Strawberries

Note: "**The Mid-Atlantic Berry Guide for Commercial Growers**", a cooperative publication for PA, MD, NJ, DE, WV, and VA, provides additional information.

Annual Production System on Plastic Mulch ("Plasticulture")

This system is recommended for DE, MD, NJ, VA, southeastern PA, and for trial in other areas of PA.

Recommended Varieties[1]

Each variety has different susceptibility and resistance to different diseases, and none are completely resistant to any disease. Be aware that Flavorfest is especially susceptible to angular leaf spot, a bacterial disease. Galletta and Flavorfest are fairly resistant to Anthracnose Fruit Rot, while Camarosa, Chandler, and Ruby June are especially susceptible. Sweet Charlie and Flavorfest are very susceptible to Phytophthora diseases. Day-neutral varieties are susceptible to Anthracnose Fruit Rot and powdery mildew. See the disease control section for information on cultivar susceptibility to *Neopestalotiopsis*.

Short Day Early	Short Day Midseason		Short Day Late	Day-Neutral
Galletta	Camarosa[4] (shipping only)	Flavorfest	AC Valley Sunset	Albion[6]
Rocco[2]	Camino Real[5] (VA and DE)	Merced (VA)	Merced (VA)	San Andreas[7]
Ruby June[2]	Chandler	Rutgers Scarlet (trial)		Seascape
Sweet Charlie[3]	Keepsake (trial)	Rutgers D'Light (trial)		Sweet Ann[8] (VA)

[1]**Listed alphabetically within type**. [2]Best regional performance has been in the lower piedmont and coastal plains of VA. [3]Matures 7-10 days earlier than Chandler; recommended for trial in southern regions of MD. Plant only in areas with low risk of frost; may require overhead sprinkler for additional frost protection during bloom. [4]Must be fully red-ripe for flavor development. [5]Camino Real fruit tolerates high rainfall events well during harvest season over other varieties. [6]Produces light yields throughout the spring summer and fall resulting in moderate total yields for the season. [7]Suitable only for tunnel production as the fruit does not take rainy conditions well during the harvest season. [8]Has produced low yields in PA.

Recommended Nutrients Based on Soil Tests

In addition to using the table below, check the suggestions on rate, timing, and placement of nutrients in your soil test report and Chapter B Soil and Nutrient Management. Your state's soil test report recommendations supersede the recommendations found below.

		Soil Phosphorus Level				Soil Potassium Level				
		Low	Med	High (Opt)	Very High	Low	Med	High (Opt)	Very High	
	N (lb/A)	P_2O_5 (lb/A)				K_2O (lb/A)				Nutrient Timing and Method
Annual System Strawberry[1]	90-120	100	70	40	0-30[3]	165	115	65	0	Total nutrient recommended
	60-75	100	70	40	0-30[3]	165	115	65	0	Broadcast and disk-in
	15-25[2]	0	0	0	0	0	0	0	0	Inject through drip at first flowering in spring
	15-25[2]	0	0	0	0	0	0	0	0	Inject through drip at fruit enlargement, about 2 weeks after first flowering

For plasticulture, fertility rates are based on 5-ft row spacing. [1]Apply 1-2 lb/A of boron with broadcast fertilizer; see also Table B-7 in Chapter B Soil and Nutrient Management. [2]If day-neutrals are being grown, see information under "Irrigation" instead of making applications at these timings. [3]Replacement value of 30 lb/A of P_2O_5 is recommended in MD, DE, and VA on Very High P soils.

Background

The annual plasticulture system has the potential for a higher profit than the conventional matted-row system. Establishment costs are higher, but production is earlier (when the crop value is highest), harvest is more efficient, and the system commonly promotes larger berries and a higher number of them. Start with a small acreage and increase acreage as knowledge and experience with the system is gained. This is an integrated system, and all of the following components are important for maximizing production and efficiency.

Site Selection

Select fields with good surface and internal drainage, a southern exposure, and protection from westerly winds. If you are planning a pick-your-own operation, take into consideration that customers prefer plasticulture over matted

rows. In the case of new areas selected for strawberry production, it is advisable to learn about the history of the location, temperature fluctuations, precipitation, photoperiod, past crops, potential insects, disease, and weed pressure. The location must have enough available water for plant maintenance, and in some cases freeze protection.

