5 [j]	0.75 [e]	12.5 [g]	0.3	1.25	-	-	5.0
	4	1.5 [j]	-	12.5 [g]	0.3	1.5	-	-	5.0
Nightshade (black)	2	-	-	12.5	-	1.0	-	4.0	5.0
	4	-	-	12.5	-	1.0	-	4.0	5.0
	6	-	-	12.5	-	1.25-1.5	-	-	-
	8	-	-	-	-	-	-	-	-
Pigweed (redroot)	2	-	0.50	12.5	-	1.0	0.08	4.0	5.0
	4	-	0.50	12.5	-	1.0	0.08	4.0	5.0
	5	-	0.67	12.5	-	1.25	0.08	4.0	5.0
	6	-	0.75	12.5	-	1.25	0.08	4.0	5.0
	8	-	-	-	-	1.5	0.08	4.0	5.0
Ragweed (common)	2	2.0 [g]	0.67	12.5	0.3	1.0	-	4.0	5.0
	4	2.0 [g]	0.67	12.5	0.3	1.0	-	4.0	5.0
	5	2.0 [g]	0.67	12.5	0.3	1.25	-	-	5.0
	6	2.0 [g]	0.75	12.5	0.3	1.25	-	-	-
	8	-	-	12.5	0.3	1.5	-	-	-
Ragweed (giant)	2	2.0	0.75 [e]	12.5	0.3	1.0	-	4.0	5.0
	4	2.0	0 75 [e]	12.5	0.3	1.0	-	4.0	5.0
	6	-	0.75 [e]	12.5	0.3	1.25	-	-	-
Sesbania (hemp)	3	2.0	0.50	12.5	-	1.0	-	-	-
	4	2.0	0.67	12.5	-	1.0	-	-	-
	5	2.0	0.75	12.5	-	1.0	-	-	-
	6	-	-	12.5	-	1.0	-	-	-
	12	-	-	-	-	1.25-1.5	-	-	-

Soybeans--postemergence overtop broadleaf herbicide rate chart [a] (continued)

Weed	Maximum leaf number [b]	Basagran (pints)	Classic (ounces)	Cobra (ounces)	FirstRate (ounces)	Flexstar (pints)	Harmony GT XP (ounces)	Pursuit (ounces)	Raptor (ounces)
Sicklepod	1	-	0.50 [e]	12.5 [d]	0.3	-	-	-	-
	2	-	0.67 [e]	12.5 [d]	-	-	-	-	-
	3	-	0.75 [e]	-	-	-	-	-	-
Sida (prickly)	4	1.5	-	12.5	-	1.5	-	-	-
	6	1.5-2.0	-	-	-	-	-	-	-
	8	2.0	-	-	-	-	-	-	-
Smartweed	4	1.5	0.5	12.5 [d]	0.3	1.0	0.08	4.0	5.0
	5	1.5	0.67	-	-	1.25-1.5	0.08	-	5.0
	6	1.5-2.0	0.75	-	-	1.25-1.5	0.08	-	-
	8	2.0	-	-	-	-	0.08	-	-
	10	2.0	-	-	-	-	0.08	-	-
Spurred anoda	2	1.5	-	12.5 [d]	-	-	-	-	-
	4	1.5	-	-	-	-	-	-	-
	6	1.5-2.0	-	-	-	-	-	-	-
	8	2.0	-	-	-	-	-	-	-
Velvetleaf	2	1.5 [l]	0.67 [e,l]	12.5 [f]	0.3	1.25-1.5	0.08 [l]	4.0	5.0
	4	1.5-2.0 [l]	0.67 [e,l]	12.5 [f]	0.3	1.25-1.5	0.08 [l]	4.0	5.0
	6	2.0	0.67 [e,l]	-	-	-	0.08 [l]	-	5.0
	8	-	0.75 [e,l]	-	-	-	0.08 [l]	-	5.0

a Taken from product labels. See labels for recommended adjuvants.

b Do not count cotyledons as leaves.

c means control not claimed on label.

d Label claims only partial control or suppression.

e See label for special use directions concerning split applications.

f See label for special use directions.

g Add crop oil concentrate according to label.

h Apply 1 to 1.5 pints Ultra Blazer per acre plus 2 pints nonionic surfactant per 100 gallons spray solution anytime before weed begins blooming.

I Control may be inconsistent.

j Label claims control only with two applications, second application of same rate 5 to 14 days after first.

k Label claims control only with sequential application, preplant incorporated or preemergence followed by postemergence.

l Label recommends addition of liquid nitrogen. See label.

m Other formulations of glyphosate are available.

Soybeans--postemergence overtop broadleaf herbicide rate chart [a] (continued)

Weed	Maximum leaf number [b]	Reflex (pints)	Resource (ounces)	Roundup Weather Max [m] (ounces)	Stellar (ounces)	Storm (pints)	Synchrony XP (ounces)	Touchdown [m] Total (pints)	Ultra Blazer (pints)
Balloonvine	2	-	-	-	-	-	-	-	1.5
	4	-	-	-	-	-	-	-	-
	6	-	-	-	-	-	-	-	-
Beggarweed (Florida)	2	-	-	-	-	-	-	-	1.5
	3	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	-	-	-
	6	-	-	-	-	-	-	-	-
Burcucumber	3	-	-	16	-	-	0.75	1.5	-
	4	-	-	16	-	-	0.75	1.5	-
Cocklebur	2	1.25	-	16	5.0	1.5	0.75	1.5	1.5
	4	1.25	-	16	7.0	1.5	0.75	1.5	-
	5	-	-	16	-	1.5	0.75	1.5	-
	6	-	-	16	-	1.5	0.75	1.5	-
	8	-	-	16	-	-	0.75	1.5	-
	10	-	-	16	-	-	-	1.5	-
Cowpea	1	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	-	-	-
Crotalaria	4	1.0	-	-	-	1.5	-	1.5	1.0-1.5 [h]
	6	1.5	-	-	-	1.5	-	1.5	1.0-1.5 [h]
Croton (tropic)	1	1.0	-	-	-	1.5	-	1.5	1.0
	2	1.0	-	-	-	1.5	-	1.5	1.5
	4	1.5	-	-	-	-	-	-	-
	6	-	-	-	-	-	-	-	-
Jimsonweed	4	1.0	8.0	16	7.0	1.5	0.75	1.5	1.0
	5	1.25	-	16	-	1.5	0.75	1.5	1.5
	6	1.25	-	16	-	1.5	-	1.5	1.5
	8	1.5	-	16	-	-	-	1.5	-
	10	-	-	16	-	-	-	1.5	-
	12	-	-	16	-	-	-	1.5	-
Lambsquarters	2	1.5	-	16	-	1.5	0.75	1.5	2.0 [h,i]
	3	-	-	16	-	1.5 [i]	0.75	1.5	2.0 [h,i]
	4	-	-	16	-	1.5 [i]	0.75	1.5	-
	6	-	-	16	-	1.5 [i]	0.75	1.5	-
	8	-	-	16	-	-	0.75	1.5	-

Soybeans--postemergence overtop broadleaf herbicide rate chart [a] (continued)

Weed	Maximum leaf number [b]	Reflex (pints)	Resource (ounces)	Roundup Weather Max [m] (ounces)	Stellar (ounces)	Storm (pints)	Synchrony XP (ounces)	Touchdown [m] Total (pints)	Ultra Blazer (pints)
Morningglory (entireleaf)	2	1.0	-	16	-	1.5	0.75	1.5	1.0
	3	1.5	-	16	-	1.5	0.75	1.5	1.5
	4	-	-	16	-	1.5	-	1.5	1.5
Morningglory (ivyleaf)	2	1.5	-	16	-	1.5	0.75	1.5	1.0
	3	-	-	16	-	1.5	0.75	1.5	1.5
	4	-	-	16	-	1.5	-	1.5	1.5
Morningglory (pitted)	2	1.5	-	16	-	1.5	0.75	1.5	1.0
	3	1.5	-	16	-	1.5	0.75	1.5	1.5
	4	1.5	-	16	-	1.5	-	1.5	1.5
	8	-	-	16	-	-	-	2.0	-
Morningglory (tall)	2	1.0	-	16	-	1.5	0.75	1.5	1.0
	3	1.5	-	16	-	1.5	0.75	1.5	1.5
	4	1.5	-	16	-	1.5	-	1.5	1.5
Nightshade (black)	2	1.0-1.25 [d]	-	16	5.0	1.5	-	1.5	1.0
	4	1.0-1.25 [d]	-	16	-	1.5	-	1.5	1.5
	6	-	-	16	-	1.5	-	1.5	1.5
	8	-	-	16	-	-	-	1.5	-
Pigweed (redroot)	2	1.0	8.0	16	5.0	1.5	0.75	1.5	0.5
	4	1.0	-	16	5.0	1.5	0.75	1.5	0.5
	5	1.5	-	16	5.0	1.5	0.75	1.5	1.0
	6	1.5	-	16	5.0	1.5	0.75	1.5	1.0-1.5
	8	-	-	16	-	-	0.75	1.5	-
Ragweed (common)	2	1.0	4.0	16	5.0	1.5	0.75	1.5	1.0
	4	1.0	6.0	16	5.0	1.5	0.75	1.5	1.5
	5	1.5	8.0	16	5.0	1.5	-	1.5	-
	6	1.5	8.0	16	5.0	1.5	-	1.5	-
	8	-	-	16	-	-	-	1.5	-
Ragweed (giant)	2	-	-	16	5.0	1.5	0.75	1.5	1.0-1.5
	4	-	-	16	7.0	1.5	0.75	1.5	-
	6	-	-	16	-	-	-	1.5	-
Sesbania (hemp)	3	1.0	-	22	-	1.5	-	2.0	1.0 [h]
	4	1.0	-	22	-	1.5	-	2.0	1.0 [h]
	5	1.0	-	-	-	-	-	-	1.5 [h]
	6	1.0	-	-	-	-	-	-	1.5 [h]
	12	1.5	-	-	-	-	-	-	-

Soybeans--postemergence overtop broadleaf herbicide rate chart [a] (continued)

Weed	Maximum leaf number [b]	Reflex (pints)	Resource (ounces)	Roundup Weather Max [m] (ounces)	Stellar (ounces)	Storm (pints)	Synchrony XP (ounces)	Touchdown [m] Total (pints)	Ultra Blazer (pints)
Sicklepod	1	-	-	16	-	-	0.75	1.5	-
	2	-	-	16	-	-	0.75	1.5	-
	3	-	-	22	-	-	-	2.0	-
Sida (prickly)	4	-	8.0	16	-	1.5 [i]	-	1.5	-
	6	-	-	16	-	-	-	1.5	-
	8	-	-	16	-	-	-	2.0	-
Smartweed	4	1.5	-	16	-	1.5	0.75	1.5	1.0
	5	-	-	16	-	1.5	0.75	1.5	1.5
	6	-	-	16	-	1.5	0.75	1.5	1.5
	8	-	-	16	-	-	-	2.0	-
	10	-	-	16	-	-	-	2.0	-
Spurred anoda	2	1.5	-	16	-	1.5 [i]	-	1.5	-
	4	-	-	16	-	1.5 [i]	-	1.5	-
	6	-	-	22	-	-	-	2.0	-
	8	-	-	22	-	-	-	2.0	-
Velvetleaf	2	1.5	4.0	16	5.0	1.5 [i]	0.75	1.5	-
	4	-	4.0	16	5.0	1.5 [i]	0.75	1.5	-
	6	-	4.0	16	5.0	-	0.75	1.5	-
	8	-	6.0	16	-	-	0.75	1.5	-

a Taken from product labels. See labels for recommended adjuvants.

b Do not count cotyledons as leaves.

c means control not claimed on label.

d Label claims only partial control or suppression.

e See label for special use directions concerning split applications.

f See label for special use directions.

g Add crop oil concentrate according to label.

h Apply 1 to 1.5 pints Ultra Blazer per acre plus 2 pints nonionic surfactant per 100 gallons spray solution anytime before weed begins blooming.

I Control may be inconsistent.

j Label claims control only with two applications, second application of same rate 5 to 14 days after first.

k Label claims control only with sequential application, preplant incorporated or preemergence followed by postemergence.

l Label recommends addition of liquid nitrogen. See label.

m Other formulations of glyphosate are available.

Soybeans--application rates and perennial grass sizes [a]

Herbicide	Weed	Weed size and herbicide rate[b] (oz/ A)	
		First Application	Second Application[c]
Fusilade DX [d]	Rhizome johnsongrass	8 to 18 inches	6 to 12 inches
		16-24 oz	12-24 oz
	Bermudagrass	4 to 8 inches	4 to 8 inches
		16-24 oz	12-24 oz
Poast	Rhizome johnsongrass	20 to 25 inches	12 inches
		24 oz	16 oz
	Bermudagrass	6-inch stolon	4-inch stolon
		24 oz	16 oz
Poast Plus	Rhizome johnsongrass	15 to 25 inches	6 to 12 inches
		24 oz	24 oz
	Bermudagrass	6 inches or 6-inch diameter	1 to 4 inches
		36 oz	24 oz
Select	Rhizome johnsongrass	12 to 24 inches	6 to 18 inches
		8-10 oz	6-8 oz
	Bermudagrass	3 inches	3 to 6 inches
		8-16 oz	8-16 oz
Targa	Rhizome johnsongrass	10 to 24 inches	6 to 10 inches
		10 oz	7 oz
	Bermudagrass	up to 6 inches	up to 6 inches
		10 oz	7 oz

[a] Taken from product labels.

[b] Weed size refers to height of johnsongrass and length of bermudagrass runners in inches.

[c] Make second application only if needed to control regrowth or new plants. Size refers to regrowth or new plants.

[d] Do not apply more than 32 ounces total per acre per season to soybeans.

Soybeans--application rates and annual grass sizes [a]

Species	Fusilade DX		Fusion		Poast		Poast Plus	
	Height (inches)	Rate (ounces per acre)	Height (inches)	Rate (ounces per acre)	Height (inches)	Rate (ounces per acre)	Height (inches)	Rate (ounces per acre)
Barnyardgrass	2-3	12	2-3	8	8	16	3-8	24
Crabgrass	1-2	12	1-2	8	6	16	3-6	24
Crowfootgrass	- [b]	-	-	-	-	-	- [b]	-
Foxtail (giant)							4-8	24
Foxtail (giant)	2-6	12	2-6	8	8	16	1-4	18
Foxtail (green)							4-8	24
Foxtail (green)	2-4	12	2-4	8	8	16	1-4	18
Foxtail (yellow)	2-4	12	2-4	8	8	16	1-8	24
Goosegrass							3-6	24
Goosegrass	2-4	8	2-4	8	6	16	1-3	18
Johnsongrass seedlings	2-8	6	2-8	6	8	16	1-8	24
Panicum (fall)							3-8	24
Panicum (fall)	2-6	12	2-6	6	8	16	1-4	18
Panicum (Texas)	2-8	12	2-8	8	8	16	1-4	18
Panicum (Texas)							4-8	24
Sandbur (field)	2-4	12	2-4	8	3	20	-	-
Shattercane	6-12	6	6-12	6	18	16	6-18	24
Signalgrass (broadleaf)	2-4	12	2-4	8	8	16	1-4	18
Signalgrass (broadleaf)							4-8	24
Volunteer corn							12-20	24
Volunteer corn	12-24	6	12-24	6	20	16	1-12	18

[a] Taken from product labels.

[b] - means control not claimed on label.

Soybeans--application rates and annual grass sizes [a] (continued)

Species	Pursuit		Raptor		Select		Targa	
	Height (inches)	Rate (ounces per acre)	Height (inches)	Rate (ounces per acre)	Height (inches)	Rate (ounces per acre)	Height (inches)	Rate (ounces per acre)
Barnyardgrass	1-3	4.0	2-5	5	2-8	6-8	2-6	8
Crabgrass	1-3	4.0	-	-	2-6	6-8	2-6	8
Crowfootgrass	-	-	-	-	2-6	6-8	2-6	7
Foxtail (giant)	1-6	4.0	2-6	5	2-12	6-8	2-8	7
Foxtail (green)	1-3	4.0	2-6	5	2-8	6-8	2-4	7
Foxtail (yellow)	1-3	4.0	2-6	5	2-8	6-8	2-4	7
Goosegrass	-	-	-	-	2-6	6-8	2-6	7
Johnsongrass seedlings	1-8	4.0	4-8	5	4-10	6-8	2-8	5
Panicum (fall)	-	-	2-6	5	2-8	6-8	2-6	7
Panicum (Texas)	-	-	-	-	2-6	6-8	2-4	8
Sandbur (field)	-	-	-	-	2-6	6-8	2-6	7
Shattercane	1-8	4.0	2-8	5	6-18	6-8	6-12	5
Signalgrass (broadleaf)	1-8	4.0	-	-	2-6	6-8	2-6	8
Volunteer corn	-	-	2-8	5	4-18	4-8	6-18	5

[a] Taken from product labels.

[b] - means control not claimed on label.

Soybeans--feeding restrictions on soybean hay following treatment with various herbicides [a]

Herbicide	Hay		Seed
	Do not feed	No restrictions	Preharvest
2,4-D	x	-	-
2,4-DB	60 days [b]	-	60 days
Axiom	x	-	-
Basagran	30 days	x	-
Boundary	40 days	-	-
Canopy EX	x	-	45 days
Classic	x	-	60 days
Cobra	x	-	45 days
Command	x	-	-
Dual II Magnum/Cinch	x	-	-
Extreme	x	-	85 days
FirstRate	14 days	-	65 days
Flexstar	x	-	Before bloom
Fusilade DX	x	-	Before bloom
Fusion	x	-	Before bloom
Gramoxone Inteon	x	-	— [e]
Harmony GT XP	x	-	60 days
Liberty	45 days	-	45 days
Linex/Lorox preemergence	-	x	-
MicroTech	40 days	x [c]	-
Outlook	x	-	-
Poast Plus/Poast	-	x	75 days
Prowl	-	x	-
Pursuit	x	-	85 days
Python	x	-	-
Raptor	x	-	85 days
Reflex	x	-	Before bloom
Resource	x	-	60 days
Roundup Weather Max (regular soybeans-preharvest label) [f]	25 days	-	7 days
Roundup Weather Max (Roundup-Ready soybeans) [f]	14 days	-	14 days

[a] These restrictions apply to soybean hay. For feeding of green forage, see labels as restrictions may be different.

[b] Minimum time between application and hay making.

[c] Do not feed if MicroTech is applied after crop emergence.

[d] Do not apply after pod set.

[e] When at least 65 percent of the seed pods have reached a mature brown or when seed moisture is 30 percent or less.

[f] Other glyphosate formulations are available.

Soybeans--feeding restrictions on soybean hay following treatment with various herbicides [a] (continued)

Herbicide	Hay		Seed
	Do not feed	No restrictions	Preharvest
Scepter	x	-	90 days
Select	x	-	60 days
Sencor	40 days	-	-
Sonalan	x	-	-
Stellar	x	-	80 days
Storm	x	-	50 days
Synchrony XP	x	-	60 days
Targa	x	-	80 days [d]
Touchdown Total or Touchdown HiTech(regular soybeans–preharv [f]	25 days	-	7 days
Touchdown Total or Touchdown HiTech(Roundup-Ready soybeans) [f]	x	x	14 days
Treflan	-	x	-
Ultra Blazer	x	-	50 days
Valor	x	-	-

[a] These restrictions apply to soybean hay. For feeding of green forage, see labels as restrictions may be different.

[b] Minimum time between application and hay making.

[c] Do not feed if MicroTech is applied after crop emergence.

[d] Do not apply after pod set.

[e] When at least 65 percent of the seed pods have reached a mature brown or when seed moisture is 30 percent or less.

[f] Other glyphosate formulations are available.

Approved tank-mixes for soil-applied herbicides in soybeans [a]

■ = approved tank-mixes.[b] See individual labels for specific mixtures that may be prohibited and for specific application rate and timing information.

	Command	Dual II Magnum / Cinch	Linex/ Lorox	MicroTech	Outlook	Prowl	Pursuit	Scepter	Sencor	Treflan
Command		■	■	■	■	■		■	■	
Dual II Magnum/Cinch	■		■			■	■	■	■	■
FirstRate		■			■		■			■
Linex/Lorox	■	■		■	■	■	■		■	
MicroTech	■		■			■	■	■	■	■
Outlook	■		■			■	■	■	■	■
Prowl	■	■	■	■	■		■	■	■	
Pursuit		■	■	■	■	■			■	■
Python [c]										
Scepter	■	■		■	■	■				■
Sencor	■	■	■	■		■	■	■		■
Treflan		■		■			■		■	
Valor								■		

PREMIXES

Axiom			■					■	■	■
Boundary	■					■		■	■	

NOTE: Unless specifically prohibited on product lables, other tank-mix combinations may be appropriate for use.

[a] Roundup Weather Max, Gramoxone Max, Touchdown, or 2,4-D may be tank-mixed with many of these products for increased burndown in conservation tillage systems. See burndown herbicide section for more information about these potential tank-mix partners.

[b] Tank-mix is approved on either one or both herbicide labels. See product labels for more information.

[c] Tank-mixing Python with other herbicides is allowed; however, no specific partners are stated in the product label. When tank-mixing, read and follow the product labels for important information on herbicide use.

[d] Tank-mixing with other herbicides is allowed; however, no specific partners are stated on the product label.

Soybeans - conventional tillage

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Cocklebur, lambsquarters, marestail, pigweed spp., common ragweed, smartweed, and velvetleaf, and suppression of the following - annual grasses (foxtails, barnyardgrass, crabgrass spp., fall panicum), common chickweed, jimsonweed, morningglory spp., yellow nutsedge, prickly side, and giant ragweed	Chlorimuron 0.21-0.64 oz + thifensulfuron 0.07-0.21 oz	Synchrony XP 28.4DG 1.0-3.0 oz	Apply to either conventional, reduced till, or no-till plantings. In reduced tillage and no-tillage plantings, Synchrony XP will also provide burndown control of many existing winter annual and summer annual weeds. Burndown applications shoujld include a crop oil concentrate at 1% v/v and be made in a minimum of 20 gallons per acre. The addition of 2,4-D LVE at 1 pint/acre will enhance burndown control. The addition of 2,4-D LVE is required with the 1.0 oz/acre rate and is recommended for all other rates. Do not apply more than 1.5 oz/acre of Synchrony XP to soils with composite pH greater than 7.0.
Preplant			
Johnsongrass (rhizome)	Glyphosate 1.0-2.0 lb	Roundup Weather Max 0.7-1.4 qt or Touchdown Total 0.75-1.5 qt or other labeled glyphosate formulation	Use in 10 to 40 gallons of water per acre. Spray when johnsongrass is 24 to 30 inches high and in boot to head stage. Rainfall within 1 hour may reduce effectiveness. Allow at least 7 days before plowing. Use one of the preplant incorporated herbicides for johnsongrass seedling control before planting. Do not feed or forage treated crops within 8 weeks after application. Touchdown Total is available as a non-surfactant containing formulation called Touchdown HiTech. Other glyphosate formulations are available.

Soybeans - conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preplant incorporated			
Barnyardgrass, carpetweed, crabgrass, foxtail (giant, green, and yellow), galinsoga, goosegrass, nutsedge (yellow), panicum (fall), pigweed, and signalgrass (broadleaf)	s-metolachlor 0.95-1.6 lb	Dual II Magnum/Cinch 7.64 EC 1.0-1.67 pt	If used preplant incorporated, incorporate not more than 2 inches deep within 14 days before planting. Apply before weeds or crop emerges. Observe all precautions, rates of application, and weeds controlled on the respective labels. The s-metolachlor plus metribuzin combination may be applied as the prepackaged mix Boundary (1.5 to 3.5 pints per acre).
	Approved combinations: Tank-mix with Sencor or Scepter; preemergence with Linex/Lorox, Scepter, or Sencor		
Barnyardgrass, carpetweed, crabgrass, foxtail (giant, green, and yellow), goosegrass, nutsedge (yellow), panicum (fall), pigweed spp., pusley (Florida), signalgrass, and witchgrass	Dimethenamid-p 0.66-0.98 lb	Outlook 6.0EC 14.0-21.0 oz	Apply Outlook and incorporate into the upper 1.0 to 2 inches of the soil surface. Temporary growth suppression may occur under extreme conditions of high rainfall and extended periods of water-saturated soils. Not recommended for coarse soils with less than 1.5 percent organic matter.
	Approved combinations: Tank-mix with Scepter or Sencor		
Barnyardgrass, carpetweed, crabgrass, foxtail (giant, green, and yellow), goosegrass, johnsongrass (seedling), lambsquarters, panicum (fall), pigweed, signalgrass, smartweed, spurges, and wild cane or shattercane	Pendimethalin 0.5-1.5 lb	Prowl 3.33 EC 0.6-1.8 qt or Prowl H2O 3.8CS 0.5-1.5 qt	Adjust rate to soil texture. Incorporate 1.0 to 2 inches deep within 7 days after application. Soybeans may be planted immediately. Observe all precautions, rates of application, and weeds controlled on the respective labels.
	Approved combinations: Tank-mix with Scepter or Sencor; preemergence with Linex/Lorox or Sencor		

Soybeans - conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preplant incorporated (continued)			
Cocklebur, foxtail (giant, green, and yellow), jimsonweed, johnsongrass (seedling), lambsquarters, pigweed spp., ragweed (common), sida (prickly) or teaweed, smartweed, velvetleaf, and suppression of burcucumber, morningglory spp., and ragweed (giant)	Imazaquin 0.125 lb	Scepter 70DG 2.8 oz	Apply before planting and incorporate uniformly into the top 1 to 2 inches of soil. Observe labeled rotational crop restrictions. Do not graze or feed treated soybean forage, hay, or straw to livestock. Injury in the form of stunting and leaf discoloration may occur with some soybean varieties under certain adverse weather conditions.
Cocklebur and pigweed only	Imazaquin 0.095 lb	Scepter 70DG 2.15 oz	
	Approved combinations: Tank-mix with Dual II Magnum/Cinch, Outlook, Prowl, or Treflan		
Barnyardgrass, Brachiaria, bromegrass, carpetweed, crabgrass, foxtail (giant, green, and yellow), goosegrass, johnsongrass (seedling), lambsquarters, panicum (fall, Texas), pigweed, purslane, pusley (Florida), sandbur, stinkgrass, wild cane or shattercane	Trifluralin 0.5-1.0 lb	Treflan HFP 4EC 1.0-2.0 pt	Incorporate immediately with tandem disk set to cut 4 to 6 inches or within 24 hours after application. Use lower rates on sandy and sandy loam soils and higher rates on loam and silt loam soils. Plant soybeans after early season adverse weather has passed. Do not plant deeper than 2 inches. Follow label for proper soil incorporation procedures. Observe all precautions, rates of application, and weeds controlled on the respective labels.
	Approved combinations: Tank-mix with Scepter or Sencor; preemergence with Linex/Lorox, Scepter, or Sencor		

Soybeans - conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preplant incorporated (continued)			
Johnsongrass control and above annual weeds for respective chemicals	Trifluralin 1.0-2.0 lb or Pendimethalin 1.0-2.0 lb	Treflan HFP 4EC 2.0-4.0 pt or Prowl 3.33 EC 1.2-2.4 qt	In the fall (preferably) or early spring, bring johnsongrass rhizome to soil surface by moldboard plow, spring tooth harrow, or chisel plow. Thoroughly disk soil before treatment to cut johnsongrass rhizome into 2- to 3-inch pieces. Apply herbicide to well-worked, dry-surfaced soil. Apply in spring at the rate suggested for your soil and thoroughly incorporate with a tandem disk set to cut 4 to 6 inches deep and operated at 4 to 6 miles per hour and cross disk. Soybeans can be planted immediately. Cultivate at least once during growing season. Usually requires two annual applications for effective control. Follow label as to rotational crops that may be safely grown. Use a johnsongrass seedling control herbicide the succeeding year.
Wild cane or shattercane control and above annual weeds for respective chemicals	Trifluralin 0.5-1.25 lb	Treflan HFP 4EC 1.0-2.5 pt	Follow soil preparation, mixing, application, and incorporation instructions listed above.
Preemergence			
Barnyardgrass, carpetweed, crabgrass, foxtail (giant, green, yellow), galinsoga, goosegrass, panicum (fall), purslane	Flufenacet + metribuzin 0.3-0.55 lb	Axiom 68DF 7.0-13.0 oz	Apply Axiom alone or in combination with recommended tank-mixes as a broadcast spray. Do not apply aerially. Can be applied up to 14 days preplant. Do not use on sandy soils with less than 1.0 percent organic matter.
	Approved combinations: Tank-mix with Linex/Lorox, Scepter, or Sencor		

Soybeans - conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preemergence (continued)			
Anoda (spurred), barnyardgrass, crabgrass, foxtail (giant, green, and yellow), goosegrass, johnsongrass (seedling), lambsquarters, panicum (fall), purslane, sandbur (field), sida (prickly), signalgrass (broadleaf), smartweed, and velvetleaf	Clomazone 0.5-1.0 lb	Command 3ME 1.33-2.66 pt	Apply in a minimum spray volume of 10 gallons per acre. Do not apply within 1,200 feet of areas listed on the label. Do not exceed 30 psi spray pressure. Off-site movement of spray drift or vapors of Command 3ME can cause foliar whitening or yellowing of some plants.
	Approved combinations: Tank-mix with Scepter or Sencor		
Barnyardgrass, beggarweed, carpetweed, crabgrass, foxtail (giant, green, and yellow), galinsoga, goosegrass, nutsedge (yellow), panicum (fall), pigweed, pusley (Florida), signalgrass, and witchgrass	s-metolachlor 0.95-1.6 lb	Dual II Magnum/Cinch 7.64 EC 1.0-1.67 pt	Apply before, during, or after planting but before weeds or crop emerges. May be incorporated into the top 2 inches of soil within 14 days before planting. Small grains may be planted 4.5 months after treatment. Do not graze or feed forage or fodder from small grains or soybeans. Observe all precautions, rates of application, and weeds controlled on the respective labels. Do not use metribuzin on coarse-textured, coastal plain soils. The s-metolachlor plus metribuzin combination may be applied as the prepackaged mix Boundary (1.5 to 3.0 pints per acre).
	Approved combinations: Tank-mix with Linex/Lorox, Scepter, or Sencor; preplant incorporated with Scepter, Sencor, or Treflan		
Cocklebur, horseweed, jimsonweed, lambsquarters, morningglory spp., pigweed spp., ragweed (common, giant), smartweed, velvetleaf, venice mallow	Cloransulam-methyl 0.032-0.040 1b	Firstrate 84DF 0.6-0.75 oz	Apply Firstrate alone or tank-mix in combination with other herbicides registered for preplant surface application in soybean. For best results apply within 2 weeks of planting, but prior to crop or weed emergence. When applied in combination, follow use instructions and restrictions for each product used in tank mixture.

Soybeans - conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preemergence (continued)			
Barnyardgrass, carpetweed, crabgrass, foxtail (giant, green, and yellow), galinsoga, goosegrass, lambsquarters, mustard, panicum (fall), pigweed, purslane, pusley (Florida), ragweed, and smartweed. Will not control cocklebur, jimsonweed, morningglory spp., or velvetleaf	Linuron 0.3-1.0 lb	Linex/Lorox 50DF 0.6-2.0 lb or 4L 0.6-2.0 pt	Apply after planting and before beans germinate. Provide good agitation in tank before and during application. Follow labeled directions regarding soybean planting depth. Do not use on light, sandy soils with low organic matter as injury may occur. Do not plant any crop not on label within 4 months of application. Often provides short-term grass control. Observe all precautions, rates of application, and weeds controlled on the respective labels. When used in combinations, linuron rates generally should be reduced.
	Approved combinations: Tank-mix with Dual II Magnum/Cinch, MicroTech, Outlook, or Prowl; preplant incorporated with Prowl or Treflan		
Barnyardgrass, carpetweed, crabgrass, foxtail (giant, green, and yellow), galinsoga, goosegrass, nightshade (black), panicum (fall), pigweed, pusley (Florida), signalgrass, and witchgrass	Alachlor 1.5-4.0 lb	MicroTech 4FL 1.5-4.0 qt or other alachlor formulation	Apply immediately after planting and before crop and weeds emerge. Use lower rates on sandy and sandy loam soils, higher rates on silt loam soils. This chemical also may be used as a preplant incorporated treatment. Shallow incorporation or surface blend generally is most effective, particularly on light, sandy soils. Alachlor is not recommended for incorporation on coarse soils in the Southeast. Observe all precautions, rates of application, and weeds controlled on respective labels.
	Approved combinations: Tank-mix with Linex/Lorox, Scepter, or Sencor		

Soybeans - conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preemergence (continued)			
Barnyardgrass, carpetweed, crabgrass, foxtail (giant, green, and yellow), goosegrass, nutsedge (yellow), panicum (fall), pigweed spp., pusley (Florida), signalgrass, and witchgrass	Dimethenamid-p 0.66-.98 lb	Outlook 6.0EC 14.0-21.0 oz	Do not exceed a rate of 14 ounces per acre on coarse soils with less than 1.5 percent organic matter. PPI treatments are not recommended on these soils. Temporary growth suppression may result under extreme conditions of high rainfall and extended periods of water-saturated soil. Outlook may be applied up to the third true leaf stage. Observe all precautions, rates of application, and weeds controlled on the respective labels.
	Approved combinations: Tank-mix with Linex/Lorox, Scepter, or Sencor		
Barnyardgrass, carpetweed, crabgrass, foxtail (giant, green, and yellow), goosegrass, lambsquarters, panicum (fall), pigweed, pusley (Florida), signalgrass, smartweed, spurge, and velvetleaf suppression	Pendimethalin 0.5-1.25 lb	Prowl 3.33 EC 0.6-1.5 qt or Prowl H2O 3.8CS 0.5-1.3 qt or other pendimethalin formulations	Apply to a seedbed that is firm and free of trash. Rainfall is necessary for activation, and treatment is most effective when adequate rainfall or overhead irrigation is received within 7 days after application. If rainfall is not adequate for activation, a shallow cultivation should be made to control existing weeds and place herbicide in zone of weed seed germination. Under certain environmental conditions, soybeans may become brittle at soil surface. Prowl is available under other trade names. Observe all precautions, rates of application, and weeds controlled on specific labels.
	Approved combinations: Tank-mix with Linex/Lorox, Scepter, or Sencor; preplant incorporated with Scepter or Sencor		

Soybeans - conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preemergence (continued)			
Carpetweed, chickweed, henbit, lambsquarters, nightshades, pigweed, sida (prickly), smartweed, velvetleaf, and suppression of morningglory	Flumetsulam 0.04-0.07 lb	Python 80 WDG 0.8-1.33 oz	If incorporating, do so to a depth of 2 inches. Rainfall or irrigation is necessary to activate this product. A shallow cultivation may be necessary if rainfall doesn't occur within 7 to 10 days after application. Do not apply to emerged soybeans or injury may result. Observe labeled rotational restrictions.
Cocklebur, foxtail (giant, green, and yellow), jimsonweed, lambsquarters, pigweed spp., ragweed (common), smartweed, sida (prickly) or teaweed, and suppression of burcucumber, morningglory spp., and ragweed (giant)	Imazaquin 0.125 lb	Scepter 70DG 2.8 oz	Apply during or after planting but before crop emergence. If sufficient rainfall for activation is not received within 7 days of application, a shallow tillage or cultivation is recommended. This chemical may be tank-mixed with a residual herbicide for improved annual grass control. Observe labeled rotational crop restrictions. Injury in the form of stunting and leaf discoloration may occur with some soybean varieties under certain adverse weather conditions. Scepter is also available in a package mix with glyphosate under the trade name Backdraft. Use rate is 1.5 to 2 quarts per acre. Observe precautions, rates of application, and weeds controlled on respective labels.
Cocklebur and pigweed only	Imazaquin 0.095 lb Approved combinations: Tank-mix with Dual II Magnum/Cinch, MicroTech, Outlook, or Prowl; preplant incorporated with Dual II Magnum/Cinch, Outlook, Prowl or Treflan	Scepter 70DG 2.15 oz	

Soybeans - conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preemergence (continued)			
Anoda (spurred), barnyardgrass, beggarweed, carpetweed, coffeeweed, jimsonweed, lambsquarters, mustard spp., panicum (fall), pigweed spp., purslane, pusley, ragweed, sicklepod, sida (prickly), signalgrass, smartweed, and velvetleaf	Metribuzin 0.25-0.375 lb Approved combinations: Tank-mix with Dual II Magnum/Cinch, MicroTech, Outlook, or Prowl; preplant incorporated with Command, Dual II Magnum/Cinch, Outlook, Prowl, or Treflan	Sencor 4L 0.50-0.75 pt or DF 0.33-0.50 lb	Apply immediately after planting. Plant at least 1.5 inches deep. Do not use on sand or sandy loam soils or soils with less than 0.5 percent organic matter. If used on coarser textured soils with less than 2 percent organic matter or if heavy rainfall follows soon after application, severe stand losses can occur. Certain organic phosphate soil insecticides placed in contact with seed also may result in increased soybean injury from metribuzin. Do not use on Altona, Coker 102 and 156, Gervin, Semmes, Tracy, or Varsoy varieties. The lowest rates have not effectively controlled cocklebur, jimsonweed, or morningglory. Rainfall (0.25 to 0.50 inches) within 2 weeks after application is necessary to activate herbicide. Do not use treated vines for feed or forage. Do not replant treated areas to any crop other than soybeans within 4 months after treatment. Read and follow the label for such use. Observe all precaution, rates of application, and weeds controlled on respective labels.

Soybeans - conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preemergence (continued)			
Anoda (spurred), carpetweed, croton (tropic), horseweed, jimsonweed, lambsquarters, morningglory spp., nightshade spp., pigweed spp., prickly sida (teaweed), ragweed (common)	Flumioxazin 0.064-0.080 lb	Valor SX 51WDG 2.0-2.5 oz	Apply preemergence using ground equipment only. Crop injury may occur from applications made to poorly drained soils or under cool, wet conditions. Apply in 10 to 30 gallons per acre. Can be tank-mixed with Boundary, Lasso, Dual II Magnum, Outlook or Define and applied at a minimum of 14 days prior to planting. Valor can also be tank-mixed with Sencor, Firstrate, Linex/Lorox, Python, or Scepter for additional broadleaf weed control. A co-pack of Valor plus FirstRate is available under the trade name Gangster.

Full-Season, No-till Soybeans

Successful production of full-season, no-till soybeans and double-crop, no-till soybeans depends on control of existing vegetation (cover crops and weeds) and broadleaf and grass weeds that emerge after planting. A diversity of herbicides and cover crop/residue situations makes it impossible to utilize a single program to efficiently control weeds and grasses in all situations. Herbicide selection based on weed histories of each farm or field is necessary to achieve weed-free high-yield soybeans.

Existing vegetation is traditionally controlled by the nonselective herbicides, glyphosate (Roundup Weather Max, Touchdown Total, Touchdown HiTech, and others) or paraquat (Gramoxone Inteon) in no-till soybeans. If in-crop applications of glyphosate are planned, consider use of an alterative burn down program to reduce the potential for development of tolerant or resistant species. Two paraquat applications may be required for satisfactory control of some species. More recently, 2,4-D, Harmony Extra, Canopy EX, and Sencor were labeled for control of broadleaf weeds prior to planting full-season, no-till soybeans. In double-crop, no-till soybeans planted into barley or wheat stubble, Linex/Lorox or Sencor plus adjuvants have controlled small broadleaf weeds without the addition of nonselective herbicides. Annual grass control in no-till soybeans can be obtained with preemergence applications of MicroTech, Outlook, Dual II Magnum/Cinch, Define, Prowl and Prowl H2O, or with any of several postemergence grass herbicides. Stem brittleness and lodging can be associated with Prowl when soil conditions are cool and wet; these conditions can occur most frequently in early planted, full-season, no-till soybeans.

Annual broadleaf weed control can be achieved with preemergence or postemergence broadleaf herbicides. Because of the diversity of species in many fields, it is frequently necessary to apply postemergence herbicides to control weeds that escape preemergence herbicides.

Escalating herbicide costs and our interests in keeping herbicide use to a minimum are encouraging many people to consider use of only postemergence herbicides. Our experience leads us to suggest that existing vegetation always be controlled prior to planting. Preemergence or postemergence herbicides can then be selected that will control weeds that emerge after planting. Reducing or eliminating all or some of the preemergence herbicides can reduce costs in fields that historically have needed postemergence herbicides. This approach might first be tried in double-crop, no-till soybeans where weed populations have traditionally been low and then expanded to full-season, no-till soybeans.

2,4-D Preplant Use on Full-Season, No-Till Soybeans

2,4-D is now labeled for use prior to planting soybeans. Use the following chart to determine the amount of 2,4-D to use and the time interval needed between application and planting soybeans. The following is a list of restrictions and limitations for the preplant use of 2,4-D on soybeans:

- Do not apply when weather conditions, such as temperature air inversions or wind, favor drift from treated areas to susceptible plants.
- Do not exceed the 2,4-D rates given on the product label.
- Do not apply 2,4-D prior to planting soybeans if you are not prepared to accept the results of soybean injury, including possible loss of stand and yield.
- Do not replant fields treated with 2,4-D in the same growing season with crops other than those labeled for 2,4-D preplant use.
- Do not mow or cultivate weeds prior to treating with 2,4-D or poor control may result.
- Do not cut for feed or graze soybeans grown in fields that have received a 2,4-D preplant application.

2,4-D application rate chart for preplant use on full-season, no-till soybeans [a]

Product	Use Rate	Amount of active ingredient per acre	When to apply (preplant interval)
2,4-D amine (4 pounds of active ingredient per gallon) [b]	0.75-1.0 pt	0.375-0.5 lb	15 days
	1.0-2.0 pt	0.5-1.0 lb	30 days
2,4-D ester (4 pounds active ingredient per gallon) [b]	0.75-1.0 pt	0.375-0.5 lb	7.0 days
	1.0-2.0 pt	0.5-1.0 lb	30 days

[a] Some 2,4-D formulations (such as Salvo) have shorter preplant intervals. Consult label.

[b] Some 2,4-D formulations are available that contain greater than 4.0 lb ai/gal. Consult label.

Clarity Soybean Preplant Applications

Clarity is labeled for preplant applications in soybeans. Research has shown its utility in the early-season control of horseweed/marestail, especially those resistant to glyphosate (Roundup Weather Max, Touchdown Total, Touchdown HiTech, and others).

- Apply 4-16 fluid ounces of Clarity per acre to control emerged broadleaf weeds prior to planting soybeans.
- Do not exceed 16 fluid ounces of Clarity per acre in a spring application pior to planting soybeans.
- Following application of Clarity and a minimum accumulation of 1.0 inch of rainfall or overhead irrigation, a waiting interval of 14 days is required for 8 fluid ounces per acre, and 28 days for 16 fluid ounces per acre. These intervals must be observed prior to planting soybeans or injury may occur.
- Do not make Clarity preplant applications to soybeans in geographic areas with average annual rainfall less than 25 inches.

Soybeans - full-season, no-till

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Contact kill of most annual weeds and annual cover crops	Paraquat 0.5-1.0 lb [a] + surfactant	Gramoxone Inteon 2.0-4.0 pt + surfactant as specified by label	Utilize 2.0-2.5 pints/acre for weeds 1-3 inches tall, 2.5-3.0 pints/acre for weeds 3-6 inches tall, and 3.0-4.0 pints/acre for weeds over 6 inches tall. Apply in 20 to 60 gallons of water per acre. This chemical may not control weeds taller than 6 inches. Increase gallonage as density of stubble, crop residue, or weeds increases. 2,4-DB at 0.5 to 0.75 pint/acre may be added to this program for additional knockdown activity.
Alternate method for increased activity on harder to control annual weeds, such as horseweed or marestail, lambsquarters, and vetch (annual)	Paraquat 0.25-0.75 lb [a] + surfactant followed by paraquat 0.25-0.75 lb + surfactant + residual herbicide	Gramoxone Inteon 1.0-3.0 pt + surfactant as labeled followed by Gramoxone Inteon 1.0-3.0 pt + surfactant as labeled 7.0-15 days later + residual herbicide as needed	Apply as directed above. 2,4-D may be needed with first application. Refer to label.

Soybeans - full-season, no-till (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Control of annual weeds and annual cover crops and suppression or control of perennial weeds or covers	Glyphosate 0.5-5.0 lb [a]	Roundup Weather Max 0.5-3.1 qt or Touchdown Total 0.375-3.6 qt or other labeled glyphosate formulation	This chemical is effective in heavy annual weed infestations and with large weeds where thorough coverage with paraquat is not possible. Higher rates will control perennial species, but those species often are not present or susceptible at the time of planting. Use 0.75 to 1.0 pound for annual weeds up to 6 inches tall and 1.5 pounds for weeds taller than 6 inches. Use a minimum of 1.5 pounds for horseweed (marestail) control. Horseweed taller than 6 inches may not be controlled. Applications with fan-type nozzles generally have been more effective than with flood nozzles. Use 10 to 40 gallons of water per acre. Lower volumes are recommended for use with other glyphosate formulations. Touchdown Total is available in a non-surfactant formulation called Touchdown HiTech. A package-mix of glyphosate + Dual II Magnum is available under the trade name Sequence. Use 2.5-3.5 pints/acre.