Plant Bed Preparation, Fumigation and Fertilization

Use soil test results to determine specific nutritional needs. It is unlikely that the soil will have enough nutrients to sustain a full production season. Apply 50-75 lb/A actual N, and P_2O_5 and K_2O preplant as indicated by soil test results. Apply 1-2 lb/A of boron unless soil test results indicate above-normal levels, and work into the beds. Base additional P_2O_5, K_2O and B application rates on soil test results. It is particularly important to adjust the soil pH to the 6-6.5 range; see section B-2 Liming Soils.

Prepare raised beds 30 to 40 inches wide and 6 to 8 inches high on 5- to 6-ft row centers, covered with black plastic mulch to promote higher soil temperatures during the winter months. Beds should be center-crowned and firm. Avoid using beds with flat tops. Planting beds with a trapezoidal shape would help the rainwater move to the aisles and away from the plants and fruits, reducing potential disease incidences. Depending on soil type, plant vigor, and plant tissue test results, inject an additional 30-50 lb/A of N through the drip system in the spring.

Many fumigants will provide weed control early in the season. This is especially important as the plant canopy is still underdeveloped and there is little competition for light between the crop and the weeds. There are fewer options for late-season weed control. For additional control of weeds that emerge from the plant holes, and for banded treatments between the mulched beds, see Weed Control below.

Choose from the following options for bed preparation, fumigation, and fertilization:

1. Prepare soil, apply fertilizer, then apply fumigant. See section E 1.5 Soil Fumigation for fumigant choices, materials, rates, and precautions. Wait 20 days to allow the fumigant to act and disperse before transplanting.
2. Prepare raised beds as described above and apply 4.0 to 6.0 lb/A of Devrinol DF-XT to the surface of the bed and the area between beds. Lay drip irrigation and plastic mulch. Wait a few days before transplanting strawberry plants into the beds as Devrinol has the potential to injure the plants.
3. Apply fertilizer, prepare raised beds, and inject metam-sodium (Vapam HL) at 56.0 to 75.0 gal/A or 37.0 gal/mulched A. Immediately reshape beds (to form a firm, crowned bed) and apply 4.0 to 6.0 lb/A of Devrinol DF-XT to the surface of the bed and the area between beds, and lay drip irrigation and plastic mulch. Wait 20 days between fumigation and planting to allow the fumigant to act and to disperse.
4. Apply fertilizer and prepare raised beds as described above. Apply 4.0 to 6.0 lb/A of Devrinol DF-XT to the surface of the bed. Apply drip irrigation and plastic mulch. Inject metam-sodium (Vapam HL) through the drip system at 37 gal/mulched A. Wait 20 days between fumigation and planting to allow the fumigant to act and to disperse.

Plants and Planting

Use plug transplants propagated from actively growing runner tips and produced in certified nurseries. Plugs can be purchased or produced if the selected cultivar does not have intellectual property protection. To produce plugs from runner tips, use a well-drained (high porosity) soilless mix.. A poorly drained growing medium promotes root diseases. Select runners with one to two fully functional leaves. Runner tips can be grown in 50-cell trays. Maintain adequate moisture on the growing media and leaves for the first two to three days. Fungal diseases are a common challenge with plug production; maintain a frequent scouting program for foliar and root diseases. Consult your Extension office for a list of nurseries that supply plugs and runner tips and/or directions for propagating from tips. The list of nurseries can be found at the Virginia Cooperative Extension publication titled “Shoppers Guide for Berry Plants in the Mid-Atlantic and the Carolinas” accessed at the following link: *https://www.pubs.ext.vt.edu/HORT/HORT-270NP/HORT-270NP.html*.

Plugs can be planted mechanically with a waterwheel-type planter; however, be careful to plant the crown of the transplant at soil level, as deep planting can promote decay and shallow planting can cause desiccation of the plant. Space plants 12 to 16 inches apart in each of the double rows in a staggered pattern. More space between plants will promote better wind flow between plants and near the fruits, promoting an environment with lower disease pressure. However, it will decrease overall production per area. If using double rows, space rows 12-18 inches apart; this requires a 36- to 40-inch-wide bed. The 18-inch between-row spacing has produced high yields. In northern NJ and most of PA, plant in mid to late August. In southeastern PA, southern NJ, DE, MD and northern VA, plant in late August to mid-September for highest first-year yields. In southern and coastal VA, plant in late September.