Soybeans - full-season, no-till (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Burndown control of emerged winter annual, perennial, and summer annual weeds including buttercup, chickweed, dandelion, deadnettle, henbit, lambsquarters, pricly lettuce, mustard spp., pigweed, ragweed spp., smartweed, speedwell, and velvetleaf	Chlorimuron 0.25 oz + tribenuron 0.075 oz	Canopy EX 29.5 DG 1.1 oz	Apply to no-till or conventional tillage fields anytime after fall harvest, up to 45 days before soybean planting. For best results, apply to annual weeds that are up to 3 inches in height or diameter, and to perennial weeds that are up to 6 inches in height or diameter. For best burndown results, the addition of 1 pint/acre of 2,4-D LVE is recommended, and is required for control of some species. Applications of Canopy EX must include either a crop oil concentrate or a nonionic surfactant. Crop oil concentrate is the required adjuvant unless tank mixing with a product that precludes use of crop oil concentrate. On soils with soil pH of 7.0 or less, Canopy EX may be applied at rates of 1.5-3.3 oz/acre and will also provide residual control of cocklebur, henbit, marestale, pigweed spp., common ragweed, smartweed, and winter annual mustard spp., and will provide suppression of annual grasses, chickweed, jimsonweed, morningglory spp., yellow nutsedge, prickly sida, giant ragweed, and velvetgleaf. When applied at rates greater than 1.1 oz/acre, longer rotational restrictions apply.

Soybeans - full-season, no-till (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Dock (curly), eveningprimrose (cutleaf), geranium (Carolina), horseweed, knotweed (prostrate), lettuce (prickly), smartweed (Pennsylvania), thistle (Canada), and many other broadleaf weeds	Thifensulfuron-methyl and tribenuron-methyl 0.023-0.028 lb + surfactant or crop oil concentrate or liquid fertilizer	Harmony Extra XP 0.5-0.6 oz + surfactant (1.0 qt/100 gal) or crop oil concentrate (1.0 qt/100 gal) or liquid fertilizer	Apply Harmony Extra at least 45 days prior to planting soybeans, either conventional or no-till. Allow crop to stand for 5 weeks before tillage or mowing. Best results are obtained when applications are made to young, actively growing weeds. Tis is an excellent treatment, especially when combined with 2,4-D estger, for control of Canada thistle and manyhard-to-kill weeds in full-season no-till sobeans. Use for improved control of Canada thistle, Carolina geranium, cutleaf eveningprimrose, and most other broadleaf weeds.
Enhanced control of annual broadleaf weeds relative to Gramoxone Inteon or Roundup Weather Max alone	Metribuzin 0.19 lb	Sencor 75DF 4 oz	Apply in combination with 12 to 16 ounces of Roundup Weather Max in 10 to 20 gallons of water per acre or with 24 to 48 ounces of Gramoxone Max using a minimum of 20 gallons of water per acre. Adjust Roundup Weather Max or Gramoxone Max rates on the basis of weed size as directed by the label. Apply Gramoxone Max in combination with a nonionic surfactant as specified by the label.

Soybeans - full-season, no-till (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
The addition of Synchrony XP to glyphosate containing herbicides will increase the burndown control of dandelion, curly dock, henbit, marestail, morningglory spp., yellow nutsedge, evening primrose, ragweed spp., sicklepod, smartweed spp., and velvetleaf versus application of glyphosagte alone	Chlorimuron 0.16 oz + thifensulfuron 0.052 oz	Synchrony XP 28.4 DG 0.75 oz	Synchrony XP can be tank-mixed with glyphosate-containing herbicides registered for soybeans for burndown of existing summer and winter annual weeds. Apply up to 30 days before planting and prior to soybean emergence. Always include 0.25% v/v non-ionic surfactant. The addition of 1-2% w/w ammonium sulfate may increase performance of this tank-mix. 1 pint/acre of 2,4-D LVE will enhance performance and may be applied up to 7 days before planting. Synchrony XP will also provide limited preemergence control of jimsonweed, lambsquarters, marestail, yellow nutsedge, pigwwed spp., ragweed, spp., and smartweed spp. For season-long control, a planned PRE or POST sequential program is required. Supplemental labeling of Synchrony XP allows 1 to 3 oz of product per acre from 45 days before planting to just before soybean emergence. However, the rotational restrictions will be longer than for the 0.75 oz rate.

[a] To aid in the control of marestail/horseweed, common lambsquarters, common ragweed, and other emerged, susceptible broadleaf weeds, 2,4-D may be added to Gramoxone Max, Roundup Weather Max, Touchdown Total and other labeled glyphosate formulations, and applied early preplant. Refer to 2,4-D Application Chart on page 2-166.

Soybeans - full-season, no-till (continued)

Weed Problem	Remarks
For residual weed control, use one of the following herbicides or herbicide combinations along with an herbicide for control of vegetation existing at planting from the previous list:	
Control of annual weeds and grasses as listed for specific herbicides in previous tables	Control of annual weeds and grasses as listed for specific herbicides in previous tables For annual grass control in full-season, no-till soybeans, use either MicroTech, Command ME, Dual II Magnum/Cinch, Outlook, or Prowl. Where split paraquat applications are used, a portion of the residual grass herbicide may be applied with the initial paraquat application for improved early-season grass control. Stem brittleness and lodging can be associated with applications of Prowl when soil conditions are cool and wet. Because these conditions frequently occur early in the growing season, especially under no-till conditions, the use of MicroTech or Dual II Magnum/Cinch for early, full-season, no-till plantings is recommended. Late-season grass control will tend to be better with the longer residual herbicides such as Dual II Magnum/Cinch or MicroTech than with the somewhat shorter residual herbicides, such as Prowl. Supplement the grass control herbicide with Linex/Lorox, Sencor, Scepter, or Python for broadleaf weed control. Carefully monitor weed development and supplement the preemergence herbicide program with appropriate postemergence or postdirected herbicides. Pursuit plus glyphosate is a broad-spectrum herbicide mixture sold as Extreme for control of many broadleaf weeds and grasses in no-till soybeans. Postemergence applications can be made only to Roundup Ready® soybeans. Residual control of many annual broadleaf weeds and grasses can be obtained with Extreme. With either of these herbicides, one application per season is registered. If subsequent control is needed, apply other postemergence herbicides. If soybeans are Roundup Ready®, glyphosate could be applied postemergence.
Control of glyphosate-resistant horseweed	Horseweed populations resistant to glyphosate (Roundup Weather Max, Touchdown Total, etc.) have been identified in the mid-Atlantic region. Glyphosate will not kill these plants. Control after soybeans have emerged is difficult. After soybeans have been planted, FirstRate or Classic are the best options, but they will only suppress horseweed over 4.0 to 6.0 inches tall. Thus it is important to control glyphosate-resistant horseweed before planting soybeans. The most effective treatments are Gramoxone Inteon (2 applications is the most consistent treatment) or treatments containing Classic (Canopy EX) or FirstRate applied before planting. Use of 2,4-D with the burndown application will improve horseweed control. Finally, in other regions of the United States, populations of horseweed have been identified that are resistant to paraquat, FirstRate, Classic, and atrazine. Using a variety of herbicides as well as tillage is important to reducing the chance of developing horseweed populations resistant to multiple herbicides.
Control of perennial weeds in full-season, no-till soybeans: Perennial broadleaf weeds	No selective herbicides are available to control perennial broadleaf weeds in soybeans, and these weeds may become prevalent under continuous no-till culture. Spot treatment with glyphosate (Roundup Weather Max, Touchdown Total, and others) may be used. Other alternatives include rotation to corn or another grass crop in which 2,4-D and dicamba (Banvel/Clarity/Distinct) may be used, tillage, treatment before the soybean crop is established or treatment after harvest.
Perennial grass weeds (johnsongrass and bermudagrass)	In general, soil-applied herbicides used to control perennial grasses must be incorporated and cannot be used in no-till culture. Perennial grasses, therefore, must be controlled in no-till with spot treatments of glyphosate (Roundup Weather Max, Touchdown Total, and others) or glyphosate treatments via selective application equipment (rope wick or recirculating sprayer), or with postemergence overtop herbicides, such as Targa, Fusilade DX, Fusion, Poast Plus/Poast, and Select. See directions under postemergence treatments listed below. Carefully consider these options before establishing no-till soybeans in areas containing a perennial grass infestation.

Soybeans - no-till, small-grain stubble

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Contact kill of most annual weeds and weeds listed in previous tables for specific residual herbicides	Paraquat 0.5-1.0 lb + surfactant + clomazone, s-metolachlor, alachlor, dimethenamid-p, or pendimethalin (residual grass control) + linuron, flumetsulan, imazaquin or metribuzin	Gramoxone Inteon 2.0-4.0 pt + surfactant as specified by label + Command ME, Dual II Magnum/Cinch, MicroTech, or other alachlor formulations, Outlook, or Prowl + Linex/Lorox, Python, Scepter, or Sencor	Use 2.0-2,5 pints/acre for weeds 1-3 inches tall, 2.5-3.0 pints/acre for weeds 3-6 inches tall, and 3.0-4.0 pints per acre for weeds over 6 inches tall. Weeds over 6 inches tall may not be controlled. Apply to small-grain stubble after planting and before emergence of soybeans. Use 20 to 60 gallons of diluted spray per acre. As the density of the stubble or crop residue increases, the spray gallonage should increase to ensure complete coverage and kill. Do not graze or feed treated forage to livestock. Observe all precautions, rates of application, and weeds controlled on respective labels.

Soybeans - no-till, small-grain stubble (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Kill of most annuals and some perennials and weeds listed in previous tables for specific residual herbicides	Glyphosate 0.5-5.0 lb	Roundup Weather Max 0.5-3.1 qt or Touchdown Total 0.375-3.6 qt or other labeled glyphosate formulation	Refer to previous table. At the normal time of planting soybeans, johnsongrass and bermudagrass will not be at the proper stage of growth for effective control. Do not feed or forage glyphosate-treated crops within 8 weeks after application. See label for specific weeds controlled. Use 1.0 pound per acre for control of annual broadleaf weeds and grasses up to 6 inches high and 1.5 pounds per acre for annual broadleaf weeds and grasses more than 6 inches high. Applications with fan-type nozzles generally have been more effective than with flood-type nozzles. Use 3.0 to 10 gallons of water per acre and low-rate technology instructions for most economical glyphosate use rates or 10 to 40 gallons of water using high-volume instructions and corresponding glyphosate rates. Observe all precautions, rates of application, and weeds controlled on respective labels. Touchdown Total is available as a non-surfactant containing formulation called Touchdown HiTech. Sequence is a glyphosate + Dual II Magnum package-mix. Use rate is 2.5-3.5 pints/acre
	Approved cokmbinations: Tank-mix with Dual II Magnum/Cinch, MicroTech, or Outlook with either Linex/Lorox, Python, Scepter, or Sencor		

Identifying tank-mix partners for postemergence weed control in soybeans [a]

Often the variety of weed in a given field is great enough to consider tank-mixing two (or more) herbicides to broaden the spectrum of control. Keeping track of the potential tank-mix partners is a difficult task. The following is meant as a guide of approved tank-mix partners. Always consult the pesticide label for each herbicide included in the tank-mixture for specific details, because the tank-mixture may be approved on the label of one of the tank partners but not on both.

	2-4,D (Butyrac)	Basagran	Classic	Cobra	Extreme	FirstRate	Flexstar	Fusilade	Fusion	Harmony GT XP	Poast/Poast Plus	Pursuit	Raptor	Reflex	Resource	Roundup Weather Max or Touchdown Total [b]	Scepter	Select	Stellar	Storm	Synchrony XP [c]	Targa	Ultra Blazer
2,4-DB (Butyrac)		■	■	■			■					■		■			■		■		■		■
Basagran	■			■		■	■	■	■	■	■	■		■	■		■	■	■				■
Classic	■			■			■	■	■	■				■	■	■		■	■	■		■	■
Cobra	■	■	■			■		■		■		■	■		■	■	■	■	■		■	■	
Extreme																							
FirstRate		■		■					■	■	■	■		■		■			■	■	■	■	
Flexstar	■	■	■					■	■	■	■	■			■		■	■			■	■	
Fusilade		■	■	■			■			■		■	■	■	■						■		■
Fusion		■	■			■	■			■		■	■	■						■	■		■
Harmony GT XP		■	■	■		■	■	■	■			■		■				■	■	■	■	■	
Poast/Poast Plus		■				■	■					■	■	■	■						■		■
Pursuit	■	■		■		■	■	■	■	■	■			■	■		■	■	■	■		■	■
Raptor				■				■	■		■				■			■	■			■	
Reflex	■	■	■			■		■	■	■	■	■			■	■	■	■			■	■	
Resource		■	■	■			■	■		■	■	■	■	■		■	■	■		■	■	■	■
Roundup Weather Max, Touchdown Total and other glyphosate formulations(b)			■	■		■								■							■		
Scepter	■	■		■			■					■		■	■				■				■
Select		■	■	■		■	■			■		■	■	■	■				■	■	■		■
Stellar	■	■	■	■		■				■		■	■			■	■	■			■		
Storm			■						■	■		■			■			■					
Synchrony XP(c)	■			■			■	■	■		■			■							■	■	■
Targa			■	■		■	■			■		■	■	■									■
Ultra Blazer	■	■	■			■		■	■	■	■	■			■		■	■					

NOTE: Unless specifically prohibited on product lables, other tank-mix combinations may be appropriate for use.

a Tank-mixing a broadleaf and grass herbicide may result in antagonism whereby a loss in grass activity may occur.

b For use on Roundup Ready soybean varieties only. Other glyphosate formulations are available.

c For use on STS soybean varieties only, with reduced rates for use on non-STS soybeans.

Soybeans - no-till or conventional

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence broadleaves broadcast			
Anoda (spurred), beggarsticks, cocklebur, galinsoga, jimsonweed, mustard (wild), nutsedge (yellow), purslane, ragweed (common and giant), sida (prickly) or teaweed, smartweed (Pennsylvania), velvetleaf, and suppression of thistle (Canada)	Bentazon 0.75-1.0 lb + crop oil concentrate	Basagran 0.75-1.0 qt + crop oil concentrate 1.0 qt	Apply thoroughly to weeds when they are small and actively growing. Add crop oil concentrate to the spray solution according to label instructions. Weed growth stages generally correspond to soybean growth stages of one- to two-trifoliate leaves. For best results, treat before weeds reach the size limits listed on the label. Control has generally been most effective using fan tips and pressures of 40 to 50 pounds per square inch. Yellow nutsedge may be controlled best when the application is followed in 7 to 10 days with a repeated application or by cultivation in 10 to 14 days. Soybeans may exhibit a slight yellowing, bronzing, or speckled appearance, which generally is soon outgrown. Do not apply to soybeans growing under unfavorable conditions and exhibiting stress symptoms. Rainfall within 8 hours of application may reduce effectiveness. Do not apply within 30 days of harvest. Do not feed forage to livestock. The addition of 2,4-DB (2 ounces per acre) is recommended to aid in the control of morningglories and common cocklebur.

Soybeans - no-till or conventional (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence broadleaves broadcast (continued)			
Cocklebur, jimsonweed, pigweed, ragweed (common), smartweed, velvetleaf, and suppression of burcucumber, morningglory spp., ragweed (giant), and sicklepod	Chlorimuron-ethyl 0.008-0.012 lb + surfactant 0.25 percent	Classic 0.5-0.75 oz + surfactant 0.25 percent	Apply to young, actively growing weeds within labeled weed growth stages. Apply at 25 to 40 pounds per square inch with a minimum of 10 gallons per acre. Always add 0.25 percent surfactant. Do not use crop oil, crop oil concentrate, or vegetable oil spray additives. Flood-type, low pressure nozzles are not recommended. Observe labeled crop rotational restrictions. The addition of 2,4-DB (2 ounces per acre) is recommended to aid in the control of morningglories and common cocklebur.
Burcucumber, jimsonweed, ragweed (giant), and velvetleaf	Lactofen 0.20 lb	Cobra 12.5 oz	Cobra is currently labeled for control of large (15 to 36 inches) broadleaf weeds, such as velvetleaf, giant ragweed, jimsonweed, and burcucumber [State Local Need (SLN's) labels for Maryland, Delaware, and Virginia]. The addition of crop oil concentrate at 0.25 to 0.5 pint per acre, especially when weeds are near maximum labeled growth stages, is recommended. Consult label. Apply in 20 to 30 gallons of water using flat fan or hollow cone nozzles. Do not apply within 45 days of harvest. The addition of 2,4-DB (2 ounces per acre) is recommended to aid in the control of morningglories and common cocklebur.
Cocklebur, jimsonweed, horseweed (marestail), morningglory, ragweed (common, giant), smartweed, and velvetleaf	Chloransulam-methyl 0.016 lb	FirstRate 0.3 oz	Thorough mixing is required. FirstRate water-dispersible packets are not soluble in liquid fertilizer solutions. Premixing in water is required. Do not apply aerially. Apply before 50 percent flowering stage of soybeans. Always use an approved adjuvant system. UAN will be required for improved velvetleaf control.

Soybeans - no-till or conventional (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence broadleaves broadcast (continued)			
Anoda (spurred), carpetweed, cocklebur, copperleaf (Virginia), croton (tropic), eclipta, groundcherry (ground), jimsonweed, lambsquarters, morningglory sp., mustard (wild), nightshade (black), pigweed sp., purslane, ragweed (common, giant), sida (prickly), smartweed, sunflower, and velvetleaf	Fomesafen 0.25-0.35 lb	Flexstar HL 1.0-1.5 pt	Best control of susceptible weeds is obtained when Flexstar HL is applied early to actively growing weeds. Flexstar XL should be used with a minimum of 1.0 percent nitrogen or a minimum of 4 pounds of ammonium sulfate per 100 gallons of spray volume. Always add a nonionic surfactant or crop oil concentrate as discussed on the label. Do not use flood-type spray nozzles. A maximum of 1.6 pints of Flexstar XL can be applied per acre in alternate years in Maryland, Delaware, and Virginia; a maximum or 1.3 pints can be applied per acre in alternate years in New Jersey, Pennsylvania, and West Virginia. Consult label for tank-mix partners.
Burcucumber, lambsquarters, pigweed spp., smartweed, and velvetleaf	Thifensulfuron-methyl 0.004 lb	Harmony GT XP 75DF 0.08 oz + approved tank-mixes: Roundup Weather Max or Touchdown Total or other labeled glyphosate formulation	Always add either a nonionic surfactant (0.25% v/v) or crop oil concentrate (0.5% v/v) plus either ammonium nitrogen solution such as 28 percent UAN (2–4 qt/A) or spray grade ammonium sulfate (2–4 lb/A). Touchdown Total is available as a non-surfactant containing formulation called Touchdown HiTech.
Barnyardgrass, cocklebur, crabgrass, foxtail (giant, green, and yellow), jimsonweed, johnsongrass (seedling), morningglory spp., pigweed spp., shattercane, smartweed, and velvetleaf	Imazethapyr 0.063 lb	Pursuit 4.0 oz	Apply early postemergence when weeds are actively growing and before most exceed a height of 3 inches. Use a nonionic surfactant at a rate of 2 pints per 100 gallons of spray mixture. Use of fertilizer solution is recommended for optimum weed control. Pursuit is available in a package mix with glyphosate under the trade name Extreme. Use rate is 3 pt/acre.

Soybeans - no-till or conventional (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence broadleaves broadcast (continued) Artichoke (Jerusalem), chickweed (common), cocklebur, jimsonweed, lambsquarters, morningglory (entireleaf, ivyleaf, smallflower, tall), mustard sp., nightshade (black, Eastern black, hairy), pigweed sp., purslane, ragweed (common, giant), sunflower, and velvetleaf	Imazamox 0.039 lb	Raptor 5.0 oz	Applications of Raptor require the addition of an adjuvant and a nitrogen fertilizer solution—consult label. Occasionally, internode shortening and/or temporary yellowing of soybeans may occur, especially if under environmental stress. When adequate soil moisture is present, Raptor will provide residual activity of susceptible germinating weeds. Consult label for tank-mix partners.
Cocklebur, jimsonweed, morningglory spp., nightshade, pigweed, ragweed (common), and smartweed	Fomesafen 0.25-0.375 lb + surfactant or crop oil concentrate	Reflex 1.0-1.5 pt + surfactant or crop oil concentrate	Apply in a minimum of 10 gallons of water and 40 to 60 pounds per square inch when weeds are small and before weeds reach maximum growth stages described on the label. Apply in combination with 0.25 to 0.5 percent nonionic surfactant or 0.5 to 1.0 percent crop oil concentrate. Do not apply Reflex more than once every 2 years. Carefully observe labeled rotational crop restrictions. The addition of 2,4-DB (2 ounces) is recommended for help in controlling morningglories.
Velvetleaf	Flumiclorac 0.027-0.054 lb + crop oil concentrate	Resource 4.0-8.0 oz + crop oil concentrate 1.0 qt	Apply 4 to 8 ounces of Resource as a broadcast over-the-top postemergence spray to 6- to 10-leaf velvetleaf using higher rates for larger velvetleaf. Resource has activity against several other weeds when they are in the 2- to 3-leaf stage, including cocklebur, lambsquarters, common ragweed, jimsonweed, pigweed species, and prickly sida, but control declines on larger weeds. Labeled combinations include Basagran, Classic, Cobra, Pursuit, and Scepter.

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence broadleaves broadcast (continued) Control of most annual grasses and broadleaf weeds in conventional and no-till soybean production systems, and control or suppression of many perennial weeds, including bermudagrass, Canada thistle, field bindweed, hemp dogbane, horsenettle, nutsedge, quackgrass, rhizome johnsongrass, and trumpetcreeper	Glyphosate 1.0-2.0 lb	Roundup Weather Max 0.7-1.4 qt or Touchdown Total 0.75-1.5 qt or other labeled glyphosate formulation	**For use only on soybean varieties designated Roundup-Ready.** Glyphosate may by applied postemergence from cracking through the full flowering stage. Adjust application rates for individual weed species and weed size as directed by the label. Apply 1.0 to 2 pounds per acre for perennial suppression or control. Use extreme care to avoid drift to adjacent crops or other desirable vegetation. Do not graze or feed treated soybean forage. The current Roundup Weather Max formulation is very effective in removing pesticide residues from spray equipment. Carefully clean equipment prior to application. Most effective in narrow-row soybeans. The combined total application from crop emergence through harvest must not exceed 2.0 quarts per acre of Roundup Weather Max or 2.2 quarts per acre of Touchdown Total. The maximum rate for any single in-crop application is 1.4 quarts per acre for Roundup Weather Max and 1.5 quarts per acre for Touchdown Total. Allow a minimum of 14 days between final application and harvest of soybeans. As a preharvest application, apply after pods have set and lost all green color. As a harvest aid, do not apply more than 22 ounces per acre of Roundup Weather Max or 0.75 quart per acre of Touchdown. Touchdown Total is available as a non-surfactant formulation called Touchdown HiTech. A glyphosate + Dual II Magnum package-mix is available under the trade name Sequence. Rates are 2.5 to 3.5

Soybeans - no-till or conventional (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence broadleaves broadcast (continued)			pints/acre.
Cocklebur, pigweed, and suppression of sicklepod	Imazaquin 0.063-0.125 lb + surfactant 0.25 percent	Scepter 70DG 1.4-2.8 oz + surfactant 0.25 percent	Apply after crop emerges but before weeds are 12 inches high. Do not apply when weeds and soybeans have been subjected to temperature or moisture stress. Allow 90 days between application and harvest. Observe labeled crop rotation restrictions.
Amaranth (palmer), nightshade (eastern black), pigweed (redroot, smooth), ragweed (common), waterhemp (common, tall), and velvetleaf	Flumiclorac 0.027 lb + lactofen 0.093 lb + crop oil concentrate	Stellar 3.1EC 5.0 oz + crop oil concentrate 1.0-2.0 pt	Good coverage of young actively growing weeds is essential for good control. Apply Stellar in 10 to 30 gallons of water per acre on a broadcast basis at a pressure of 40 to 60 psi measured at the nozzle. Use flat fan or hollow cone nozzles. Do not use flood nozzles. Always add crop oil concentrate or methylated seed oil at 1.0 to 2 pints per acre. Soybean leaves that are sprayed may exhibit bronzing and speckling, and may be cupped or crinkled at the tip. The crop will outgrow these effects.

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence broadleaves broadcast (continued) Beggarsticks, beggarweed (Florida), bristly starbur, burcucumber, cocklebur, cowpea, hemp sesbania, lambsquarters, jimsonweed, morningglory spp., nutsedge (yellow), pigweed spp., ragweed spp., sicklepod, smartweed spp., velvetleaf, and suppression of marestail, nutsedge (purple), and thistle (Canada)	Chlorimuron-ethyl + thifensulfuron-methyl 0.013-0.02 lb + crop oil concentrate	Synchrony XP 28.4DF 0.75-1.125 oz + crop oil concentrate 1.0% v/v	**Synchrony is for use only on soybean varieties designated as -STS- in the variety name.** These soybeans contain a trait that enhances tolerance to sulfonylurea herbicides. The normal use rate of Synchrony XP on STS soybeans is 0.75 oz/acre. Synchrony XP may be used at 1.125 oz/acre for preserving the STS trait in STS soybean seed production. Different rotational crop guidelines occur for both rates. Make applications to small, actively growing weeds. Split applications may be required for certain weeds, including burcucumber, morningglory species, and sicklepod. Carefully observe crop rotation intervals, and note that extended crop rotation intervals apply when Synchrony STS is applied following preemergence applications of other sulfonylurea or imidazolinone herbicides.
Cocklebur, pigweed spp., wild sunflower, and suppression of common lambsquarters, jimsonweed, common milkweed, common ragweed, smartweed and velvetleaf	Chlorimuron-ethyhl + thifensulfuron-methyl 0.007 lb	Synchrony XP 28.4DF 0.375 oz	**Synchrony for use on non-STS soybeans** Synchrony is labeled for use on non-STS soybeans at a reduced rate for broadleaf weed control. Apply to weeds 1 to 4 inches in height. Add a non-ionic surfactant at 0.25% v/v (1 qt/100 gal spray solution). Do not use crop oil concentrate. Can be tank-mixed with other herbicides for improved weed control.

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence broadleaves broadcast (continued)			
Buffalobur, burcucumber, carpetweed, cocklebur (common, two-leaf only), croton (tropic), groundcherry (lanceleaf), ironweed, jimsonweed, mustard (wild), morningglory spp., nightshade (black), pigweed, purslane, pusley (Florida), ragweed (common and giant), smartweed (Pennsylvania), smell melon, and spurge (prostrate)	Acifluorfen-sodium 0.25-0.375 lb	Ultra Blazer 1.0-1.5 pt	Apply when weeds are 2 to 4 inches high and actively growing and when soybeans are in the one- to two-trifoliate leaf stage. Use standard herbicide sprayers equipped with hollow cone or flat fan nozzles. (Best results have been obtained with fan-type nozzles.) Use 40 to 60 pounds per square inch at the nozzle tips and a minimum of 20 gallons spray volume per acre. Add a nonionic surfactant at the rate of 1.0 pint per 100 gallons. Do not apply when crop and weeds are under stress, such as from drought, flooding, excessive fertilizer, soil salts, wind injury, frost damage, unseasonably cold night and day temperatures, or injury from previous herbicides. Application with 30 gallons of spray volume per acre, a minimum of 50 pounds per square inch, and the addition of surfactant to the 2L formulation may improve control on drought-stressed or slightly oversized weeds; but applications made under these conditions generally will be less satisfactory than those made under optimum conditions. Do not apply if rain is threatening (6-hour rain-free period is required for best results). Do not apply within 50 days of harvest, and do not use treated plants for feed or forage. The addition of 2,4-DB (2 ounces per acre) is recommended to aid in the control of morninglories and common cocklebur.

Soybeans - no-till or conventional (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence broadleaves broadcast (continued) Improved spectrum of control for weeds listed above for both bentazon and acifluorfen-sodium	acifluorfen-sodium 0.25-0.375 lb + bentazon 0.5-1.0 lb	Ultra Blazer 1.0-1.5 pt + Basagran 1.0-2.0 pt or use Storm 1.5 pt	See labels for specific ratios of bentazon/acifluorfen-sodium depending on weed species and size. Always use spray additives (nonionic surfactant or crop oil concentrate) in accordance with specific label instructions. Blazer and Basagran are available as the prepackaged mix Storm (1.5 pints per acre).
Postemergence grasses broadcast Barnyardgrass, crabgrass, foxtail (giant, green, and yellow), goosegrass, johnsongrass (seedling), panicum (fall), shattercane, and volunteer corn	Fluazifop-P-butyl 0.09-0.19 lb + crop oil concentrate	Fusilade DX 6-12 oz + crop oil concentrate 0.5-1.0% v/v	Apply to actively growing grasses at the rate and growth stage indicated on the label for the individual grass species with a minimum of 10 gallons of water per acre and 30 to 60 pounds per square inch. Do not use flood nozzles. Add 1.0 percent crop oil concentrate or 0.25 percent nonionic surfactant to the spray mixture. Rainfall within 1.0 hour of application will decrease effectiveness.

Soybeans - no-till or conventional (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence grasses broadcast (continued)			
Bermudagrass or wiregrass, johnsongrass (rhizome), and quackgrass	Fluazifop-P-butyl 0.25-0.375 lb + crop oil concentrate	Fusilade DX 16-24 oz + crop oil concentrate 0.5-1.0% v/v	Apply in the manner described above to johnsongrass 8 to 18 inches high and before boot stage and, if necessary, to regrowth 6 to 12 inches high. Apply in the manner described above to bermudagrass 4 to 8 inches in runner length or quackgrass 6 to 10 inches high. Make sequential treatments when bermudagrass regrowth shows 4- to 8-inch runners or quackgrass regrowth shows up to 10 inches. Under heavy grass pressure the first application of Fusilade DX can range from 16 to 24 ounces per acre. This can be followed by a second application that can range from 12 to 24 ounces per acre. Do not apply more than 32 ounces total per acre per season to soybeans.
	(sequential treatment on regrowth) Fluazifop-P-butyl 0.19-0.375 lb + crop oil concentrate	Fusilade DX 12-24 oz + crop oil concentrate 0.5-1.0% v/v	
Johnsongrass (seedling), muhly (wirestem), quackgrass, volunteer corn and small grains, and most small grass species	Fluazifop-P-butyl + fenoxaprop-ethyl 0.125-0.21 lb + crop oil concentrate or nonionic surfactant	Fusion 6.0-10.0 oz + crop oil concentrate 0.5-1.0% v/v or nonionic surfactant 0.25-0.5% v/v	Apply in 5 to 40 gallons of spray mixture. Consult label for rates and weed heights for individual species. Use of crop oil concentrate or nonionic surfactant is required. Flat fan nozzles are recommended for optimum results.
Barnyardgrass, crabgrass, foxtails, goosegrass, johnsongrass (seedling), panicum (fall), shattercane, volunteer corn, and cereal grains	Sethoxydim 0.19-0.38 lb + crop oil concentrate	Poast Plus 1.5-3.0 pt or Poast 1.0-1.5 pt + crop oil concentrate 2.0 pt or Dash 2.0 pt	Apply to actively growing grasses at the rate and size indicated on the label for the individual grass species with 10 to 20 gallons of water per acre and 40 pounds per square inch. Do not use flood-type nozzles. Always add 2 pints of crop oil concentrate per acre. Rainfall within 1.0 hour of application will decrease effectiveness.

Soybeans - no-till or conventional (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence grasses broadcast (continued)			
Bermudagrass, johnsongrass (rhizome), and wiregrass	Sethoxydim 0.19-0.28 lb + crop oil concentrate	Poast Plus 1.5-2.25 pt or Poast 1.5 pt + crop oil concentrate 2.0 pt or Dash 2.0 pt	Apply to actively growing grasses in the manner described above. Apply first application to johnsongrass 15 to 20 inches high or bermudagrass plants less than 6 inches in diameter. Apply regrowth treatments to 6- to 10-inch johnsongrass or 1.0- to 4-inch-diameter bermudagrass plants. Rainfall within 1.0 hour of application will decrease effectiveness.
	(sequential treatment on regrowth) Sethoxydim 0.19-0.28 lb + crop oil concentrate	Poast Plus 1.5 pt or Poast 1.0 pt + crop oil concentrate 2.0 pt or Dash 2.0 pt	
Quackgrass	Sethoxydim 0.47 lb + crop oil concentrate	Poast Plus 2.25 pt or Poast 1.5 pt + crop oil concentrate 2.0 pt or Dash 2.0 pt	Apply to actively growing quackgrass 6 to 8 inches high and to regrowth 6 to 8 inches high with 2 pints of crop oil concentrate per acre in the manner described above. Rainfall within 1.0 hour of application will decrease effectiveness.
	(sequential treatment on regrowth) Sethoxydim 0.29 lb + crop oil concentrate or Dash 2.0 pt	Poast Plus 1.5 pt or Poast 1.0 pt + crop oil concentrate 2.0 pt	
Barnyardgrass, crabgrass, foxtail (giant, green, and yellow), goosegrass, johnsongrass (seedling), panicum (fall, Texas), shattercane, and volunteer cereals and corn	Clethodim 0.094-0.125 lb + crop oil concentrate	Select 2EC 6.0-8.0 oz + crop oil concentrate 2.0 pt	Apply to actively growing grasses in 10 to 40 gallons of water by ground or 3 to 10 gallons of water by air. See label for tank-mix instructions.

Soybeans - no-till or conventional (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence grasses broadcast (continued)			
Bermudagrass and quackgrass	Clethodim 0.125-0.25 lb + crop oil concentrate	Select 2EC 8.0-16.0 oz + crop oil concentrate 2.0 pt	Time first application when bermudagrass is 3 inches tall and quackgrass is 4 to 8 inches tall. Apply second application when regrowth of bermudagrass is 3 inches tall and quackgrass is 4 to 8 inches tall.
	(sequential treatment on regrowth) Clethodim 0.125-0.25 lb + crop oil concentrate	Select 2EC 8.0-16.0 oz + crop oil concentrate 2.0 pt	
Johnsongrass (rhizome)	Clethodim 0.125-0.156 lb + crop oil concentrate	Select 2EC 8.0-10.0 oz + crop oil concentrate 2.0 pt	Time first application when johnsongrass is 12 to 24 inches tall. Apply second application when regrowth reaches 6 to 10 inches tall.
	(sequential treatment on regrowth) Clethodim 0.094-0.125 lb + crop oil concentrate	Select 2EC 6.0-8.0 oz + crop oil concentrate 2.0 pt	
Barnyardgrass, crabgrass, foxtail (giant, green, and yellow), goosegrass, johnsongrass (seedling), panicum (fall), shattercane, volunteer cereals, and corn	Quizalofop-P-ethyl 0.06-0.1 lb + crop oil concentrate	Targa 5.0-8.0 oz + crop oil concentrate 1.0% v/v	Apply to actively growing grasses in 10 to 40 gallons of water per acre using flat fan or hollow cone nozzles. Always add crop oil concentrate. Do not graze treated fields or harvest for forage or hay. Do not apply within 80 days of harvest or after pod set. Rainfall within 1.0 hour of application will decrease effectiveness.

Soybeans - no-till or conventional (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence grasses broadcast (continued)			
Bermudagrass, johnsongrass (rhizome), and quackgrass	Quizalofop-P-ethyl 0.12 lb + crop oil concentrate	Targa 10 oz + crop oil concentrate 1.0% v/v	Apply to actively growing grasses in manner described above. Time first application when johnsongrass is 10 to 24 inches tall, bermudagrass is 3 inches tall, and quackgrass is 6 to 10 inches tall. Apply regrowth treatments to 6- to 10-inch johnsongrass, 3-inch bermudagrass, and 4- to 8-inch quackgrass.
	(sequential treatment on regrowth) Quizalofop-P-ethyl 0.09 lb + crop oil concentrate	Targa 7.0 oz + crop oil concentrate 1.0% v/v	
Postemergence broadleaves or grasses postdirected			
Cocklebur, morningglory spp., and suppression of jimsonweed, lambsquarters, pigweed, ragweed, and velvetleaf	2,4-DB 0.175-0.22 lb	2,4-DB 0.7 to 0.9 pt Butyrac and others	Apply as directed spray into rows when soybeans are 8 to 12 inches high and cocklebur, morningglory, jimsonweed, and redroot pigweed have not exceeded a height of 3 inches. Top of weed seedling must be sprayed. Use precision-directed spray application equipment. Apply with sprayer nozzles mounted on skids or gauge wheels. Do not spray more than one-third of the base of soybean as severe injury may occur. Do not harvest within 60 days after application. Observe all precautions, rates of application, and weeds controlled on respective labels.
	Approved combinations: Tank-mix with Linex (for directed spray method only)		

Soybeans - no-till or conventional (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Postemergence broadleaves or grasses postdirected (continued) Barnyardgrass, crabgrass, goosegrass, johnsongrass (seedling), and pigweed	Paraquat 0.07-0.125 lb + surfactant	Gramoxone Inteon 4.5-8.0 oz + surfactant as recommended	Apply in 20 to 40 gallons of water per acre when soybeans are at least 8 inches tall and weeds 2 to 4 inches. Use as a precision directed spray, hitting no more than the lower 3 inches of the soybeans. Follow label for necessary application equipment and procedures. Do not treat more than twice per growing season. Do not graze or feed treated forage to livestock.
Spot treatment Cocklebur, johnsongrass, pigweed, volunteer corn and shattercane, and other perennial weeds	Glyphosate 1.0-3.0 lb	Roundup Weather Max 0.7-2.2 qt or Touchdown Total 0.75-2.25 qt qt or other labeled glyphosate formulation	Apply Roundup Weather Max and Touchdown Total prior to initial pod set when appplying them as a spot application. Do not treat more than 10 percent of total field area to be harvested. If non-Roundup-Ready soybeans, the crop receiving spray in treated area will be killed. Touchdown Total is also available in a non-surfactant formulation called Touchdown HiTech.
Harvest aids	Paraquat 0.125-0.25 lb + surfactant	Gramoxone Inteon 8.0-16.0 oz + surfactant as recommended	Harvest aid applications of Gramoxone Inteon: Indeterminate varieties—apply when at least 65% of seed pods have reached a mature brown color or when seed moisture is 30 percent or less. Determinant varieties—apply when plants are mature, i.e., beans are fully developed, 1/2 of leaves have dropped, and remaining leaves are yellowing. Do not apply within 15 days of harvest. Do not graze or harvest for forage or hay.

Soybeans - no-till or conventional (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Harvest aids (continued) Useful for late-season control of johnsongrass and other perennial weeds	Glyphosate 1.0-3.0 lb	Roundup Weather Max 0.7-2.2 qt or Touchdown Total 0.75-2.25 qt or other labeled glyphosate formulation	Roundup Weather Max or Touchdown Total may be applied preharvest as a broadcast spray with ground or aerial equipment as a harvest aid. Apply to mature soybeans when pods have lost their color. Make preharvest applications at least 7 days before harvest with no more than 3.3 quarts per acre by ground (Roundup Weather Max) or 4.3 quarts per acre Touchdown Total; no more than 44 ounces per acre by air (Roundup Weather Max) or 0.75 quart per acre for Touchdown Total. Allow at least 25 days before grazing or harvesting for livestock feed following harvest aid application. Touchdown Total is also available in a non-surfactant containing formulation called Touchdown HiTech.

Weed Control in Sunflowers

Sunflowers

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preplant incorporated Barnyardgrass, carpetweed, crabgrass, foxtails, goosegrass, johnsongrass (seedling), lambsquarters, panicum (fall and Texas), pigweeds, purslane, sandbar, shattercane, signalgrass, and velvetleaf (suppression)	Pendimethalin 0.5-1.5 lb	Prowl 3.33EC 1.2-3.6 pt or Prowl H2O 3.8CS 1.0-3.0 pt	Prowl controls many annual grasses and certain broadleaf weeds as they germinate. It will not control established weeds. Incorporate prior to planting and within 7 days of application. Mechanically incorporate into the top 1.0 to 2 inches of soil. Check label for rotational restrictions. Do not feed forage or graze livestock in treated fields.

Sunflowers (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preplant incorporated (continued)			
Barnyardgrass, carpetweed, crabgrass, chickweed, foxtails, johnsongrass (seedling), henbit, lambsquarters, panicum (fall, Texas), pigweed, purslane, sandbur, shattercane, and signalgrass	Ethalfluralin 0.56-1.125 lb	Sonalan 3EC 1.5-3.0 pt	Use incorporation equipment that thoroughly and uniformly mixes Sonalan into the top 2 to 3 inches of the seedbed. It may be applied and incorporated up to 3 weeks prior to planting. Sonalan controls weeds as they germinate. It will not control established weeds. If replanting is required, replant only to crops listed on the Sonalan label. Higher rates of Sonalan are labeled for control of annual groundcherry and nightshade in soybeans. These higher rates are not labeled for use in sunflowers.
Barnyardgrass, carpetweed, crabgrass, foxtails, goosegrass, johnsongrass (seedling), lambsquarters, panicum (fall and Texas), pigweed, purslane, sandbur, shattercane, and signalgrass	Trifluralin 0.5-1.0 lb	Treflan 4EC 1.0-2.0 pt	Treflan controls many annual grasses and certain broadleaf weeds as they germinate. It will not control established weeds. Incorporate within 24 hours of application. Mechanically incorporate into top 2 to 3 inches of the seedbed. With most equipment and methods of application, a second incorporation is required, should be in a different direction, should not be deeper than the first, and may occur anytime before planting. Check label for rotational restrictions.
Preemergence			
Many annual grasses and broadleaf weeds	Paraquat 0.625-1.0 lb	Gramoxone Inteon 2.5-4.0 pt	In no-till situations where existing vegetation needs to be controlled, Gramoxone Inteon can be utilized and is usually tank-mixed with a residual herbicide. Gramoxone Inteon is generally rainfast within 30 minutes. Apply to small emerged weeds. Weeds 1.0 to 6.0 inches tall are easiest to control.

Sunflowers (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Preemergence (continued) Barnyardgrass, carpetweed, crabgrass, foxtails, goosegrass, johnsongrass (seedling), lambsquarters, panicum (fall and Texas), pigweed, purslane, sandbur, shattercane, signalgrass, smartweed, and velvetleaf	Pendimethalin 0.5-1.5 lb	Prowl 3.33EC 1.2-3.6 pt or Prowl H2O 3.8CS 1.0-3.0 pt	Prowl controls many annual grasses and certain broadleaf weeds as they germinate. It will not control established weeds. Destroy existing weeds before applying Prowl. Check label for rotational restrictions. Do not feed forage or graze livestock in treated fields.
Postemergence Barnyardgrass, crabgrass, foxtails, goosegrass, johnsongrass (seedling), panicum (fall and Texas), sandbur, shattercane; also perennials such as bermudagrass, johnsongrass (rhizome), and quackgrass	Sethoxydim 0.14-0.47 lb	Poast 1.5EC 0.75-2.5 pt	Do not apply to grasses or crops under stress as unsatisfactory control and crop injury may result. Always add a nonphytotoxic oil concentrate to the spray tank as recommended on the label. Commercially released varieties of sunflower are tolerant to Poast at all stages of growth; however, leaf speckling has been occasionally observed on sunflowers with no corresponding reduction in vigor or growth.
Harvest aids	Paraquat 0.3-0.5 lb	Gramoxone Inteon 2L 1.2-2.0 pt	Apply when sunflower seeds reach physiological maturity (when seed moisture is 35% or lower). For many varieties, this corresponds to the time when the black of the heads are yellow and the bracts are turning brown. Do not graze treated areas or feed treated forage to livestock. Use the higher rate when crop stands or weed infestations are heavy.

Weed Control in Tobacco

A number of good products that provide adequate, season-long weed control are available for use on tobacco. To achieve the best degree of weed control, each of the products in the list, when used, should be incorporated into the soil. Although all of these materials are good in controlling annual grasses, they may be weak for controlling broadleaf weed species. Timely cultivation will help when weed escapes occur.

Tobacco - conventional tillage

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Anoda (spurred), barnyardgrass, crabgrass, foxtails, goosegrass, jimsonweed, johnsongrass (seedling), lambsquarters, panicum (fall), ragweed (common), sandbur (field), sida (prickly), and velvetleaf	Clomazone 0.75-1.0 lb	Command 3ME 2.0-2.6 pt	Make a single broadcast application in a minimum of 20 gallons of water per acre. Apply immediately before or up to 30 days prior to transplanting. Can also be applied over-the-top of tobacco plants immediately or up to 7 days after transplanting, but prior to emergence of weeds. If weeds emerge before preemergence application can be made, cultivate before or immediately preceding treatment. Observe application precautions stated on label.
Barnyardgrass, carpetweed, crabgrass, foxtail (giant, green, yellow), goosegrass, lambsquarters, panicum (fall), pigweed, purslane, and ragweed suppression	Napropamide 1.0-1.5 lb	Devrinol 50DF 2.0-3.0 lb	Incorporate shallowly, 1.0 to 2 inches deep, the same day of application. After harvest, moldboard-plow before planting a succeeding crop.
Barnyardgrass, crabgrass, foxtail (giant, green, yellow), panicum (fall, Texas), signalgrass, shattercane, volunteer rye and wheat, bermudagrass, and johnsongrass suppression	Sethoxydim 0.28 lb + crop oil concentrate 2.0 pt	Poast 1.5 EC 1.5 pt + crop oil concentrate 2.0 pt	Do not apply Poast to grasses under stress such as lack of moisture. Do not cultivate within 5 days before or 7 days after applying Poast. To control bermudagrass, delay cultivation until 14 to 21 days after applying Poast. Do not apply within 42 days of harvest. Do not apply more than 4 pints per acre per season. Do not apply if rainfall is expected within 1.0 hour following application. Do not mix Poast with other pesticides or crop injury may result.
Barnyardgrass, carpetweed, crabgrass, foxtail (giant, green, yellow), goosegrass, johnsongrass (seedling), lambsquarters, panicum (fall), pigweed spp., and purslane	Pendimethalin 0.5-1.0 lb	Prowl 3.33EC 0.6-1.2 qt or Prowl H2O 3.8CS 0.5-1.0 qt	Incorporate shallowly, 1.0 to 2 inches deep, within 7 days of application. Set transplants below treated zone. In Maryland, Prowl has provided good control of purslane.

Tobacco - conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Anoda (spurred), carpetweed, cocklebur, copperleaf (Virginia), croton (tropic), galinsoga (hairy), groundcherry (clammy, cutleaf), jimsonweed, lambsquarters, morningglory (entireleaf, ivyleaf, palmleaf, pitted, purple, red, small-flower, tall), mustard (wild), nightshade (Eastern, hairy, silverleaf), nutsedge (purple, yellow), pigweed sp., poorjoe, purslane, sida (prickly), velvetleaf, and waterhemp (common, tall)	Sulfentrazone 0.25-0.375 lb	Spartan 4F 8.0-12.0 oz	Preemergence and preplant incorporated applications of Spartan require rainfall or irrigation to activate the herbicide. If adequate moisture (0.5 to 1.0 inch) is not received within 7 to 10 days after treatment, a shallow cultivation may be needed. Tank-mix Spartan with an appropriate grass herbicide for additional annual grass control. On fields where raised beds are not formed prior to transplanting, perform all accepted cultural practices for land preparation, fertilizer/fungicide incorporation, etc., prior to the application of Spartan. Once the field has been prepared for planting, Spartan may be surface-applied up to 14 days prior to transplanting tobacco. If the soil must be worked after a Spartan application but prior to transplanting, use only equipment that will not disturb the soil to a depth greater than 2 inches. Do not apply Spartan post-transplant. Deep incorporation will allow more product to be in contact with tobacco roots, creating the potential for greater uptake and injury. Heavy rain and cool temperatures soon after application and transplanting can also result in greater injury potential.
Barnyardgrass, bermudagrass, crabgrass, foxtail (giant, green, yellow), goosegrass, lambsquarters, pigweed and purslane suppression, and nutsedge control	Pebulate 3.0-4.0 lb	Tillam 6E 2.0-2.66 qt	Incorporate immediately after application. Set disk 4 to 6 inches deep, and incorporate in two directions. When transplanting, set roots below treated zone. Tillam may cause stunting when plants are set during cool, wet conditions. Plants usually recover once air and soil temperatures rise.

Tobacco - conventional tillage (continued)

Weed Problem	Chemical rate per acre	Product per acre	Remarks
Plant beds only			
White clover control	Napropamide 1.36 lb	Devrinol 10G 13.6 lb or 6.0 oz per 1,200 sq. ft or 1.0 oz per 200 sq. ft or 4.5 oz per 100 sq. yd plant bed	Devrinol 10G does not control emerged vegetation. Apply in the fall through early spring prior to weed emergence. Apply 1 ounce of Devrinol per 200 square feet. Lightly incorporate or irrigate within 24 hours using sufficient water to wet the soil to a 2- to 4-inch depth.
Barnyardgrass, crabgrass, foxtails, goosegrass, johnsongrass (seedling), panicum (fall), shattercane, volunteer cereal grains, and volunteer corn	Sethoxydim 0.19 lb + crop oil concentrate	Poast 1.0 pt + crop oil concentrate 2.0 pt	Apply to actively growing grasses at the rate and size indicated on the label for the individual grass species with 10 to 20 gallons of water per acre and 40 pounds per square inch. Do not use flood-type nozzles. Always add 2 pints of crop oil concentrate per acre. Rainfall within 1.0 hour of application will decrease effectiveness.

Vegetable Herbicide Rotation Restrictions

The following table summarizes the crop rotation restrictions to direct seeded crops after certain vegetable herbicide applications have been made. Consult the label if two or more of these materials are applied in the same season. This list is not a substitute for the herbicide label.

Vegetable Herbicide rotation restrictions

	Rotational crops (months after application)[a] - Alfalfa to Pumpkins										
Herbicide	**Alfalfa**	**Cabbage**	**Cucum-bers**	**Field Corn**	**Grain Sorghum**	**Lima Beans**	**Musk-melon**	**Onions**	**Peas**	**Peppers**	**Pumpkins**
2,4-D	3	3	3	NR	3	3	3	3	3	3	3
Accent	12	10 [b]	10 [e]	NR	10	1 [b]	10	10 [e]	10 [b]	10 [b]	10 [b]
Aim	1	1	1	NR	1	1	1	1	1	1	1
Alanap	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Assure II/Targa	4	4	4	4	4	4	4	4	NR	4	4
Atrazine	SY	SY	SY	NR	NR	SY	SY	SY	SY	SY	SY
Axiom	NY	NY	NY	NR	NY	NY	NY	NY	NY	NY	NY
Balance	10	18	18	NR	6	18	18	18	18	18	18
Banvel	AH	AH	AH	NR	NR	AH	AH	AH	AH	AH	AH
Basagran	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Basis	10	18	18	NR	18	18	18	18	8	18	18
Beacon	8	18	18	0.5d	8	18	18	18	8	18	18
Boundary	4.5	12	12	8	12	12	12	18	12	12	12
Buctril	1	1	1	1	1	1	1	1	1	1	1
Callisto	NY	NY	NY	NR	NY	NY	NY	NY	NY	NY	NY
Canopy EX	12	18	18	10	12	12	30	18	12	30	18
Celebrity Plus	12	10 [e]	10 [e]	NR	10 [e]	10 [e]	10 [e]	10 [e]	10	10 [e]	10 [e]
Clarity	3	AH	AH	NR	NR	AH	AH	AH	AH	AH	AH
Classic [e]	12	18	18	9	9	30	30	30	9	30	18
Cobra	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Command [e]	16	12	9	9	9	16	9	16	NR	NR	NR
Curbit	NR	NR	NR	NR	NR	AH	NR	AH	NR	NR	NR
Dacthal	8	NR	8	8	8	8	8	NR	8	8	8
Define	12	4	12	NR	12	12	12	18	12	4	12
Degree/Degree Extra	SY	SY	SY	NR	NY	SY	SY	SY	SY	SY	SY
Devrinol	12	NR	12	12	12	12	12	12	12	NR	12
Distinct	1	1	1	1	1	1	1	1	1	1	1
Dual II Magnum/Cinch	4	NY	12	NR	NR	NR	12	12	NR	12	12
Eptam	0	AH	AH	AH	AH	AH	AH	AH	AH	AH	AH
Evik	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY

Vegetable Herbicide rotation restrictions (continued)

Herbicide	Rotational crops (months after application)[a] - Alfalfa to Pumpkins										
	Alfalfa	Cabbage	Cucum-bers	Field Corn	Grain Sorghum	Lima Beans	Musk-melon	Onions	Peas	Peppers	Pumpkins
Exceed	18	18 [e]	18	1 [e]	10	18	18	18	10	18	18
Extreme	4	40	40	8.5	18	NR	40	40	40	40	40
Field Master	SY	SY	SY	NR	NR	SY	SY	SY	SY	SY	SY
First Rate	9	30B	30B	9	9	30B	30B	30B	30B	30B	30B
Flexstar	18	18	18	10	18	10	18	18	10	18	18
Fusilade DX/Fusion	2	NR	NR	2	2	NR	NR	NR	NR	NR	NR
Galigan	2	2(NR) [f]	2	10	10	2	2	2	2	2	2
Goal	2	2(NR) [f]	2	10	10	2	2	2	2	2	2
Gramoxone products	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Guardsman Max	SY	SY	SY	NR	NY	SY	SY	SY	SY	SY	SY
Harmony Extra XP	2	2	2	2	2	2	2	2	2	2	2
Harmony GT XP	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Harness	SY	SY	SY	NR	SY	SY	SY	SY	SY	SY	SY
Harness Xtra	SY	SY	SY	NR	NY	SY	SY	SY	SY	SY	SY
Hornet	10.5	26B	26B	NR	12	26B	26B	26B	18	26B	26B
Karmex	24	24	24	NY	NY	24	24	24	24	24	24
Kerb [e]	0	7	7	5	5	5	7	7	12	12	7
Liberty	4	4	4	NR	2.5	4	4	4	4	4	4
Liberty ATZ	SY	SY	SY	NR	NR	SY	SY	SY	SY	SY	SY
Lightning	9.5	40B	40B	8.5 [e]	18	40B	40B	40B	9.5	40B	40B
Lorox/Linex	4	4	4	NR	4	4	4	4	4	4	4
Marksman	SY	SY	SY	NR	NR	SY	SY	SY	SY	SY	SY
Matrix	12	12	12	NR	12	10	12	12	12	12	12
Micro-Tech/Partner	AH	NY	NY	NR	NR	NR	NY	NY	NY	NY	NY
NorthStar	8	18	18	0.5	8	18	18	18	18	18	18
Outlook	NY	NY	NY	NR	NY	NY	NY	NY	NY	NY	NY
Permit	9	15	9	1	2	9	9	18	9	10	9
Poast	NR	NR	NR	AH	AH	NR	NR	NR	NR	NR	NR
Poast Plus	NR	NR	NR	AH	AH	NR	NR	NR	NR	NR	NR
Prefar	4	NR	NR	4	4	4	NR	NR	4	NR	NR
Princep	SY	SY	SY	NR	SY	SY	SY	SY	SY	SY	SY
Prism	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Prowl	NY	NY	NY	NY	NY	NR	NY	NY	NY	NY	NY
Pursuit [e]	4	40B	40B	8.5 [g]	18	NR	40B	40B	4	40B	40B
Python	4	26B	26B	NR	12	26B	26B	26B	4	26B	26B
Raptor	9	9	9	9	9	9	9	9	9	9	9

Vegetable Herbicide rotation restrictions (continued)

Herbicide	Rotational crops (months after application)[a] - Alfalfa to Pumpkins										
	Alfalfa	Cabbage	Cucum-bers	Field Corn	Grain Sorghum	Lima Beans	Musk-melon	Onions	Peas	Peppers	Pumpkins
Ready Master ATZ	SY	SY	SY	NY	NY	SY	SY	SY	SY	SY	SY
Resource	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Ro-Neet	AH	AH	AH	AH	AH	AH	AH	AH	AH	AH	AH
Roundup products	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Sandea	9	15	NR	1	2	NR	NR	18	9	10	NR
Scepter [e]	18	18	18	9.5 [e,g]	11	11	18	18	18	18	18
Select	NR	1	1	1	1	1	1	NR	1	1	1
Sempra	9	15	9	1	2	9	-	18	9	10	9
Sencor	4	12	12	4	12	12	12	18	8	12	12
Sinbar	24	24	24	24	24	24	24	24	24	24	24
Solicam	B	B	B	B	B	B	B	B	B	B	B
Sonalan	AH	AH	AH	AH	AH	AH	AH	AH	AH	AH	AH
Spin-aid	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Spirit	18	10	18	1 [g]	10	18	18	18	10	18	18
Starane	4	4	4	NR	NR	4	4	4	4	4	4
Steadfast	12	18	18	NR	18	10	18	18	18	18	18
Stellar	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Stinger	10.5	NR	18	NR	10.5	18	18	10.5	18	18	18
Synchrony XP [e]	12	18	18	9	9	9	30	30	9	30	18
Tillam	AH	AH	AH	AH	AH	AH	AH	AH	AH	AH	AH
Touchdown products	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Treflan	NR	NR	NR	5	5	NR	5	5	NR	NR [f]	5
Ultra Blazer	AH	AH	AH	AH	AH	AH	AH	AH	AH	AH	AH
Valor	12	12	12	2	2	12	12	12	12	12	12
Yukon	9	15	9	1	2	NI	NI	18	9	10	9

[a] AH = After Harvest; B = Bioassay of Soil Recommended before Planting; D = Days, NI = No Information, NR = No Restrictions, NY = Next Year, SY = Second Year Following Application

[b] 18 Months with a soil pH >= 6.5

[c] 20 Days per pint

[d] 30 Days per pint

[e] Read the label for additional restrictions due to special state retrictions, varieties, rate, rainfall, soil, pH, application rate, etc.

[f] Transplanted

[g] Corn hybrids, which are classified as tolerant (IT) or resistant (IR) to Sceptor and/or other imidazoline herbicides (example Pursuit), may be planted in the spring of the following year following Sceptor or Pursuit application

[h] See current 2,4-D label

Vegetable Herbicide rotation restrictions (continued)

	Rotational crops (months after application) [a] - Snap beans to Winter wheat									
Herbicide	**Snap beans**	**Soybeans**	**Squash**	**Sweet corn**	**Tomatoes**	**Water-melon**	**White potatoes**	**Winter barley**	**Winter rye**	**Winter wheat**
2,4-D	3	.25-1 [h]	3	NR	3	3	3	3	3	3
Accent	10 [b]	0.5	10	10	10 [b]	10	10 [b]	4	4	4
Aim	1	1	1	1	1	1	1	12	12	1
Alanap	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Assure II/Targa	NR	NR	4	4	4	4	4	4	4	4
Atrazine	SY	SY	SY	NR	SY	SY	SY	SY	12	SY
Axiom	NY	NR	NY	NY	NY	NY	1	NY	NY	NY
Balance	18	6	18	6	18	18	6	6	18	4
Banvel	AH	1 [d]	AH	AH	AH	AH	AH	1 [c]	1 [c]	1 [c]
Basagran	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Basis	8	0.5	10	10	18	18	4	8	18	4
Beacon	8	8	18	8	18	18	18	3	3	3
Boundary	12	NR	12	12	12	12	8	4.5	12	4.5
Buctril	1	1	1	1	1	1	1	1	1	1
Callisto	NY	NY	NY	NY	NY	NY	NY	4	4	4
Canopy EX	12	NR	30	18	10	18	18	4	4	4
Celebrity Plus	10	1	10 [e]	10 [e]	10 [e]	10 [e]	10 [e]	4	4	4
Clarity	AH	1 [d]	AH	AH	AH	AH	AH	AH	1 [c]	AH
Classic [e]	9	NR	30	18	9	18	30	3	3	3
Cobra	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Command [e]	9	NR	NR	9	9 [f]	9	9	12	12	12
Curbit	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Dacthal	AH	8	8	8	8	8	8	8	8	8
Define	12	NR	12	12	12	12	18	12	12	12
Degree/Degree Extra	SY	NY	SY	NY	SY	SY	SY	SY	SY	AH
Devrinol	12	12	12	12	NR	12	12	12	12	12
Distinct	1	1	1	1	1	1	1	1	1	1
Dual II Magnum/Cinch	NR	NR	12	NR	6	12	NR	4.5	4.5	4.5
Eptam	NR	AH	AH	AH	AH	AH	NR	AH	AH	AH
Evik	NY	NY	NY	NY	NY	NY	NY	AH	AH	AH
Exceed	10	18 [e]	18	3	18 [e]	18 [e]	10	3	3	3
Extreme	40	NR	40	18	40	40	26	9.5	4	4
Field Master	SY	NY	SY	NY	SY	SY	SY	NY	NY	NY
First Rate	30B	NR	30B	9	30B	30B	30B	30B	30B	3
Flexstar	10	10	18	10	18	18	18	4	4	4
Fusilade DX/Fusion	NR	NR	NR	2	NR	NR	NR	2	2	2

Vegetable Herbicide rotation restrictions (continued)

Herbicide	Rotational crops (months after application) [a] - Snap beans to Winter wheat									
	Snap beans	Soybeans	Squash	Sweet corn	Tomatoes	Water-melon	White potatoes	Winter barley	Winter rye	Winter wheat
Galigan	2	NR	2	10	2	2	2	10	10	10
Goal	2	NR	2	10	2	2	2	10	10	10
Gramoxone products	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Guardsman Max	SY	NY	SY	SY	SY	SY	SY	SY	SY	SY
Harmony Extra XP	2	2	2	2	2	2	2	NR	2	NR
Harmony GT XP	1.5	NR	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Harness	SY	NY	SY	NY	SY	SY	SY	SY	SY	AH
Harness Xtra	SY	NY	SY	SY	SY	SY	SY	SY	SY	SY
Hornet	26B	10.5	26B	18	26B	26B	18	4	4	4
Karmex	24	24	24	24	24	24	24	24	24	12
Kerb [e]	5	5	7	5	7	7	12	12	12	12
Liberty	4	NR	4	4	4	4	4	2.5	2.5	2.5
Liberty ATZ	SY	SY	SY	NR	SY	SY	SY	SY	12	SY
Lightning	9.5	9	40B	18	40B	40B	26	9.5	4	4
Lorox/Linex	4	NR	4	4	4	4	NR	4	4	4
Marksman	SY	SY	SY	NR	SY	SY	SY	10	10	10
Matrix	10	10	12	10	1	12	NR	12	12	4
Micro-Tech/Partner	NY	NR	NY	NR	NY	NY	NY	AH	AH	AH
NorthStar	8	8	18	8	18	18	8	3	3	3
Outlook	NY	NR	NY	NY	NY	NY	NY	4	4	4
Permit	9	9	9	3	8	9	9	2	2	2
Poast	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Poast Plus	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Prefar	4	4	NR	4	NR	NR	4	4	4	4
Princep	SY	SY	SY	NR	SY	SY	SY	SY	SY	SY
Prism	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Prowl	NR	NR	NY	NY	NY	NY	NR	4	NY	4
Pursuit [e]	4	NR	40B	18	40B	40B	26	9.5	4	4
Python	26B	NR	26B	18	26B	26B	12	4	4	4
Raptor	9	9	9	9	9	9	9	4	4	3
Ready Master ATZ	SY	NY	SY	NY	SY	SY	SY	SY	SY	SY
Resource	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Ro-Neet	AH	AH	AH	AH	AH	AH	AH	AH	AH	AH
Roundup products	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Sandea	NR	9	NR	3	NR	NR	9	2	2	2
Scepter [e]	11	NR	18	18	18	18	18	11	18	3

Vegetable Herbicide rotation restrictions (continued)

	Rotational crops (months after application) [a] - Snap beans to Winter wheat									
Herbicide	**Snap beans**	**Soybeans**	**Squash**	**Sweet corn**	**Tomatoes**	**Water-melon**	**White potatoes**	**Winter barley**	**Winter rye**	**Winter wheat**
Select	1	1	1	1	NR	1	1	1	1	1
Sempra	9	9	9	3	8 [f]	-	9	2	2	2
Sencor	12	NR	12	12	4	12	4	4	12	4
Sinbar	24	24	24	24	24	24	24	24	24	24
Solicam	B	B	B	B	B	B	B	B	B	B
Sonalan	AH	AH	AH	AH	AH	AH	AH	AH	AH	AH
Spin-aid	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Spirit	10	10	18	8	10	18	10	3	3	3
Starane	4	4	4	NR	4	4	4	NR	NR	NR
Steadfast	10	0.5	18	10	18	18	18	4	4	4
Stellar	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Stinger	18	10.5	18	NR	18	18	18	NR	NR	NR
Synchrony XP [e]	9	NR	30	18	9	18	30	3	3	3
Tillam	AH	AH	AH	AH	AH	AH	AH	AH	AH	AH
Touchdown products	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Treflan	NR	NR	5	5	NR [f]	5	NR	NR	NR	NR
Ultra Blazer	AH	AH	AH	AH	AH	AH	18	AH	AH	AH
Valor	12	NR	12	4	12	12	12	4	4	2
Yukon	9	9	9	3	8	NI	9	2	2	2

[a] AH = After Harvest; B = Bioassay of Soil Recommended before Planting; D = Days, NI = No Information, NR = No Restrictions, NY = Next Year, SY = Second Year Following Application

[b] 18 Months with a soil pH >= 6.5

[c] 20 Days per pint

[d] 30 Days per pint

[e] Read the label for additional restrictions due to special state retrictions, varieties, rate, rainfall, soil, pH, application rate, etc.

[f] Transplanted

[g] Corn hybrids, which are classified as tolerant (IT) or resistant (IR) to Sceptor and/or other imidazoline herbicides (example Pursuit), may be planted in the spring of the following year following Sceptor or Pursuit application

[h] See current 2,4-D label

Disease and Nematode Management for Field Crops

A. P. Grybauskas
University of Maryland, College Park
R. P. Mulrooney
University of Delaware
E. L. Stromberg and P. M. Phipps
Virginia Polytechnic Institute and State University

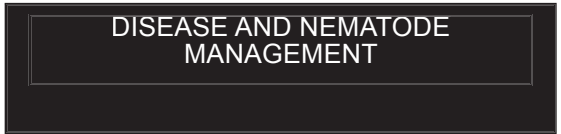
Disease management in field crops is optimized by developing a long-term management program. Prevention and risk reduction through the integration of various cultural practices, including crop rotation, tillage, fertilizer management and pesticides, are the goals of an effective and economical disease management program. The starting point of any management program is the selection of locally adapted, disease-resistant cultivars. Because of the importance of this selection, tables providing descriptions of reactions of commonly grown cultivars to prevalent diseases have been included in this section. The lists are not all-inclusive because new cultivars may be released after the printing of this bulletin or lack of adequate testing prevents inclusion of information at printing. Updates are available through your county Extension office.

The remainder of this section is a compilation of recommended chemical disease control measures that were registered at printing. This is not intended to be an exhaustive index of all registered fungicides and nematicides. The information in this section is provided as a guide to available products, but does not substitute for or supersede the information found on the pesticide label of a specific product. Use pesticides only as the label directs. Trade names are included to aid in the identification of the specific active ingredient of a pesticide known to be effective. No discrimination against a similar product is intended or implied by omission. Mention of a commercial product does not constitute an endorsement by the authors or by their respective Extension services. Consult the pesticide label for any changes in rate, timing, handling, or registration.

Corn and Sorghum Diseases

Seed and Seedling Diseases of Corn and Sorghum

Seed treatment for corn continues to be a highly effective and inexpensive disease management tool for early-season seed- and soilborne problems. In particular because corn yield depends on plant population, seed treatments help to protect the yield potential by reducing stand losses from early-season diseases. As a result all major brands of hybrid seed are sold already treated. Similarly, hybrid sorghum production also benefits from seed treatments as nontillering types depend on emergence to achieve optimum plant populations. Treating sorghum seed is also important to preventing the development of certain seedborne smut diseases and the systemic form of downy mildew and to reducing the introduction and damage caused by sorghum ergot. Hybrid sorghum seed, like corn, is therefore sold already treated.



Foliar Diseases of Corn

A few chemical control measures are registered for foliar diseases of corn. However, their use is limited to the production of seed corn and is not recommended for general production. Rarely, when a highly susceptible hybrid is planted no-till into corn stubble and favorable conditions exist for gray leaf spot, can an economic return on a fungicide be realized. If this unusual circumstance occurs, consult your county Extension office for information on products and rates. Use resistant hybrids, especially in continuous no-till production systems.

Many disease-causing organisms are harbored in infested corn debris; thus, they are more readily available to infect corn in systems where debris remains on the soil surface and is allowed to build up. It is recommended that you plant hybrids resistant to gray leaf spot and southern corn leaf blight. Also, where johnsongrass is a problem use hybrids with resistance to MDMV and MCD. For indirect protection against stalk rots, plant hybrids with good "stay green" characteristics.

Nematode Diseases of Corn

Base the need for a nematicide on the results of a soil test for the presence and level of plant pathogenic nematodes and on the site history. The best time to collect samples for nematode testing is fall, immediately after harvest. Before deciding to use a nematicide, consult your county Extension office for information on proper soil sampling procedures for nematode testing and for information on threshold levels. Nematode testing is available through the Delaware, Maryland, and Virginia Cooperative Extension Services and at some commercial soil testing laboratories.

Corn - Nematicide recommendations

Nematode	Nematicide common name	Nematicide trade name	Formulated rate	Remarks
Root-knot, lesion, lance, sting, stunt, and stubby-root	Terbufos	Counter 15G Counter CR	8.0 oz/1,000 linear row ft Do not exceed 8.7 lb/A 6.0 oz/1,000 linear row ft Do not exceed 6.5 lb/A	**Restricted Use.** Apply at planting in seed furrow or in 7-inch bands over row, and lightly incorporate. Use of Accent or Beacon herbicide on corn treated with Counter may cause severe crop injury. Consult label for details on restrictions and precautions.
	Ethoprop	Mocap 15G	12.0-16.0 oz/1,000 linear row ft	**Restricted Use.** Apply at planting in a 12- to 15-inch band over each row and mix with top 2 to 4 inches of soil. Do not use in-furrow.

Forage Crop Diseases

Disease management in perennial forage crops is based on planting locally adapted, disease-resistant cultivars and using good cultural practices to help reduce losses from diseases. Disease resistance ratings of alfalfa cultivars are compiled by the National Alfalfa Alliance and are updated annually. The list can be viewed on the web at www.alfalfa.org. You may download the list for free, or purchase a copy of the list for a nominal fee from the organization. Note that at this time no commercially available alfalfa cultivars have an acceptable level of resistance to Sclerotinia crown and stem rot. Stand establishment of forage legumes may benefit from the use of seed-protectant fungicides, particularly in spring no-till seeding, when conditions slow the germination process. In general, cool, wet soil conditions favor seed decay and damping-off diseases. Most seed companies now sell alfalfa seed treated with a fungicide for damping-off management. However, most other forage crops are not commonly pretreated.

Alfalfa - Major diseases, probability of outbreaks and recommended minimum level of resistance for alfalfa cultivars to be grown in the mid-Atlantic

	Bacterial wilt	Verticillium wilt	Fusarium wilt	Anthracnose	Phytophthora root rot	Root-knot nematode	Aphanomyces root rot	Sclerotinia crown and stem rot	Leaf & stem spots
Outbreak probability	Low	Moderate	Moderate	Moderate	Moderate	Low	Unknown [3]	No-till fall seeding High	High
Recommended minimum resistance [1]	MR	MR	MR	R	R	Soil test [2]	MR	NA	NA

1 Always get the highest level of resistance available whenever possible. Recommended minimums will not prevent serious losses in the event of a major outbreak. Consider the recommendation as a guideline for choosing between varieties when HR is not available across the board.

2 Nematode risk can be determined with a soil test prior to planting. When root-knot nematode is a threat and you must plant alfalfa, choose a variety with as high a level of resistance as you can find.

3 Aphanomyces root rot has not been formally identified or surveyed for in the mid-Atlantic. It is, however, likely to be a problem. In general, plant cultivars that have at least an MR rating, except if planting in spring in which case select cultivars with at least an R rating.

Key: E = excellent, VG = very good; G = good, F = fair, P = poor, N = no control, NR = not registered, - = information not available.

Forage crops - Seed treatment fungicides

Crop	Disease	Active ingredient	Trade name	Remarks
Alfalfa, forage beans, forage cowpeas, forage soybeans, forage velvet beans, lespedeza clover, pea vine, hay, trefoil, and vetch	Damping-off and early season Phytophthora root rot	Metalaxyl Mefenoxam	Allegiance FL Apron XL LS	Registered for application by commercial seed treaters only. Excellent control of Pythium damping-off.
Alfalfa, clover, lespedeza, and trefoil	Seed decay and damping-off	Captan	Captan 400	Good control of Pythium damping-off and some common seed- and soilborne decay organisms. Apply seed treatment materials in a slurry or with commercial mist-type equipment. Follow instructions on labels.
Alfalfa, clover, and other small-seeded legumes	Seed decay and damping-off	Thiram	Thiram-50 WP Gustafson 42-S Thiram	Control of Pythium damping-off is less effective. Apply seed treatment materials in a slurry or with commercial mist-type equipment. Follow instructions on label.

Forage crops - Soil treatment fungicides

Crop	Disease	Active ingredient	Trade name	Remarks
Alfalfa	Damping-off and early season Phytophthora root rot	Mefenoxam	Ridomil Gold EC Ridomil Gold WSP	Soil treatment generally not necessary if seed is treated with Allegiance or Apron. Consider soil treatment only where there is a history of Phytophthora, soil is heavy, cold and wet conditions prevail, and the variety is relatively susceptible. Most alfalfa seed is treated with Apron. Use the low rate of Ridomil with Apron-treated seed. Apply 1/4 to 1/2 pints per acre of EC formulation or 1/4 to 1/2 lb per acre of WSP as a broadcast surface spray at planting in a minimum of 20 gallons of water per acre. Do not feed green forage or cut hay for 60 days following application.

Small Grain Diseases

Seed and Seedling Diseases of Small Grains

Fungicide seed treatments, properly applied, are highly recommended and can be considered as inexpensive stand establishment insurance. Seed treatments minimize losses from seed decay, seedling blights, and seed- and soilborne diseases, and for small grains are the only means of combating the smut diseases. Slurry applications or commercial liquid applications provide the best adhesion and most uniform coverage; thus, they provide the most effective control.

Problems with loose smut control are often due to poor fungicide coverage and higher levels of smut in seed or soil after a disease-favorable year. Hopper box treatments may not provide the coverage necessary to ensure adequate control. Most commercially available seed is sold with a seed treatment already applied. The effectiveness table below lists the most common treatment products and their performance against the most common diseases of wheat and barley in our region.

Effectiveness of seed treatments in the management of wheat and barley diseases that typically occur in the mid-Atlantic region

Seed Treatment	Rate (fl oz/cwt)	Pythium damping-off	Wheat loose smut	Wheat Early season Powdery mildew	Wheat seedborne scab	Wheat early season septoria	Barley loose smut	Barley stripe
Baytan 30 + Captan 400	1.25 + 2.0	G	E	E	F	G	E	G
Baytan 30 + Thiram 42S	1.25 + 3.3	F	E	E	F	G	E	G
Dividend Extreme	4.0	E	E	G	G	G	NR	NR
Dividend Extreme	2.0	E	E	F	F	G	NR	NR
Dividend XL	1.0	E	E	F	F	G	NR	NR
Dividend XL	0.5	E	VG	P	P	F	NR	NR
Flo-Pro IMZ	0.25-0.5	-	N	N	F	-	N	E
Raxil + Thiram	3.5	G	E	P	G	-	E	G
Raxil MD	5.0	E	E	P	F	-	E	G
Raxil XT	0.16 [1]	E	E	P	F	-	E	G
Vitavax 200	3.0-4.0	G	G	P	G	N	G	F

Key: E = excellent, VG = very good; G = good, F = fair, P = poor, N = no control, NR = not registered, - = information not available.

[1] Raxil XT is a WP formulation. The rate stated is in oz/cwt.

Small grains - Seed treatment guidelines

Crop	Crop Management	Cultivar susceptibility to powdery mildew	Fungicide trade name	Remarks
Wheat	High or expected yield > 70 bu/A	Susceptible	Baytan 30 + Captan or Baytan 30 + Thiram	Does not provide full season control of mildew. Plant Baytan-treated seed no more than 1.5 inches deep. See rates in efficacy table above. Loose smut control is excellent and damping-off control is adequate.
	High	Moderately susceptible	Baytan 30 + Captan or Baytan 30 + Thiram or Dividend XL (1.0-2.0 fl oz) or Dividend Extreme (2.0-4.0 fl oz)	See Baytan remarks above. Mildew protection with Dividend tends to decline earlier in spring than with Baytan. Higher rates of Dividend are more effective against mildew and last longer.
	High	Moderately resistant or Resistant	See remarks	Powdery mildew management with seed treatment is not required. Select any of the products listed in the efficacy table except Flo-Pro IMZ, which is a specialty product for barley stripe management. Targets are loose smut and damping-off management.
	Moderate or expected yield 50 to 70 bu/A	Moderately susceptible or Susceptible	Baytan 30 + Captan or Baytan 30 + Thiram or Dividend XL (1.0-2.0 fl oz) or Dividend Extreme (2.0-4.0 fl oz)	Powdery mildew management with these seed treatments can produce a yield response in disease-favorable years. See Baytan comments above. Mildew protection with Dividend tends to decline earlier in the spring than with Baytan.
	Moderate	Moderately resistant or Resistant	Dividend XL (0.5-1.0 fl oz) or Dividend Extreme (2.0 fl oz) Any Raxil formulation Any Vitavax formulation	With this combination of management and resistance the higher level of mildew protection is not warranted.
	Low	Any level	See remarks	Select products primarily for loose smut and damping-off control.
Barley and oats	N/A	N/A	See remarks	Select products primarily for smut and damping-off control

Foliar Diseases of Small Grains

Control of foliar diseases of small grains begins with the selection of well-adapted, disease-resistant cultivars. Chemical control of foliar diseases has been generally found to be uneconomical unless a high-yield potential may be realized. Intensive management practices, especially use of high-nitrogen fertility and narrow rows, increase both the yield and disease potential in a small-grain crop. To control foliar diseases and protect the higher yield potential of the crop, use of seed treatments or foliar-applied fungicides may be warranted for an intensively managed or high-yield potential crop. The decision to use seed treatments for foliar diseases, especially powdery mildew, is covered in the previous table.

Protect yields with foliar fungicides when (a) the expected yield is at least 70 bushels per acre (depends on actual cost of production and on potential market price); (b) scouting indicates threshold levels of disease are present; (c) the stage of crop growth is suitable for treatment; (d) the cultivar is relatively susceptible; and (e) the forecast indicates that conditions will be favorable for continued disease development. A foliar fungicide decisionmaking guide for the management of powdery mildew and scouting guidelines for glume blotch are provided. Favorable conditions for powdery mildew are temperatures between 60 and 75°F that coincide with periods of high relative humidity but not leaf wetness. Leaf rust develops most rapidly when temperatures are between 60 and 85°F and free moisture from showers or dew can be found on leaves from early evening until late morning. Stagonospora (Septoria) glume blotch is favored by wind-blown rain, high relative humidity, and temperatures between 68 and 82°F.

Small grains - Barley cultivars and their reactions to diseases

Cultivar	Powdery mildew [a]	Leaf rust	Scald	Net Blotch	Barley yellow dwarf virus
Barsoy	S	VS	S	MS	S
Boone	S	S	S	MR	MS
Callao	R	MS	S	MR	MR
Nomini	R	S-MS	S	MS	MR
Pamunkey	R	S	S	MS	MR
Pennbar 66	R	MR	MR	MR	-
Pennco	R	MR	MR	S	MR
Starling	R	MR	MS	S	MR
Sussex	MR	S	MS	MS	MR

Key: VS = very susceptible; S = susceptible; MS = moderately susceptible; MR = moderately resistant; R = resistant; — = data not available.

Disease reactions for powdery mildew and leaf rust can change rapidly due to changes in the composition of the pathogen races.

Small grains - Soft red winter wheat cultivars and their reactions to common diseases in the mid-Atlantic

Cultivar	Powdery mildew [a]	Leaf rust	Leaf and glume blotch	Head scab [b]	WSSMV [c]
Agripro Crawford	R-MR	-	MS	S	MS
Agripro Hickory	MR-MS *	S	MS	S	MS
Agripro Mason	MR-MS *	MR	MS	S	MS
Agripro Patton	S	R-MR	MR	MS	MR
Featherstone 520	MR-MS *	MR	MR	S	MS-S
JGL Coyote	R-MR	-	MS	S	S
NK Century II	S	S	MS	S	S
NK Coker 9025	MS-S	MR	MR	S	MR
NK Coker 9184	MS	R	MS	S	MS
NK Coker 9663	MS	R	MS	S	MS
NK Coker 9704	MS *	MR	MS	S	MR-MS
NK Coker 9835	S	S	MS	S	MR-MS
Pioneer 2552	MS *	MS	MS	S	R-MR
Pioneer 25R37	MR-MS	MS	MR	S	R-MR
Pioneer 25R78	MR	MR	MS	S	MR
Pioneer 2643	MR *	MR-MS	-	S	MS-S
Pioneer 26R24	MS-S	MS	-	S	S
Pioneer 26R58	MS	MS	MS	S	MR
Public Catoctin	MS-S	MR	MS-S	S	S
Public Fleming	R	R	-	S	-
Public Florida 304	S	MS	S	S	MR
Public Freedom	MR *	R	MS	MS	S
Public Jackson	S	S	MS	S	MS-S
Public Madison	MR-MS *	S	MS	S	R-MR
Public McCormick	R	R	MR	S	R-MR
Public Pocahontas	S	S	S	S	S
Public Roane	MS-S	R-MR	MS	MS	S
Public Sisson	R-MR	S	MR	S	MR
Southern States FFR 518W	R-MR *	R	MS	S	S
Southern States FFR 520W	MR	S	MR	S	MR
Southern States FFR 522W	S	R	MS	S	S
Southern States FFR 535W	MR-MS	MR-MS	MR	S	MS

Small grains - Soft red winter wheat cultivars and their reactions to common diseases in the mid-Atlantic (continued)

Cultivar	Powdery mildew [a]	Leaf rust	Leaf and glume blotch	Head scab [b]	WSSMV [c]
Southern States FFR 550W	MR	S	MR	S	MR-MS
Southern States FFR 555W	S	S	MS	S	MS-S
Southern States FFR 560W	MS	-	MS	S	R-MR
Southern States FFR 566W	MR-MS	R	-	S	S
USG 3209	R-MR	S	MR	S	S
USG 3350	S	-	MS	S	S
USG 3408	MR-MS	R	MR	S	S
USG 3430	S	-	MS	S	MS
USG 3650	MR	S	-	S	MR-MS
Vigoro Tribute	R	R	MR	S	MR

Key: S = susceptible; MS = moderately susceptible; MR = moderately resistant; R = resistant; - = data not available.

[a] Pockets of different races of powdery mildew often develop throughout Delaware, Maryland, and Virginia. The reactions listed are the ones most commonly observed in Maryland. An * indicates cultivar was last rated for mildew 2 or more years ago. Current resistance level is probably lower as new races develop frequently.

[b] Due to soft red winter wheat's widespread lack of resistance to scab, an S rating is given even when no direct test data are available.

[c] Wheat spindle streak mosaic virus is also known as wheat yellow mosaic virus.

Small grains - Efficacy of foliar-applied fungicides to manage wheat diseases common in mid-Atlantic region

Active Ingredient	Fungicide Trade name	Powdery mildew	Leaf Rust	Stripe Rust	Stagonospora leaf and glume blotch	Tan spot	Scab (Head blight)
Azoxystrobin	Quadris	F-G [a]	E	VG-G [b]	VG	E	NR
Azoxystrobin + propiconazole	Quilt	F-G [a]	G	VG	G	G	NR
Mancozeb	Dithane M-45 Penncozeb	P	P	P	P	P	P
Propiconazole	Tilt	VG	VG	E	G	VG	P
Pyraclostrobin	Headline	G	E	VG-G [b]	VG	VG	NR
Trifloxystrobin + propiconazole	Stratego	G	VG	VG	VG	VG	NR

[a] Greater efficacy at the higher application rates.

[b] Pre-infection applications are more effective.

Effectiveness of foliar fungicides is highly dependent on disease severity, disease-favorable weather, and product timing. The above ratings are for head-to-head comparisons under a best fungicide case scenario. Use decision guides to determine when to apply products.

Key: E = excellent, VG = very good, G = good, F = fair, P= poor, NR = not recommended.

Small grains - Foliar-applied fungicides

	Active Ingredient	Fungicide trade name	Application rate per acre	PHI (days)	Remarks
Wheat	Azoxystrobin	Quadris	6.2-10.8 fl oz	14 for hay Beginning of flowering for grain	See efficacy chart for target diseases. Do not apply before jointing [stage 6 on Feekes' or 31 on Zadoks' scale (Fig. 1)]. Applications can be made through heading (Stage 10.5 on Feekes' or 59 on Zadoks' scale). Do not apply once flowering begins. Do not apply more than 0.77 quarts per acre per season. Do not harvest treated wheat for forage. Minimum rate for powdery mildew control is 7.7 fl oz per acre. Do not make more than 2 applications per season of this or other strobilurin (QoI) fungicide (pyraclostrobin or trifloxystrobin) to reduce development of resistance to this class of fungicides.
	Pyraclostrobin	Headline	6.0-9.0 fl oz	14 for hay Beginning of flowering for grain	See efficacy chart for target diseases. Applications can be made through heading (Stage 10.5 on Feekes' or 59 on Zadoks' scale). Do not apply once flowering begins. Do not apply more than 18 fl oz per season. To reduce development of resistance to this class of fungicides, do not make more than 2 applications per season of this or other strobilurin (QoI) fungicide (pyraclostrobin or trifloxystrobin).

Small grains - Foliar-applied fungicides (continued)

	Active Ingredient	Fungicide trade name	Application rate per acre	PHI (days)	Remarks
Wheat	Propiconazole	Tilt	2.0-4.0 fl oz	Beginning of flowering	See efficacy chart for target diseases. Applications can be made through heading (Stage 10.5 on Feekes' or 59 on Zadoks' scale). Do not apply once flowering begins. Do not apply more than 4.0 fl oz per acre per season. Do not graze or feed livestock treated forage or cut green crop for hay or silage. After harvest, the straw may be used for bedding or feed. Soybeans may be double-cropped, but do not use hay, forage, or fodder from soybeans for feed or bedding. Do not plant rotational crop within 105 days unless it is on label.
	Propiconazole + trifloxystrobin	Stratego	10 fl oz	Beginning of flowering	See efficacy chart for target diseases. Applications allowed through heading (Stage 10.5 on Feekes' or 59 on Zadoks' scale). Do not apply more than 10 fl oz per acre per season. Do not graze or feed livestock treated wheat straw, forage or hay. Do not cut green crop for hay or silage. After harvest straw may be used for bedding. Double-crop soybeans are allowed, but do not use hay, forage, or fodder from the soybean crop as feed or bedding.
	Mancozeb	Dithane M45 Penncozeb 80WP	2.0 lb 1.0-2.0 lb	26	Make application up through heading (Stage 10.5 on Feekes' or 59 on Zadoks' scale). Do not apply once flowering begins. Do not apply more than 3 times per season (6 lb of product). Do not graze livestock in treated areas prior to harvest.

Small grains - Foliar-applied fungicides (continued)

	Active Ingredient	Fungicide trade name	Application rate per acre	PHI (days)	Remarks
Wheat, barley and triticale	Propiconazole + azoxystrobin	Quilt	10.5 - 14.0 fl oz	45	See efficacy chart for target diseases. Applications can be made through heading (Stage 10.5 Feeke's or 59 on Zadok's scale) for wheat only. Applications to barley and triticale can be made through flag leaf development (Stage 9 Feeke's or 39 on Zadok's scale). Do not apply more than 2 applications per season. Do not harvest for forage. Under certain conditions crop injury may occur when tank mixed with herbicides or fertlizer.
Barley and rye	Pyraclostrobin	Headline	6.0-9.0 fl oz	14 for hay	Application allowed up to 50% heading (Stage 10.3 on Feekes' or 55 on Zadoks' scale). Do not apply more than 18 fl oz per season. To reduce the development of resistance to this class of fungicide, do not make more than 2 applications per season
Barley, rye, oats	Propiconazole	Tilt	2.0-4.0 fl oz	See remarks	Application allowed up to flag leaf emergence (Stage 8 on Feekes' or 37 on Zadoks' scale). Do not apply more than 4.0 fl oz per acre per season. Do not apply to oats within 40 days of harvest. Do not graze or feed livestock treated forage or cut green crop for hay or silage. After harvest, the straw may be used for bedding or feed. Tilt-treated oats can be grazed or used for forage and hay. Soybeans may be double-cropped, but do not use hay, forage, or fodder from soybeans for feed or bedding. Do not plant rotational crop within 105 days unless it is on label.

Small grains - Foliar-applied fungicides (continued)

	Active Ingredient	Fungicide trade name	Application rate per acre	PHI (days)	Remarks
Barley, rye, oats, and triticale	Mancozeb	Dithane M45 Penncozeb 80WP	2.0 lb 1.0-2.0 lb	26	Make application up through heading (Stage 10.5 on Feekes' or 59 on Zadoks' scale). Do not apply once flowering begins. Do not apply more than 3 times per season (6 lb of product). Do not graze livestock in treated areas prior to harvest.