Alternatively, dormant plants may be planted directly in the field with a tool that allows the roots to be inserted into the soil without digging a hole. Planting time varies from mid-June to mid-July. The roots of dormant plants may also be trimmed to allow planting in 32-cell trays, followed by growing the plants in the trays until planting at the usual time for plug plants.

Irrigation

At planting, overhead irrigation can be used to set the plants, and where conditions are warm, to cool plants and plastic and improve establishment. However, overhead irrigation will promote weeds in the aisles and increase the potential for diseases and should be avoided late in the day. Cooling from sprinkler irrigation occurs because of evaporation of the water from plant tissue and plastic mulch, absorbing approximately 15,309 calories per oz, as long as the air vapor pressure is lower than the saturated vapor pressure. For more information about strawberry transplant establishment, see "Methods for Strawberry Transplant Establishment in Florida", available for download at *https://edis.ifas.ufl.edu/publication/HS1376*.

In cooler locations, plug transplants require little to no overhead irrigation for establishment. In the fall, irrigation through the drip system may promote plant growth before row covers are applied. In the spring, overhead mist irrigation may be required for frost and freeze protection. Farmers must be aware of the potential damage caused by overhead water as a freeze protection method. For each ounce of water turning from liquid to solid, approximately 80 calories are released, providing energy to maintain the plant tissues near or above 32°F. This is the reason why plants can survive these events as long as there is enough water reaching the foliage to maintain a layer of liquid water on the surface of the ice. However, as the ice on top of the plants starts to melt the next morning, evaporative cooling starts (same phenomenon as during plant establishment). The transition of the water from ice to liquid and then gas will absorb energy from the air and surrounding tissue, lowering the temperature below 32°F and potentially damaging the plants. Farmers must continue to apply water until there is no more ice present on the plants.

Maintain adequate soil moisture in raised beds using frequent drip irrigation during the growing season. Preferably, base your irrigation scheduling on soil moisture sensors or crop evapotranspiration estimations. This is effective in increasing fruit size without wetting the fruit and increasing rots. Soil moisture sensors are a good option to maintain adequate moisture in the system without promoting deep water percolation and nutrient leaching.

When day-neutral varieties are being grown, apply 1 to 2 lb/A of N per week through the drip system if 60-75 lb of N were incorporated preplant. Nitrogen requirements will differ with variety and soil type. On heavier soils, 'Seascape' performs well with 1 to 2 lb/A of N per week while 'Albion' has shown a higher requirement, requiring 2 to 5 lb/A of N per week. Verify the planting's nutritional status through foliar analysis.

Row Covers

Floating row covers (FRC) are an essential part of plasticulture systems in the Mid-Atlantic to reduce the desiccating effects of winter winds, and for frost and freeze protection during winter and early spring. A few studies have also found use of row covers in the late fall enhanced degree-day accumulation and produced an increase in yield. Ultraviolet light resistant covers weighing 1-1.4 oz/sq yd and providing 60-70% light transmission have been effective. If row covers are used for freeze protection, install FRC between October 15 and November 15, depending on location and planting date, if fall FRC deployment is desired. The use of row covers in the spring advances bloom and harvest; row covers can be kept on or removed depending on how early you want fruit, but be aware the earlier the plants bloom, the more likely it is that frost protection will be needed. Leaving the covers on too long in the spring may interfere with pollination, increase disease risk, and increase potential mite damage. Leave the covers at the edge of the field so plants can quickly be covered if there is a frost warning.

Pest Control

Use an effective disease control program. If there is a known risk for Phytophthora Crown Rot caused by *Phytophthora cactorum* on the newly set transplants, follow the recommendations for plant dips and/or soil-applied treatments as outlined in the Disease Control section. During late summer and fall, insecticides and miticides should be applied to prevent aphids and mites from reaching damaging levels in the spring. After plants are established and just before covering plants with the floating row in the fall, apply a fungicide to control leaf spots. After the covers are removed in the spring, maintain a good pest control program. Bloom sprays are important for control of both Botrytis Gray Mold and Anthracnose Fruit Rot (AFR). See the Disease Control and Insect Control sections below for materials and rates.