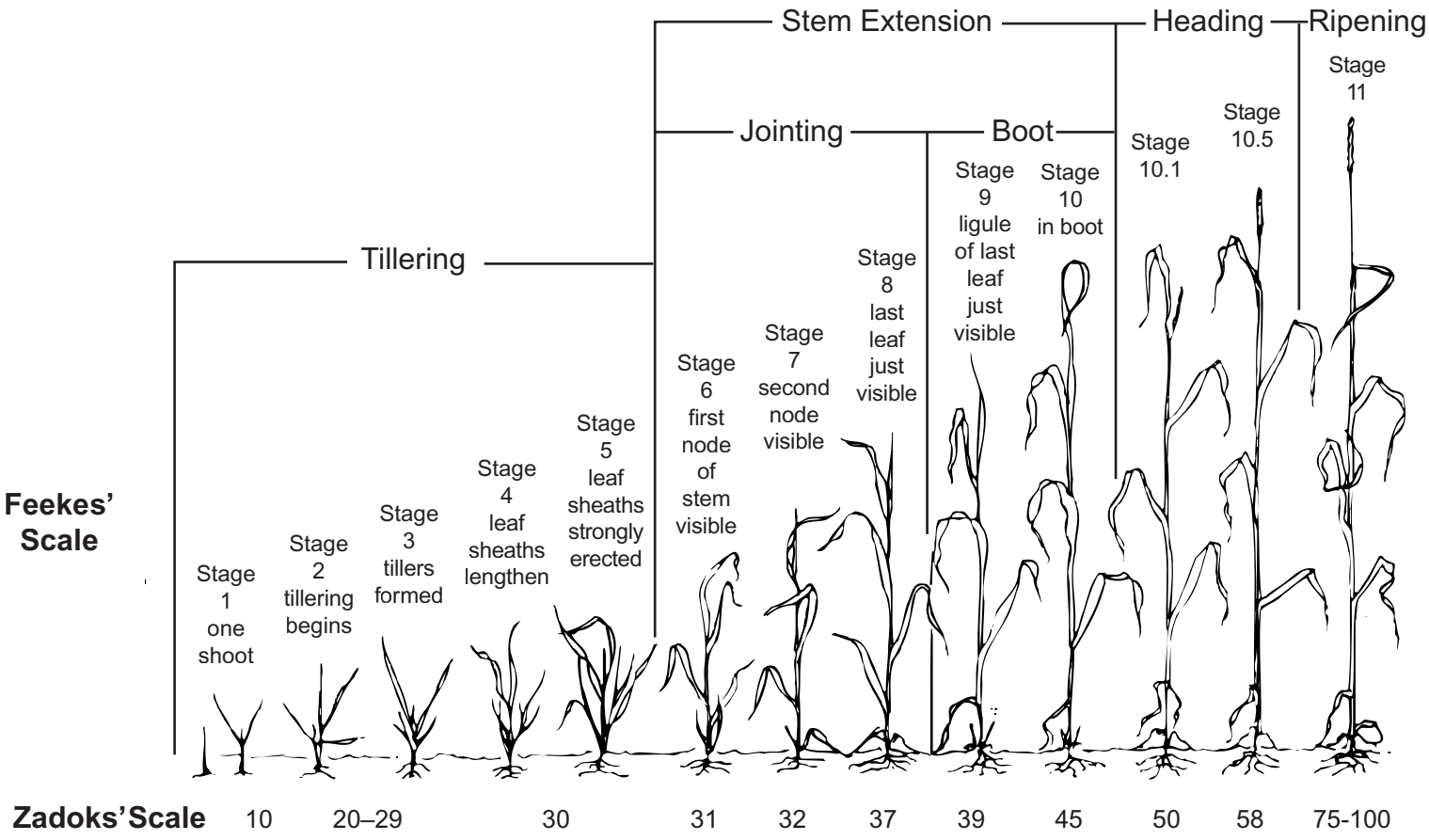


Figure 1. Stages of growth of small grains.

Wheat powdery mildew foliar fungicide decision guide and score sheet

Factor **Score**

1. Cultivar susceptibility to powdery mildew

Consult local publications available from county Extension offices or this bulletin for current ratings.

Resistance rating	HR	R	MR	MS	S	VS
Score	0	0	0	1	2	3

_____

2. Site yield potential (in bushels per acre)

If yield potential is less than 45 bushels per acre, do not spray.

Yield	45-55	55-65	65-75	75-85	>85
Score	0	1	2	3	4

_____

3. Spring nitrogen management (in pounds per acre)

Spring N	<60	60-90	60-90	90-120	90-120
Timing	-	split	at greenup	split	at greenup
Score	0	1	2	3	4

_____

4. Environment

This is based on temperature and moisture conditions for the past 2 weeks and forecast for the next week.

Temperature Average (°F)	Dry	Humid
50-60	1	3
60-70	2	4
70-80	1	3
>80	0	0

If heavy rain has occurred, subtract 2 from score total. _____

5. Disease assessment

Scout the field to determine how high up the plant powdery mildew can be detected.

Growth stage 6-8 (one joint to flag leaf visible)

Mildew on	Flag	Flag-1	Flag-2	Flag-3	Flag-4
Score	4	3	2	1	Do not spray [a]

_____

Growth stage 9-10 (flag leaf fully expanded to boot)

Mildew on	Flag	Flag-1	Flag-2	Flag-3	Flag-4
Score	6	5	3	1	Do not spray [a]

_____

Growth stage 10.1-10.5 (heading)

Mildew on	Flag	Flag-1	Flag-2	Flag-3
Score	6	4	2	Do not spray [a]

_____

[a] Do not spray, scout field again in 5 to 7 days.

Total Score _____

The decision threshold is 13. If the total score is 13 or more, a fungicide application can be beneficial.

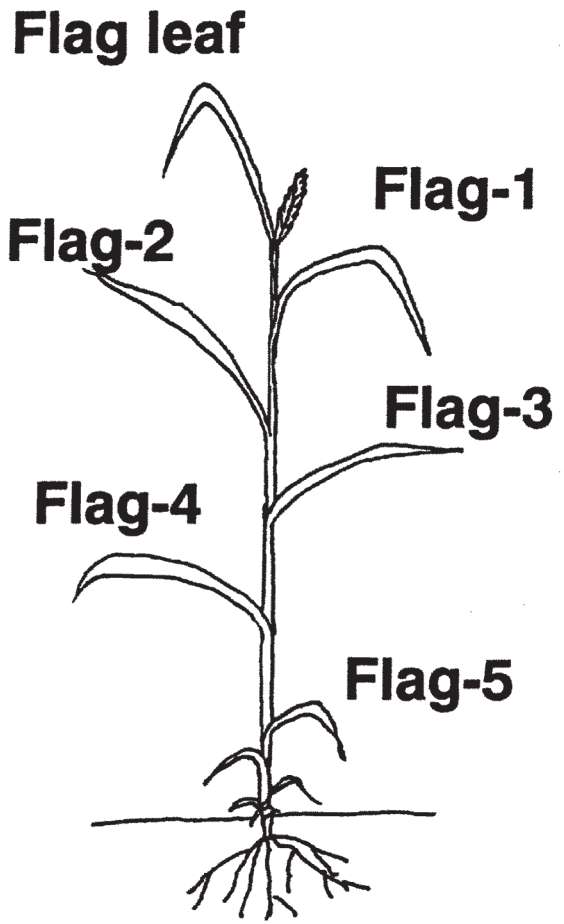


Figure 2. Determination of treatment threshold for septoria leaf and glume blotch in wheat

Septoria Leaf and Glume Blotch Scouting Guide

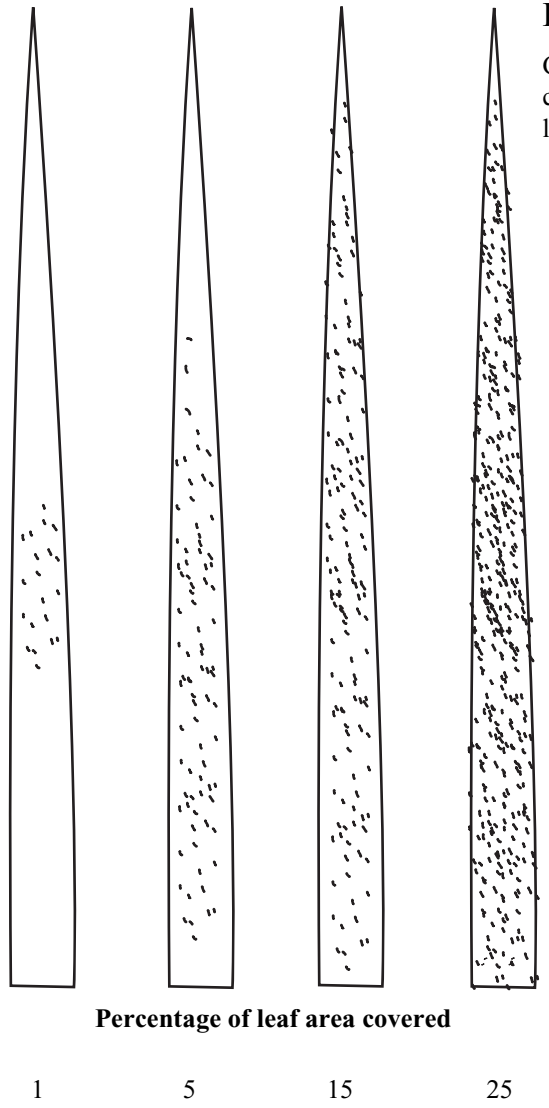
Examine the following leaf positions at the indicated growth stage:

Flag-4 and Flag-5 for Zadoks' growth stages 31 to 37 and Feekes' growth stages 6 to 8 (jointing to flag leaf emergence)

Flag-3 for Zadoks' growth stages 38 to 45 and Feekes' growth stages 9 to 10 (flag leaf fully expanded to boot)

Flag-2 for Zadoks' growth stages 46 to 59 and Feekes' growth stages 10.1 to 10.5 (boot splitting to heading)

Scout fields weekly from Zadoks' growth stage 31 through 59 (Feekes' 6 through 10.5). Randomly select 10 locations within a wheat field. At each location, examine and record the number of indicator leaves out of ten main tillers with one or more leaf and glume blotch lesions. If 25 percent of the 100 indicator leaves in the field have one or more lesions, then a fungicide application may be beneficial.



Leaf Rust of Wheat Scouting Guide

Consider a fungicide application for a high yield potential crop when rust covers 1 percent of upper, fully expanded leaves prior to heading.

Figure 3. Percentage of leaf area affected by leaf rust. (James, C. 1971 *A Manual of Assesment Keys for Plant Diseases.* Publication 1458. Canada Department of Agriculture.)

Soybean Diseases

Seed and Seedling Diseases of Soybeans

Inadequate stands, lack of uniform stands, and death of seedlings are often the result of seed or seedling diseases. The causal agents of these diseases are assorted fungi and bacteria that are seed- or soilborne or found in crop residues. Seed can become infected with fungi or bacteria just before harvest, particularly when harvest is delayed because of foul weather. Improper drying and storage may also lower seed quality. In general, soybeans in the mid-Atlantic region rarely respond to seed treatments because of the capacity of soybeans to compensate for reduced stands. Consider seed treatments for seed lots that have 85 percent or better germination (by the warm germination test) only if they are to be planted in cold wet soils (below 55°F). Treat seed if germination is between 75 and 85 percent, due to some fungal seed infection, with a fungicide. Seed with germination below 75 percent generally should not be treated or used for seed. Seed treatments cannot make up for seed of poor quality and low germination. For seed that test below 75 percent, reclean and retest before making a final determination. Remember, once seed are treated, they cannot be used for food, feed, or oil. Most soybean seed treatments are mixtures of different active ingredients. The following table provides guidelines for when to consider treatment and recommends the components (active ingredients) best suited for the primary problem created by the situation.

Soybeans - Recommended seed treatment fungicides

Situation	Required Active ingredient	Fungicide Trade name	Remarks
Early planting into cold (less than 55°F) and potentially wet soil	Metalaxyl Mefenoxam	Allegiance FL Soygard Apron XL LS Maxim XL	Pythium damping-off is the primary target for this situation. Metalaxyl and mefenoxam are by far the best active ingredients to control Pythium damping-off. Allegiance and Apron should not be used alone. Use Soygard or Maxim XL or combine Allegiance or Apron with other general-use registered seed treatment fungicides like captan or thiram. To avoid adverse effects on nitrogen-fixing bacterial inoculants, add inoculant to seed within 4 hrs of planting or apply in-furrow. Do not use treated seed for food, feed, or oil.
Fungal infested seed lot (germination 75 to 85 percent)	Azoxystrobin Fludioxanil Thiabendazole Captan Thiram	Soygard Maxim XL Rival Captan 400 42-S Thiram	Many other formulations are available. To avoid adverse effects on nitrogen-fixing bacterial inoculants, add inoculant to seed within 4 hrs of planting or apply in-furrow. Do not use treated seed for food, feed, or oil.

Soybeans - Recommended seed treatment fungicides (continued)

Situation	Required Active ingredient	Fungicide Trade name	Remarks
Seed lot germination > 85% and normal planting conditions	None		No seed treatment required.
Seed lot germination < 75%	None		Regardless of planting conditions, no seed treatment can compensate for a poor seed lot. Clean the seed lot and test germination again. If germination cannot be brought above 75%, do not use for planting.

Foliar, Stem, and Pod Diseases of Soybeans

Applications of foliar-applied fungicides have not been shown to consistently and significantly increase soybean yields in the Mid-Atlantic states. However, seed quality generally is improved. This practice is more likely to be beneficial and economical for soybeans that are grown for seed production.

Soybeans - Using foliar fungicides to manage soybean rust

Crop Stage [1]	Disease Level in your Crop	Risk [2]	Fungicide Application [3] 1st Application	Reapplication (if needed)
Vegetative	No disease		SPRAYING NOT RECOMMENDED	
R1 (flowering begins) to R5 (Beginning Seed)	No disease	Risk LOW	SPRAYING NOT RECOMMENDED	
	No disease, but	Risk HIGH Rust observed in sentinel plots or predicted in area and weather favorable.	chlorothalonil[4] or	triazole[6] or premix / tank mix[7]
			strobilurin[5] or	triazole[6] or premix / tank mix[7]
			triazole[6] or	premix / tank mix[7]
			premix / tank mix[7]	triazole[6] or premix / tank-mix[7]
R6 (Full Seed) or later	Irrelevant		NO BENEFIT TO SPRAYING	
Vegetative - early	Rust in field		BENEFIT TO SPRAYING UNCERTAIN	
Late vegetative to R5 (Beginning Seed)	Rust in field but low incidence (0-10%)	Risk HIGH	triazole[6] or	premix / tank mix[7]
			premix / tank mix[7]	triazole[6] or premix / tank-mix[7]
	Rust Incidence High		BENEFIT TO SPRAYING UNCERTAIN	
R6 or later	Irrelevant		NO BENEFIT TO SPRAYING	

1 Vegetative = all stages before flowering; V5 = main stem with 5 nodes of fully expanded trifoliate leaves; R1 = beginning flowering; R5 = beginning seed formation (small seed (1/8-inch) in pods at one of the four top nodes on main stem); R6 = full seed (green seed fills pod cavity at one of four uppermost nodes); R7 = beginning maturity.

2 Risk is determined according to national, regional, and local reports of rust activity and disease forecasts. Low risk is defined as no rust in the region and forecasts do not project an influx of spores into area. Incidence is the percentage of leaves with symptoms.

3 One or two applications may be needed depending on when rust appears. Spraying before flowering is not recommended, except when the crop is approaching R1. This is especially true for late planted crops and/or very late-maturing cultivars that may develop a large canopy before flowering. Spray coverage and penetration into the canopy are essential. Before making applications late in the season, consult label for days to harvest restrictions. Consecutive applications of the same class of product (strobilurin -> strobilurin or triazole -> triazole) should not be made due to resistance concerns. A maximum of three applications of Section 18 products may be applied collectively; however, no more than two applications of any given active ingredient can be made. Tetraconazole (Domark) may only be applied once. Other restrictions may apply. All products should be applied according to label directions. You must be in possession of appropriate state label to use section 18 product.

4 Chlorothalonil (e.g., Bravo, Echo) is a protectant fungicide that should only be used in a pre-infection program.

5 Strobilurins (e.g., Quadris, Headline) work best if applied before infection. Due to high risk of resistance development solo applications should be restricted to the first application before disease develops in field.

6 Triazoles (e.g., Bumper, Domark, Folicur, Laredo, Orius, PropiMax, Tilt) have limited after-infection activity and may not perform well if more than 10% of leaves are infected.

7 Premixed products (e.g. Headline SBR, Quilt and Stratego) are manufactured combinations of a strobilurin and a triazole. Tank mixes of label-approved products may also be used as you would a premix.

Adapted by A. Grybauskas for use in Maryland (version 29 June 05) from Dorrance, A.E., Draper, M.A., and Hershman, D.E., eds. 2005. Using foliar fungicides to manage soybean rust. Land Grant Universities Cooperating NC-504 and OMAF, SR-2005.

Soybeans - Foliar applied fungicides

Disease	Fungicide common name	Fungicide trade name	Production rate per acre	Remarks
Pod and stem blight, anthracnose, Cercospora leaf blight, frogeye, purple seed stain, and brown spot	Thiophanate methyl	Topsin M 70WP Topsin M WSB	0.5-1.0 lb	Make first application when pods begin to form and second application 14 days later. Do not use treated vines or plants for forage or for hay. Do not make more than 2 applications per season of Topsin or Quadris. Bravo products may be applied up to three times per season but PHI is 6 weeks. See labels for other restrictions.
	Chlorothalonil	Bravo 500 Bravo Weather Stik Bravo Ultrex	2.0-3.5 pt 1.5-2.25 pt 1.4-2.2 lb	
	Azoxystrobin	Quadris	6.2-15.4 fl oz	
Rust	Azoxystrobin	Quadris	6.2 - 15.4 fl oz	Make an application at the first sign of rust in the immediate area or based on regional advisories. More than one application may be needed. See chart Soybean Rust Fungicide Use Guidelines for timing, alternation of products and tank mixes. Other products contain this ingredient. Do not apply more than 1.5 lb of the active ingredient per season. Do not apply within 14 days of harvest.
	Chlorothalonil	Bravo Weather Stik Echo 720 Echo 90DF	16-36 fl oz 16-40 fl oz 0.875-2.0 lb	Make first application at the first sign of rust in the immediate area or based on regional advisories. This product has no systemic activity and works on the plant surface as a protectant against infection. There is no after-infection activity. See chart Soybean Rust Fungicide use guidelines for timing, alternation of products and tank mixes. Do not exceed 3 applications per season. Do not exceed 6 pints per season. Do not apply within 6 weeks of harvest.
	Pyraclostrobin	Headline	6-12 fl oz	Make an application at the first sign of rust in the immediate area or based on regional advisories. More than one application may be needed. See chart Soybean Rust Fungicide Use Guidelines for timing, alternation of products and tank mixes. Other products contain this ingredient. Do not apply more than 0.4 lb of active ingredient per season. Do not apply within 21 days of harvest.

Soybeans - Foliar applied fungicides (continued)

Disease	Fungicide common name	Fungicide trade name	Production rate per acre	Remarks
Rust	Tebuconazole	Folicur 3.6F Orius 3.6F	3-4 fl oz	Section 18 approved product registered through 10 Nov 2007. Make an application at the first sign of rust in the immediate area or based on regional advisories. More than one application may be needed. See chart Soybean Rust Fungicide Use Guidelines for timing, alternation of products and tank mixes. Other products contain this ingredient. Do not apply more than two applications of products containing this active ingredient. Do not apply within 30 days of harvest.
	Myclobutanil	Laredo EC	4-8 fl oz	Section 18 approved product registered through 10 Nov 2007. Make an application at the first sign of rust in the immediate area or based on regional advisories. More than one application may be needed. See chart Soybean Rust Fungicide Use Guidelines for timing, alternation of products and tank mixes. Do not apply more than two applications of this product. Do not apply within 28 days of harvest.
	Tetraconazole	Domark 230ME	4-6 fl oz	Section 18 approved product registered through 10 Nov 2007. Make an application at the first sign of rust in the immediate area or based on regional advisories. More than one application may be needed for disease control. Only one application of this product is permitted. See chart Soybean Rust Fungicide Use Guidelines for timing, alternation of products and tank mixes. Do not apply after growth stage R5 (beginning seed at upper nodes).
	Pyraclostrobin + Tebuconazole	Headline SBR	7.8 fl oz	Section 18 approved product registered through 10 Nov 2007. Make an application at first sign of rust in immediate area or based on regional advisories. More than one application may be needed. See chart Soybean Rust Use Guidelines for timing, alternation of products and tank mixes. Do not make more than two applications of products containing either active ingredient. Do not make applications within 30 days of harvest.

Soybeans - Foliar applied fungicides (continued)

Disease	Fungicide common name	Fungicide trade name	Production rate per acre	Remarks
Rust	Trifloxystrobin + Propiconazole	Stratego	5.5-10.0 fl oz	Section 18 approved product registered through 10 Nov 2007. Make an application at first sign of rust in immediate area or based on regional advisories. More than one application may be needed. See chart Soybean Rust Use Guidelines for timing, alternation of products and tank mixes. Do not make more than two applications of products containing either active ingredient. Do not make applications after growth stage R6 (full seed).
	Azoxystrobin + propiconazole	Quilt	14.0-20.5 fl oz	Section 18 approved product registered through 10 Nov 2007. Make an application at first sign of rust in immediate area or based on regional advisories. More than one application may be needed. See chart Soybean Rust Use Guidelines for timing, alternation of products and tank mixes. Do not make more than two applications of products containing propiconazole. Do not apply more than 1.5 lb of azoxystrobin per season. Do not make applications after growth stage R6 (full seed).

Nematode Diseases of Soybeans

The need for nematode management should be based on the site history and the results of a soil test for the presence and level of plant pathogenic nematodes. Fall is the best time to collect samples for nematode testing. However, samples may be taken during the growing season when crop damage is evident. Consult your county Extension office for information on proper sampling procedures for nematode testing and for information on threshold levels. Nematode testing is available at some commercial soil testing laboratories and through the Delaware, Maryland, and Virginia Cooperative Extension Services.

Cultural practices, such as rotation, fallow, and use of resistant or tolerant cultivars, will reduce nematode populations. Consider chemical control only when these measures are not feasible. However, use of nonfumigant nematicides alone is not recommended for cyst nematode control. Rotations with nonhost crops and resistant cultivars are particularly effective in controlling soybean cyst nematodes. But, continuous cropping of cyst nematode-resistant cultivars in infested fields is not recommended because of the probability that resistance will become ineffective after continuous use. The best rotation would use 1 or 2 years of a nonhost crop (for example, corn or sorghum), followed by a cyst nematode-resistant cultivar. It is not advisable to return to a cyst-susceptible cultivar even after a nonhost rotation until soil test results indicate cyst nematode populations have dropped below the economic threshold.

Soybeans - Resistance of publicly developed soybean cultivars to soybean cyst and root-knot nematodes

Cultivar	Nematode	
	Cyst (races)	Southern root-knot
MaturityGroup III		
Fayette	R(3,14)	S
IA 3005	R(3)	-
Jack	R(3)	-
Linford	R(3,14)	S
Maverick	R(3,14)	S
Pana	R(2,3,4,14), MR(5)	S
Saline	R(3,14)	S
MaturityGroup IV		
Avery	R(3,4)	-
Bronson	R(3,14)	S
Delsoy 4210	R(3,14)	-
Delsoy 4500	R(3)	-
Delsoy 4710	R(3,14)	MR
Delsoy 4900	R(3)	-
Egyptian	R(3,4)	-
Ina	R(1,2,3,4,5)	S
LS 92-4173	R(3,14), MR(4,5)	-
LS 94-3207	R(1,2,3,5,14)	-
LS-93-0375	R(3,14)	-
Manokin	R(1,3)	MR
Mustang	R(3,14)	S
Nile	R(3)	-
Pharoah	R(3,14)	S
Pyramid	R(3,4)	-
Rend	R(3,4,14)	S
TN 4-86	R(3,14)	-
TN 4-94	R(3,14)	S
MaturityGroup V		
Accomac	R(1,3)	R
Anand	R(3,5,14)	R
Delsoy 5500	R(3,14)	-
Delsoy 5710	R(ALL)	R
Forrest	R(1,3)	R
Fowler	R(2,3,5,14)	S
Hartwig	R(ALL)	R
KS 5292	R(1,3)	-
TN 5-85	R(1,3)	-
TN 5-95	R(3,14)	-
Wicomico	R(1,3)	S

Key: T = tolerant; S = susceptible; MS = moderately susceptible; MR = moderately resistant; R = resistant; (1,3) = races of nematode; - = data not available.

Soybeans - Sources of soybean commercial cultivar reactions to cyst nematodes

Brand	Web Site Address
AgriPro	www.agripro.com
Agway	www.agwayfarmseed.com
Asgrow	www.farmsource.com/SeedCatalog/search.asp
Campbell	www.campbellseed.com
DeKalb	www.farmsource.com/SeedCatalog/search.asp
DeltaPine	www.deltapineseed.com
Garst	www.garstseed.com
Hartz	www.farmsource.com/SeedCatalog/search.asp
Mycogen	www.mycogen.com
NK	www.nkseeds.com
Pioneer	www.pioneer.com
Southern States	www.farmerfirst.com
Stine	www.stineseed.com

Soybeans - Nonfumigant nematicides [a]

Nematode	Common name	Trade name	Formulated Rate	Remarks
Root-knot, lesion, and stubby-root	Aldicarb	Temik 15G	11.0-22.0 oz/1,000 linear row ft 10.0-20.0 lb/A	**Restricted Use.** Apply at planting in 6- to 8-inch bands over rows, and immediately work into or cover with soil. See label for additional restrictions and use information related to soil type.
Cyst				Use of nematicides alone for the control of cyst nematodes is not recommended. Instead, a 2-year rotation scheme using resistant cultivars and nonhost crops is more effective and considerably less expensive.

[a] Nonfumigant nematicides, such as Temik, do not turn into a gas and move through soils as do soil fumigants. They must be incorporated into the soil between herbicide application and seeding a crop. Soil temperature is not a limiting factor when applying nonfumigant nematicides.

Soybeans - Fumigant nematicides [a]

Nematode	Common name	Trade name	Formulated Rate	Remarks
All types	1,3-D	Telone II	5.2-7.0 gal	**Restricted Use.** Fumigant nematicides are not recommended in Maryland or Delaware. Apply 2 weeks preplant, at least 12 inches deep, with single injector shank offset 3 inches from seed furrow. Seal soil surface immediately with press wheel or other equipment.

[a] Fumigant nematicides are not recommended in Maryland or Delaware. Spring treatments with soil fumigants must be applied 14 days preplant. Follow these simple steps when applying soil fumigants:
(A) Work crop remains into soil in the fall so they are well decomposed before treatment.
(B) Tillage to a depth of 12 to 18 inches often improves results; break up all clods and loosen soil thoroughly.
(C) At time of treatment, the soil should be between 50 and 80 °F at the 5-inch level and have adequate moisture for good seed germination.
(D) Consult product labels for additional information.

Tobacco Diseases

Plant Bed Diseases of Tobacco

Management of tobacco diseases is best achieved by carefully selecting and integrating various cultural practices. The primary tools used in tobacco disease management are a selection of resistant cultivars, rotation, sanitation, plant bed irrigation management, and chemical control. Fumigation of the plant bed site, an important first step in site preparation, is generally not sufficient to totally eliminate soilborne plant pathogens and has no effect on pathogens that are airborne or splash-dispersed from sites outside of the beds. It is in part for this reason that some chemical controls may be necessary for disease management in the plant beds. This is very important as field disease management is greatly enhanced by the use of healthy transplants.

Tobacco - Fungicides and bactericides for plant beds

Disease	Pesticide common name	Pesticide trade name	Rate	Remarks
Blue mold	Mancozeb	Dithane DF	0.25 lb/50 gal (1 tsp/gal)	Apply 3 gallons of solution per 1,000 square feet starting when plants are the size of a dime and continuing at 5- to 7-day intervals (except after rainfall, repeat immediately) until beds are destroyed. Gradually increase spray volume as plants increase in size. Transplant-size plants require 6 to 12 gallons of solution per 1000 square feet for thorough coverage. May be used for greenhouse and float-bed systems. See label for instructions on reducing plant injury. Prevent float water contamination with spray.
Anthracnose	Ferbam Mancozeb	Carbamate WDG Dithane DF	1.5 lb/50 gal (1 tbsp/gal) 0.25 lb/50 gal (1 tsp/gal)	Apply 3 gallons of solution per 1,000 square feet starting when plants are the size of a dime and continuing at 14-day intervals (except after rainfall, repeat immediately) until beds are destroyed. See additional remarks listed for blue mold management with Dithane.
Wildfire and angular leaf spot	Streptomycin sulfate	Agrimycin-17	0.25-0.5 lb/50 gal (1-2 tsp/gal)	Apply Agri-Strep as a preventive foliar spray at 5 gallons of solution per 100 square yards of plant beds.
	Lime + copper sulfate	Bordeaux	4.0 lb-6.0 lb + 4.0 lb/50 gal	Mix 1-3/4 cups of spray lime with 1 cup of copper sulfate (bluestone) in 5 gallons of water. Use as a preventive soil drench. Make a second application in 7 to 10 days. Do not mix with other chemicals.

Field Diseases of Tobacco

The present lack of plant resistance to blue mold and plant parasitic nematodes is an example of a situation where chemical control measures must be considered for the field. Blue mold in particular has the potential to be extremely devastating and is highly unpredictable. This disease can only be managed on a preventive basis as no rescue treatments are available. Base the need for nematicides, on the other hand, on the site history and the results of a soil test for the presence and amount of plant pathogenic nematodes. Before deciding to use a nematicide, contact your county Extension office for information on proper soil sampling for nematodes and for information on threshold levels. The following recommendations pertain to Maryland-type tobacco; other chemical registrations may be available for the types of tobacco grown in Virginia. Consult your county Extension office for additional information.

Tobacco - Disease control materials for field plants

Disease	Pesticide common name	Pesticide trade name	Rate	Remarks
Metalaxyl-insensitive blue mold	Dimethomorph + Mancozeb	Acrobat MZ	0.5-2.5 lb/A	Apply only if there is a threat of Ridomil (metalaxyl)-insensitive blue mold. Requires a 7-day spray schedule and thorough spray coverage to be effective. Use up to 100 gallons per acre as plants increase in size to achieve complete coverage. Discontinue sprays when the threat of blue mold no longer exists. See specific label instructions for rates, volume of spray solutions, and nozzle arrangement needed for coverage. Do not apply within 30 days of harvest.
	Mancozeb	Dithane DF	1.5-2.0 lb/A	
Blue mold	Mefenoxam	Ridomil Gold EC	1.0 pt/A	Apply as a broadcast soil treatment before transplanting, and incorporate into the top 2 to 4 inches of soil. A second soil application of 1/2 pint per acre of Ridomil Gold can be made at the last cultivation only if Ridomil Gold was applied preplant. Consult label for details.
Black shank	Mefenoxam	Ridomil Gold EC	1.0-1.5 qt/A	Apply as described for blue mold in fields where black shank has been a recent problem and is expected. Treatment should not be necessary for black shank-resistant cultivars. If problems develop with resistant cultivars, check soil for nematode populations as resistance and fungicide effectiveness can be compromised by other root infestations.
		Ridomil Gold WSP	1.0-2.0 lb/A	

Tobacco - Disease control materials for field plants (continued)

Disease	Pesticide common name	Pesticide trade name	Rate	Remarks
Root-knot, lesion, and other nematodes	Oxamyl	Vydate L	1 gal/A	**Restricted Use.** Consult label for transplant water treatment rates. Sample rate is for broadcast applications in at least 40 gallons of water per acre. Incorporate in top 4 to 6 inches of soil.
	Fenamiphos	Nemacur 3	1.3-2.0 gal/A	**Restricted Use.** Sample rate is for broadcast soil treatment using 20 gallons of water per acre. Incorporate in top 2 to 4 inches of soil. Consult individual labels for rates and restrictions for these combinations.
	Ethoprop	Mocap EC	1.0-2.0 gal/A	**Restricted Use.** Sample rate is for broadcast application and must be incorporated into top 2 to 4 inches of soil. Various formulations and combinations with insecticides are available. Consult label for rates, application methods, and restrictions.
	1,3-Dichloropropene	Telone II	6-12 gal/A	**Restricted Use.** Fumigant nematicide applied broadcast via in-row injection and placed at least 12 inches below the final soil surface. Work plant debris into soil and allow to decompose before treatment. Soil should be reworked and be free of clots prior to application. Soil temperature should be between 50 and 80 °F at 6-inch level and have adequate soil moisture at time of treatment. To prevent fumigant loss, seal soil after treatment. See label for methods of soil sealing and additional restrictions and precautions.
Tomato Spotted Wilt Virus (TSWV)				TSWV is a virus disease that is a potential problem for Maryland tobacco producers. There are no products that directly control plant viruses. However, because the disease is spread by thrips, use insecticides to reduce thrips population. See the insect control section for additional information.

Insect Pest Management for Field Crops

G.P. Dively, Extension pest management specialist,
Department of Entomology,
University of Maryland, College Park
J.M. Whalen, University of Delaware
A.D. Herbert Jr. and R. Youngman
Virginia Polytechnic Institute and State University

This section of the bulletin is intended to help growers manage insect populations with methods effective for Mid-Atlantic conditions. The recommendations deal primarily with chemical control; however, the use of insecticides on field crops should be considered supplementary to cultural and biological control methods. Except where otherwise indicated, the insecticides listed are for use as foliar sprays. Common insecticide names are followed by trade names in parentheses, followed by specific formulations. Rates are usually given in pounds of active ingredient per acre and in pounds of the formulated product per acre. Safety, price, availability, effectiveness, and other factors should be considered when narrowing the list to the product that is chosen for use. The list is revised annually and is for use during the current calendar year only. The list also is subject to annual review. Contact your county Extension educator for information about the status of a particular insecticide.

Time limits: Days to harvest refers to the legal number of days before harvest that insecticides can be applied safely to avoid excessive residues on the harvest crop. Read all labels carefully because the time limits may vary depending upon the rate used and the final use of the harvested crop. If not specified under Remarks, the days-to-harvest restriction applies regardless of whether the harvest is for forage or grain. This time period in no way signifies how long the insecticide will remain active in controlling insects.

Information in this section is not a substitute for the product label-always read the label before use.

Steps in Managing Insects in Field Crops

Biological and Cultural Controls

1. Apply cultural and biological control practices whenever possible to prevent pest populations from reaching damaging levels. In many situations, cultural practices, such as crop rotation, resistant cultivars, tillage and fertility management, and early harvest, can reduce the intensity of pest attack and also increase the crop's ability to withstand insect feeding. Parasites, predators, and disease pathogens are natural enemies of insect pests, which are present in virtually every field situation. A number of parasitic species have been imported, released, and established in Maryland and other Mid-Atlantic states to control some of the major insect pests. Some species have been successful in establishing repeating generations, some have to be re-released annually, and others have not been successful. USDA-APHIS, along with several cooperating states, is working toward developing new parasite species that may someday further the biological control effort. The goal of any management program is to maximize the impact of these local and introduced natural enemies and avoid applications of disruptive insecticides unless they are absolutely necessary. Keep in mind that low population levels of host insects are required to maintain these beneficial organisms. Simply stated: no food, no beneficials. In this section, major cultural and biological control methods are described for individual pests and marked with this special symbol: 
2. Accurately identify the pest. A prerequisite to all pest management decisionmaking is correct identification of the problem. Often, damage is evident in a field but no insect pest can be found. Learn to recognize the symptoms of insect feeding to identify the problem if the insect is not present. Consult a crop advisor or your county Extension educator for help if you have questions.
3. Understand the pest and crop dynamics to properly evaluate the consequences of the situation. Decisionmaking guidelines are provided in this section for

most insect pests. They include information regarding the biology of the pest, its potential risk to the crop, and the best management strategy. The best strategy often differs from one pest species to another and among fields.

4. Monitor to detect a problem before damage reaches an advanced stage. Frequent and regular field inspections must be conducted to determine the density and development of insect pest populations. Sampling information is given in this section for each insect pest. If growers do not have the time to regularly monitor their crops, they can hire a professional scout or certified crop advisor. Contact your county Extension educator for information on the availability of pest management services and for information regarding where to obtain special sampling equipment, such as sweep nets and shake cloths.

   Another way to monitor the adult stage (moth) of certain insect populations is with black light traps and pheromone traps. These devices are used to determine when an insect pest becomes active, when to start looking for the insect in the field, and whether there is enough moth activity to cause economic problems. To get specific moth activity information in Maryland, call toll-free the following data phones, which are updated twice weekly during the growing season by the Maryland Department of Agriculture. For data relating to the Eastern Shore and southern Maryland, call 800-492-2105; for information relating to central and western Maryland, call 800-492-2106. For Delaware trap data, call 302-451-8851 for weekly updates of average daily catches of corn borer and corn earworm.

5. Apply control measures only if the insect population level exceeds the treatment threshold. Do not apply controls simply because a neighbor does or there is a reported threat of a pending pest outbreak. Populations of most insect pests vary widely from field to field. The most basic concept in pest management is that control action is not justified unless the expected losses exceed the cost of control. The decisionmaking guidelines in this section include treatment thresholds that help growers decide if insecticide applications or other management actions are needed to avoid economic loss. Treatment thresholds are generally expressed as a numerical count of a given insect stage or as a damage level based on a recommended sampling procedure. A threshold is only a guide or starting point that approximates the population density that will cause economic injury if left uncontrolled. It is not written in stone. Control decisions also are based on the field history, presence of natural enemies, crop stage and vigor, cultivar, weather conditions, and other factors. Growers may have to adjust thresholds to fit their specific field situations.
6. If an insecticide treatment is required, apply the right material at the proper time with the appropriate application method. Often, failure to control an insect or mite pest is blamed on the product when the cause lies elsewhere. The most common reasons for control failures include improper timing of applications (usually applied late when the pests are too large or numerous); making applications with an insufficient volume of diluted spray (commonly occurs with aerial application during hot, dry conditions); clogged or poorly arranged nozzles or granular distributors; high pH and/or mineral content of the spray water, which can rapidly degrade most chemicals; and selecting the wrong insecticide.
7. Follow up all pest control actions to evaluate results. Evaluation is often omitted on the assumption that the treatment has done its job. This step is necessary to determine whether the insecticide or nonchemical measure has suppressed the pest population enough to prevent economic loss. It also provides information regarding the need for additional control actions and ways that the control actions can be fine-tuned to make them more suitable for the particular field situation.

Where to get additional pest management information.

Sampling and decisionmaking guidelines and information about current pest activity are provided in weekly IPM newsletters and reports, Extension leaflets and fact sheets, telephone recordings, radio talks, newspapers, and websites. These publications and information sources furnish more up-to-date facts on insect occurrence, the need for and timing of insecticide applications, and suggestions for more effective control. Contact your county Extension educator or state pest management specialist if you want to receive IPM information. Access pest and crop management information directly at the PestNet website at http://www.mdipm.umd.edu/ and at the Delaware Weekly Crop Update website at http://www.udel.edu/IPM/. For Virginia data on corn earworm, consult the Virginia Corn Earworm Advisory at any local Extension office for weekly updates, or call 757-657-6450, ext. 126, or check the IPM website at http://IPM-WWW.ento.vt.edu:8000/nipmn/VA-IPM/updates.html.

Insect Control in Alfalfa

Alfalfa Weevil

Biological and cultural control.

The presence of five parasitic wasp species, several predator insect species, and two major fungus diseases has greatly reduced the dependence on insecticide controls for alfalfa weevil throughout the state. Most growers in central and western Maryland rarely apply insecticides for this pest because of well-established natural enemies. Scouting data collected over the past 12 years indicate that economic damage may only occur every 6 to 8 years in fields with good natural controls. Alfalfa weevil populations are generally higher on the Delmarva Peninsula where the parasites may be less adapted to the hot summers.

The following management practices can help establish and maintain good weevil biological control:

1. Harvest early instead of treating with insecticides if the crop has attained sufficient growth before larval feeding damage becomes severe.
2. Avoid insecticide applications except in field situations where thresholds have been exceeded and early harvest is not possible.
3. If sprays are required, leave untreated portions of fields as a nursery to maintain beneficial insects for the next cutting or next year.

Another cultural practice is late fall removal of the last crop for hay or by grazing. This removes overwintering egg-laying sites for the adult weevils and helps to reduce the early season brood of weevil larvae.

Sampling.

Begin sampling for weevil larvae during middle to late April, depending on the arrival of warmer weather in the spring. With earlier, warmer springs, sampling must start in late March to early April in the Delmarva production areas. Each field must be sampled weekly or more frequently to properly apply insecticide when necessary. Randomly walk through the field in a “W” or zigzag pattern and collect 30 stems. Record the number of stems that show weevil-feeding injury. Place all stems top first in a bucket. Shake the stems individually against the sides of the bucket, and count the number of healthy larvae. Measure 10 stems to get an average plant height for the field.

Decisionmaking.

The general rule is to treat the field when 50 percent or more of the tips show weevil-feeding injury before full-bud stage. For more precise decisions, use the tables accompanying this section to make a spray decision. Select the table that fits the plant height category of the field being sampled. Estimate the cost of the spray per acre and the value of the crop in dollars per ton of hay equivalent. In the appropriate table, find the number of larvae that corresponds to the value of the crop and cost of spray. If the field population of weevil larvae per 30 stems exceeds the level in the table, then an insecticide application would be profitable. If the population falls below the tabulated level, then control is not required, but resampling may be necessary in 5 to 7 days. If the crop is in full bud and the Category III table indicates to spray, it may be more cost-effective to harvest early rather than to spray. However, if harvesting is impossible for at least 3 days or more and the feeding injury is increasing, then spray with a short-residual insecticide. Remember that the days-to-harvest restrictions may dictate which insecticide can be used.

If the weevil population is above the threshold when the first crop is harvested, check the field in the same way as before, 4 to 5 days after cutting. If regrowth does not occur within 4 or 5 days after cutting, a stubble spray is warranted if carryover populations exceed 2 larvae or adults per crown. An alternative decision method is to calculate the number of days of complete regrowth defoliation (D) that can be tolerated using the equation $D = A/(B \times C)$, in which A = insecticide plus application cost ($/acre), ex., $7.00; B = value of hay ($/ton), ex., $100.00; and C = loss factor (1st bloom harvest = 0.0198; 28-day harvest = 0.0345). An example for a 1st bloom harvest of the new crop is calculated as follows: $7.00/(100 \times 0.0198) = 7.00/1.98 = 3.5$ days. For this example, a stubble spray is warranted if carryover populations are expected to defoliate the regrowth for more than 3.5 days.

When sprays are properly timed, usually only one application is required for alfalfa weevil control. All insecticides listed below can injure honeybees and parasites of the alfalfa weevil. Avoid spraying when alfalfa or weeds are in bloom, or apply treatments only in the evening or early mornings when bees are inactive. Good weed control will greatly reduce the hazard to honeybees.

Alfalfa-Category I: Plant height, 12 to 18 inches for alfalfa weevil control

Value of hay per ton	Cost of insecticide application per acre $8	$10	$12	$14	$16
	Number of larvae per 30-stem sample				
$80	68	85	102	119	136
100	54	68	81	95	108
120	45	57	68	79	91
140	39	49	59	68	77
160	34	43	51	60	68

Remarks: Use long-residual insecticides. When the threshold is reached, delay treatment until feeding becomes evident on the top inch of growth. Early treatments are more detrimental to weevil parasites. Retreatment may be necessary before cutting.

Alfalfa-Category II: Plant height, 18 to 24 inches for alfalfa weevil control

Value of hay per ton	Cost of insecticide application per acre $8	$10	$12	$14	$16
	Number of larvae per 30-stem sample				
$80	75	97	113	131	150
100	62	75	90	105	120
120	50	62	75	87	100
140	43	54	64	75	86
160	37	47	56	65	75

Remarks: Use short-residual insecticides or lower rates according to label and days to harvest.

Alfalfa-Category III: Plant height, 24 to 30 inches for alfalfa weevil control

Value of hay per ton	Cost of insecticide application per acre $8	$10	$12	$14	$16
	Number of larvae per 30-stem sample				
$80	78	97	117	137	157
100	63	78	94	110	126
120	52	65	78	91	105
140	45	56	67	78	90
160	39	49	58	68	79

Remarks: Use short-residual insecticides. Early cutting may be advisable. Stubble sprays may be necessary.

Alfalfa-Recommended insecticides for alfalfa weevil control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Carbofuran (Furadan 4F)	0.25-1.0 lb	0.5 pt 1.0 pt 2.0 pt	7 14 28	**Restricted Use.** Follow label directions carefully. The days-to-harvest restriction depends upon rate used. Do not apply more than once per cutting and twice per season.
Chlorpyrifos (Lorsban 4E)	0.5-1.0 lb	1.0 pt more than 1.0 pt but not more than 2.0 pt	14 21	**Restricted Use.** The days-to-harvest restriction depends upon the rate used. Only one application may be made per cutting. Some temporary yellowing may occur after application but will disappear within a week.
Cyfluthrin (Baythroid 2E)	0.025-0.044 lb	1.6-2.8 oz.	7	**Restricted Use.** Use a minimum of 2 gallons of water per acre for aerial application. May be applied ULV with oil by ground equipment in a total volume of one quart per acre. One application per cutting may be made and no more than a total of 11.2 fluid ounces per acre can be applied per season.
Gamma-cyhalothrin (Proaxis)	0.01-0.015 lb	2.56-3.84 oz	1-7	**Restricted Use.** Do not apply within 1 day of harvest for forage or within 7 days of harvest for hay. Total product allowed per acre is 0.96 pt of formulation.
Indoxacarb (Steward)	0.065-0.11 lb	6.7-11.3 oz	7	Do not apply more than 45 fluid ounces (0.44 lb a.i.) per acre per crop season. Make no more than one application per cutting.
Lambdacyhalothrin (Warrior)	0.02-0.03 lb	2.56-3.84 oz	1-7	**Restricted Use.** The days to harvest is 1 for forage or 7 days for hay. Total product allowed per acre is 4 ounces.
Methomyl (Lannate LV 2.4E) (Lannate 90SP)	0.9 lb	3.0 pt 1.0 lb	7	**Restricted Use.** This formulation is also labeled for beet armyworm and lygus bugs. Do not apply to dormant alfalfa when minimum daily temperature is 50 degrees F or lower.

Alfalfa-Recommended insecticides for alfalfa weevil control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Permethrin (Permethrin 3.2EC)	0.1-0.2 lb	4.0-8.0 oz	14	**Restricted Use.** Permethrin is extremely toxic to fish. Do not apply more than 0.2 pound per cutting. There is no days-to-harvest restriction when using rates of 0.1 pound active ingredient or less. When rates greater than 0.1 pound active ingredient are used, do not apply within 14 days of harvest.
Phosmet (Imidan 50 WP)	0.5 - 0.67 lb	1.0 - 1.33 lb	7	General use.
Zeta-cypermethrin (Mustang MAX)	0.014-0.025 lb	2.24-4.0 oz	3 days for cutting or grazing	**Restricted Use.** Do not apply less than 7 days apart. Apply in minimum of 2 gallons of finished spray per acre by aerial equipment or 10 gallons per acre by ground equipment. A maximum of 4 ounces per acre may be applied per cutting.

Armyworm, Cutworm, and Corn Earworm

Sampling/Decisionmaking.

True armyworms and various cutworms may damage small plants during early spring and reduce the yield of the first cutting. Infestations of fall armyworms and earworms are more likely to occur in late summer to early fall. These caterpillars are more difficult to control. Seedling stands suffer the most damage. Treatment is suggested when there are two or more larvae per square foot in seedling fields or five or more larvae per square foot in established fields.

Alfalfa-Recommended insecticides for armyworm, cutworm, and earworm control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Carbaryl (Sevin 80S)	1.5 lb	1.8 lb	7	A 5-percent Sevin bait at 20 pounds per acre also is effective against cutworms. This formulation is not recommended for fall armyworm.

Alfalfa-Recommended insecticides for armyworm, cutworm, and earworm control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Cyfluthrin (Baythroid 2E)	0.025-0.044 lb	1.6-2.8 oz	7	**Restricted Use.** Use a minimum of 2 gallons of water per acre for aerial application. May be applied ULV with oil by ground equipment in a total volume of one quart per acre. One application per cutting may be made and no more than a total of 11.2 fluid ounces per acre can be applied per season.
Gamma-cyhalothrin (Proaxis)	0.01-0.015 lb	2.56-3.84 oz	1-7	**Restricted Use.** Do not apply within 1 day of harvest for forage or within 7 days of harvest for hay. Total product allowed per acre is 0.96 pt of formulation.
Indoxacarb (Steward)	0.09-0.11 lb	9.2-11.3 oz	7	Do not apply more than 45 fl oz (0.44 lb a.i.) per acre per crop. Make no more than one application per cutting.
Lambdacyhalothrin (Warrior)	0.02-0.03 lb	2.56-3.84 oz	1-7	**Restricted Use.** The days to harvest is 1 for forage or 7 days for hay.
Methomyl (Lannate LV 2.4E) (Lannate 90SP)	0.6 lb 0.225-0.9 lb	2.0 pt 0.25-1.0 lb	7	**Restricted Use.** Methomyl is preferred for fall armyworm. Corn earworm is not on the label. Wait 7 days after application before grazing or feeding forage. Do not apply to dormant or semidormant alfalfa when minimum daily temperature is 50 degrees F or lower.
Permethrin (Permethrin 3.2EC)	0.05-0.2 lb	2.0-8.0 oz	14	**Restricted Use.** For cutworm only. Permethrin is extremely toxic to fish. Do not apply more than 0.2 pound per cutting. There is no days-to-harvest restriction when using rates of 0.1 pound active ingredient or less. When rates greater than 0.1 pound active ingredient are used, do not apply within 14 days of harvest.

Alfalfa-Recommended insecticides for armyworm, cutworm, and earworm control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Zeta-cypermethrin (Mustang MAX)	0.014-0.025 lb (armyworm)	2.24-4.0 oz	3	**Restricted Use.** Not labeled for corn earworm. Wait 3 days for cutting or grazing. Do not make applications less than 7 days apart. Apply in a minimum of 2 gallons of finished spray per acre by aerial equipment or 10 gallons per acre by ground equipment. A maximum of 4 ounces per acre may be applied per cutting.

Grasshopper

Sampling/Decisionmaking.

Young stands less than 6 inches in height or stubble regrowth may need protection against grasshoppers during drought or in new fall seedlings. If four to five nymphs per square yard in crop areas are observed, a treatment may be justified. Control of nymphs is easier to achieve than control of adults.

Alfalfa-Recommended insecticides for grasshopper control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Carbofuran (Furadan 4F)	0.125-0.25 lb	0.25-0.50 pt	7	**Restricted Use.** Follow directions on label.
Chlorpyrifos (Lorsban 4E)	0.25-0.5 lb	0.5-1.0 pt	7 (0.5 pt rate), 14 (1 pt rate)	Make only one application per cutting. Some temporary yellowing may occur after application but should disappear within a week and not cause yield loss.
Cyfluthrin (Baythroid 2E)	0.031-0.044 lb	2.0-2.8 oz	7	**Restricted Use.** Same restrictions as under alfalfa weevil.
Gamma-cyhalothrin (Proaxis)	0.01-0.015 lb	2.56-3.84 oz	1-7	**Restricted Use.** Do not apply within 1 day of harvest for forage or within 7 days of harvest for hay. Total product allowed per acre is 0.96 pt of formulation.

Alfalfa-Recommended insecticides for grasshopper control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Malathion (Cythion 57% EC)	0.9-1.4 lb	1.2-2.5 pt	0	
Zeta-cypermethrin (Mustang MAX)	0.018 - 0.025 lb	2.8-4.0 oz	3 days for cutting or grazing	**Restricted Use.** Do apply less than 7 days apart. Apply in a minimum of 2 gallons of finished spray per acre by air or 10 gallons per acre by ground. A maximum of 4 ounces per acre may be applied per cutting.

Pea Aphid

Biological and cultural control.

The use of insecticide sprays for alfalfa weevil or potato leafhopper will generally reduce the effectiveness of beneficial insect populations and may require 1 to 2 years before these populations recover. Ratios of 1 or more adult or larval ladybird beetles to 10 to 50 aphids give good control. Avoid spraying your first crop because sprays will kill alfalfa weevil parasites.

Sampling/Decisionmaking.

Treatment is rarely needed (1 year in 15) because several new species of ladybird beetles, wasp parasites, and other beneficial insects usually control this pest. However, heavily infested plants may turn yellow and wilt during the spring. Keep fields under close surveillance early in the season during periods of cool weather. Use the same stem-bucket technique recommended for alfalfa weevil, and record the number of aphids per stem. Also, keep a relative tally of the ratio of predators to aphid numbers. If more than 50 aphids per stem of alfalfa under 10 inches or if more than 100 aphids per stem of alfalfa over 10 inches are present, early harvesting is recommended.

Alfalfa-Recommended insecticides for pea aphid control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Carbofuran (Furadan 4F)	0.25-1.0 lb	0.5-2.0 pt	7-28	**Restricted Use.** The days-to-harvest restriction depends upon the rate used. Follow directions on label.

Alfalfa-Recommended insecticides for pea aphid control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Cyfluthrin (Baythroid 2E)	0.044 lb	2.8 oz	7	**Restricted Use.** Use a minimum of 2 gallons of water per acre for aerial application. Suppression only. May be applied ULV with oil by ground equipment in a total volume of 1 quart per acre. One application per cutting may be made and no more than a total of 11.2 fluid ounces per acre can be applied per season.
Dimethoate 4EC	0.5 lb	1.0 pt	10	**Restricted Use.** Make one application per cutting. Effective only on cutting on which applied. May be less effective during drought conditions.
Gamma-cyhalothrin (Proaxis)	0.01-0.015 lb	2.56-3.84 oz	1-7	**Restricted Use.** Do not apply within 1 day of harvest for forage or within 7 days of harvest for hay. Total product allowed per acre is 0.96 pt of formulation.
Lambdacyhalothrin (Warrior)	0.02-0.03 lb	2.56-3.84 oz	1-7	**Restricted Use.** The days to harvest is 1 for forage or 7 days for hay.
Malathion (Cythion 57% EC)	1.25 lb	1.0 qt	0	
Methomyl (Lannate LV 2.4EC) (Lannate 90SP)	0.45-0.9 lb 0.225-0.9 lb	1.5-3.0 pt 0.25-1.0 lb	7	**Restricted Use.** Wait 7 days after application before grazing or feeding forage. Do not apply to dormant or semidormant alfalfa when minimum daily temperature is 50 degrees F or lower.

Potato Leafhopper

Biological and Cultural Control.

To conserve biological control agents such as parasites and predators, avoid unnecessary spraying. For example, alfalfa weevil parasites and predators, such as big-eyed bugs and lady beetles, and other predacious insects remain in alfalfa fields throughout the season. These same predator species also spread to adjacent corn, soybean, and vegetable crops to search for prey and then return to alfalfa fields in late summer and early fall to feed on aphids, leafhoppers, and late-season caterpillar pests. Alfalfa is considered an excellent "catch crop" for beneficial insects, especially during dry hot weather. The catch crop is an important asset for the entire farm crop system.

Intercrop systems of oats and alfalfa aid in the establishment of spring-seeded alfalfa. By growing quickly, the oat plants reduce weed growth while allowing the slower-growing alfalfa to become established. The oat plants also aid in the drying process, especially in fields with tri-species mixtures of oat, alfalfa, and orchardgrass. Studies have demonstrated that densities of potato leafhopper are significantly reduced when oats are planted with alfalfa.

Sampling.

Begin scouting established alfalfa fields the first week after the first cutting. New field seedings should be sampled beginning in early May. Resample each field once a week. Use a 15-inch sweep net anytime during the day as long as the foliage is dry. Sweeping wet alfalfa is difficult, and the samples are almost impossible to count. Take 10 sweeps at each of 10 random locations in the field. Count the number of adult and nymphal leafhoppers for each set of 10 sweeps. Tally the total, and record the number per 100 sweeps. Examine 20 random stems to determine average stem height and the percentage of plants in the bud or flower stage.

Decisionmaking.

If the leafhopper count per 100 sweeps exceeds 10 times the average stem height, control is recommended. For example, alfalfa 6 inches in height should be treated if counts exceed 60 leafhoppers per sweep. If alfalfa is more than 60 percent bud or in flower or if more than 28 days have elapsed since last cutting, plan to harvest within 7 to 10 days and avoid spraying. However, resample the field soon after cutting to determine the need for control. Remember that none of the insecticides carries over to the next cutting, so control decisions must be made independently on each cutting. Also note that potato leafhopper sprays will have a minimum impact on the survival of the alfalfa weevil parasites.

Treatments must be applied before yellowing begins. If stunted, yellowed plants appear as a result of leafhopper injury, the field should be harvested immediately rather than sprayed. This profile conserves beneficial organisms.

Alfalfa-Recommended insecticides for potato leafhopper control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Carbofuran (Furadan 4F)	0.5-1.0 lb	1.0 pt 2.0 pt	14 28	**Restricted Use.** Follow safety precautions on the label. The days-to-harvest restriction depends upon the rate used.
Chlorpyrifos (Lorsban 4E)	0.25-0.50 lb	0.5-1.0 pt	14	Make only one application per cutting. Some temporary yellowing may occur after application but should disappear within a week and not cause yield loss.

Alfalfa-Recommended insecticides for potato leafhopper control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Cyfluthrin (Baythroid 2E)	0.013-0.025 lb	0.8-1.6 oz	7	**Restricted Use.** Use a minimum of 2 gallons of water per acre for aerial application. May be applied ULV with oil by ground equipment in a total volume of 1 quart per acre. One application per cutting may be made and no more than a total of 11.2 fluid ounces per acre can be applied per season.
Dimethoate 4EC	0.25-0.50 lb	0.5-1.0 pt	10	Dimethoate also will control aphids and grasshoppers. Make only one application per cutting. May be less effective during drought conditions.
Gamma-cyhalothrin (Proaxis)	0.0075-0.0125 lb	1.92-3.20 oz	1-7	**Restricted Use.** Do not apply within 1 day of harvest for forage or within 7 days of harvest for hay. Total product allowed per acre is 0.96 pt of formulation.
Lambdacyhalothrin (Warrior)	0.015-0.025 lb	1.9-3.2 oz	1-7	**Restricted Use.** The days-to-harvest is 1 for forage or 7 days for hay.
Permethrin (Permethrin 3.2EC)	0.1-0.2 lb	4.0-8.0 oz	14	**Restricted Use.** Permethrin is extremely toxic to fish. Do not apply more than 0.2 pound per cutting. There is no days-to-harvest restriction when using rates of 0.1 pound active ingredient or less. When rates greater than 0.1 pound active ingredient are used, do not apply within 14 days of harvest.
Zeta-cypermethrin (Mustang MAX)	0.014-0.025 lb	2.24-4.0 oz	3 days for cutting or grazing	**Restricted Use.** Do not make applications less than 7 days apart. Apply in a minimum of 2 gallons of finished spray per acre by aerial equipment or 10 gallons per acre by ground equipment. A maximum of 4 ounces per acre may be applied per cutting.

WebWorm

Sampling/Decisionmaking.

Webworms are slender, greenish-black, spotted caterpillars with three dark spots on the side of each segment and a light stripe running down the middle of the back. Control is rarely needed, but webworms may be destructive in last cuttings during drought conditions. When this pest is present, early harvest will often eliminate the problem. However, if the crop is more than 2 weeks from cutting and 25 to 30 percent of the terminals are webbed, treatment is suggested. Use sufficient gallonage and pressure to thoroughly cover and penetrate the foliage.

Alfalfa-Recommended insecticides for webworm control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Cyfluthrin (Baythroid 2E)	0.025-0.044 lb	1.6-2.8 pt	7	**Restricted Use.** Same restrictions as under alfalfa weevil.
Gamma-cyhalothrin (Proaxis)	0.0075-0.0125 lb	1.92-3.20 oz	1-7	**Restricted Use.** Do not apply within 1 day of harvest for forage or within 7 days of harvest for hay. Total product allowed per acre is 0.96 pt of formulation.
Lambdacyhalothrin (Warrior)	0.015-0.025 lb	1.92-3.2 oz	1-7	**Restricted Use.** The days to harvest is 1 for forage or 7 for hay.
Zeta-cypermethrin (Mustang MAX)	0.014-0.025 lb	2.24-4.0 oz	3 days for cutting or grazing	**Restricted Use.** Do not apply less than 7 days apart. Apply in a minimum of 2 gallons of finished spray per acre by aerial equipment or 10 gallons per acre by ground equipment. A maximum of 4 ounces per acre may be applied per cutting.

Insect Control in Corn

Corn Leaf Aphid

Sampling/Decisionmaking.

Aphids are rarely a problem because infestations either build up too late or are controlled by the insect's natural enemies, such as lady beetles and wasp parasites. Economic infestations may occur in midsummer inside the leaf whorl surrounding the developing tassel. If treatment is considered, it should be applied before 50 percent of the tassels emerge to be most effective. Unfold the whorl leaves of 20 plants at each of five locations in the field, and note the severity of aphid colonies and any natural enemy activity. Treatment may be needed when 25 percent of the plants are heavily infested and natural enemy activity is low. Outbreaks of aphids rarely occur (1 in 15 years) due to effective natural controls. Unnecessary insecticide sprays will eliminate these beneficial organisms.

Corn-Recommended insecticides for corn leaf aphid control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Esfenvalerate (Asana XL)	0.03-0.05 lb	5.8-9.6 oz	0	**Restricted Use.** Check label for spraying instructions before use.
Microencapsulated methyl parathion (Penncap-M 2F)	0.5-0.75 lb	2.0-3.0 pt	12	**Restricted Use.** Check label for spraying instructions before use.

Cutworm

Cultural Control.

Herculex Bt corn hybrids provide control of cutworm infestations consisting primarily of young larvae during the seedling stage. However, transgenic suppression is less effective against infestations of older larvae that can carryover from the weed growth or cover crop present prior to planting. The application of preplant "burndown" herbicides at least 2 weeks before planting may reduce cutworm populations by eliminating food and egg-laying sites.

Sampling.

Late-planted, minimum-till fields with heavy spring weed growth or poorly drained soils are the most likely to encounter cutworms. Check each field twice a week from the spike through the 5-leaf stage. Leaf feeding is the first sign that cutworms are present. Look for small, irregular holes in leaves and cut plants. Look for leaf damage caused by young cutworms too small to sever corn seedlings, and check these areas again in 24 to 48 hours. If cutworms are present, examine at least 10 sets of 20 plants throughout the field, and record the percentage of cut or damaged plants. At the same time, look under clods and trash and dig 1 to 2 inches deep around the base of damaged plants to find cutworms. Record the average size and number of cutworms.

Decisionmaking.

Preplant incorporated or at-planting soil insecticides may also suppress light to moderate infestations, but control is generally unsatisfactory for heavy infestations, particularly under dry soil conditions. If a soil insecticide is being used for corn rootworm control in a field with conditions associated with cutworm problems, choose a product also labeled for cutworms. A combination

herbicide/insecticide preemergence spray applied within 1 week of plant emergence is suggested in late-planted fields with a history of cutworm problems. Adding an insecticide with an incorporated residual herbicide during early spring is not recommended because the timing of this treatment is generally too far in advance of cutworm infestations.

Because of the erratic nature of cutworm outbreaks, rescue treatments rather than preventative treatments are recommended, particularly in conventional tillage corn and during years when tillage and planting begin early in the spring. As a general rule, a rescue treatment should be applied before the 3- to 5-leaf stage if 10 percent or more of the young plants show fresh leaf feeding and cutworms are present. At the 3- to 5-leaf stage, treatment should be applied if 5 percent of the plants are cut and there are four or more cutworms per 100 plants. Control attempts when the majority of the cutworms are 0.75-inch to 1-inch long may give poor results. Rescue sprays are usually most effective if the surface is moist to wet at the time of application. The following procedures will help to improve control when a contact insecticide treatment is used: (1) direct sprays at the base of the plants where cutworms actively feed; (2) use at least 30 gallons of water per acre, especially in dry weather; (3) spray in the evening when cutworms are active; and (4) when possible, cultivate after the insecticide application to improve contact with cutworms, especially in dry weather.

Corn-Recommended insecticides for cutworm control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Preemergence				
Chlorpyrifos (Lorsban 4E) (Lorsban 15G)	0.5-1.0 lb 1.0 lb	1.0-2.0 pt 8.0 oz/1,000 row ft	35	**Restricted Use.** for the 4E formulation. Broadcast-use minimum of 20 gallons of water per acre. At planting, band or T-band application.
Esfenvalerate (Asana XL)	0.03-0.05 lb	5.8-9.6 oz	21	**Restricted Use.**
Gamma-cyhalothrin (Proaxis)	0.0075-0.0125 lb	1.92-3.20 oz	21	**Restricted Use.** Do not apply within 21 days of harvest. Total product allowed per acre is 0.96 pt of formulation.
Permethrin (Permethrin 3.2EC)	0.1-0.2 lb	4.0-8.0 oz	30	**Restricted Use.** Apply from 5 days before planting up to emergence. Band or broadcast-use minimum 10 gallons finished spray per acre by ground or 1 gallon per acre by air.
Tefluthrin (Force 3G)	1.25-1.5 oz/1,000 row ft	4-5 oz/1,000 row ft	0	**Restricted Use.** May be banded or in-furrow.

Corn-Recommended insecticides for cutworm control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Zeta-cypermethrin (Mustang MAX)	0.001 lb ai/1000 row ft	0.16 fl oz/1000 row ft	30 for grain or fodder, 60 days for forage	**Restricted Use.** Apply as an in-furrow, band, or T-band treatment using a minimum 4-inch band.
Postemergence				
Chlorpyrifos (Lorsban 4E)	1.0-1.5 lb	1.0-2.0 pt	35	**Restricted Use.** Use sufficient water to ensure thorough coverage of treated plants.
Esfenvalerate (Asana XL)	0.03-0.05 lb	5.8-9.6 oz	21	**Restricted Use.** Use sufficient water to ensure thorough coverage of treated plants.
Gamma-cyhalothrin (Proaxis)	0.0075-0.0125 lb	1.92-3.20 oz	21	**Restricted Use.** Do not apply within 21 days of harvest. Total product allowed per acre is 0.96 pt of formulation.
Lambdacyhalothrin (Warrior)	0.015-0.025 lb	1.92-3.20 fl oz	21	**Restricted Use.** Apply before, during, or after planting.
Microencapsulated methyl parathion (Penncap-M 2F)	0.5-1.0 lb	2.0-4.0 pt	12	**Restricted Use.** Best control obtained when young larvae are treated. Fields with high populations of weeds, such as dock, yellowrocket, and coarse grasses, are highly attractive to egg-laying cutworm moths.
Permethrin (Permethrin 3.2EC)	0.1-0.2 lb	4.0-8.0 oz	30	**Restricted Use.** Use a minimum of 1 gallon finished spray per acre by air or 10 gallons per acre by ground. Apply prior to brown-silk stage.
Zeta-cypermethrin (Mustang MAX)	0.008-0.018 lb	1.28 - 2.8 oz	30 for grain or fodder, 60 days for forage	**Restricted Use.** Apply by air or ground equipment using sufficient water to obtain coverage (minimum of 2 gallons per acre by air and 10 gallons per acre by ground).

European Corn Borer

Cultural control.

Because European corn borer larvae overwinter in corn stalks, fall plowing or mowing of stalks can reduce corn borer survival and moth emergence the following spring. However, this practice will provide the most benefit when used in isolated or large growing areas.

Bt Corn Hybrids.

Hybrids with high levels of resistance to European corn borer are commercially available from many seed providers. These hybrids have been genetically modified through biotechnology to produce the Bacillus thuringiensis (Bt) endotoxin–the same protein found in nature and commercial Bt formulations for control of European corn borer and other caterpillars. Due to the long history of safe Bt use and the efficient way that the toxin is delivered through the plant, Bt hybrids offer a highly effective and environmentally compatible alternative to managing European corn borer. However, the Bt gene itself does not confer a yield advantage, rather it simply protects whatever yield potential is already present in a particular hybrid. Thus, the gain in yield from Bt expression depends on the agronomic traits of the hybrid and the level of corn borer injury inflicted on that hybrid.

Projections based on historical corn borer infestations in the mid-Atlantic region indicate that the premium cost for Bt seed should return $4 to $28 per acre depending on corn price, yield, Bt hybrid, and most importantly, the level of insect damage prevented. Field tests have shown that the protection afforded by Bt expression is not the same in all hybrids and that the spectrum of pests controlled may also vary. Refer to table comparing hybrid performance against target pest spectrum.

Resistance Management.

European corn borer and other affected pests have the potential to develop resistance to the Bt toxin. Consequently, all Bt hybrids are registered conditionally by EPA, meaning that they are subject to review, changes in use, or even cancellation, if resistance or other unexpected problems occur. Resistance management in Bt corn is currently based on two complementary principles: "high dose" and "refuge." Bt hybrids have been designed to produce very high levels of toxin, much higher and consistent than levels resulting from a Bt insecticide application. The dose is high enough to eliminate all corn borers with no genes for resistance, as well as those with one copy of a resistance gene. Refuges provide a source of unselected corn borer moths to mate with any surviving resistant moths emerging from nearby Bt corn. In the mid-Atlantic area, a refuge includes non-Bt corn, wheat, potatoes, beans, peppers, sweet corn, sorghum, apples, and many herbaceous flowers and weeds large enough for the larvae to enter. Computer simulation models suggest that 20 percent of the local population, in any year, should not be exposed to Bt expression.

Steps for Using Bt-corn and Implementing Resistance Management

1. Contact your local seed dealers for availability of Bt seed and information on the spectrum of pests controlled. Choose Bt versions of commercial hybrids that are proven performers on your farm. Keep in mind that many hybrids have some tolerance to corn borer injury and agronomic traits for competitive yields regardless of insect damage.
2. Because corn borer populations fluctuate widely, keep track of the number of larvae or galleries per plant in your non-Bt corn and evaluate Bt hybrids over several years.
3. Plant Bt hybrids in fields where the risks of European corn borer damage are the greatest. As a general rule, yield gains should be higher in the earliest plantings which are more vulnerable to first generation attack; in very late planted fields which are more vulnerable to second generation attack; in fields with high yield potential; in continuous corn fields; and on non-till farms. Also, potential returns from Bt hybrids are greater in areas with mild winters and where the growing season allows two generations to occur, such as the Eastern Shore.
4. Plant no more than 80 percent of your total corn acreage to Bt hybrids. Plant non-Bt corn refuges on each farm either adjacent to or within Bt fields at the same time. Refuges can be arranged as blocks or strips in fields. Seed mixes, including Bt and non-Bt hybrids, and single or narrow strips are not recommended. Refuge strips should be 6 to 12 rows wide to effectively delay resistance and provide similar economic returns as a separate block refuge. Refuge strips within a field of Bt corn experience less damage than blocks of refuge.
5. Carefully record and mark where Bt and non-Bt hybrids are planted, so the performance of each hybrid can be monitored through the growing season.
6. Continue to scout and use an IPM approach for corn pests not controlled by Bt corn. Performance against other caterpillars such as stalk borers, true armyworms, corn earworm, and fall armyworm may vary with the Bt hybrid. Many pest managers feel that the transgenic crops require more management, at least during the first few years of adoption.
7. Monitor Bt corn to verify corn borer control for both first and second generations. Do not wait until harvest. Normally, seed lots contain a small percentage of off-types that may produce less or no Bt toxin. If unusual feeding damage is observed (greater than 4 percent of the plants infested), resistance may be occurring. Consult with your seed company, crop advisor, or local Extension specialist for assistance in investigating suspected resistance cases.

8. Most companies require growers to sign an agreement to affirm their willingness to follow the recommended resistance plan. Keep in mind that the Bt technology is a highly effective and environmentally safe management tool. So, it is in everyone's best interest to preserve it for the future. Planting more than 80 percent of your total acreage to Bt hybrids or planting the refuges too far away from the Bt fields is irresponsible and may lead to resistance on your farm.

Insecticide whorl treatments.

Use of a Bt hybrid is a preventative approach because the potential for European corn borer damage is impossible to predict prior to planting time. As an alternative remedial approach, a whorl application of an insecticide can be applied to prevent first generation damage if the corn borer infestation exceeds the treatment threshold. Keep in mind that this treatment, if timed and applied properly, will achieve no more than 80% control compared to 100% efficacy of the Bt hybrids. Furthermore, historical records of statewide corn borer infestations indicate that economic levels of first generation damage have occurred in only 3 out of the last 20 years. Also note that foliar insecticide treatments to prevent second generation corn borer are not economically feasible and thus not recommended. To apply a whorl treatment, consider the following sampling and decisionmaking guidelines.

Sampling.

Corn should be checked each week for fresh whorl feeding when the plants reach 18 to 24 inches high. Examine 20 consecutive plants at each of five locations in the field and record the percentage of infested plants showing fresh whorl feeding. Newly hatched larvae feed on the leaves, causing a characteristic "windowpane" or "shothole" injury that is readily visible as the whorl unrolls. Pull the whorl leaves from two infested plants at each location and carefully unroll the leaves while counting the number of live larvae. Multiply the percentage of plants infested and the number of live larvae per infested plant to generate an estimate of the potential number of larvae per plant.

Decisionmaking.

As a general rule, control is suggested in fields where 80 percent or more of the plants are found to be infested with an average of at least one larva per plant. If control is attempted, insecticides must be applied early in the period of infestation before the larvae tunnel too deeply in the whorl or stalk. For more precise decisions, use the following equation to estimate the net dollars gained by applying a whorl insecticide treatment. The equation assumes that two-thirds of the larvae will be killed if the treatment is applied properly and timed at the peak of egg hatch. Keep in mind that this prediction is less reliable the longer the application is delayed after the sampling date.

Net Dollars Gained = (0.67 x FL x PLP x MV x EY) - Cost of Control where

FL = fraction of yield lost per borer per plant if not controlled. This value is 0.059 during the early whorl stages; 0.050 during the late whorl stages; 0.031 during the blister stage; and 0.024 during the dough stages.

PLP = potential number of larvae per plant.

MV = market value of the corn (dollars per bushel).

EY = expected yield (bushels per acre).

Example situation.

A corn field is in the late whorl stage and is expected to yield 150 bushels per acre with an anticipated market value of $3 per bushel. Scouting results indicate that an average of two young corn borers per plant are located in the whorl and have not begun to enter the stalk. The recommended insecticide costs $10 per acre and the application cost is $4.50 per acre. A grower initiating a whorl treatment under these conditions stands to gain $15.65, calculated from the equation:

Net Dollars Gained = (0.67 x 0.050 x 2 x $3.00 x 150) - $14.50.

Comparison of control efficacy [a] of the available Bt seed products

Criterion	Transformation event			
	MON-810	**BT-11**	**TC1507**	**MON-863**
Product registrant	Monsanto	Syngenta (formerly Northrup-King)	Dow AgroSciences	Monsanto
Trademarks	YieldGard	YieldGard	Herculex I	YieldGard Rootworm
Type of Bt Cry gene	Cry1Ab	Cry1Ab	Cry1F	Cry3A
First generation European corn borer control	Yes	Yes	Yes	No
Second generation European corn borer control	Yes	Yes	Yes	No
Southern cornstalk borer control	Yes	Yes	Yes	No
Corn earworm control	Yes	Yes	No	No
Fall armyworm control	Partial	Partial	Yes	No
True armyworm control	Yes	Yes	Yes	No
Black cutworm control	No	No	Yes	No
Common stalk borer control	Partial	Partial	Partial	No
Corn rootworm control	No	No	No	Yes
Grubs and wireworm control	No	No	No	No
Ear rots and mycotoxins - indirect control	Partial	Partial	No	No
Stalk rots - indirect control	Partial	Partial	Partial	No

[a] a Relative control efficacy: No-less than 20 percent; Partial-20 percent to 80 percent depending on crop and pest stage and environmental conditions; Yes–greater than 80 percent.

Note: Not all transformation events listed above are approved in Japan and the European Union.

Available Bt Hybrids

Many YieldGard Bt hybrids (YGCB) with practically 100% corn borer protection are available from a number of seed providers. These hybrids also provide good protection against armyworms and prevent 95% of the corn earworms feeding in the ear from pupating, thus reducing the number of moths that infest soybean fields with podworms later in the season. Herculex I hybrids are also registered and provide good protection against foliage-feeding caterpillars such as cutworms and fall armyworms but less ear protection from corn earworms. The seed of all Bt corn hybrids are pre-treated with coatings of insecticides (Cruiser or Poncho) to control other early season insect pests. Other Bt hybrids are available that express beetle-active toxins in the roots to control rootworms (see section on rootworms for more information); however, these hybrids do not control corn borers or other caterpillars. Stacked hybrids (such as YieldGard Plus) with both corn borer and rootworm resistant genes are also available. It is important to know which target pests one wants to control with the Bt technology. For instance, why use a stacked corn borer and rootworm resistant hybrid in a rotated field or even in a continuous cornfield on the Eastern Shore where rootworms are not a problem. Many YGCB, YGRW, and Herculex hybrids are also stacked with Roundup Ready (RR) or other herbicide-resistant genetic traits. The resistance management requirements for Bt corn have not changed for new and re-registered hybrids (see Steps for Implementing Resistance Management under European Corn Borer). Growers are urged to consult their seed providers and the National Corn Growers Association website http://www.ncga.com for more information about available Bt hybrids, resistance management, and special marketing restrictions.

Corn-Recommended insecticides for first generation European corn borer control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Bacillus thuringiensis (Dipel 10G)	0.5-1.0 lb	5.0-10.0 lb	0	Apply 5 pounds as a band over whorl with ground equipment or 10 pounds broadcast by air. More effective when larvae are young. Dipel is one of the safest options because the oral and dermal toxicity is very low.
Bt hybrid corn				See text under European corn borer.
Carbaryl (Sevin 80S)	2.0 lb	2.5 lb	48	Direct spray into whorl. Best results are obtained when larvae are young and exposed on the leaves.
Carbofuran (Furadan 4F)	1.0 lb	2.0 pt	30	**Restricted Use.** Use a minimum of 3 gallons of diluted spray per acre. Do not apply 4F within 30 days of harvest. Do not enter 4F-treated fields within 14 days of application unless protective equipment is used. Do not make more than two foliar applications per season.
Chlorpyrifos (Lorsban 4E) (Lorsban 15G)	1.0 lb	2.0 pt 6.5 lb	35	**Restricted Use.** A banded application over whorl with ground equipment is preferred. Do not exceed two applications per season. Do not graze or harvest for silage within 14 days of last treatment.
Cyfluthrin (Baythroid 2E)	0.025-0.044 lb	1.6-2.8 oz	21	**Restricted Use.** Pre-harvest interval is 21 days for grain and fodder, or 0 days for green forage. Maximum allowed amount per crop season is 11.2 fl oz or no more than four applications. Apply with a minimum spray volume of 2 or 10 gallons per acre by air or ground, respectively.
Esfenvalerate (Asana XL 0.66 EC)	0.04-0.05 lb	5.8-9.6 oz	21	**Restricted Use.** Esfenvalerate is extremely toxic to fish. For application, see remarks for chlorpyrifos. High rates required.

Corn-Recommended insecticides for first generation European corn borer control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Fipronil (Regent 4SC)		0.24 oz/1,000 ft row (30-inch rows)	90	**Restricted Use.** Apply at planting time with precision injection equipment using a microtube or other suitable metering orifice that is directed into the open seed furrow. Can be mixed into pop-up liquid fertilizer and applied in-furrow. Read label for application directions. Do not plant leaf vegetables within 1 month following application, root crops within 5 months following application, or small grains or other rotational crops within 12 months following application.
Gamma-cyhalothrin (Proaxis)	0.01-0.015 lb	2.56-3.84 oz	21	**Restricted Use.** For control before larvae bore into the plant or ear. Do not apply within 21 days of harvest. Total product allowed per acre is 0.96 pt of formulation.
Lambdacyhalothrin (Warrior)	0.02-0.03 lb	2.56-3.84 oz	21	**Restricted Use.** Use before larvae bore into plant stalks and ears.
Permethrin (Permethrin 3.2EC)	0.1-0.2 lb	4.0-8.0 oz	30	**Restricted Use.** Extremely toxic to fish. Direct spray or granulars into whorl. Higher rates are recommended. For the sprayable products, use a minimum of 3 gallons of finished spray by air or 20 gallons of finished spray with ground equipment. Apply only prior to brown silk stage.
Zeta-cypermethrin (Mustang MAX)	0.017 - 0.025 lb	2.72 - 4.0 oz	30 for grain or fodder, 60 days for forage	**Restricted Use.** Apply by air or ground equipment using sufficient water to obtain coverage (minimum of 2 gallons per acre by air and 10 gallons per acre by ground).

Fall Armyworm

Sampling/Decisionmaking.

Damage occurs during midsummer through harvest. Scout at least weekly all late plantings of both silage or grain corn before tassel emergence. Examine 20 consecutive plants at each of five locations in the field for the presence of whorl feeding. Larvae feed in the whorls of the plants, causing a shredded or ragged appearance. They may burrow deep into the whorl and feed on the growing tip. Plants infested with fall armyworms often recover and grow normally without any significant effect on yield. Control at the whorl stage is usually not practical, particularly by air, and should not be attempted unless 75 percent of the plants exhibit whorl feeding and one or more larvae per plant is found. Treatment is not recommended for silage corn.

Control Options.

Recommended insecticides include cyfluthrin (Baythroid 2E) at 2.8 oz per acre, methomyl (Lannate LV 2.4EC) at 1.5 pints per acre, or zeta-cypermethrin (Mustang MAX) at 3.2-4.0 oz per acre applied in a minimum of 50 gallons of water directed into the whorl of the plants. Baythroid should be used for infestations consisting of first and second instars only.

Grasshopper

Sampling/Decisionmaking.

Damage may occur during middle to late summer, especially during drought seasons. Examine fields next to pastures and other grassy areas where grasshoppers overwinter and develop. Treating these adjacent breeding sites before the young grasshoppers move into the cornfield may reduce the size of the area that must be sprayed later. Treatment of noncropped areas is suggested when young grasshoppers reach 20 per square yard. Field sprays may be justified when 5 to 8 grasshoppers per square yard are present during the silking period.

Corn-Recommended insecticides for grasshopper control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Carbofuran (Furadan 4F)	0.25-0.5 lb	0.5-1.0 pt	30	**Restricted Use.** Rates vary depending on the infestation level. Check label for restrictions, especially if Furadan was used at planting.
Chlorpyrifos (Lorsban 4E)	0.25-0.5 lb	0.5-1.0 pt	35	
Cyfluthrin (Baythroid 2E)	0.033-0.044 lb	2.1-2.8 oz	0-21	**Restricted Use.** Pre-harvest interval is 21 days for grain and fodder, or 0 days for green forage. Maximum allowed amount per crop season is 11.2 fl oz or no more than four applications. Apply with a minimum spray volume of 2 or 10 gallons per acre by air or ground, respectively.

Corn-Recommended insecticides for grasshopper control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Dimethoate 4EC	0.5 lb	1.0 pt	14	Do not make more than three applications per year.
Esfenvalerate (Asana XL 0.66 EC)	0.03-0.05 lb	5.8-9.6 oz	21	**Restricted Use.** Esfenvalerate is extremely toxic to fish.
Gamma-cyhalothrin (Proaxis)	0.01-0.015 lb	2.56-3.84 oz	21	**Restricted Use.** Do not apply within 21 days of harvest. Total product allowed per acre is 0.96 pt of formulation.
Lambdacyhalothrin (Warrior)	0.02-0.03 lb	2.56-3.84 fl oz	21	**Restricted Use.** Apply by air with a minimum of 2 gallons of water per acre.
Microencapsulated methyl parathion (Penncap-M 2F)	0.5-0.75 lb	2.0-3.0 pt	12	**Restricted Use.** Check label for spraying instructions before use.
Zeta-cypermethrin (Mustang MAX)	0.017 - 0.025 lb	2.72-4.0 oz	30 for grain or fodder, 60 days for forage	**Restricted Use.** Apply by air or ground equipment using sufficient water to obtain coverage (minimum of 2 gallons per acre by air and 10 gallons per acre by ground).

Japanese Beetle-Adult Feeding

Sampling/Decisionmaking.

Damage is caused when the adult beetles prevent pollination by early silk clipping. Begin scouting in mid-July before pollination to determine the number of beetles present and the potential for silk clipping damage. Pollination takes place during a period of about 36 hours. If the silks are wilted or have turned brown, pollination is complete and further silk feeding will not affect yields.

Examine 20 plants in each of five locations in the field to determine the stage of pollination, the number of beetles per plant, and the percentage of plants with silks cut back to 0.5 inch or less. An insecticide application may be necessary if 50 percent of plants have silks cut back to 0.5 inch or less, as this indicates that Japanese beetles are present and pollination is still in progress.

Corn-Recommended insecticides for Japanese beetle control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Cyfluthrin (Baythroid 2E)	0.025-0.044 lb	1.6-2.8 oz	0-21	**Restricted Use.** Pre-harvest interval is 21 days for grain and fodder, or 0 days for green forage. Maximum allowed amount per crop season is 11.2 fl oz or no more than four applications. Apply with a minimum spray volume of 2 or 10 gallons per acre by air or ground, respectively.
Gamma-cyhalothrin (Proaxis)	0.01-0.015 lb	2.56-3.84 oz	1-7	**Restricted Use.** Do not apply within 21 days of harvest. Total product allowed per acre is 0.96 pt of formulation.
Lambdacyhalothrin (Warrior)	0.02-0.03	2.56-3.84	21	**Restricted Use.** Apply by air with a minimum of 2 gallons of water per acre.
Zeta-cypermethrin (Mustang MAX)	0.017-0.025 lb	2.72-4.0 oz	30 for grain or fodder, 60 days for forage	**Restricted Use.** Apply by air or ground equipment using sufficient water to obtain coverage (minimum of 2 gallons per acre by air and 10 gallons per acre by ground).

Northern Corn Rootworm and Western Corn Rootworm

Cultural Control.

Not all fields have rootworm problems. Rootworms are usually not a problem in hot, sandy soils, such as those on the Delmarva Peninsula. Rotation to a non-corn crop for just one year is the most effective and environmentally compatible method to manage rootworm problems. Where rotation is not applied, second and third year continuous cornfields are at higher risks for yield losses from rootworms than fields planted in corn for 4 or more years. Major losses due to rootworm injury occur after corn becomes lodged. If corn is moderately or heavily infested and remains standing, significant yield reduction may not always occur, particularly under good growing conditions. Corn plants can also compensate for earlier corn rootworm injury.

Bt Corn Hybrids.

Many hybrids of YieldGard Rootworm (YGRW) Bt corn adapted to the Mid-Atlantic area are available. In addition, Herculex RW was registered late in 2005 and hybrids of this new event should be available in 2006. Expression of a beetle-active protein toxin in the roots of these hybrids kills corn rootworms. Control efficacy is equal to or better than standard soil insecticide treatments. However, these hybrids do not control corn borers or other caterpillars. Stacked hybrids of YieldGard Plus Bt corn with both corn borer and rootworm resistant genes are available. Also, Herculex XTRA, which combines the corn rootworm protection of Herculex RW with the caterpillar protection of Herculex I, may be available in 2006. Bt hybrids with rootworm protection provide an excellent preventative

option in continuous second and third year cornfields where the risks of rootworms are high. However, the rootworm-active toxins expressed in these hybrids do not provide protection against other soil insects, such as grubs, wireworms, seedcorn maggots, and cutworms. For this reason, all Bt corn seed is pre-treated with Poncho or Cruiser. In most situations, these seed treatments should control all soil pests but the low rates of both insecticides may fail to provide enough suppression of high grub or wireworm infestations. The resistance management requirements for YGRW hybrids are essentially the same as those for the corn borer resistant Bt hybrids (see Steps for Implementing Resistance Management under European Corn Borer). Consult your seed providers and the National Corn Growers Association website http://www.ncga.com for more information about available rootworm resistant hybrids, resistance management, and marketing restrictions.

Sampling.

If crop rotation is not possible, monitoring of adult rootworm beetles is strongly recommended to estimate the potential for economic damage and the need for insecticide protection the following year. Two sampling methods are suggested; direct visual counts and yellow sticky traps. Recent research has shown that sticky traps are equal to visual counts in predicting potential root damage but provide a more efficient way of assessing adult rootworm activity. For both methods, each field should be visited weekly for 3 or 4 weeks during late July through mid-August to estimate the number of adult rootworms present. Contact your local Extension agent for more precise information regarding the time to begin sampling.

Attractive sticky panel traps are commercially available from several pest management supply companies. The recommended type is the Olsen 4-by-6–inch sticky panel, which is coated with a special yellow reflecting pigment that attracts adult rootworms (Figure 1). Traps should be placed at a density of one trap every 5 acres and attached to the corn plant at the ear zone with a wooden dowel and secured with a clothespin. Traps should be changed weekly when the number of captured beetles is recorded. Consult your local Extension agent or state pest management specialist for more information on where to obtain traps and how to use them.

Visual counts of adult beetles active on plants should be made weekly at five locations in every 40 acres. Count the number of corn rootworm adults on 10 plants at each location. Distinguishing between northern and western corn rootworm adults is no longer necessary because the eastern species has virtually replaced the northern species.

Decisionmaking.

The level of adult rootworm activity that justifies the use of a soil insecticide depends on the number of years the field has been in continuous corn and the particular sampling method used. Second- and third-year cornfields are generally at higher risk to rootworm injury than fields in continuous corn for 4 or more years. Reasons for this are (1) adult rootworm populations that invade first- and second-year cornfields consist of a greater percentage of females, thus egg-laying pressure per beetle sampled is proportionately higher; and (2) natural control factors that help to reduce rootworm injury are more fully established in fields with a longer history of rootworm activity.

In second- and third-year cornfields, the use of a soil insecticide is recommended if visual counts exceed 0.25 adult rootworms per plant or if yellow-panel-trap catches exceed 10 adults per week. In fields with continuous corn for 4 or more years, a soil insecticide is recommended if visual counts exceed 2 adult rootworms per plant or yellow-panel-trap catches exceed 35 adult rootworms per week.

Example situation.

Two weekly samples were taken after female beetles were active and more than 10 percent were full of eggs. The highest count was 40 northern corn rootworm (NCR) and 120 western corn rootworm (WCR) adults per 50 plants. Because the number of NCR adults is halved and added to the count for WCR adults, the average number of rootworm adults is 3 [that is, (40 NCR ÷ 2) + 120 WCR = 140 Adults ÷ 50 Plants = 3)]. In this situation, the estimated population count exceeds 2; thus, rotation to another crop or a soil insecticide is recommended for the next season if corn is being planted in the field.

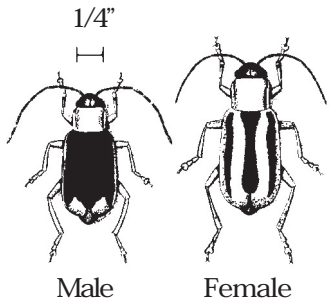


Figure 1. Different wing markings of western corn rootworm adults.

Soil insecticides.

Band applications of granular insecticides generally provide better rootworm control in conventionally tilled corn if they can be incorporated into the top inch of the soil. All the soil insecticides listed for rootworm control are labeled for band applications. Even if the label allows in-furrow placement, better root protection usually results when the product is banded over a wider portion of the root zone. However, in-furrow treatments may provide better protection from wireworms or other seed-attacking insects and still give adequate rootworm control in many situations. Ribbed press wheels, spring tines, or drag chains should be used to lightly incorporate the granulars.

In no-till situations, soil incorporation of granulars may not be possible and surface residue may prevent some granules from reaching the soil. Where corn is not tilled into heavy surface residue, in-furrow and banded applications are equally effective provided that the granulars are banded in front of the closing devices. This allows some incorporation by the action of the furrow-closing wheels or press wheels. The use of drag chains after the closing wheels greatly reduces the impact of surface residue as a barrier. Keep in mind that when granulars are being placed in front of the closing devices or in-furrow with the seed, direct seed injury may result with some products. See Remarks under each recommended insecticide. Placing the insecticide below the seed level, as may occur if mixed and applied with some fertilizers, is not effective.

Corn-Recommended insecticides for northern corn rootworm and western corn rootworm larval control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Bt corn hybrid				See text under Rootworm and Bt corn comparison table for comments.
Carbofuran (Furadan 4F)	0.8 lb/1,000 ft row	2.5 oz/1,000 ft row	30	Unlike granular soil insecticides, the application window of banded or broadcasted treatment of Furadan 4F is narrowly defined and should be timed closely to coincide with corn rootworm hatch. Rainfall or irrigation is critical to moving the insecticide into the root zone for the best protection. If rain does not fall, control may be marginal and less than the protection afforded by granular insecticides applies at planting time. Root protection can be improved if Furadan 4F is cultivated into the soil; however, this is not possible with no-till. Postplant application of Furadan 4F in a narrow band at the base of the plant is more effective than a broadcast application. In-furrow or broadcast applications of Furadan 4F at planting are too early and do not have the lasting residual activity to control European corn borers feeding in the whorls of corn plants during mid-to-late June. Broadcast applications of Furadan 4F at planting or postplant do not concentrate enough toxicant in the root zone to control high infestations of wireworms.

Corn-Recommended insecticides for northern corn rootworm and western corn rootworm larval control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Chlorethoxyfos (Fortress 5G) (Fortress 2.5G)		3.0-4.5 oz/1,000 ft row 6.0-9.0 oz/1,000 ft row	30	**Restricted Use.** Apply in a T-band or in-furrow.
Chlorpyrifos (Lorsban 15G)	1.2 oz/1,000 ft row	8.0 oz/1,000 ft row	35	Apply in a band over the row behind the planter shoe and closing or covering devices. See label for information on the use of T-bands.
Clothianidin (Poncho 1250)	1.25 mg per kernel		-	Seed treatment only. Poncho 1250 replaces Prescribe and high rates of Gaucho 600 for corn rootworm protection. Seed must be ordered pre-treated or treated by only commercial seed treaters. The polymer seed coating affects plantability, thus talc for air pickup or graphite for finger pickup must be applied to the hopper box for lubrication. Avoid carrying over treated seed due to germination problems.
Ethoprop (Mocap 10G)		10.5 oz/1,000 ft row	-	**Restricted Use.** Apply as a band over closed seed furrow. Do not place in direct contact with seed.
Fipronil (Regent 4SC)		0.24 oz/1,000 ft row (30-inch rows)	90	**Restricted Use.** Apply at planting time with precision injection equipment using a microtube or other suitable metering orifice that is directed into the open seed furrow. Can be mixed into pop-up liquid fertilizer and applied in-furrow. Read label for application directions. Do not plant leaf vegetables within 1 month following application, root crops withing 5 months following application, or small grains or other rotational crops within 12 months following application.
Tefluthrin (Force 3G)	1.2-1.5 oz/1,000 ft row	4.0-5.0 oz/1,000 ft row	-	**Restricted Use.** Tefluthrin may be banded or in-furrow. Check label for details.

Corn-Recommended insecticides for northern corn rootworm and western corn rootworm larval control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Terbufos (Counter 15G)	1.2 oz/1,000 ft row	8.0 oz/1,000 ft row	-	**Restricted Use.** Band in front of closing devices or in-furrow directly with the seed. Check label for details. Use of Accent or Beacon herbicides following Counter applications may result in severe crop injury. Check label for variety information and planting restrictions.
Thiamethoxam (Crusier 5FS)	1.25 mg per kernel		-	Seed treatment only. Seed must be ordered pre-treated with Cruiser 5FS or treated by only commercial seed treaters. Light to moderate infestations only.

Seedcorn Maggot

Sampling/Decisionmaking.

Cool or wet spring weather can result in delayed germination, which increases the chances of seedcorn maggots attacking the seed. In fields with less than adequate drainage, fields following set-aside acreage, old sod fields, or fields that are heavily manured or have high crop residues, the seed should be treated if soil insecticides are not used.

Seed treatments will protect germinating corn seed against seed corn maggot. Producers can apply planter-box treatments, which include products containing imidacloprid (Latitude, Concur) and permethrin (Kernel Guard Supreme, KickStartVP). All label uses of seed treatments containing lindane or diazinon have been cancelled; however, existing stocks in the marketplace can be used.

Products that are only available as commercially treated seed include thiamethoxam (Cruiser 5FS), clothianidin (Poncho 250, Poncho 1250), and chlorpyrifos (Lorsban). Check the labels of soil insecticides for information about seed corn maggot.

Note that excess dust from certain seed treatments may interfere with the electronic monitor of air planters. The polymer coating of Poncho seed treatments may affect plantability, thus talc for air pickup or graphite for finger pickup must be applied to the hopper box for lubrication. Consult your seed or insecticide dealer for specific information about seed treatment combinations.

Slug

Sampling/Decisionmaking.

Slugs can become serious pests in no-till fields during spring periods of cool, wet weather. Fields with heavy layers of manure, crop refuse, or thick weed cover run a higher risk of infestation. Slugs feed at night; thus, late evening observations are required for population estimates. Begin checking for slugs before corn emergence because these pests are known to feed on the germinating seed and sprout if the seed furrow is not completely closed in no-till fields. Survey first the wet areas or areas with heavy surface trash, and watch for damaged plants. Turn over clods of dirt and surface trash around five plants at 10 locations and determine the average number of slugs associated with each plant.

Under normal growing conditions, corn can usually recover from the leaf feeding damage caused by slugs. However, stand reduction can be severe if the slugs start feeding on the young sprouts in the seed furrow below the ground. Populations of five or more slugs around each plant between the spike and 3-leaf stage may require treatment, especially if injury is already heavy, plant growth is slow, and cool, wet conditions prevail. If the weather turns hot and dry, 10 or more slugs per plant may be tolerated, particularly if the seedlings reach the 3-leaf stage.

Control Options.

Deadline M-Ps (4% metaldehyde) at 10 to 40 lbs per acre and TrailsEnd LG (3.5% metaldehyde) at rates up to 20 lbs are labeled for slug control on field corn. Deadline is a soil surface treatment that is either broadcasted or banded; apply in the early evening. TrailsEnd should be banded over the row at planting or slightly later. Field testing of TrailEnd resulted in 60 to 70% control with a rate of 9 to 10 lbs per acre banded, comparable to control by DeadlineM-Ps. In heavily infested fields, rescue treatments of 30% urea-based nitrogen can be applied at night as a direct contact irritant. This approach can cause significant slug mortality, provided that slugs are actively feeding up on plants when the application is made. Poor control have been linked to windy conditions during the night which discourage slugs from feeding on the upper exposed surfaces of plants. In several studies, spray volumes of 20 gallons/acre consisting of 5, 10, and 20 gallons of the nitrogen formulation reduced slug densities by 48%, 74%, and 81%, respectively. The 10-gallon rate mixed 1:1 with water is recommended based on cost and less risk from direct injury to the corn foliage. Another cultural option is to apply liquid nitrogen formulations containing potash to suppress slug activity. This treatment can be applied during the day because the salt residue from the potash on leaf surfaces irritates and repels slugs when they become active at night. Other cultural practices that can reduce slug damage include: use of less manure, trash wheels to reduce the amount of surface litter around seedlings, and shift to conventional tillage practices for at least one growing season. The latter is the most effective remedy in continuous no-till fields when all other means fail. Contact your county Extension educator for more information on how to use cultural practices.

Spider Mite

Sampling/Decisionmaking.

Mite populations often seem to explode as plants reach the grain-fill period, especially during extended hot, dry weather when the plants are stressed. Sprays applied for other insect pests during midsummer can devastate the mite predator complex and, thus, may increase mite problems. If corn has not dented, treatment may be needed if mite colonies are present along the midribs on the lower surfaces of one-third to one-half of the leaves on 50 percent of the plants. This can also be expressed as 15 to 20 percent of the total leaf area covered with mite colonies, and mites are beginning to colonize significant areas of the field.

Corn-Recommended miticides for spider mite control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Dimethoate 4EC	0.5 lb	1.0 pt	14	Do not make more than three applications per year.

Stalk Borer

Sampling/Decisionmaking.

Refer to the sampling procedures for true armyworm. For stalk borers, treatment is suggested if more than 4, 6, and 10 percent of the plants are initially damaged at the 2-, 3-, and 4-leaf stages, respectively, and the worms have not bored into the stalks. Good weed control eliminates egg laying sites. Increased seeding rates should be used in high-risk fields.

Insecticides must be applied early in the larval migration from grassy areas to corn before the borers enter the plant. The best timing is approximately 10 to 12 days after application of glyphosate (Roundup) herbicide or after complete burn down with paraquat herbicide (about 3 to 5 days).

An alternative strategy for managing stalk borer infestations is to apply a burndown herbicide at least 10 days before corn is planted. The slightly earlier burndown herbicide application means that a suitable alternative host (for example, corn) will not be available to the stalk borer larva as it emerges from its herbicide-treated host. As a consequence of this action, the exposed larvae are subject to a much higher mortality rate from such factors as predation, starvation, and adverse environmental conditions.

Corn-Recommended insecticides for stalk borer control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Chlorpyrifos (Lorsban 4E)	2.0-3.0 lb	2.0-3.0 pt	35	**Restricted Use.** Apply as a postemergent foliar spray. Do not apply in combination with herbicides. Only one application per season.
Cyfluthrin (Baythroid 2E)	0.025-0.044 lb	1.6-2.8 oz	0-21	**Restricted Use.** Pre-harvest interval is 21 days for grain and fodder, or 0 days for green forage. Maximum allowed amount per crop season is 11.2 fl oz or no more than four applications. Apply with a minimum spray volume of 2 or 10 gallons per acre by air or ground, respectively.
Esfenvalerate (Asana XL 0.66 EC)	0.03-0.05 lb	5.8-9.6 oz	21	**Restricted Use.** Esfenvalerate is extremely toxic to fish. Apply as a preemergent or foliar spray. May be applied too early if mixed with herbicides.
Gamma-cyhalothrin (Proaxis)	0.01-0.015 lb	2.56-3.84 oz	21	**Restricted Use.** For control before larvae bore into the stalk. Do not apply within 21 days of harvest. Total product allowed per acre is 0.96 pt of formulation.
Lambdacyhalothrin (Warrior)	0.02-0.03 lb	2.56-3.84 fl oz	21	**Restricted Use.** Apply by air with a minimum of 2 gallons of water per acre. Warrior is also effective in chemigation systems.

Corn-Recommended insecticides for stalk borer control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Permethrin (Permethrin 3.2EC)	0.1-0.2 lb	4.0-8.0 oz	12	**Restricted Use.** Permethrin is extremely toxic to fish. Apply as a preemergent or foliar spray. May be applied too early if mixed with herbicides.
Zeta-cypermethrin (Mustang MAX)	0.017-0.025 lb	2.72-4.0 oz	30 for grain or fodder, 60 days for forage	**Restricted Use.** Apply by air or ground equipment using sufficient water to obtain coverage (minimum of 2 gallons per acre by air and 10 gallons per acre by ground).

True Armyworm

Sampling/Decisionmaking.

No-till fields planted into a small-grain cover crop, pastures, and weedy fields all have a high risk for armyworm infestations. Survey field edges that border small grains or large grassy areas, and watch for damaged plants. If armyworm damage is seen, examine 20 plants at each of five locations within the field and record the percentage of damaged plants, the average size, and the severity of injury.

Bt Corn Hybrids.

Protein expression in YieldGard and Bt-Xtra hybrids suppresses true armyworm activity during the seedling and whorl stages. YieldGard hybrids also reduce the whorl feeding injury caused by fall armyworm. Use of these hybrids is suggested in non-till fields planted into a small grain cover crop or in late-planted fields for silage.

Armyworms usually migrate from small grains starting in late May. Spot treatment is warranted if infestations are confined to small areas. Control is recommended if 35 percent or more of the plants are infested and 50 percent or more defoliation is seen on the damaged plants, provided that larvae average less than 0.75 inch long. Worms greater than 1.25 inches long usually have completed their feeding.

Corn-Recommended insecticides for true armyworm control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Preemergence				
Bt corn hybrid				See text under true armyworm.
Chlorpyrifos (Lorsban 4E)	0.5-1.0 lb	1.0-2.0 pt	35	**Restricted Use.** Broadcast-use minimum of 20 gallons of water per acre.

Corn-Recommended insecticides for true armyworm control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Esfenvalerate (Asana XL)	0.03-0.05 lb	5.8-9.6 oz	21	**Restricted Use.** Broadcast-apply as necessary to maintain control.
Lambdacyhalothrin (Warrior)	0.02-0.03 lb	2.56-3.54 fl oz	21	**Restricted Use.** Use for control of the first and second instar only.
Permethrin (Permethrin 3.2EC)	0.1-0.2 lb	4.0-8.0 oz	-	**Restricted Use.** Apply from 5 days before planting up to emergence. Band or broadcast-use a minimum of 10 gallons finished spray per acre by ground or 1 gallon per acre by air.
Postemergence				
Bacillus thuringiensis (Agree WG) (Biobit HP) (Crymax) (Deliver LC) (Dipel ES) (Javelin WG) (Xentari)	-	 1-2 lb 0.5-2 lb 1.5-2.5 pt 0.5-1.5 lb 0.5-2 lb	0	Bt insecticides work best against small armyworms (first and second instars) when populations first begin to develop and full-coverage sprays are applied. Use sufficient water to ensure thorough coverage of treated plants. Repeat treatment as necessary. If larger larvae or heavy populations are present, a contact insecticide should be used.
Carbaryl (Sevin XLR Plus)	1.0-2.0 lb	1.0-2.0 qt	48	Use sufficient water to ensure thorough coverage of treated plants.
Chlorpyrifos (Lorsban 4E)	0.5-1.0 lb	1.0-2.0 pt	35	Use sufficient water to ensure thorough coverage of treated plants.
Cyfluthrin (Baythroid 2E)	0.025-0.044 lb	1.6-2.8 oz	0-21	**Restricted Use.** Pre-harvest interval is 21 days for grain and fodder, or 0 days for green forage. Maximum allowed amount per crop season is 11.2 fl oz or no more than four applications. Apply with a minimum spray volume of 2 or 10 gallons per acre by air or ground, respectively.
Esfenvalerate (Asana XL)	0.03-0.05 lb	5.8-9.6 oz	21	**Restricted Use.** Use sufficient water to ensure thorough coverage of treated plants.

Corn-Recommended insecticides for true armyworm control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Lambdacyhalothrin (Warrior)	0.02-0.03 lb	2.56-3.54 fl oz	21	**Restricted Use.** Use for control of the first and second instar only.
Methomyl LV 2.4EC	0.3-0.6 lb	1.0-2.0 pt	0 ears, 3 forage	
Microencapsulated methyl parathion (Penncap-M 2F)	0.5-0.75 lb	2.0-3.0 pt	12	Check label for spraying instructions before use. Best results are obtained when young larvae are treated.
Permethrin (Permethrin 3.2EC)	0.1-0.2 lb	4.0-8.0 oz	-	**Restricted Use.** Use minimum of 1 gallon finished spray per acre by air or 10 gallons per acre by ground. Apply prior to brown-silk stage. Use higher rate for longer residuals.
Zeta-cypermethrin (Mustang MAX)	0.02-0.025 lb	3.2-4.0 oz	30 for grain or fodder, 60 days for forage	**Restricted Use.** Apply by air or ground equipment using sufficient water to obtain coverage (minimum of 2 gallons per acre by air and 10 gallons per acre by ground).

White Grub

Sampling/Decisionmaking.

Start sampling 2 to 3 weeks before planting by randomly selecting 10 samples (1 square foot per sample) for every 10 acres. At each sample, dig the soil out to a depth of 6 inches and count the number of grubs. Grubs also can be counted during tillage operations, although this method is less accurate and not always possible in minimum tillage fields. Note the location of the grubs in the soil and take some time to identify the type of grub by examining the pattern of hairs on the underside of the last abdominal segment (Figure 2). May/June beetle grubs have two parallel rows of hairs, and they are more damaging than the other grubs. Japanese beetle grubs have a V-shaped arrangement of hairs, and the masked chafer grubs have a random pattern of hairs. These grubs rarely cause economic damage to corn.

Application of a soil insecticide may be required if counts exceed two May/June beetle grubs per square foot. Most grub species complete their feeding stage by early May in Virginia to mid-May in Maryland and Delaware; thus, late-planted corn and conventionally tilled corn are at lower risk for damage.

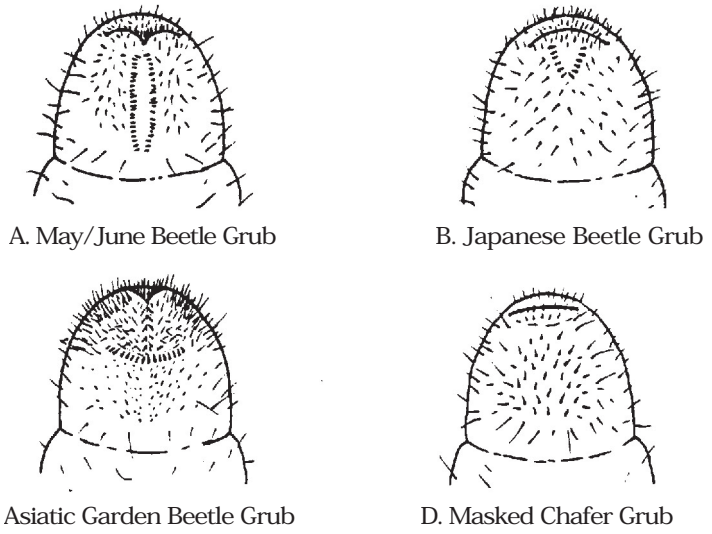


Figure 2. Last abdominal segment of common white grubs.

Corn-Recommended insecticides for white grub control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Chlorethoxyfos (Fortress 5G) (Fortress 2.5G)	0.15 oz/1,000 ft row	3.0 oz/1,000 ft row 6.0 oz/1,000 ft row	30	**Restricted Use.** Apply T-banded or in-furrow. Do not apply as a surface band behind the presswheel. Fortress 5G is available only as a smart box closed system.
Chlorpyrifos (Lorsban 15G)	1.2-2.4 oz/1,000 ft row	8.0-12.0 oz/1,000 ft row	0	Apply at planting in-furrow or as a T-band.
Clothianidin (Poncho 250)	0.25 mg/kernel		0	Application by commercial seed treaters only. Higher rates with Poncho 1250 may be necessary to control heavy infestations. The polymer seed coating affects plantability, thus talc for air pickup or graphite for finger pickup must be applied to the hopper box for lubrication. Avoid carrying over treated seed due to germination problems.
Fipronil (Regent 4SC)		0.24 oz/1,000 ft row (30-inch rows)	90	**Restricted Use.** Apply at planting time with precision injection equipment using a microtube or other suitable metering orifice that is directed into the open seed furrow. Can be mixed into pop-up liquid fertilizer and applied in-furrow. Read label for application directions. Do not plant leaf vegetables within 1 month following application, root crops within 5 months following application, or small grains or other rotational crops within 12 months following application.
Phorate (Thimet 20G)	0.68 oz/1,000 ft row	4.5-6.0 oz/1,000 ft row	0	**Restricted Use.** Apply banded. Do not place granulars in direct seed contact.
Tefluthrin (Force 3G)	1.2-1.5 oz/1,000 ft row	4.0-5.0 oz/1,000 ft row	0	**Restricted Use.** Force can be banded or applied in-furrow. Use the 5-ounce in-furrow rate for severe grub infestations.

Corn-Recommended insecticides for white grub control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Terbufos (Counter 15G)	0.9-1.2 oz/1,000 ft row	6.0-8.0 oz/1,000 ft row	-	**Restricted Use.** Apply at planting in a 7-inch band over the row in front of or behind the presswheel to lightly incorporate. This formulation can also be applied in-furrow. If application is made at planting, do not make postemergence or cultivate time treatments of Counter. Use of Accent or Beacon herbicides following Counter 15G applications may result in severe crop injury.
Thiamethoxam (Crusier 5FS)	0.125-0.80 mg/kernel		0	Only commercial seed treaters can apply this product. Higher rates may be necessary to control heavy infestations.

Wireworm

Sampling/Decisionmaking.

Most reports of wireworm damage have been in fields where corn follows established sod or where there has been a corn-soybean-small grain rotation and a history of weeds in the field 2 to 3 years before damage to the corn is evident. The adult wireworm prefers to lay eggs in small grain stubble or in grassy areas. Bottom lands or low spots in the field often have the heaviest populations.

Most soil insecticides used for corn rootworms provide some degree of wireworm control; however, rates higher than those used for rootworms and in-furrow treatments are usually needed to control heavy wireworm infestations. If wireworm damage is detected after planting, rescue treatments generally do not work. Use soil insecticide during the replanting operations if the stand has been severely reduced. Seed treatment for seedcorn maggot and lindane will help suppress populations.

Corn-Recommended insecticides for wireworm control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Chlorpyrifos (Lorsban 15G)	1.8 oz/1,000 ft row	12.0 oz/1,000 ft row	0	Broadcast and disk in before planting.
Clothianidin (Poncho 250)	0.25 mg/kernel		0	The polymer seed coating affects plantability, thus talc for air pickup or graphite for finger pickup must be applied to the hopper box for lubrication. Avoid carrying over treated seed due to germination problems.

Corn-Recommended insecticides for wireworm control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Fipronil (Regent 80WG) (Regent 4SC)	0.12 oz/1,000 ft row	0.15 oz/1,000 ft row 0.24 oz/1,000 ft row	90	**Restricted Use.** Apply at planting time with precision injection equipment using a microtube or other suitable metering orifice that is directed into the open seed furrow. Can be mixed into pop-up liquid fertilizer and applied in-furrow. Read label for application directions. Do not plant leaf vegetables within 1 month following application, root crops within 5 months following application, or small grains or other rotational crops within 12 months following application.
Tefluthrin (Force 3G)	1.25-1.5 oz/1,000 ft row	4.0-5.0 oz/1,000 ft row	0	**Restricted Use.** Apply in-furrow at planting for best control. Rotational crops may be planted 30 days after application.
Terbufos (Counter 15G) (Counter 20CR)	0.9-1.2 oz/1,000 ft row	6.0-8.0 oz/1,000 ft row	0	**Restricted Use.** Apply at planting in a 7-inch band over the row in front of or behind the presswheel and lightly incorporate. Counter can also be applied in-furrow. If application is made at planting, do not make postemergence or cultivation time treatments of Counter. Use of Accent or Beacon herbicides following Counter 15G applications may result in severe crop injury.
Thiamethoxam (Crusier 5FS)	0.125-0.80 mg/kernel		0	Seed protection only. Application by commercial seed treaters only. Higher rates may be needed to control heavy wireworm populations.

Insect Control in Grain Sorghum

Corn Earworm, Fall Armyworm, and Webworm

Sampling/Decisionmaking.

Damage caused by fall armyworms and corn earworms may occur from July through frost. The armyworm may attack the whorl, causing a ragged, shot-hole appearance to the leaves, but applications of insecticides in the whorl stage are generally unprofitable. Both species of caterpillar feed in the heads of sorghum during the bloom period through the milk stages. Open-headed hybrids are damaged less than the compact-head types. The small, fuzzy, striped sorghum webworms also feed within the developing seed. This problem is usually more severe in the late-maturing fields from mid-August to October.

European corn borer, corn earworm, and fall armyworm.

These pests can be found in the whorl during June through July. Although the ragged "shot hole" damage may be dramatic, control of worms in the whorl stage seldom is economically justified. One exception is the European corn borer, which can be a potentially major pest problem on sorghum in the mid-Atlantic area. Whorl infestations are similar to those in corn; however, the tunneling injury has a much greater impact on sorghum yield because of the smaller stems and damaged grain heads that drop off later. Insecticide treatments are suggested if 50 to 80 percent of the plants are infested with live larvae.

Begin sampling blooming-stage fields in early August by counting the number of worms of each species on a minimum of 200 random plants from 20 different areas in fields 10 acres in size or less. Make frequent head inspections when sorghum is beginning to flower, and continue at 5-day intervals until hard dough stage. To examine heads for sorghum webworm, beat heads on a piece of white paper or cloth. Small larvae (less than one-eighth of an inch in length), which are commonly overlooked during head inspections, will be detected with this method.

Control to prevent yield losses from whorl damage should be considered if 40 to 60 percent or more of the plants are infested and show heavy leaf damage. For head infestations, treat only when larvae are damaging the head or when the developing growing point and the number of fall armyworms and corn earworms averages more than two per head. For webworms, treatment is suggested where infestations average five or more worms per head during the postbloom period.

Grain sorghum-Recommended insecticides for earworm, fall armyworm, and webworm control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Carbaryl (Sevin 80S) (Sevin XLR 4F)	1.5 lb	3.0 pt	21	Webworm control only. A ground application with at least 15 gallons of diluted spray is preferred. Aerial applications should use 5 gallons of spray per acre. No preharvest waiting period is required for forage use.
Chlorpyrifos (Lorsban 4E)	0.5-1.0 lb	1.0-2.0 pt	30 (1 pt rate) 60 (2 pt rate)	**Restricted Use.** Webworm control only. Do not apply more than 1.5 pounds active ingredient per acre per season. Do not treat sweet varieties of sorghum.
Cyfluthrin (Baythroid 2E)	0.020-0.044 lb	1.3-2.8 oz	14	**Restricted Use.** First and second instars of fall armyworm only. Apply with a minimum spray volume of 2 or 10 gallons per acre by air or ground, respectively. Maximum allowed per season is 8.4 fl oz per acre or six applications. No greater than a 10-day interval between sprays.

Grain sorghum-Recommended insecticides for earworm, fall armyworm, and webworm control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Gamma-cyhalothrin (Proaxis)	0.01-0.015 lb	2.56-3.84 oz	30	**Restricted Use.** Do not apply within 30 days of harvest. Total product allowed per acre is 0.48 pt of formulation.
Lambdacyhalothrin (Warrior)	0.02-0.03 lb	2.56-3.84 fl oz	30	**Restricted Use.** Use for earworm and fall armyworm control of first and second instars only. Do not graze livestock or harvest for silage or hay.
Methomyl (Lannate LV 2.4EC) (Lannate 90SP)	0.45 lb 0.22-0.44 lb	1.5 pt 2.5-5.0 lb	14	**Restricted Use.** Methomyl is preferred for fall armyworm and all other species control both in whorl and head. Use high gallonage and direct spray into whorl for best results.
Zeta-cypermethrin (Mustang MAX)	0.011-0.025 lb	1.76-4.0 oz	14-45	**Restricted Use.** Pre-harvest intervals are 14 days for grain and stover, or 45 days for forage. Do not make applications closer than 10 days apart. Apply with a minimum spray volume of 2 or 10 gallons per acre by air or ground, respectively. Maximum allowed amount per crop season is 0.125 lb ai per acre.

Grasshopper

Sampling/Decisionmaking.

Damage generally occurs at plant emergence but may also occur during middle to late summer, especially during drought seasons. Examine no-till fields and fields next to pastures and other grassy areas where grasshoppers overwinter and develop. Field sprays may be justified when five to eight grasshoppers per square yard are present. Wait until grasshopper numbers exceed this level and feeding injury exceeds 50 percent or more defoliation on 35 percent or more of the plants. Spot treatment is suggested if infestations are confined to smaller areas.

Grain sorghum-Recommended insecticides for grasshopper control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Carbaryl (Sevin XLR 4F)	1.5 lb	3.0 pt	21	A ground application with at least 15 gallons of diluted spray is preferred. Use 5 gallons of spray per acre for aerial applications. No preharvest waiting period is required for forage.
Chlorpyrifos (Lorsban 4E)	0.25-0.5 lb	0.5-1.0 pt	30	**Restricted Use.** Do not apply more than 1.5 pounds active ingredient per acre per season. Do not treat sweet varieties of sorghum.
Cyfluthrin (Baythroid 2E)	0.038-0.044	2.0-2.8 oz	14	**Restricted Use.** Apply with a minimum spray volume of 2 or 10 gallons per acre by air or ground, respectively. Maximum allowed per season is 8.4 fl oz per acre or six applications. No greater than a 10-day interval between sprays.
Dimethoate (Dimethoate 4EC)	0.5 lb	1.0 pt	28	Do not apply after heading.
Gamma-cyhalothrin (Proaxis)	0.01-0.015 lb	2.56-3.84 oz	30	**Restricted Use.** Do not apply within 30 days of harvest. Total product allowed per acre is 0.48 pt of formulation.
Lambdacyhalothrin (Warrior)	0.02-0.03 lb	2.56-3.54 fl oz	21	**Restricted Use.** Do not graze livestock or harvest for silage or hay.
Zeta-cypermethrin (Mustang MAX)	0.02 - 0.025 lb	3.2-4.0 oz	14-45	**Restricted Use.** Pre-harvest intervals are 14 days for grain and stover, or 45 days for forage. Do not make applications closer than 10 days apart. Apply with a minimum spray volume of 2 or 10 gallons per acre by air or ground, respectively. Maximum allowed amount per crop season is 0.125 lb ai per acre.

Greenbug and Corn Leaf Aphid

Biological and cultural control.

Natural enemies usually keep corn leaf aphids under control. If a field is heavily infested but more than 20 percent of the aphids appear brown and swollen from being parasitized or more than one aphid predator per 50 to 100 aphids is present, then insecticide is generally not necessary. The use of resistant hybrids is an important tool in greenbug management. In areas where aphids consistently damage sorghum, growers are encouraged to consult with local seed dealers about the possibility of resistant hybrids. Also keep natural enemies in mind. Greenbugs that are parasitized turn into brown or bronze mummies and cling to the leaves. If a field that has reached the threshold level also has more than 20 percent of the aphids appearing brown and swollen from being parasitized or there is more than one aphid predator per 50 to 100 aphids, control generally should be delayed because predators and parasitic wasps should soon bring the infestation under control.

Sampling/Decisionmaking.

A minimum of 40 randomly selected plants from different areas of the field should be examined each week. Aphids are seldom evenly distributed across a field. Avoid examining only field borders. Examine a greater number of plants in fields larger than 80 acres. Record the leaf symptoms caused by aphid feeding, and estimate the infestation level of aphids and the presence of natural enemies.

Corn leaf aphids.

The corn leaf aphid is the predominant aphid found feeding on sorghum in our area. This insect can damage seedling plants; however, larger plants generally tolerate high numbers of aphids without economic loss. Research has shown that yield losses have occurred only when the aphid causes stand loss. On larger plants, infestations of 800 to 1,500 aphids per plant do not substantially reduce yield. In addition, corn leaf aphids are generally controlled by beneficial insects found in grain sorghum. Treatment should only be considered if aphid populations are increasing and seedling plants are dying. Natural enemies usually keep corn leaf aphids under control. If a field is heavily infested but more than 20 percent of the aphids appear brown and swollen from being parasitized or more than one aphid predator per 50 to 100 aphids is present, then insecticide is generally not necessary.

Greenbug aphids.

In comparison, the greenbug aphid can cause significant economic loss. If chemical control is considered, refer to the treatment threshold table below and decide on the basis of the number of aphids per plant, leaf damage, percentage of parasitized aphids (mummies), and the ratio of aphid predators to aphids.

Grain sorghum-Treatment thresholds for greenbug aphid

Plant size	When to treat
Emergence to about 6 inches	When colonies of 10 to 40 winged adult aphids are present on the majority of the plants 6 inches to boot stage and initial signs of red spotting or yellowing of leaves starting to appear.
Six inches through the boot stage	When majority of plants are infested with rapidly increasing colonies of 50 to 100 aphids, but before leaves begin to die.
Boot stage through soft-dough stage	When small to large colonies totaling more than 500 aphids per plant are present and increasing on the majority of plants; some lower leaves are beginning to become wet and sticky with honeydew; or some leaves are showing yellowing and reddening with a few leaves dying.

Grain sorghum-Recommended insecticides for greenbug and corn leaf aphid control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Chlorpyrifos (Lorsban 4E)	0.25-1.0 lb	0.5-2.0 pt	30	**Restricted Use.** Do not apply more than 1.5 pounds active product per acre per season. Do not treat sweet varieties of sorghum.
Dimethoate (Dimethoate 4E) (Dimethoate 2.67E)	0.25-0.50 lb 0.22-0.44 lb	0.5-1 pt 0.75-1.5 pt	28	
Malathion (57% EC)	0.75 lb	1.5 pt	7	A ground application with at least 15 gallons of water per acre is preferred. Use at least 5 gallons of diluted spray per acre for aerial applications.
Zeta-cypermethrin (Mustang MAX)	0.02 - 0.025 lb	3.2-4.0 oz	14-45	**Restricted Use.** Not for greenbugs. Pre-harvest intervals are 14 days for grain and stover, or 45 days for forage. Do not make applications closer than 10 days apart. Apply with a minimum spray volume of 2 or 10 gallons per acre by air or ground, respectively. Maximum allowed amount per crop season is 0.125 lb ai per acre.

Insect Control in Grasses and Pastures

Grasses and pastures-Recommended insecticides for general insect control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Carbaryl (Sevin 80S) (Sevin XLR Plus, Sevin 4F, carbaryl 4L)	1-1.5 lb	1.25-1.88 lb 1-1.5 qt	14	For control of armyworms, chinch bugs, and fall armyworms on mixtures of grasses in pastures used for grazing or hay, and for grasses grown for seed only. Treat during late afternoon when temperatures are above 70 degrees F. Can apply up to two applications per year but not more than once every 14 days. Do not exceed a total of 3.75 lb of the 80S or 3 qt of the flowable formulations per acre per year.
Malathion (malathion 8) (malathion 57EC, 5EC)	1-1.25 lb 0.9-1.25 lb	1-1.25 pt 1.5-2 pt	1 0	For control of aphids, grasshoppers, leafhoppers, and cereal leaf beetles on mixtures or pure stands of grasses for grazing or hay. Apply in sufficient water for good coverage or use the recommended rate plus 1 gallon of diesel fuel per acre by airplane or turbine-type sprayer.

Cereal Rust Mite on Timothy

Sampling/Decisionmaking.

Infestations of these minute, cold-adapted mites are expanding, and virtually all timothy grown in central Maryland and southeastern Pennsylvania is infested to some degree. Populations build up gradually in the fall and remain active through winter. Egg-laying peaks in early March and mite damage peaks in late April-May. Infested leaves tend to curl and show a rusting appearance. Prolonged feeding results in retarded growth, stunting, and discoloration. Check for mites and curled leaf blades, starting during March before green-up. Use a 20x magnifying lens to identify mite stages, or bring leaf samples to the Extension office for identification.

Cultural Control.

Natural controls are not adequate and all varieties are susceptible. Alternative grass species such as orchard grass, tall fescue, bluegrass, and reed canary grass are significantly less susceptible. Cutting late in fall (end of November) after timothy becomes dormant eliminates the mite's food and shelter and discourages buildup during winter and early spring. This practice is recommended even if there is insufficient forage to remove the hay.

Chemical control.

Under a 24(c) registration, carbaryl (Sevin XLR PLUS) can be used in Maryland, Delaware, and Pennsylvania. Using ground equipment only, apply 3 pints per acre (1.5 pounds active ingredient per acre) with adequate water for complete coverage (20 or more gallons by ground). One application should provide control. Apply at approximately 4 weeks after green-up in fields with a history of cereal rust mites and/or when 25 percent of the plant tillers exhibit curled tips of the new leaf blades.

Insect Control in Small Grains - Barley, Oats and Wheat

Aphids

Sampling grain aphids at tillering during fall and early spring.

Grain aphids usually are held in check by their natural enemies, which include predators, parasites, and fungal diseases. When looking for aphids, it is important to recognize these natural enemies. Check grain fields each week starting in the fall or early spring if damage symptoms are evident. Infestations of aphids, particularly the greenbug and corn leaf aphid, occasionally build up in the fall. The first noticeable symptoms are often circular yellow to brown spots with dead plants in the center. These spots may increase in size if the infestation is allowed to persist. To determine aphid activity on tillering grain, examine 20 sites throughout the field. Each site should consist of at least 5 linear feet of a row. Look at areas in the field that are showing plant stress symptoms. Aphid damage may be confused with moisture stress or nitrogen deficiency. Count the number of aphids on small plants and, if aphids are numerous, estimate the numbers per linear foot of a row of larger plants. Make a tally of the proportion of each species, particularly if greenbugs are present.

Decisionmaking in grain aphids at tillering during fall and late winter.

Treatment during the fall for aphid control is normally not necessary, except in the southernmost counties in intensively managed wheat where aphids have a history of transmitting virus diseases in fall. The potential for viral transmission is impossible to predict; however, consider treatment when infestations exceed 10 to 20 winged aphids per linear foot of row, especially if the greenbug aphid is the predominant species and plant damage is observed. Treatment during the early spring before heading is occasionally needed if localized infestations are causing stand reductions and late winter weather is unusually mild. Treatment is suggested if aphid counts exceed 150 per linear foot of row throughout the majority of the field and a low degree of beneficial insect activity is present. If greenbug is the predominate species, lower thresholds to 50 per linear foot of row.

Sampling grain aphids during the grain head stage.

To determine aphid activity after the grain heads form, count the number of aphids on 100 heads throughout the field. Do not bias sampling by checking a few heads along the field margins where infestations usually are higher. Check for natural enemies at the same time that aphids are being counted. Aphids usually are clustered as colonies among bracts of the grain head and may move slightly when disturbed. Anything that actively moves when disturbed is probably a predator. Make a note of the ratio of predators to aphids.

Decisionmaking in grain aphids during the grain head stage.

The need for treatment depends primarily on the number of aphids, plant maturity, and the presence of natural enemies. Treatment during the grain head stage is generally considered when aphid numbers exceed more than 25 per head, especially if the crop is late, cool weather is forecasted, and the natural enemy complex is lacking. Control is not advised if the crop is approaching the hard-dough stage where there is good predator/parasite activity. Ratios of one or more predators to every 50 to 100 aphids are sufficient to achieve biological control.

Small grains-Recommended insecticides for aphid control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Dimethoate (Dimethoate 4EC) (Dimethoate 2.67EC)	0.25-0.38 lb	0.50-0.75 pt 0.75-1.0 pt	35	May not give acceptable control when temperatures are below 60 degrees F. Do not apply within 14 days of grazing. Labeled for use on wheat only. Do not make more than 2 applications per season.

Small grains-Recommended insecticides for aphid control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Disulfoton (Di-Syston 8E) (foliar-fall or spring)	0.25-0.75 lb 0.5-1.0 lb	4.0-12.0 oz (wheat) 0.5-1.0 pt (barley)	30	**Restricted Use.** When applying as a broadcast spray with water or liquid fertilizer to barley at planting, do not graze treated fields or cut for forage within 30 days of treatment. When applying to barley as a foliar spray in the spring or fall, do not graze treated fields or cut for forage after any application. Check label for specific application rates and other restrictions.
Gamma-cyhalothrin (Proaxis)	0.015 lb	3.84 oz	30	**Restricted Use.** Wheat and triticale only. Do not apply within 30 days of harvest. Total product allowed per acre is 0.48 pt of formulation.
Imidacloprid (Gaucho 480) (Gaucho XT)	0.03-0.09 lb per cwt of seed 0.031 lb per cwt of seed	1-3 oz per cwt of seed 3.4 oz per cwt of seed	Check the label for plant-back restrictions	Either a commercial seed treater or the producer at or immediately before planting may make applications. The former is recommended to ensure that seed is thoroughly coated to effectively control aphids transmitting barley yellow dwarf virus. Only for use in preventing disease transmission during fall. Note that most virus infections in Maryland and Delaware have occurred during spring; thus, gain in yield may not be enough to justify the cost of seed treatment. Gaucho XT contains metalaxyl fungicide (same as Allegiance FL seed treatment fungicide) and tebuconazole fungicide (same as Raxil fungicide).

Small grains-Recommended insecticides for aphid control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Lambdacyhalothrin (Warrior)	0.02-0.03 lb	2.56-3.84 oz	30	**Restricted Use.** Wheat only. For fall treatment to prevent viral disease transmission by aphids, field tests in Virginia have shown an application of 2 oz of Warrior at one month after planting (2 - to 3-leaf stage through early tillering) provides the best control. Despite the convenience, do not apply Warrior with the fertilizer at planting time because the residual activity will not control aphids later when they colonize fields. For spring infestations, Warrior controls aphids when applied early for cereal leaf beetles in combination with fungicide treatments before flag-leaf stage.
Malathion 8EC	1.0-1.25 lb	1.0-1.25 pt	7	
Microencapsulated methyl parathion (Penncap-M 2F)	0.5-0.75 lb	2.0-3.0 pt	15	**Restricted Use.** Check label for other restrictions.
Thiamethoxam (Crusier 5FS)	0.03-0.05 lb per cwt of seed	0.75-1.33 oz per cwt of seed	45	See remarks for Gaucho-treated seed, which also apply to Crusier; however, observe a 120-day plant-back restriction for all crops not listed on the label.
Zeta-cypermethrin (Mustang MAX)	0.02-0.025 lb	3.2-4.0 oz	14	**Restricted Use.** Wheat and triticalli only. Aids in control of aphids.

Armyworm

Biological and cultural control.

Parasites, diseases, insect predators, and birds usually keep armyworms under control in small grains. However, the effectiveness of these natural control agents is reduced during cool, wet springs and during growing seasons that follow years of drought.

Sampling.

Armyworms should be detected while they are still small and easier to control. Check fields once each week starting the second week of May. Examine first the debris and undergrowth on the ground surface along field margins and lodged areas. Small worms usually are found curled in a C-shape around the base of the plants or under the debris and winter annual weeds. Armyworm frass or droppings also may be found on the soil surface. If small armyworms are present in these areas, obtain 10 to 20 worm counts at 50-pace intervals throughout the field. Note the average size of the worms and whether any defoliation of the flag leaf or head clipping has occurred.

Decisionmaking.

As a general rule, barley should be treated if the number of armyworms exceeds one per linear foot between rows and most of the worms are greater than 0.75 inch long. In wheat, armyworms tend to nibble on the tips of kernels rather than clip heads; thus, populations around two to three worms per linear foot between rows are required to justify control. In high-management wheat fields with 4-inch rows, treatment is recommended when armyworm levels exceed three to five per square foot of surface area.

Note that wheat fields with mixed infestations of armyworms and sawfly caterpillars may need treatment even if worm counts of each pest do not exceed threshold levels. Also, if the grain crop is close to harvest or the majority of armyworms are longer than 1.5 inches and no head clipping has occurred, control may not be needed.

Small grains-Recommended insecticides for armyworm control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Carbaryl (Sevin XLR Plus (4 lb/ga))	1.0-1.5 lb	2.0-3.0 pt	21	Apply to wheat only. Do not make more than two applications after grain heads emerge. No time limits on use as pasture or forage.
Lambdacyhalothrin (Warrior)	0.02-0.03 lb	2.56-3.84 fl oz	30	**Restricted Use.** Wheat only.
Methomyl (Lannate LV 2.4EC) (Lannate 90SP)	0.23-0.45 lb	0.75-1.5 pt 0.25-0.5 lb	7	**Restricted Use.** Use a minimum of 3 gallons diluted spray per acre by air. Do not graze or feed treated forage or hay to livestock within 10 days of last treatment.
Microencapsulated methyl parathion (Penncap-M 2F)	0.5-0.75 lb	2.0-3.0 pt	15	**Restricted Use.** Check label for restrictions.
Zeta-cypermethrin (Mustang MAX)	0.011-0.025 lb	1.76-4.0 oz	14	**Restricted Use.** Wheat and triticalli only, not barley. Use sufficient water to obtain full coverage of foliage (minimum of 10 gallons by ground and 2 gallons by air). Maximum allowed amount per crop season is 0.125 lb ai per acre.

Cereal Leaf Beetle

Biological and cultural control.

A number of introduced parasites have been instrumental in keeping cereal leaf beetle populations below economic damage levels. Also, favorable planting dates may help suppress populations. Wheat planted early in the fall immediately after the Hessian fly-free date will be more advanced in growth the next spring than late-planted small grains. These early plantings will be less attractive to and more tolerant of the beetles when they peak in the spring. Cereal leaf beetle infestations on spring-planted oats cannot be avoided by means of an early planting date. Generally, barley is more advanced in maturity and thus less attractive when beetles are active.

Sampling.

Scouting should begin in early April as soon as adult beetles are observed. Use the adult abundance in each field as an indicator of potential egg pressure. Samples should be taken at a minimum of 10 random sites in the interior of each field (avoid the edges). At each site, 10 tillers (stems) should be examined to count the number of eggs and larvae. This will result in 100 tillers (stems) per field being examined. Eggs may be on the leaves near the ground. If the population consists mainly of eggs, then schedule field visits at a later date when greater than 50 percent of the immatures are larvae. Cereal leaf beetle is often unevenly distributed in the field, so it may be necessary to subdivide the field into two or more parts and sample each part as an individual field.

All fields that are not treated early should still be scouted for cereal leaf beetle larvae, as well as other insect pests. Later in April or early May, make detailed counts of larvae at 10 sites spread throughout the field. At each site, select a spot at random and carefully delineate the stems of a 6- to 8-inch section of a single row. Examine all the leaf blades, visually estimate the amount of defoliation, count the number of larvae, note the average larval size, and then count the number of stems in the delineated row section. Tally the total number of larvae and stems examined, and compute the average count of larvae per stem.

Decisionmaking.

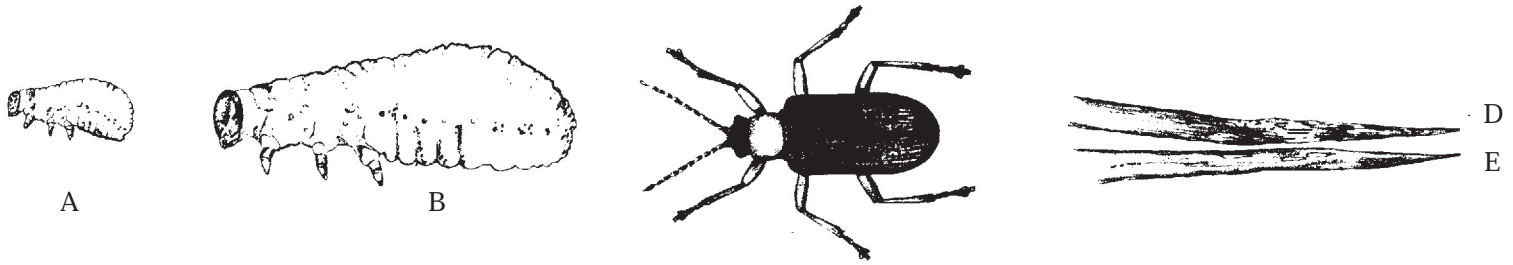
Damage can build up quickly, often in as little as 5 days, after larvae become large and high temperatures make the insects very active. Leaf feeding reduces the plant's ability to produce photosynthates and limits reproductive growth, particularly if the upper leaves are destroyed. Yields can be reduced by 45 percent when defoliation is 100 percent early in the heading period. Later damage, late in the grain-fill period, does not have a great impact. Keep in mind that the three stem leaves (flag leaf and two leaves below) all contribute to filling grain heads and achieving favorable grain test weight. In fact, the two lower stem leaves are about as important as the flag leaf.

An earlier-triggered threshold is now recommended to allow growers more lead time to take action and apply insecticides together with fungicides to share the application cost. The threshold is 25 or more eggs and/or small larvae per 100 tillers (or one per every four tillers). The orange-brown eggs are easy to find on the upper surface of the leaves. They are shaped like little cucumbers deposited singly or in chains of two or three close to the midrib. Treatment is suggested when the egg threshold is reached and more than 50 percent of the sample count consists of larvae - that is, after 50 percent egg hatch. This decisionmaking strategy works only if a good representative sample estimate of the egg density is obtained and growers wait until 50 percent of the eggs have hatched, at which time most eggs have been laid for the season. If the tendency is to focus on hot spots that exceed the threshold, then fields will be over-treated.

The concern about an early treatment strategy is that growers will automatically treat preventively and overuse insecticides. This can lead to an aphid problem by removing valuable predators, disrupt parasites of the cereal leaf beetle, and add unnecessary cost. If implemented properly, making the spray decision early can almost totally prevent defoliation, often allows the insecticide to be applied together with fungicides to share the application cost, and will not result in more fields treated than would ordinarily be treated later using a larval-based threshold. Use the egg/larval threshold with care and try to apply it to the high management fields only, that is, those that have a yield potential of greater than 60 bushels per acre. Also, avoid using insecticides at top-dress times because these applications are too early in relation to cereal leaf beetle movement into grain fields.

The cereal leaf beetle has a tendency to seek out the sparse wheat fields with the lowest yield potential. It may not be cost-efficient to apply early season controls in these fields, even though egg/larval densities exceed the threshold. In these situations, wait to see how well the crop responds to the nitrogen applications and then evaluate the larval infestation and the economics of treatment. Avoid spraying sparse plantings if possible because they serve as nurseries to increase populations of parasites that will help control the cereal leaf beetles next year.

If fields are not treated early using the egg/larval threshold, insecticidal control is suggested if larval density averages more than 50 per 100 tillers, defoliation is more than 10 percent, and most larvae are still young enough to cause additional injury. Once wheat reaches the hard dough stage, beetle damage has little effect on the yield and thus controls are no longer required.



A–B. Larvae C. Adult D. Larval feeding injury E. Adult feeding injury

Figure 3. Cereal leaf beetle.

Small grains-Recommended insecticides for cereal leaf beetle control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Carbaryl (Sevin 80S) (Sevin XLR Plus)	1.0 lb	1.25 lb 2.0 pt	21	**Restricted Use.** Wheat only. Do not make more than two applications after grain heads emerge. No time limits on use as pasture or forage.
Lambdacyhalothrin (Warrior)	0.02-0.03 lb	2.56-3.84 fl oz	30	**Restricted Use.** Wheat only.
Methomyl (Lannate LV) (Lannate 90SP)	0.17-1.35 lb	0.75-1.5 pt	7	**Restricted Use.** Use a minimum of 3 gallons of diluted spray per acre by air. Do not graze or feed treated forage or hay to livestock within 10 days of last treatment.
Zeta-cypermethrin (Mustang MAX)	0.011 - 0.025 lb	1.76 - 4.0 oz	14	**Restricted Use.** Wheat and triticalli only, not barley. Use sufficient water to obtain full coverage of foliage (minimum of 10 gallons by ground and 2 gallons by air). Maximum allowed amount per crop season is 0.125 lb ai per acre.

Grass Sawfly Caterpillar

Sampling.

The sawfly caterpillar is a sporadic pest of wheat and barley, primarily on the Eastern Shore. It is easily distinguished from armyworms and other caterpillars by its solid-green body, its prominent amber head and its many legs (three pairs of jointed legs, each ending with a claw and eight pairs of short, fleshy prolegs without claws). Young caterpillars are lighter green and somewhat translucent. Mature worms are about 1.25 inches long and assume a curled position when disturbed.

Like armyworms, sawfly caterpillars must be detected when they are still young before head clipping occurs. Grain fields should be checked once each week starting the first week in May. This pest normally appears about a week earlier than armyworms, although mixed populations are frequently found in the same areas. First examine the crop for clipped heads and partially consumed leaf blades in rank growing areas and along field margins adjacent to woods. Shake the plants before counting the larvae on the ground. Unlike armyworms, this insect feeds during the day. If caterpillars are present, then sample as recommended for armyworms.

Decisionmaking.

One sawfly caterpillar clips an average of five to eight grain heads during its larval development. The general rule is to treat when most caterpillars are greater than 0.75 inch long and worm counts exceed 0.4 per linear foot of row or 0.7 every square foot. The best time to treat is between May 15 and May 25. It is too late if the number of clipped heads per unit area is 3 to 4 times the average worm count and most caterpillars are greater than 1 inch long.

Fields with mixed infestations of armyworms and sawfly caterpillars may need treatment even if worm counts of each pest do not exceed threshold levels. Usually one foliar application of insecticide controls both insect pests. It is not wise to delay treatment in case armyworms appear later. If an armyworm problem is going to develop, the young worms are normally present when treatment is applied for sawfly caterpillars.

Small grains-Recommended insecticides for grass sawfly control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Lambdacyhalothrin (Warrior)	0.02-0.03 lb	2.56-3.84 oz	30	**Restricted Use.** Wheat only.
Zeta-cypermethrin (Mustang MAX)	0.02-0.025 lb	3.2-4.0 oz	14	**Restricted Use.** Wheat and triticalli only. Use sufficient water to obtain full coverage of foliage (minimum of 10 gallons by ground and 2 gallons by air). Methomyl (Lannate LV 2.4EC) and microencapsulated methyl parathion (Penncap-M) are effective if used at the rates recommended for armyworms. Lannate and Penncap-M are also labeled on barley.

Hessian Fly

The Hessian fly has not been a major pest in the mid-Atlantic states because of the practice of planting wheat after the "fly-free dates." However, populations have recently been increasing as a result of changes in production practices. In 1998, economic impacts from Hessian fly were reported in numerous fields during the late spring. In some situations, entire fields were severely stunted and not worth harvesting. These fields had been planted in continuous wheat and/or in no-till situations with volunteer small grains present at the time of planting. In other fields, spring infestations caused plants to lodge near harvest with lodging ranging from 5 to 25 percent. All infested fields were planted after the "fly-free date"; however, the warm winter conditions apparently allowed an extra generation to develop during the last fall or early spring.

Since there are no effective chemical controls for Hessian fly, be sure to use the following combination of cultural practices to reduce the likelihood of Hessian fly damage: 1) avoid planting wheat following wheat and try to locate wheat away from areas that had Hessian fly problems the previous spring. Keep in mind that the adult flies disperse only short distances from their sites of emergence; 2) if possible, plow under infested wheat stubble as soon as possible after harvest. The adult Hessian fly is a weak insect that cannot work its way up through the soil; 3) keep down all growth of volunteer wheat to reduce fall egg laying, thus reducing the chances that the fly population will carry through to the following spring; 4) do not use wheat as a fall cover crop near fields with infestations or near fields to be used for grain. Rye or barley are less preferred host plants for Hessian fly, thus are suggested if planting cover crops prior to the fly-free date; 5) plant resistant or tolerant varieties. In 1998, a small grain variety trial at Georgetown indicated that certain varieties (SS EXP 3409D, SS EXP 3409R, Roane, and Pioneer 25R26) exhibited low to moderate stem lodging. Talk to your seed dealer to determine which variety characteristics are fly resistant; and 6) always plant after the fly-free date.

Small grains - Fly-free dates for Maryland counties for Hessian fly control

Allegany	Sept. 27	Dorchester	Oct. 9	Queen Anne's	Oct. 7
Anne Arundel	Oct. 7	Frederick	Oct. 2	Somerset	Oct. 10
Baltimore	Oct. 2	Garrett	Sept. 20	St. Mary's	Oct. 9
Calvert	Oct. 8	Harford	Oct. 1	Talbot	Oct. 8
Caroline	Oct. 7	Howard	Oct. 2	Washington	Oct. 1
Carroll	Sept. 28	Kent	Oct. 6	Wicomico	Oct. 10
Cecil	Oct. 3	Montgomery	Oct. 4	Worcester	Oct. 11
Charles	Oct. 8	Prince George's	Oct. 7		

Small grains - Fly-free dates for Delaware counties for Hessian fly control

Kent	Oct. 8
New Castle	Oct. 3
Sussex	Oct. 10

Insect Control in Soybeans

Pod Feeding Insects (Corn Earworm, Fall Armyworm, and other Podworms)

Sampling.

Outbreaks often follow a midsummer drought, which causes the corn to ripen earlier and become less attractive to the moths. Female moths prefer to lay eggs in open-canopied, late-blooming soybean fields. Drought conditions also delay soybean maturity and prevent normal canopy growth, so peak moth activity is more coincidental with blooming of open-canopied fields.

Sampling should start during mid-August and be repeated at least weekly in each field until a spray decision is made or the pods are no longer available due to advanced maturity. Concentrate first on the high-risk fields that are late blooming, open canopied, or previously treated with insecticides. The best way to sample is by placing a standard 3-foot drop cloth between rows and shaking vigorously the row sections of plants over the cloth. Each shake sample consists of a total of 6 feet of row and at least 10 samples should be taken in every 40 acres. The number and size of earworms should be recorded along with observations on the presence of natural enemies.

In narrow-row or broadcast beans, a drop cloth is impractical and, thus, a 15-inch sweep net must be used. Walk along the rows, swinging the sweep net so that the opening passes through the foliage. The net is turned 180 degrees after each sweep as you advance with each step to swing the net through the foliage in the opposite direction. Each stroke is counted as one sweep. A series of 25 sweeps should be taken at each of 10 sites in every 40 acres.

Decisionmaking.

Treatment is suggested if drop cloth counts exceed one medium to large earworm per narrow foot row of beans or two per wide foot row of beans (greater than 20 inches). If using the sweep net method and counts exceed three medium to large earworms per 25 sweeps in narrow foot row of beans or broadcast beans or five per 25 sweeps in wide foot rows, treatment is necessary.

The timing strategy is to wait until most of the larvae are 0.375 inch or more in length, and then treat when pod damage is first evident. This allows for most egg laying and hatching to occur before treatment and, thus, reduces the chances of a second spray being needed later. Some defoliation may occur before it is time to treat, and this injury should be evaluated just like that of any defoliator. If other defoliating pests are present when pod damage is first evident, then adjustments should be made in the treatment thresholds for earworms. For example, if green cloverworms are actively feeding and have already caused 15 percent defoliation, then insecticide treatment would be justified at lower earworm infestations, about one-half the normal threshold. Finally, treatment may not be necessary if the majority of worms are infected with the fungus disease. This white to greenish-white fungus can have a significant impact on earworm populations.

Resistance Management.

Increasing levels of podworm resistance in the South is evidence that pyrethroid insecticide is gradually losing effectiveness. In 2004 for the first time, Virginia reported control failures of pyrethroids in soybeans at rates that should have killed most larvae. To avoid future resistance, many states now recommend nonpyrethroids such as Larvin, Lannate, Penncap-M, and Steward.

Soybeans-Recommended insecticides for podworm control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Bacillus thuringiensis (Agree WG, Biobit HP, Crymax, Deliver LC, Dipel DF, Xentari)	Check the label for rates	Check the label for rates	0	Use for podworms and other caterpillar pests only. Bacillus thuringiensis formulations are slower acting and more effective when larvae are young, but they are one of the safest options because of their low oral and dermal toxicity. They will not control beetles or sucking insects.

Soybeans-Recommended insecticides for podworm control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Cyfluthrin (Baythroid 2E)	0.025-0.044 lb	1.6-2.8 oz	15-45	**Restricted Use.** First and second instars only. Pre-harvest interval is 45 days for grain and feeding on dry vines, or 15 days for green forage. Maximum allowed amount per crop season is 11.2 fl oz per acre. Apply with a minimum spray volume of 2 or 10 gallons per acre by air or ground, respectively.
Esfenvalerate (Asana XL 0.66 EC)	0.03-0.05 lb	5.8-9.6 oz (corn earworm only)	21	**Restricted Use.** Esfenvalerate is extremely toxic to fish. Do not feed or graze livestock on treated plants. Do not exceed more than four applications per acre per season.
Gamma-cyhalothrin (Proaxis)	0.0075-0.0125 lb	1.92-3.20 oz	45	**Restricted Use.** Total product allowed per acre is 0.48 pt of formulation.
Indoxacarb (Steward)	0.055-0.11 lb	5.6-11.3 oz	21	Particularly effective on beet armyworm and other podworms that have developed resistance to pyrethroids. Use the 7.2-oz rate for best control of mixed-size beet armyworms. The minimum interval between treatments is 5 days. Do not apply more than 45 oz (0.44 lb a.i.) per acre per crop. Do not feed or graze livestock on treated fields.
Lambdacyhalothrin (Warrior)	0.025-0.03 lb	3.2-3.84 oz	45	**Restricted Use.** Use high rates for fall armyworm; low rates for corn earworm.
Methomyl (Lannate LV) (Lannate 90SP)	0.12-0.23 lb 0.1-0.2 lb	0.4-0.75 pt 0.125-0.25 lb	14	**Restricted Use.** Rates for corn earworm only. Wait 3 days to feed or graze as forage or 12 days for hay. Up to two applications may be used per season.
Permethrin (Permethrin 3.2EC)	0.01-0.2 lb	4.0-8.0 oz	60	**Restricted Use.** Permethrin is extremely toxic to fish. Do not apply more than 0.4 pound active ingredient per acre per season. Do not graze or harvest for forage. Use high rates (0.1 to 0.2 lb) when the majority of infestation is composed of older larvae.

Soybeans-Recommended insecticides for podworm control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Thiodicarb (Larvin 3.2F)	0.25-0.75 lb	10.0-30.0 oz	28	Use lower rates for maximum protection of beneficials where moderate pest populations exist. Do not feed forage, hay, or straw at all.
Zeta-cypermethrin (Mustang MAX)	0.02-0.025 lb	2.8-4.0 oz (corn earworm) 3.2-4.0 oz (fall armyworm)	21	**Restricted Use.** Use sufficient water to obtain full coverage of foliage (minimum of 10 gallons by ground and 2 gallons by air). Do not make applications less than 7 days apart. Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Maximum allowable amount per season is 0.15 lb ai per acre.

Defoliating Insects (Green Cloverworm and other caterpillars, Bean Leaf Beetles, Japanese Beetles, Mexican Bean Beetles, Grasshoppers)

Foliage-feeding insects and their impact.

Foliage-feeding insects are present in practically all soybean fields during the growing season. Most of these pests have chewing mouthparts and cause a characteristic type of defoliation. Bean leaf beetles feed on the tender terminal leaves and eat small, rounded holes, usually between the veins. Mexican bean beetle adults and larvae crush and strip away the leaf tissue between the veins, giving the leaves a distinctive lacelike pattern. Japanese beetles concentrate on the upper foliage and eat larger holes with only the main veins intact, giving the leaves a skeletonized look. Young green cloverworms scrape the leaf tissues, leaving irregular, shiny windows on the leaf surface; older worms eat irregular holes between the veins, giving the leaves a tattered appearance. Grasshoppers, skipper larvae, and woollybear caterpillars eat large holes in the leaves; often the holes have ragged margins and/or only the main veins are left intact.

Regardless of the pest involved, the effects of defoliation by chewing insects on soybean yield are the same. Foliage feeders reduce the total leaf area available for photosynthesis; consequently, plants may lack the ability to produce enough food for normal growth and seed production. However, soybeans can tolerate considerable defoliation, depending on the stage of growth, plant vigor, and growing conditions. During the early seedling stage, damage to the cotyledons and leaves may result in some stand reduction, but the capacity of plants to recover from early season injury is remarkable. A field with a good stand can compensate for reductions of up to 30 percent of the plant density before yield is affected, if other growing conditions are adequate.

During the vegetative stages when the plants are growing and producing new leaves (prior to bloom), and again after seed enlargement is complete, soybeans can tolerate 30 to 40 percent defoliation without significant loss of yield. Soybeans seem to compensate by adding new leaves and by increasing food production in the remaining functional leaves. Vegetative growth usually slows down or actually stops at the time pods begin to fill; thus, plants are more sensitive during pod development and seed enlargement when more than 20 percent defoliation can cause economic yield loss.

Foliage-feeding insects sometimes can benefit the soybean crop. In full-season beans with rank growth and closed canopies, the outer leaves shade the lower parts of the plant that receive inadequate light. Insect feeding on the outer canopy often allows more light penetration and air circulation, thus promoting blossom set and overall increased photosynthesis.

Sampling.

Check for early-season pests as soon as the plants emerge. Scout for mid-season to late-season defoliating insects in early July and continue weekly until 50 percent of the leaves are yellow. More frequent field visits may be necessary if a pest population is increasing. Estimate the level of defoliation to the nearest 10% on 20 to 30 plants selected at random throughout the field. Walk through the entire field because pest populations often are not evenly distributed. Pull up each plant to examine the total leaf area, not just the upper canopy. Try to identify the predominant pest species associated with the feeding injury. Also note the average stage of plant growth.

If the overall defoliation level of a plant cannot be estimated easily, then sub-sample as follows: (a) select one leaflet at random from the upper one-third of the foliage; (b) select four leaflets from the lower two-thirds of the plant (two leaflets from each half of the branches); and (c) estimate the amount of defoliation on each leaflet to the nearest 10 percent and average (see Figure 4). If the field appears more than 5 to 10 percent defoliated, either examine plants directly or use a drop cloth or sweep net to determine the number and size of stages of each pest species at 5 to 10 locations in the field. Recording the relative numbers of each stage helps determine the timing of insecticide treatments. Also, note the presence of parasitized and/or diseased pest species because treatment may be unnecessary even though defoliation exceeds economic levels. Cloverworms are killed by a fungus disease that causes larvae to become hard, mummified, and covered with powdery-white to light-green spores. The presence of diseased worms usually signals the decline of the pest population.

Decisionmaking.

Spray only when defoliating insects are actively feeding and the following defoliation thresholds are exceeded: at seedling - 40%; at prebloom - 30%; at bloom and podset - 15%; after full green bean stage - 35%. Populations of bean leaf beetle, Mexican bean beetle, and Japanese beetle occasionally reach damaging levels, particularly at seedling stages and when a complex of defoliating insects is present. In most years, green cloverworm populations can be considered a beneficial resource because they host parasites, predators, and fungal diseases that later transfer over to late-season populations of podworms (earworms). For leaf-feeding caterpillars, spray only if defoliation exceeds the thresholds listed above for each maturity stage and provided that green cloverworms and other caterpillars are still active and will cause significantly more damage. Consider the relative size and age composition of the population. Also consider the presence of natural controls, such as cloverworms and other caterpillars infected with the fungal and bacterial diseases. For grasshoppers, consider treatment if nymphs are present and defoliation exceeds the thresholds listed above. Although grasshoppers often are concentrated along field edges or waterways, they sometimes occur in large areas in the center of the field, especially if weeds were present last year. Determine the exact location of grasshoppers in the field and spray only those areas.

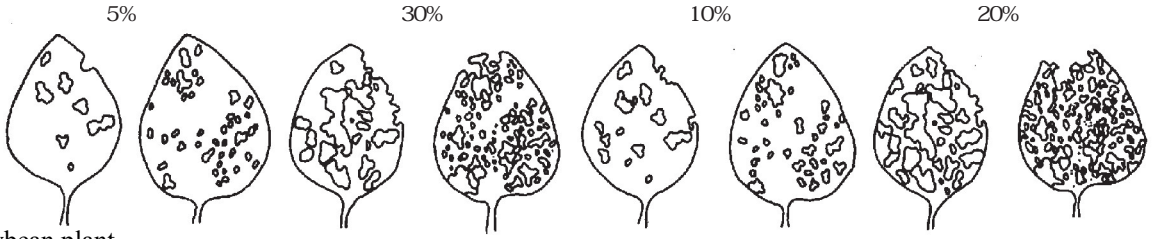


Figure 4. Defoliation in a soybean plant.

Soybeans-Recommended insecticides for Mexican bean beetle and cloverworm control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Bacillus thuringiensis (Agree WG, Biobit HP, Crymax, Deliver LC, Dipel DF, Xentari)	Check the label for rates	Check the label for rates	0	Use for cloverworms and other caterpillar pests only. Bacillus thuringiensis formulations are slower acting and more effective when larvae are young, but they are one of the safest options because their low oral and dermal toxicity. They will not control beetles or sucking insects.
Cyfluthrin (Baythroid 2E)	0.025-0.044 lb	1.6-2.8 oz	15-45	**Restricted Use.** Use higher rate for grasshoppers and low rate for green cloverworms. Pre-harvest interval is 45 days for grain and feeding on dry vines, or 15 days for green forage. Maximum allowed amount per crop season is 11.2 fl oz per acre. Apply with a minimum spray volume of 2 or 10 gallons per acre by air or ground, respectively.

Soybeans-Recommended insecticides for Mexican bean beetle and cloverworm control (continued)

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Esfenvalerate (Asana XL 0.66 EC)	0.015-0.03 lb	2.9-5.8 oz	21	**Restricted Use.** Esfenvalerate is extremely toxic to fish.
Gamma-cyhalothrin (Proaxis)	0.0075-0.015 lb	1.92-3.84 oz	45	**Restricted Use.** Total product allowed per acre is 0.48 pt of formulation.
Lambdacyhalothrin (Warrior)	0.015-0.025 lb	1.92-3.20 fl oz	45	**Restricted Use.**
Methomyl (Lannate LV 2.4EC) (Lannate 90SP)	0.12-0.23 lb 0.1-0.2 lb	0.4-0.75 pt 0.125-0.25 lb	14	**Restricted Use.** Wait 3 days to feed or graze as forage or 7 days for hay. Up to two applications may be used per season.
Microencapsulated methyl parathion (Penncap-M 2F)	0.5-0.75 lb	2.0-3.0 pt	20	**Restricted Use.** Do not use screens or nozzle tips finer than 50 mesh. Mix with EC-formulated products only when compatibility is known. Do not make more than two applications per season.
Permethrin (Permethrin 3.2EC)	0.05-0.1 lb	2.0-4.0 oz	60	**Restricted Use.** Permethrin is extremely toxic to fish. Do not make more than two applications per season. Do not graze or harvest for forage.
Thiodicarb (Larvin 3.2F)	0.25-0.75 lb 0.45-0.75 lb	10.0-30.0 oz (cloverworms) 18.0-30.0 oz (beetles)	28	Use lower rates for cloverworms and maximum protection of beneficials where moderate pest populations exist. Do not feed forage, hay, or straw.
Zeta-cypermethrin (Mustang MAX)	0.018-0.025 lb	2.8-4.0 oz	21	**Restricted Use.** Use higher rate for grasshoppers. Use sufficient water to obtain full coverage of foliage (minimum of 10 gallons by ground and 2 gallons by air). Do not make applications less than 7 days apart. Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Maximum allowable amount per season is 0.15 lb ai per acre.

Potato Leafhopper

Sampling/Decisionmaking.

Leafhoppers attack soybeans during late June through July but rarely reach population levels that affect yields. Using a standard 15-inch sweep net, take five sweeps in each of five locations in the field. Count the number of leafhoppers, and empty the net before proceeding to the next location. A single sweep consists of a swath of the net in one direction only across the top one-third of the plants along the row. The symptoms of leafhopper injury include localized stippling, curling, and yellowing of leaf margins. Treatment is suggested when injury appears and infestations exceed four leafhoppers per sweep in stressed beans or eight leafhoppers per sweep in normal-growing fields. Dense pubescent varieties are less susceptible.

Soybeans-Recommended insecticides for potato leafhopper control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Cyfluthrin (Baythroid 2E)	0.013-0.025 lb	0.8-1.6 oz	15-45	**Restricted Use.** Pre-harvest interval is 45 days for grain and feeding on dry vines, or 15 days for green forage. Maximum allowed amount per crop season is 11.2 fl oz per acre. Apply with a minimum spray volume of 2 or 10 gallons per acre by air or ground, respectively.
Esfenvalerate (Asana XL 0.66 EC)	0.015-0.03 lb	2.9-5.8 oz	21	**Restricted Use.** Esfenvalerate is extremely toxic to fish. Do not feed or graze livestock on treated plants. Do not exceed more than four applications per acre per season.
Gamma-cyhalothrin (Proaxis)	0.0075-0.0125 lb	1.92-3.20 oz	45	**Restricted Use.** Total product allowed per acre is 0.48 pt of formulation.
Lambdacyhalothrin (Warrior)	0.015-0.025 lb	1.92-3.20 fl oz	45	**Restricted Use.**
Permethrin (Permethrin 3.2EC)	0.05-0.1 lb	2.0-4.0 oz	60	**Restricted Use.** Permethrin is extremely toxic to fish. Do not make more than two applications per season. Do not graze or harvest for forage.
Zeta-cypermethrin (Mustang MAX)	0.018-0.025 lb	2.8-4.0 oz	21	**Restricted Use.** Use sufficient water to obtain full coverage of foliage (minimum of 10 gallons by ground and 2 gallons by air). Do not make applications less than 7 days apart. Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Maximum allowable amount per season is 0.15 lb ai per acre.

Spider Mite

Sampling/Decisionmaking.

Mite outbreaks usually are associated with hot, dry weather, which accelerates their reproduction and development. During periods of high humidity and field moisture, a fungal disease can reduce populations, but high temperatures can nullify these effects. Outbreaks also are associated with the application of certain insecticides that kill natural enemies and seem to make the soybean plant more nutritionally suitable for mites.

Check weekly for mites starting in early July through August, especially during a hot, dry season. Concentrate on the field borders and look for the early signs of white stippling at the base of the leaves. Do not confuse mite damage with dry weather injury, mineral deficiencies, or herbicide injury. If feeding injury is evident, press the underside of a few damaged leaves on white paper to reveal any crushed mites. Determine the extent of the infestation and assess the level of injury by examining 20 to 30 plants in the infested area. Field infestations often show defoliated or injured plants at some localized point, with injury becoming less evident and extending in a widening arc into the field.

If isolated spots of mite activity are confined to the perimeter of the field, spot-treatment using ground equipment is recommended to prevent further spread of mites into the field. If the infestation is distributed throughout the interior of the field, treatment of the entire field is suggested if live mites are numerous (20 to 30 per leaflet) and more than 10 percent of the plants show stippling, yellowing, or defoliation over more than one-third of the leaves. If rains come, mite development and survival will decrease but may not drop to economic levels if heavy populations are developing under high temperatures. Early detection is critical for effective control. Once yellowing occurs, plants will not recover and significant yields may be lost.

Dimethoate Performance for Mite Control.

Control failures with dimethoate have occurred in recent years for several possible reasons:

1. diminished systemic activity in drought-stressed fields due to poor absorption and translocation of the chemical into leaf tissues;
2. inadequate spray coverage by aerial application, especially if “kill by contact” is the primary means of control;
3. accelerated degradation due to alkaline hydrolysis and high iron in the water used as the carrier. (Note that original strength of dimethoate is reduced by 50 percent in 48 minutes at a pH of 9, 12 hours at a pH of 6, and 21 hours at a pH of 2, and degrades more rapidly in the presence of iron); and
4. reduced strength of the product due to storage at high temperatures.

Many control failures can be avoided if management actions are taken before mite populations become well established, thus early spot treatment of localized infestations is highly recommended. Optimum spray coverage is achieved with at least 20 gallons of diluted spray at 40 psi delivered by ground with the boom adjusted as close to the canopy as possible to achieve forceful but uniform penetration. During drought conditions, the addition of a crop oil or organosilicone can improve coverage and penetration, and reduce evaporation of spray droplets. The organosilicones are more expensive but are much more effective.

To reduce alkaline hydrolysis, use a high quality pH meter to obtain accurate readings of alkalinity. Note that a pH reading taken in the spring may be different than a summer reading when the water is used for spray operations. If a high pH situation exists, the alkalinity of the water in the spray tank can be lowered by adding an acid-based buffer. The buffer should be added to the spray tank first, before the addition of dimethoate. Also do not tank mix dimethoate and then store for an extended period of time before spraying. To safeguard against storage problems, do not store dimethoate in areas where temperatures may exceed 95°F for extended periods of time.

Soybeans-Recommended miticides for spider mite control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Chlorpyrifos (Lorsban 4E)	0.25-0.5 lb	0.5-1.0 pt	28	**Restricted Use.** Lorsban may need a second spray 4 to 5 days after the initial treatment to control newly hatched mites. Do not graze or feed forage within 14 days after application. Use of vegetable oil as an adjuvant may improve control during hot weather.
Dimethoate 4EC	0.5 lb	1.0 pt	21	Do not feed or graze within 5 days of the last application. When applying these materials by air, the addition of vegetable oil will improve control and help reduce drift.

Soybean Aphid

Sampling/Decisionmaking.

This new pest is carried by winds into the Mid-Atlantic area from other states where it overwinters. Economic infestations to date have been spotty ad occur late in the summer when most soybean fields have reached the full green bean stage. Initial infestations tend to be concentrated in hot spots of a few plants, thus it takes some effort to scout aphids. Cover a field by inspecting at least 30 plants. Check stems, petioles and undersides of leaves and count the number of aphids on whole plants. Colonies concentrate on new terminal trifoliolate leaves and new leaves on side branches, so pay special attention to these areas of the plant. Honeydew, sooty mold, or lady beetles may be seen as evidence of soybean aphid presence.

Late planted, double crop soybeans are at the greatest risk to infestations because these fields are still in the susceptible stage for damage when the aphids arrive and buildup. The weather has a major effect on soybean aphid reproduction. Temperatures over 85 degree slow or actually stop reproduction, while moderate temperatures in the 70s and low 80s allow this insect to double its population size every 2-3 days. Treatment is recommended when the average infestation level exceeds 250 aphids per plant through growth stage R-5 to the beginning of R-6 (full seed). Keep in mind that this threshold is the population level that should be controlled to prevent further population buildup from reaching the economic injury level. The economic injury level for soybean aphids is around 1,000 aphids per plant, if the soybeans are not under stress. It is important to watch for insect predators such as lady beetles and their larvae, lacewing larvae, as well as parasitized aphids. If beneficial insects are abundant, they often prevent the aphids from causing economic damage.

Soybeans-Recommended insecticides for soybean aphid control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Acephate (Orthene 90)	0.50-0.99 lb	0.56-1.10	14	**Restricted Use.** Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Maximum allowable amount per season is 4.4 lb product per acre.
Chlorpyrifos (Lorsban 4E)	0.5-1.0 lb	1.0-2.0 pt	28	**Restricted Use.** Do not graze or feed forage within 14 days after application. Apply with a minimum spray volume of 2 or 15 gallons per acre by air or ground, respectively.
Cyfluthrin (Baythroid 2E)	0.044 lb	2.8 oz	45	**Restricted Use.** Suppression only. Pre-harvest interval is 45 days for grain and feeding on dry vines, or 15 days for green forage. Maximum allowed amount per crop season is 11.2 fl oz per acre. Apply with a minimum spray volume of 2 or 15 gallons per acre by air or ground, respectively.
Esfenvalerate (Asana XL 0.66 EC)	0.03-0.05 lb	5.8-9.6 oz	21	**Restricted Use.** Do not feed or graze livestock on treated fields. Maximum allowable amount per season is 38.8 oz product per acre.
Lambdacyhalothrin (Warrior)	0.015-0.025 lb	1.92-3.20 oz	45	**Restricted Use.** Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Maximum allowable amount per season is 0.48 pts per acre.
Zeta-cypermethrin (Mustang MAX)	0.0175-0.025 lb	2.8-4.0 oz	21	**Restricted Use.** Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Do not make applications less than 7 days apart. Maximum allowable amount per season is 0.15 lb ai per acre. Use sufficient water to obtain full coverage of foliage.

Thrips

Sampling/Decisionmaking.

Thrips rarely require treatment; however, early season injury, in combination with spider mites or leafhoppers, to drought-stressed plants may occasionally reduce yields. Both nymphs and adults feed on the underside of the leaves, causing small silvery streaks and whitish or yellowish discoloration. Treatment may be required when injury appears on drought-stressed plants and more than eight thrips per leaflet are found. Treatment is not recommended in nonstressed fields because soybeans can tolerate thrips injury.

Soybeans-Recommended insecticides for thrips control

Insecticide and formulation	Rate of active ingredient per acre	Rate of formulation per acre	Time limits: Days before harvest	Remarks
Cyfluthrin (Baythroid 2E)	0.013-0.025 lb	0.8-1.6 oz	15-45	**Restricted Use.** Pre-harvest interval is 45 days for grain and feeding on dry vines, or 15 days for green forage. Maximum allowed amount per crop season is 11.2 fl oz per acre. Apply with a minimum spray volume of 2 or 10 gallons per acre by air or ground, respectively.
Gamma-cyhalothrin (Proaxis)	0.0075-0.0125 lb	1.92-3.20 oz	45	**Restricted Use.** Total product allowed per acre is 0.48 pt of formulation.
Lambdacyhalothrin (Warrior)	0.015-0.025 lb	1.92-3.20 fl oz	45	**Restricted Use.**
Methomyl (Lannate LV) (Lannate 90SP)	0.23-0.30 lb 0.23-0.34 lb	0.75-1.0 pt 0.25-0.375 lb	14	**Restricted Use.** Wait 3 days to feed or graze as forage or 7 days for hay. Up to two applications may be used per season.
Microencapsulated methyl parathion (Penncap-M 2F)	0.5-0.75 lb	2.0-3.0 pt	20	**Restricted Use.** Do not use screens or nozzle tips finer than 50 mesh. Mix with EC-formulated products only when compatibility is known. Do not make more than two applications per season.
Zeta-cypermethrin (Mustang MAX)	0.02-0.025 lb	3.2-4.0 oz	21	**Restricted Use.** Use sufficient water to obtain full coverage of foliage (minimum of 10 gallons by ground and 2 gallons by air). Do not make applications less than 7 days apart. Do not graze or harvest treated soybean forage, straw or hay for livestock feed. Maximum allowable amount per season is 0.15 lb ai per acre.

Insect Control in Tobacco

D. Conrad, Regional Extension tobacco specialist,
Central Maryland Research and Education Center,Upper Marlboro Facility
P. J. Semtner, Extension entomologist,
Southern Piedmont
T. D. Reed, Extension associate,
Southern Piedmont, Virginia Cooperative Extension Service
G.P. Dively, Extension entomologist,
Department of Entomology, University of Maryland, College Park

Insect Management for Tobacco

Several different insect pests pose serious threats to Maryland's tobacco crop. These pests must be managed properly to prevent economic damage to the crop while avoiding overuse of pesticides. Integrated pest management (IPM) makes use of natural, cultural, and chemical controls to maintain pest populations below levels that will cause economic damage to the crop. IPM promotes the application of pesticides only when they are needed and decreases production costs, pesticide residue levels, environmental contamination, and human exposure to pesticides. IPM also encourages beneficial predators and parasites that help regulate insect pest populations. IPM reduces the chance that an insect pest will develop resistance to insecticides, and, therefore, these chemicals should be effective for longer periods of time.

IPM recognizes that a certain amount of insect damage will not reduce tobacco yield or quality enough to pay for the cost of treating the crop. This tolerable level of damage is called the "treatment threshold."The treatment threshold is that pest population or injury level that requires treatment with an insecticide to prevent significant economic damage to the crop. Cultural control practices can help reduce insect infestations and feeding injury, make the tobacco plant a less desirable host, and eliminate overwintering sites for several pests. Practices include: plowing in early spring, applying proper nitrogen fertilizer, adjusting transplanting date, destroying plant beds immediately after transplanting is completed, keeping field margins clear of weeds, early topping in the button or prebutton stage, maintaining effective sucker control, cutting stalk and destroying roots soon after harvest, and rotating crops. Promote natural control by delaying insecticide applications until an insect reaches its treatment threshold and by using insecticides with low toxicity for the natural enemies of insect pests, such as Bacillus thuringiensis-based insecticides, pymetrozine (Fulfill), and spinosad (Tracer).

Insect Control in the Tobacco Plant Bed

Insects, including flea beetles, cutworms, aphids, and vegetable weevils, can cause serious problems in tobacco plant beds. The tobacco flea beetle, the most common insect pest in plant beds, can riddle young seedlings and reduce their vigor. Cutworms reduce stands by feeding on leaves or by cutting off the entire plant and killing it. Vegetable weevil larvae occasionally cause moderate damage by feeding in the buds of seedlings. Aphids can build up moderate populations and rarely cause damage to the seedlings, but they can be carried to the field on transplants and cause early-season infestations. Although insects may cause serious problems in plant beds, high-quality transplants can be produced without extensive use of insecticides. A preseeding or postemergence application of Di-Syston 15G provides effective control of flea beetles and aphids but not cutworms. Remedial applications of foliar insecticides will also control these and other pests of the tobacco plant bed. Plant beds should be checked once or twice a week for insect problems. If a pest problem develops, apply an insecticide recommended for its control.

Insect Control on Transplants Produced in the Greenhouse

Recently, transplant production in greenhouses has increased rapidly. Orthene is the only insecticide labeled for use on tobacco transplants grown in greenhouses. It provides good to excellent control of cutworms, flea beetles, and aphids. Discourage such pests as cutworms, crickets, ants, and grubs by keeping the area around the greenhouse clear of weedy vegetation and excess organic debris. Thrips do not cause economic feeding injury to greenhouse-grown seedlings; more importantly, however, thrips can vector tomato spotted wilt virus, a disease that is a potential problem for Maryland's tobacco growers.

Insect Control on Newly Transplanted Tobacco

Wireworms.

Wireworms, the larval stage of click beetles, are hard, yellowish-brown grubs that live in the soil and tunnel the roots and piths of young tobacco plants during the first month after transplanting. This injury stunts plant growth, causes irregular stands, and can reduce yields. The life cycle of wireworms takes about a year to complete and ranges from 1 to 3 years. The larvae emerge from eggs in the late summer and fall, feed on the roots of tobacco and other host plants, and overwinter into the following season. Wireworms are most serious in tobacco fields with a past history of wireworms, or in those following sod, weeds, or small grains. In these situations, the use of pretransplant applications of soil insecticides are recommended for wireworm control. Treatments should be broadcast and incorporated by double disking at least 2 weeks before transplanting. Plowing fields in early spring will help reduce wireworm populations. Sturdy, healthy, thick-stemmed transplants should also be used since they are less susceptible to wireworm damage than tender transplants. There is no remedial control for wireworms once damage has occurred. If the stand is seriously reduced, the crop may be plowed under and replanted after treatment with a recommended preplant insecticide. If replanting is not possible, cultivation often helps plants recover from wireworm damage.

Cutworms.

Cutworms are active at night, feeding on leaves and cutting off plants. This injury can cause enough damage and stand loss to require replanting. Cutworm problems are difficult to predict. However, cutworm populations can be reduced by plowing fields in the early spring. In fields plowed late, potential cutworm problems may be predicted by placing clumps of green clover at various locations throughout the field. If large numbers of cutworms are observed under the clumps after 3 to 7 days, a pretransplant treatment for cutworm control is recommended. Otherwise, fields should be checked for cutworm damage once or twice a week during the first month after transplanting. This will help warn the grower when a remedial foliar treatment is needed. Foliar treatments for cutworm control should be applied during the late afternoon or early evening.

Tobacco Flea Beetle.

Adult tobacco flea beetles feed on the leaves and stalks of tobacco in the plant bed and in the field, while the grubs or larvae feed on tobacco roots. Extensive feeding by both beetle stages on newly set transplants may cause stunting of scattered plants in the field, resulting in uneven stands. When checking tobacco fields for flea beetles, look for the characteristic "shot hole" feeding damage, and then count the flea beetles on 20 plants (2 per field-sample location). Begin treatment for tobacco flea beetle control on newly set tobacco when there are four or more beetles per plant. Though larger plants can tolerate very high flea beetle densities, treat with insecticides when densities exceed 60 beetles per plant and the bases of the lower leaves have a ragged, lacy appearance. The most effective cultural practices for reducing flea beetle damage are stalk cutting and root destruction immediately after harvest and harvesting at the normal time.

Soil-incorporated insecticides.

Pretransplant applications can provide effective control of wireworms, flea beetles, aphids, cutworms, and hornworms on tobacco. However, the timely use of foliar insecticides also provides effective control of tobacco insects feeding on tobacco foliage at a lower cost than with a systemic insecticide applied to the soil.

Several factors should be considered before selecting a soil insecticide. Lorsban, Mocap, and Vydate control both insects and nematodes. If tobacco is to be planted in land that has been in sod, weeds, or small grain the previous year or has a history of wireworm problems, an insecticide should be applied for wireworm control. Several chemicals are labeled at lower rates for wireworms than for nematodes.

Proper scouting of fields and the application of foliar insecticides at the insect's threshold are effective alternatives to the use of soil insecticides. Orthene and Vydate applied in the transplant water provide good early season (2- to 4-week) control of flea beetles. The Orthene treatment also gives some early season control of aphids, cutworms, and hornworms.

Insect Control on Larger Tobacco

Scouting tobacco fields for insects.

Tobacco fields should be scouted at least once a week throughout the season to determine whether or not insect pests are abundant enough to require treatment. Accurate samples are essential for determining the proper timing of insecticide applications. Samples should consist of observations on insects and insect damage on at least 20 percent of the plants in each field. Make counts on consecutive plants at each of 10 different locations throughout the field. Large fields will require larger samples. Resulting counts should be compared to the threshold levels listed in the following treatment threshold table. If pest populations meet or exceed the treatment thresholds, a labeled insecticide should be applied for their control.

Hornworms, budworms, flea beetles, and aphids are key foliage pest species in Maryland and scouting should be targeted for them. Use the procedure described below to scout fields for insects and their damage on individual plants. First, check the bud region carefully for budworms and the white cocoons of the budworm parasite, Campoletis sonorensis. If there is budworm damage, but no worm, do not count the plant as infested. Examine the upper one-third of the plant for aphids. Check the entire plant for hornworm damage, locate any

hornworms, and note their size and whether they are parasitized by Cotesia congregata (white, egglike cocoons on hornworm's back). The undersides of lower-, mid-, and upper-stalk tobacco leaves should be examined for the presence of aphids, and the upper surfaces of the middle and lower leaves should be checked for honeydew, flea beetles, and flea beetle feeding holes. If an unidentified insect is observed and it appears to be causing serious damage to the crop, the insect and samples of its damage should be collected and taken to a local Extension agent for assistance in identification. This can be a valuable step because beneficial insects are often mistaken for pests. In addition, the misidentification of a pest may result in the selection of the wrong insecticide for its control. Tobacco fields should be treated when one or more insect pests meet or exceed the treatment threshold levels given in the first table.

Tobacco Budworms.

Tobacco budworm larvae feed in the buds of young tobacco plants, causing many holes in the tiny developing leaves. As these leaves increase in size, the feeding holes increase proportionally, giving the leaves a ragged, distorted appearance. Tobacco plants are sometimes topped by budworms, resulting in early sucker growth that can cause stunting and the need for extra labor to remove the suckers. Tobacco budworm control should be initiated anytime prior to buttoning when there are five or more living budworms per 50 plants. After the button stage, budworms rarely cause economic damage to tobacco. Apply foliar sprays for budworm control with one or three solid-cone or hollow-cone nozzles over each row using 40 to 60 pounds of pressure per square inch (psi) to deliver 10 to 25 gallons of spray mixture per acre. Control with foliar sprays rarely exceeds 80 percent. However, Bacillus thuringiensis (Dipel) baits applied by hand or with a granular applicator usually give better than 90-percent control. When tobacco is checked for budworms, the cocoons of a wasp (Campoletis) that parasitizes budworms are often observed on the leaves near the bud. They are about a quarter of an inch long and white or grayish in color with two black bands. These cocoons are often mistaken for budworm cocoons, which are reddish-brown, three-fourths of an inch long, and formed in the soil beneath the plant. Living budworms are rarely found on plants with Campoletis cocoons in the bud region. Campoletis provides good natural control of budworms in Maryland and should be promoted as much as possible.

Hornworms.

Tobacco and tomato hornworms are large caterpillars (up to 4 inches long) that consume considerable amounts of tobacco leaf. Infestations may develop anytime from transplanting until harvest, but the most severe damage occurs during June, August, and September. Control should be initiated when there are 5 hornworms an inch or more in length per 50 plants. Do not count parasitized hornworms. Hornworms with white, egglike cocoons of the parasitic wasp Cotesia congregata on their backs eat much less than healthy horn worms and provide a source of parasites that will help reduce the next generation of hornworms. In some cases when large numbers of small hornworm larvae are found (over one per plant), an insecticide should be applied for their control. For optimum hornworm control, insecticide sprays should be directed to the upper one-third of the plant. Several cultural practices are helpful in managing hornworm populations on tobacco. Early topping, early transplanting, and effective sucker control reduce late-season infestations. Stalk cutting and root destruction as soon as possible after completion of harvest reduce overwintering populations.

Aphids.

The tobacco aphid has been the most severe insect pest of tobacco in Maryland for the past decade. It may infest tobacco seedlings in plant beds, but the most severe damage occurs on field tobacco from early July through August. Aphids can be introduced into the field on infested tobacco transplants, but winged aphids that move into the field and deposit young, wingless aphids on tobacco plants are the most destructive source of infestation. High aphid populations can reduce tobacco yield by 5 to 25 percent. Aphids deposit honeydew on tobacco leaves, and a dark, sooty mold often develops. This interferes with curing and reduces quality. The presence of sooty mold indicates that aphids have been a problem, but these materials often remain on leaves after aphids have been controlled.

A red form of the tobacco aphid has been common on tobacco in Maryland for the last 10 years and has almost completely replaced the green form. The red form reproduces more quickly and at higher temperatures and is more difficult to kill with many labeled insecticides than the green form. Early planted tobacco can suffer less aphid damage than that transplanted near the middle of the planting period. Early topping gives some reduction in aphid populations.

From late June to the end of August, producers should watch for increases in aphid populations. The undersides of leaves from the lower, middle, and upper portions of tobacco plants should be examined at regular intervals to determine the extent of aphid population buildup. Producers should also be on the lookout for honeydew, a sugary substance produced by the aphids, which gives the lower leaves a shiny appearance. Treatments should be initiated for aphid control when 10 of 50 plants are infested with colonies of any size.

The following practices can be used to manage aphids on tobacco:

- Make remedial applications of foliar insecticide at the treatment threshold before aphid populations become too high and are more difficult to control. If aphids are controlled early, they will be much easier to control for the rest of the season.
- Once insecticides are applied, natural controls rarely recover to aid in aphid

control. Aphid population resurgence becomes a problem; thus scouting becomes critical.

- Rotate insecticides if possible. If one insecticide is not providing adequate control, use another in a different class. For example, start with Orthene, then Thiodan (Golden Leaf Tobacco Spray), and then Lannate.
- After applying an insecticide for aphid control, wait at least 3 to 4 days before assessing control because these chemicals often take 1 to 3 days to reduce aphid populations, particularly Thiodan. If control is not adequate, review the conditions of application and recheck your calibration and spraying equipment before making another application.
- Insecticides applied for aphid control must come in contact with the undersides of the leaves where most aphids are found. The use of higher gallonage, higher sprayer pressure, drop nozzles, and spreader-stickers can improve coverage.

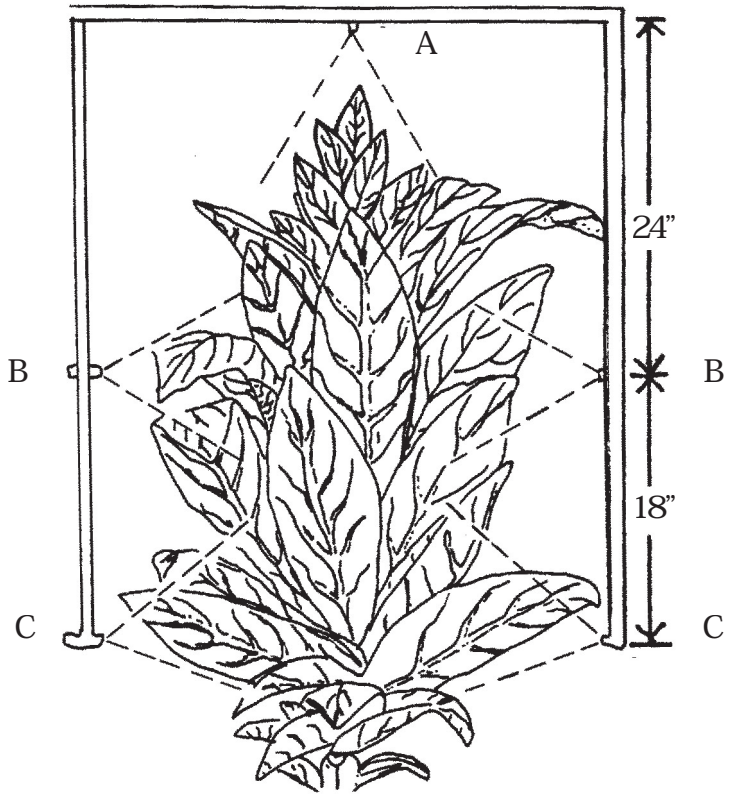


Figure 5. Ideal design for delivering sprays on tobacco plants.

- After satisfactory control has been obtained, continue to watch the crop closely because aphid populations can build up rapidly and require additional insecticide applications.
- Pretransplant band applications of soil granular systemic insecticides are not effective in Maryland. The Orthene transplant water treatment will provide some early season control of aphids.
- Use cultural practices to reduce aphid populations. Most cultural practices do not keep aphid populations below the treatment threshold, but they can reduce the need for insecticide applications after topping. Useful cultural practices include the following:

1. Control aphids in plant bed. This reduces the chances that aphids will become established in the field early in the season. Destroy plant beds after transplanting is completed.
2. Use recommended nitrogen rates. Excessive nitrogen keeps the leaves green for a longer period of time and promotes excessive sucker growth, which favors aphid infestation.
3. Top early. Aphid populations decline rapidly after topping, especially during hot, dry weather. Be alert after topping because aphid populations can build back up to damaging levels that require insecticide treatment.

Insecticide Application Methods

Apply insecticides properly for maximum insect control. For effective control on small tobacco, use a single solid-cone or hollow-cone nozzle per row directed to the bud. Operate equipment at 40 to 60 pounds of pressure per square inch, do not exceed 4.5 miles per hour, and use at least 6 to 8 gallons of mixed spray per acre. After tobacco is 2 feet tall, use one or three hollow-cone nozzles per row. If three nozzles are used, orient the two side nozzles at a 45-degree angle toward the upper third of the plant. Use 40 to 60 pounds of pressure per square inch (60 to 100 pounds of pressure per square inch for aphids) and 18 to 25 gallons of spray mixture per acre. Set the nozzles 12 to 18 inches above the tobacco. Do not exceed a speed of 4.5 mph. Drop nozzles oriented to the undersides of the leaves and used in combination with one to three nozzles over the row may improve aphid control (Figure 5).

Tobacco-Recommended treatment thresholds for various insects on tobacco

Insect	Treatment threshold	Time when insect is a problem (weeks after transplanting)
Aphids	20% or more plants infested with colonies at any position on the plants.	4 weeks to final harvest Start earlier on later transplanted tobacco
Budworms	Count only worms ½ inch or longer. Spray if 4%, 10%, or 20% of plants are infested at 3-4, 5, and 6 weeks, respectively.	1 to 3 weeks before topping
Cutworms	1 out of 20 plants with recent cutworm damage.	1 to 4 weeks
Flea beetles	Four beetles per plant on newly transplanted tobacco (less than 2 weeks old); 8 to 10 beetles per plant on 2- to 4-week-old plants; 60 beetles per plant on older tobacco; lacy and ragged appearance at the base of the lower leaves.	0 to 4 weeks
Grasshoppers	5 grasshoppers per 50 plants.	9 weeks to final harvest
Hornworms	Count only worms without parasite cocoons that are 1 inch or longer. Spray if greater than 10 worms per 100 plants before button, or greater than 20 worms per 100 plants after button.	3 weeks to harvest
Wireworms	Not determined.	1 to 4 weeks

Tobacco-Recommended insecticides for plant bed insects

Insect	Insecticide and formulation	Rate of formulation time	Re-entry [a]	Remarks
Cutworms, aphids, flea beetles, grasshoppers, and vegetable weevils	Acephate (Orthene 97P)	0.75 tb in 1 gallon of water	- [b]	Spray plants as needed. Do not pull plants until spray deposit has dried. Make spray applications for cutworms to plant beds and adjacent alleys during late afternoon.
Snails and slugs	Hydrated or air-slaked lime Metaldehyde bait	4.0 lb/acre Follow label	- [c]	Lime dust applied in a band 3 to 4 inches wide along the margin of the bed may act as a barrier. Apply during late afternoon. Apply to the soil surface in alleys and vacant areas in the plant bed in late afternoon. Do not apply directly on the foliage.

[a] Minimum time interval between application and worker re-entry into field.

[b] - Do not re-enter field until spray deposit has dried.

[c] - Not applicable.

Tobacco-Recommended insecticides for transplants grown in greenhouses

Insect	Insecticide and formulation	Rate of formulation	Re-entry time [a]	Remarks
Aphids, cutworms, flea beetles	Acephate (Orthene 97P)	0.75 tb per 3 gallons of water/ 1,000 sq ft	- [b]	Apply evenly to ensure thorough coverage. Overapplication may cause phototoxicity.

[a] Minimum time interval between application and worker re-entry into field.

[b] - Not applicable.

Tobacco-Recommended insecticides for drench treatments of bedding trays or flats

Insect	Insecticide and formulation	Rate of formulation time	Re-entry time [a]	Application to harvest	Remarks
Aphids	Imidacloprid (Admire 2F)	1.0 fl oz/ 1,000 plants	- [b]	14 hr	Admire should be mixed with water and agitated regularly to avoid settling in the spray tank. Adjust concentration according to the delivery volume of over-top application per 1,000 plants
Aphids, flea beetles	Thiamethoxam (Platinum)	0.8-1.3 oz/ 1,000 plants	-	12 hr	Do not apply to float-bed water. Use higher rates for longer residual control. Thoroughly water transplants in trays and then apply chemical evenly. Immediately after treatment, spray transplants with enough water to wash chemical off foliage and into the soil. Set transplants in the field within 2 days after treatment. Make only one drench treatment per season.
Mole crickets, wireworms	Thiamethoxam (Admire 2F)	1.4-2.8 fl oz/ 1,000 plants	-	14 hr	After application, plants in flats or trays should be watered by overhead irrigation or sprinkling hose to wash Admire from foliage into potting medium. Failure to wash Admire from foliage may result in reduced control.

[a] Minimum time interval between application and worker re-entry into field.

[b] - Not applicable.

Problem Regarding Tomato Spotted Wilt Virus (TSWV)

TSWV is now recognized as a potential problem for Maryland's tobacco growers. This disease is spread by thrips that overwinter in greenhouses. Although there is no plant bed control or field control, University of Georgia studies report a general reduction of TSWV in fields where Admire or Platinum is applied as a drench to plants while they are still in the greenhouse. Transplant water treatments are generally less effective in preventing disease transmission than tray drench treatments.

Tobacco-Recommended insecticides for pretransplant soil treatments

Insect	Insecticide and formulation	Rate of formulation time	Re-entry time [a]	Remarks
Wireworms	Ethoprop (Mocap EC) (Mocap 10G)	 1.33-4.0 qt 20.0 lb	 after incorporation after incorporation	Make broadcast application at least 14 days before transplanting (3 to 4 weeks for diazinon). Band applications are usually less effective than broadcast treatments. Do not mix granules with fertilizer or other materials. Double-disk insecticides at least four times into soil immediately after application to a depth of at least 4 inches for chlorpyrifos and ethoprop and 6 to 9 inches for diazinon. Ethoprop is also available in combination with disulfoton (Mocap Plus).
Wireworms, cutworms	Chlorpyrifos (Lorsban 15G) (Lorsban 4E)	 13.5-20.0 lb 2.0-3.0 qt	 1 day 1 day	See remarks for ethoprop.

[a] Minimum time interval between application and worker re-entry into field.

Tobacco-Recommended insecticides for transplant water treatments

Insect	Insecticide and formulation	Rate of formulation time	Re-entry time [a]	Remarks
Aphids, flea beetles	Thiamethoxam (Platinum)	0.8-1.3 oz/ 1,000 plants	12 hr	Calibrate transplanter to deliver known amount of water per plant. Mix appropriate amount of chemical in tank and drench transplants as they are being placed in the ground. Make only one treatment per season.
Aphids, flea beetles, wireworms	Imidacloprid (Admire 2F)	1.0-2.8 fl oz/1000 plants	- [b]	Calibrate transplanter to deliver known amount of water per plant. Mix appropriate amount of chemical in tank and drench transplants as they are being placed in the ground. Treat only once per season.
Flea beetles	Acephate (Orthene 97P)	0.75 lb	- [b]	Provides control for 3 to 4 weeks after transplanting. Orthene aids in control of cutworms and aphids.
Thrips, wireworms	Thiamethoxam (Platinum)	1.3 oz/ 1,000 plants	12 hr	Use higher rates for longer residual control. Thoroughly water transplants in trays and then apply chemical evenly. Immediately after treatment, spray transplants with enough water to wash chemical off foliage and into the soil. Make only one drench treatment per season.

[a] Minimum time interval between application and worker re-entry into field.

[b] - Not applicable.

Tobacco-Recommended insecticides for foliar treatments

Insect	Insecticide and formulation	Rate of formulation time	Re-entry time [a]	Application to harvest	Remarks
Aphids	Acephate (Orthene 97P)	0.75 lb	- [b]	3 days	Apply as a spray. Use highest rate for heavy infestations or if control has been poor with previous applications. If tobacco is large, use drop nozzles to orient spray to undersides of leaves. Aphids fly into tobacco fields and may go unnoticed until plants become heavily infested.
	Endosulfan (Thiodan, Golden Leaf Tobacco Spray Phaser 3EC)	0.67-1.34 qt	1 day	5 days	Apply spray evenly over entire plant, especially undersides of leaves. Repeat in 5 days if necessary. DO NOT APPLY THIODAN AT OR AFTER TOPPING.
	Imidacloprid (Provado 1.6F)	2-4 fl oz	12 hr	14 days	
	Methomyl (Lannate 90 SP) (Lannate LV 2.4EC)	0.5 lb 1.5 pt	2 days 2 days	14 days	**Restricted Use.** Apply as a spray. Several applications may be necessary to control aphids.
	Pymetrozine (Fulfill WDG)	2.75 oz	12 hr	14 days	See remarks for Methomyl.
	Thiamethoxam (Actara 25WG)	2.0-3.0 oz	12 hr	14 days	Check label for details. Do not exceed a total of 3.0 ounces (0.047 lb a.i.) per acre during each growing season. Use a minimum of 20 gallons of water per acre by ground equipment.
Budworms	Acephate (Orthene 97P)	0.75 lb	- [b]	3 days	Apply as a spray. When using a hand sprayer, apply in 25 gallons of water per acre.
	Bacillus thuringiensis (Dipel 10G)	10.0 lb	0	0	Prepare bait by mixing 1.0 lb of Dipel 2X (Bacillus thuringiensis) with 99 pounds of cornmeal. Apply bait overtop each row using duster or by gloved hand.
	Carbaryl (Sevin 80WSP) (Sevin 50WP) (Sevimol 4F)	1.25-2.5 lb 2.0-4.0 lb 1.0-2.0 qt	12 hr 12 hr 12 hr	0	Apply as a spray. Do not apply until plants are established and growing. The tobacco aphid often becomes a problem on tobacco following two or more applications of carbaryl.

Tobacco-Recommended insecticides for foliar treatments (continued)

Insect	Insecticide and formulation	Rate of formulation time	Re-entry time [a]	Application to harvest	Remarks
	Endosulfan (Thiodan, Golden Leaf Tobacco Spray Phaser 3EC)	0.67-1.34 qt	1 day	5 days	Apply as a spray. Endosulfan is very toxic. DO NOT APPLY THIODAN AT OR AFTER TOPPING.
	Methomyl (Lannate 90 SP) (Lannate LV 2.4EC)	0.5 lb 1.5 pt	2 days 2 days	14 days	**Restricted Use.** Apply as a spray. Make applications as needed. Direct the spray into the buds before buttoning.
Cabbage looper	Acephate (Orthene 97P)	0.75 lb	-	3 days	Apply as a spray in 10 to 50 gallons of water.
	Bacillus thuringiensis (Agree water-soluble pouch) (Javelin WG) (MVP 0.9F)	1.0-2.0 lb 1.0-1.25 lb 2.0-4.0 qt			
	Methomyl (Lannate 90 SP) (Lannate LV 2.4EC)	0.5 lb 1.5 qt	2 days 2 days	14 days	**Restricted Use.** Apply as a spray.
Cutworms	Acephate (Orthene 97P)	0.75 lb	-	3 days	Apply as a spray overtop of plants in affected areas when 2 percent of the plants are injured by cutworms.
Flea beetles	Acephate (Orthene 97P)	0.75 lb	-	3 days	Apply as a spray.
	Carbaryl (Sevin 80WP) (Sevimol 4F)	1.25-2.5 lb/ gallon of water 1 qt	12 hr 12 hr	0	Apply as a spray. Do not apply until plants are established and growing. The tobacco aphid often becomes a problem following two or more applications of carbaryl.

Tobacco-Recommended insecticides for foliar treatments (continued)

Insect	Insecticide and formulation	Rate of formulation time	Re-entry time [a]	Application to harvest	Remarks
	Endosulfan (Thiodan, Golden Leaf Tobacco Spray Phaser 3EC)	0.67-1.34 qt	1 day	5 days	Apply as a spray before topping. DO NOT APPLY THIODAN AT OR AFTER TOPPING.
	Methomyl (Lannate 90 SP) (Lannate LV 2.4EC)	0.25-0.05 lb 0.75-1.5 pt	2 days 2 days	14 days	**Restricted Use.** Apply as a spray.
	Thiamethoxam (Actara 25WG)	2.0-3.0 oz	12 hr	14 days	Check label for details. Do not exceed a total of 3.0 ounces (0.047 lb a.i.) per acre during each growing season. Use a minimum of 20 gallons of water per acre by ground equipment.
Grasshoppers	Acephate (Orthene 97P)	0.75 lb	-	3 days	Apply as a spray. Treat crop and a strip around the field to reduce grasshopper immigration.
Hornworms	Acephate (Orthene 97P)	0.75 lb	-	3 days	Apply as a spray. Treat infested fields before worms exceed 1.5 inches in length. Direct the spray toward the top six leaves of the plants.
	Bacillus thuringiensis (Dipel 2X) (Dipel 4L) (Biobit EC) (Biobit WP)	0.25-0.50 lb 0.5-1.0 pt 0.5-1.5 pt 0.5 lb	4 hours 4 hours 4 hours 4 hours	0	Apply as a spray. Do not allow diluted sprays to stand in tank more than 12 hours. Dipel can be tank-mixed with maleic hydrazide (MH-30).
	Carbaryl (Sevin 80WP)	1.25-2.5 lb	12 hr [b]	0	Apply as a spray.
	Endosulfan (Thiodan, Golden Leaf Tobacco Spray Phaser 3EC)	0.67-1.34 qt	1 day	5 days	Apply as a spray or dust before topping only. DO NOT APPLY THIODAN AT OR AFTER TOPPING.

Tobacco-Recommended insecticides for foliar treatments (continued)

Insect	Insecticide and formulation	Rate of formulation time	Re-entry time [a]	Application to harvest	Remarks
	Methomyl (Lannate LV 2.4EC)	0.75-1.5 pt	2 days	14 days air-cured	Check label for details.

[a] Minimum time interval between application and worker re-entry into field.

[b] - Do not re-enter field until spray deposit has dried.

Insect Pest Management Guidelines for Stored Grain

G.P. Dively, Extension entomologist,
Department of Entomology
University of Maryland, College Park

Certain information in this section was compiled by
G.F. Chappell II, Extension agent, IPM,
Virginia Polytechnic Institute and State University

Steps in Managing Insects in Stored Grain

Over 60 species of insects infest stored grains and can greatly affect its quality and subsequent value. Damage can go unnoticed until the grain is removed from the storage facility. Managing stored grain insects requires the use of various techniques including sanitation; storing sound, dry grain; managing temperature and aeration; using chemical protectants; regular sampling; and fumigation. Bin facilities also play an important role in determining whether grain quality is maintained. Bin facilities should be inspected regularly for deterioration of any type.

Stored grain insects can be categorized as follows:

Weevils and other insects that feed inside kernels.

1. These insects are considered primary pests because their eggs are laid on or in whole, undamaged kernels. The immature stages of these insects occur on the inside of the grain where detection is more difficult. The most common pests include rice, maize, and granary weevils, and lesser grain borers. They are small (0.0625 to 0.125 inch long), and the weevils recognized by the prolonged snout on the head. These insects can be found in any portion of the grain mass.

A complex of beetles, mites, and book lice called bran bugs that develop and feed outside the kernels.

2. These insects are considered secondary pests because they attack only cracked kernels (or other fine material such as flour) or fungus growth on moist grain. Species that are often collected in grain bins include the sawtoothed grain beetle, flat grain beetle, rusty grain beetle, foreign grain beetle, hairy fungus beetle, larger black flour beetle, red flour beetle, book lice, and grain mites. The adults of most beetle species are 0.0625 to 0.5 inch long with reddish-brown to black bodies. Larvae are usually cream-colored and cylindrical. Like weevils, these beetles are not confined to the top layer but are found anywhere in the grain mass. Concentrations of secondary beetles produce an increase in grain temperature and moisture, resulting in fungus growth and more favorable beetle population growth.

Surface-feeding caterpillars.

3. The Indianmeal moth is the most common pest in this group. These cream-colored caterpillars (about 0.75 inch long) inhabit primarily the outer portions of the grain mass, usually the top layer but also the bottom just above perforated drying floors or aeration ducts. They produce fine, silken webbing as they feed and move about. Mature larvae pupate within silken cocoons. The reddish-brown adults (about 0.75-inch wingspan) fly and mate in the bin headspace where they can be seen resting on the bin walls and roof.

Grain Storage Facilities

For insect prevention, as well as other reasons, bin facilities should be weathertight, rodent proof, steel, and on a moisture-proof concrete base. They should be separated from areas where hay, straw, feed, and animals are housed. Bins should be equipped with a perforated-floor aeration system and weatherproof roof vent. All bins should be inspected on a regular basis to guard against leaks and deterioration of any kind. Once filled, attempt to seal the bottom and sides of the bin so insects and rodents can only enter the top of the facility. Do not seal roof aeration exhaust or inlet vents except during fumigation so the top of the bin can be easily sampled and topdressings applied if necessary.

Importance of Clean, Dry Grain

For many reasons, stored grain should be clean, not cracked, and have a moisture content of 12 percent or lower. Insects have a more difficult time multiplying to serious levels if grain moisture is 12 percent or lower. Mold activity is greatly reduced at moisture contents below 14 percent.

Stored Grain Sanitation

Insect infestations in stored grain generally begin as the result of poor management practices and from insects already established in old grain and grain debris that was not removed or fumigated before storage of clean grain. Pests in stored grain rarely infest grain in the field; therefore, do not store new grain on top of old grain unless absolutely necessary. However, limited storage space forces many growers to violate this rule of maintaining harvests separately. If long-term storage is planned, and live, damaging insects are detected in stored grain, having the old grain treated with a registered fumigant should reduce the risk of serious losses. (Refer to the section on fumigants.)

The following suggestions to prepare bins should be completed 2 or more weeks before storing grain: (1) Brush, sweep, or vacuum the combine, truck beds, transport wagons, grain dumps, augers, and elevator buckets to remove insect-infested grain and debris. Do not forget to burn, feed, or otherwise destroy the first few bushels of grain that leave the combine auger. (2) If possible, thoroughly sweep or brush down walls, ceiling, ledges, rafters, braces, and handling equipment and remove debris from bin. (3) Remove all debris from fan, exhaust, and aeration ducts (also from beneath the slotted floor when possible). (4) Feed, burn, bury, or otherwise destroy the removed debris because it usually contains insect eggs, larvae, pupae, or adults ready to infest the new grain. (5) Remove all debris and vegetation growing within 3 to 10 feet of the bins.

Temperature and Aeration

Grains harvested and stored in the hottest part of the year stand a greater chance of becoming infested, since insects reproduce rapidly at temperatures in the range of 60 to 90°F. Farm-stored wheat, rye, barley, or oats are more likely to have insect problems than corn or beans, which are harvested during the cooler months of the year. Bin aeration during times of low outside temperature and humidity will aid in reducing the temperature of the grain. In the southern United States, it is recommended to maintain warm temperatures and low humidity until cooler temperatures arrive, and then to cool the grain to 55 to 65°F or lower as soon as possible.

Several practices should be followed when filling bins to permit even aeration of the grain mass. The upper surface of the grain mass should be level or slightly inverted to permit even aeration. The use of a grain spreader will help prevent the accumulation of fines (broken grain, weed seed, dust, and debris) in the center when filling bins. If not spread evenly, this material will accumulate in the center of the bin, preventing even aeration and providing an excellent environment for insects and fungi to develop. The accumulation of fines in the center of the bin can be greatly reduced by removing a portion of the grain mass after the facility is filled several times during the loading process. Removing the core from the bottom with the centrally located unloading augur or conveyer will remove the column of fines and invert the peaked grain in the top of the tank. After this process is completed the grain can be left alone or leveled. This process, called "coring," will increase aeration efficiency and reduce problems with insects, fungi, and hotspots. For grain stored through the winter, aeration in the fall can deter moisture migration in the bin. Moisture migration is caused by differential temperatures in the grain mass resulting in convective flow of air through the grain. The convective flow of air can result in accumulating moisture condensation in the upper center of the grain mass. These factors will contribute to the development of molds and insects.

Bin Spray

After empty bins are cleaned, spray all surfaces inside and, if possible, outside the bin with a residual surface insecticide. (See accompanying table.) Inside bins, spray walls, ceiling, ledges, braces, rafters, and floor. Outside bins, spray the base and the walls up to 15 feet above the base and the soil around the bins.

Surface insecticides should be applied 2 to 5 weeks before the grain goes into the structure to provide the best kill of existing infestations. A lengthy time period after treatment and before binning the grain is suggested to allow eggs to hatch and hidden insects to cross the toxic barrier and die. Use a garden or power sprayer at a pressure of at least 30 psi and apply spray solution to "run off" (2.5 gallons of mixed spray per 1,250 square feet of surface or as directed on the label). Do not mix more than 1 day's supply of diluted spray at a time. Spraying the outside of a structure just before the grain inside is fumigated is often worthwhile. Insects temporarily leaving the grain to escape the fumigant are killed before they can reenter the structure.

Stored Grain-Recommended insecticides for stored insect control in empty bins

Insecticide and formulation	Stored commodity	Rate of formulation per 2.5 gallons of water (treats 1,250 square feet of surface)	Remarks
Bacillus thuringiensis (Biobit,, Deliver, Dipel, Javelin , Xentari)	Grains, soybeans, sunflower seed, crop seeds, condimental seeds, spices, herbs, birdseed, popcorn, peanuts	0.5 lb/5.0-10.0 gal of water	Agitation is important. Other products are available. Read and follow label directions carefully. Formulations vary greatly. Does not control weevils, lesser grain borer, or any of the bran bugs.
Chloropyrifos-methyl and cyfluthrin (Storcide)	Stored food, feed, and oil grains	1.69 fl oz/1 gal water Apply 1 gal diluted spray/1000 sq ft	**Restricted Use.** Bin applications should only be applied from outside the bin. Only downward spray is permitted. Do not enter until sprays are dried. Applications should be made only after bins have been thoroughly cleaned.
Chlorpyrifos-methyl (Reldan 4E)	Empty-bin treatment for storage of barley, oats, rice, sorghum, or wheat	0.5 pt/3.0 gal spray	Restricted use. Do not use in bins that will be used to store corn or soybeans. May not provide control of lesser grain borer. Newer labels require treatment from outside the bin. NOTE: Reldan 4E will be sold by Gustafson until 12/31/04 to authorized distributors; distributors can sell until 12/31/05, and treated grain will be given the opportunity to move through grain channels until 2009-2010.
Cyfluthrin (Tempo 20WP, Tempo SC Ultra, Tempo WSP Ultra, Tempo WP Ultra)	Empty-bin treatment	8-16 ml/gal/1,000 sq ft	2.96 ml = 1.0 oz Treat storage facilities and allow to dry before filling with product.
Diatomaceous earth (Insecto, Protect-It, etc.)	Empty-bin treatment	0.4-1.0 lb/1,000 sq ft	Rate depends on formulation. Can be irritating to workers and abrasive to equipment.
Methoprene (Diacon II)	Warehouses, silos, storage bins or other stored commodity areas	1.0 ml/1000 sq. ft. or 3 ml/10.000 cu. ft.	Methoprene does not kill existing populations. Treat existing insect populations with an adulticide before applying methoprene for residual protection. Methoprene prevents insect reproduction.

Bacillus thuringiensis Grain Product

Bacillus thuringiensis (Bt) is a biological insecticide that has activity on some moth larvae. The gene expressing the protein toxin of this insecticide has been genetically engineered into corn. In YieldGard hybrids, the protein is expressed in the grain as well as other parts of the plant, thus providing the grain with protection from larval feeding. Recent research has shown that about 75 percent fewer Indianmeal moths emerge from Bt grains in storage, and those that survive lay 90 percent fewer eggs. This means that the effectiveness of Bt grains should be superior to Bt products applied as a topical, bin, or grain treatment. However, keep in mind that Bt corn will not control weevils or other beetles.

Treatment of Grain for Storage

After the bin has been thoroughly cleaned and treated, insecticides can be applied to the grain as it goes into the storage area. Insecticides registered for application to whole grain are called grain protectants. Most labels recommend application as the grain is entering the auger for delivery to the final storage site. Refer to the accompanying table for information on applicators and calibration. Even distribution of the product during application is desirable. Protectants also give best control when the grain moisture is low. To make enough spray to treat 1,000 bushels of grain, use one of the recommended chemicals in the table.

Stored Grain-Recommended insecticides for grain going into storage

Insectide and formulation	Grain	Rate of formulation	Remarks
Liquids - Applicators are available that sit on the auger and distribute the solution into the auger intake.			
(Pyrethrins)	Corn, wheat, rye, oats, barley, and grain sorghum	Dilute one part of spray with 29.0 gal of water. Apply 4.0-5.0 gal of solution/1,000 bu of grain.	Pyrethrins degrade quickly, only providing short residual control.
Bacillus thuringiensis (Biobit,, Deliver, Dipel, Javelin , Xentari)	Grains, soybean	See label for rates	No activity against weevils.
Chloropyrifos-methyl and cyfluthrin (Storcide)	Wheat, barley, oats, and sorghum	6.4-12 fl oz/5 gallon of water See label for rates which vary with the grain crop Apply 5 gal diluted liquid/1000 bu grain	**Restricted Use.** Dilute with water of FDA approved food grade mineral or soybean oil. Cyfluthrin, a component in Storcide does not have CODEX MRLs. Check with your grain handling before exporting.
Chlorpyrifos-methyl (Reldan 4E)	Barley, oats, rice, grain sorghum, and wheat	10.7-11.5 oz in 1.0-5.0 gal of water/1,000 bu	Reldan is not labeled for corn. Reldan does not have activity on lesser grain borer and has limited activity on existing populations of insects. NOTE: Reldan 4E will be sold by Gustafson until 12/31/04 to authorized distributors; distributors can sell until 12/31/05, and treated grain will be given the opportunity to move through grain channels until 2009-2010.

Stored Grain-Recommended insecticides for grain going into storage (continued)

Insectide and formulation	Grain	Rate of formulation	Remarks
Pinmiphos-methyl (Actellic 5E)	Corn and grain sorghum	9.2-12.3 oz in 5.0 gal of water/ 30 tons (4,070 bu) of grain	Actellic 5E is not labeled on wheat. Actellic is effective against Indianmeal moth at the highest rate and suppresses lesser grain borer. Do not apply before high temperature drying is completed. Extreme heat results in volatilization and reduction in residual control.
Dusts - Dust formulations may be sprinkled over the surface of the grain in the truck and then mixed with a shovel or rake. The protectant will mix with the grain as it is augured into the storage facility. Applicators are available that sit on the auger and distribute the dust into the auger intake.			
Diatomaceous earth (Insecto, Protect-It, etc.)	Stored grain, barley, corn, oats, rice, grain sorghum, soybeans, and wheat	1.0-2.0 lb/1,000 bu	Treat the first loads in the bottom of the bin and the last loads in the top of the bin. Product can be irritating to workers and abrasive to equipment. Reduction in test weights are possible, but can be limited when used as a topdress treatment.

NOTE: Reldan and diatomaceous earth dusts or liquids may also be applied to the top of clean grain surfaces to prevent the introduction of surface-feeding insects. Reldan, Actellic, or Bacillus thuringiensis applied as a topdress treatment will prevent the introduction of Indianmeal moth. Refer to the Topdressing and Pest Strip section for additional information.

Topdressing and Pest Strips

If a protectant is not used on all incoming grain, it is advisable to apply insecticides to the top 6 to 12 inches of grain. This approach provides an effective barrier against migrating insects such as the Indianmeal moth larvae, which concentrate in the upper layer of the grain mass. Topdressings are applied by adding the product to the last truckload of grain before it enters the auger or by raking the product into the top layer of the grain mass. Treatments can be applied to the stored grain at any time, but for best results, make application immediately after harvest before moth or beetle activity occurs.

Bacillus thuringiensis (Dipel, Biobit), Reldan, and Actellic are labeled as a topdress application. All of these products can suppress Indianmeal moth populations; however, existing populations in old grain may be difficult to control. Before making a surface application, remove any webbing that exists on the grain surface. If high numbers of Indianmeal moth worms (2 to 3 per square foot) exist, it is best to remove the webbing, fumigate, and then apply a surface application.

Apply wettable powder Bt products in a constantly agitated water suspension by mixing 1 pound of the formulation to 10 gallons of water. Use a sprinkler can or sprayer to apply 0.6 pint of the suspension per bushel as the last truckload is augered into the bin. Or apply 10 gallons of the suspension to 500 square feet of the grain surface in the bin and mix thoroughly with a scoop or rake to a depth of 4 inches. More thorough coverage may be achieved by dividing the recommended dosage into three applications and mixing the grain between applications. Apply Dipel dust as a topdressing at the rate of 4 pounds per 500 square feet and mix thoroughly to a depth of 2 to 4 inches. Remember that Bt product is only effective against certain caterpillars, such as the Indianmeal moth; it will not control weevils and secondary beetles.

As a topdressing, the rate of Reldan 4E per 1,000 square feet of grain surface is 3 ounces for wheat, 2.8 ounces for sorghum, 1.6 ounces for oats, and 2.4 ounces for barley. Mix the recommended rate of the concentrate with 2 gallons of water and apply to every 1,000 square feet of grain surface. Reldan 3% dust can also be used at the rate of 7 pounds per 1,000 square feet. Reldan is not labeled for corn.

For Actellic 5E, use 3 ounces in 2 gallons of water per 1,000 square feet for use only on corn and grain sorghum. It cannot be used on small grains except in situations where the small grain will be exported to other countries. Apply one-half of the mixture as a spray to the grain surface and rake the mixture into the grain to a depth of 4 inches. Apply the remaining one-half of the mixture to the raked surface.

Slow-release DDVP or dichlovos (Vapona) strips are registered for use in grain bins. Placement of these strips in the bin headspace will help to protect against infestations of Indianmeal moth; however, strips work best in an airtight bin. Use one strip per 1,000 cubic feet of headspace above the grain and replace every 3 to 4 months.

Calibration of Grain Auger for Insecticide Application

An important consideration regarding the application of a grain protectant with a grain auger is calibration. The illustration below shows the correct position in which to place an applicator. The correct amount of chemical must be applied to the grain mass to achieve the best results. The following procedure will give an estimated starting point for both commercial and homemade applicators of the flow drip type.

Refer to the owner's manual for the auger capacity or determine the capacity by recording the amount of material augered over a specific time period. The accompanying table can also be used to estimate auger capacity if the auger size and speed is known. Find the auger capacity and locate the number of ounces of liquid delivered per minute at the desired application rate. Setting the applicator to deliver this amount of liquid in a 1-minute time period will establish a starting setting. Check the amount applied per 1,000 bushels throughout the application operation to ensure correct rates.

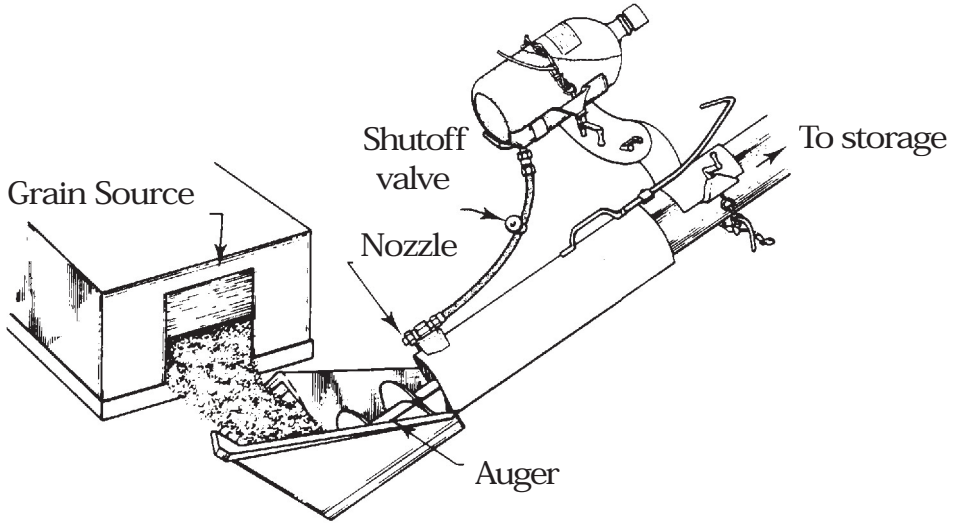


Figure 6. Gravity feed or "drip-on" applicator.

Stored Grain - Estimates of diluted insecticide based on auger capacity

Auger size (inches)	Auger speed (revolutions per minute)	Auger capacity (bu/hr)	Ounces of liquid delivered per minute from applicator calibrated to deliver:		
			3 gal/1,000 bu	5 gal/1,000 bu	7 gal/1,000 bu
6	200	300	2	3	4
	400	650	4	7	10
	600	950	6	11	15
	800	1,050	7	12	17
8	200	700	4	7	10
	400	1,400	9	15	22
	600	2,000	13	22	31
10	200	1,300	9	15	21
	400	2,800	18	30	42
	600	3,400	23	37	50

Sampling for Stored Grain Pests

Bins should be inspected on a regular basis for insects, hot spots, mold growth, or any "off odor." As a general guideline, bins should be sampled twice a month April through November and once a month December through March. Regular inspections will reduce the chances of pests becoming established. Take all necessary safety precautions. Bins should be easily accessible and all unloading equipment should be turned off. Be aware of any pesticides applied to the grain, undissipated fumigants, bridged grain, grain dusts, and high temperatures. WORKING IN TEAMS IS THE BEST POLICY, WITH AT LEAST ONE MEMBER ON THE OUTSIDE OF THE STORAGE FACILITY.

Samplers should be alert for off odors, crusting, temperature differences greater than 10°F, visible water vapor, sprouting grain, exterior bin conditions and signs, uneven snow melt or frosting, condensation, discoloration, fecal matter (birds, rodent, and insect), and birds (insect feeders).

Use a probe (grain trier) or scoop to collect the samples. Take 5 to 10, one-pint samples from various areas over the grain surface. Using a compartmentalized grain trier will allow the sampler to determine differences in grain moisture, insect populations, temperature, and grain quality at different depths in the grain mass. Label samples so problem areas within the bin can be identified. Sampling at different depths will greatly increase the chances of finding trouble spots before a large area of grain is damaged.

Grain temperature should be determined as soon as possible after the sample is taken to achieve the most accurate results. Temperature differences in the range 10 to 15°F indicate a potential problem. Usually aeration will correct the temperature difference. After corrective measures are taken, further sampling is suggested to ensure the problem has been corrected.

When sampling for insects in cool grain, samples should be warmed. Warming will increase the activity of the insects, allowing the sampler to easily spot the pests and determine if the insects are alive. Individual samples can be placed in labeled plastic bags to guard against contamination. Each sample should be placed on a sieve, which will hold the grain while allowing the pieces (fines), insects, and small debris to pass through. If insects are present, save them for identification, estimate the abundance, and determine the distribution. Pest identification is crucial when selecting a control measure. For example, several species of insects feed on fungi. Their presence indicates a moisture problem. Control of the insects with pesticides can be achieved without correcting the primary problem.

Another method of sampling involves using a grain probe trap. This trap consists of a perforated plastic tube with a funnel collector on the bottom. Traps are inserted in the grain mass and marked with colored string, which allows them to be retrieved. Traps are retrieved after 24 hours and are more efficient than

probing and sieving for beetles, but they do not adequately detect moth larvae.

Trouble spots can also be identified using a metal rod. Insert the rod into the grain and allow it to remain for several moments. Hot spots can be detected by running your hand down the rod after removing it from the grain. If temperature differences are sensed, investigate these areas further to determine the reason for the difference in grain temperature.

Accurate records should be kept so changes over time can be detected. Records can be used to refine a management strategy for your individual operation.

Generally, it is suggested to treat:

Wheat, Rye, or Triticale-One live insect per quart sample

Corn, Sorghum, Barley, Oats, or Soybeans-One live weevil or five other insects per quart sample

If these thresholds are exceeded, fumigation is suggested. However, if the weather is cool, fumigation should be delayed. Fumigation effectiveness is greatly reduced under cool conditions. For conditions that do not favor fumigation, the grain mass may be cooled to below 60°F if possible. At temperatures below 60°F, insects are for the most part inactive. When temperatures permit, fumigation should be considered.

Fumigation

Fumigation should be conducted only by trained, experienced, registered applicators. If insects are found above the suggested thresholds, fumigation is suggested. The goal of fumigation is to maintain a toxic concentration of gas long enough to kill the target pest population. The toxic gases penetrate into cracks, crevices, the commodity, and the facility treated. Fumigants provide no residual protection. Fumigants come in several forms and formulations. All label instructions and precautions should be read and carefully followed.

Fumigant selection should be based on the following factors: pest susceptibility, volatility, penetrability, corrosiveness, safety, flammability, residues, odors, application method, required equipment, and economics. Two products remain for treating stored products: methyl bromide and phosphine-producing materials, such as magnesium phosphide and aluminum phosphide.

Phosphine Fumigants

A number of phosphine-produced products are available for treating stored grain. Phosphine has no adverse effects on seed germination when applied according to label directions and at labeled rates. Phosphine reacts with copper, brass, and bronze, resulting in discoloration and corrosion. This reaction affects electrical and mechanical systems, particularly when high concentrations of phosphine are used in combination with high humidity and temperature. If the liberation of hydrogen phosphide occurs in a confined area, an explosion or fire may also result. Aluminum phosphide has been formulated with ammonium carbamate or aluminum stearate and calcium oxide to control the release and lower the combustibility. In addition to controlling the reaction, formulations that contain ammonium carbamate release a garlic odor that serves as a warning odor. The time required for phosphine release is shorter under warm, humid conditions and longer under cool, dry conditions. Since the gas diffuses through the grain rapidly, structures must be sealed properly, especially under cooler conditions.

A new fumigant gas formulation of phosphine, ECO2FUME™, is a non-flammable pre-mixed cylinderized mixture of phosphine and carbon dioxide, which is not temperature dependent, and provides effective fumigation in both sealed and unsealed storage facilities. This fumigation system is an environmentally friendly alternative that is easy to use with improved worker safety. ECO2FUME™ is a gaseous mixture of 2% phosphine (by weight) in carbon dioxide. Carbon dioxide is an excellent carrier for phosphine and diluting phosphine to this concentration ensures Eco2Fume is nonflammable in all proportions with air. Another advantage of Eco2Fume is that the relatively “low” phosphine concentration can help manage corrosion concerns. Unlike metallic phosphide fumigants, phosphine is not generated through a chemical reaction and its release is instantaneous. ECO2FUME fumigant gas comes in ready-to-use cylinders that can be dispensed directly into sealed storages or structures from the outside. Thus, confined space entry is not necessary, creating a safer working environment for operators. Unlike solid fumigants, ECO2FUME eliminates the disposal problem; partially filled cylinders can be saved until the next application or unused product may be returned to the distributor.

Notes