Harvesting

The harvest season lasts from 4 to 6 weeks. For local markets, harvest when fruit tips are red. Harvest with the plasticulture system begins earlier than harvest in the matted row system.

Renovation

Strawberries grown on plasticulture can be renovated in July and carried over for a second harvest year in cooler locations if the planting is still healthy, though there are risks to this practice. This is not recommended in warmer locations such as Virginia, and regardless of location, winter injury is more likely to occur during the second winter. Disease and insect pressure are also likely to increase substantially.

If renovation is to be undertaken, as may be desired in northern locations where fall growth was insufficient and first-year yields were low, mow tops with a rotary mower, leaving several leaves on the plant. For vigorous varieties and plantings that have thick foliage and numerous crowns, mowing, followed by crown thinning using an asparagus knife to cut away part of the plant or "breaking out" half of the plant by hand may be the most effective technique. After renovation, maintain adequate soil moisture, and insect and disease control. In early September, apply 60 lb/mulched A of N, P_2O_5, and K_2O via drip irrigation and follow the same cultural practices as for a new planting.

Berry size is usually smaller than in the first harvest season. With careful management, marketable yields of renovated beds can be equal to or greater than yields in the first harvest season. Renovation is especially useful if the planting will be harvested as a Pick-Your-Own.

Matted Row Culture

Recommended Varieties[1]

Early	Midseason		Late
AC Wendy	Allstar (VR, RSR) [2,3]	Flavorfest	AC Valley Sunset
Earliglow (RSR)[2]	Darselect[4]	Honeoye[5]	Jewel
	Keepsake (trial)		

[1]**Listed alphabetically within type**;
[2]RSR=red stele resistant; VR=Verticillium Wilt resistant.
[3]Susceptible to Angular Leaf Spot.
[4]Susceptible to Anthracnose Fruit Rot and attractive to tarnished plant bug.
[5]Becomes dark and soft under hot conditions and is not recommended for warmer locations.

Recommended Nutrients Based on Soil Tests

In addition to using the table below, check the suggestions on rate, timing, and placement of nutrients in your soil test report and Chapter B Soil and Nutrient Management. Your state's soil test report recommendations and/or your farm's nutrient management plan supersede the recommendations found below.

Matted Row Strawberry		Soil Phosphorus Level				Soil Potassium Level				
		Low	Med	High (Opt)	Very High	Low	Med	High (Opt)	Very High	
	N (lb/A)	P_2O_5 (lb/A)				K_2O (lb/A)				Nutrient Timing and Method
New Plantings[1]	110-150[2]	100	70	40		165	115	65	0	Total amount of nutrients recommended
	30	100	70	40		165	115	65	0	Broadcast and disk-in deep
	20-30	0	0	0		0	0	0	0	Sidedress 2 weeks after planting
	20-30	0	0	0		0	0	0	0	Sidedress when first runners start
	30-40	0	0	0		0	0	0	0	Topdress in mid-August
	10-20[3]	0	0	0		0	0	0	0	Topdress in spring when plants begin to grow
Established Plantings	30	100	70	40		165	115	65	0	Topdress at renovation
	20-30	100	70	40		165	115	65	0	Topdress in Mid-August
	20-30	0	0	0		0	0	0	0	Topdress in spring when plants begin to grow

[1]For new plantings, apply 1-2 lb/A of boron (B) with broadcast fertilizer; see Table B-7. for more specific recommendations. Apply 20-30 lb/A of sulfur (S) for most soils. [2]Rates are appropriate for lighter soils and should be reduced by about 25% for heavier soils in northern locations. [3]On heavier soils in northern locations, omit this application unless rainfall has been excessive.

Plants and Spacing

Use certified dormant plants packed damp in polyliners. Plant virus-free plants as early in the spring as possible. Plant in rows approximately 4 ft apart with plants 18-30 inches apart in the row. Distance will depend on variety and soil type. The approximate number of plants needed at these spacings is between 4,400 and 7,300/A.

Renovation

Strawberry plantings must be renovated annually (immediately after harvest) to thin the plants, retain vigor, and maintain berry size in subsequent years. Follow the steps below:

1. Apply 2,4-D herbicide or another selective herbicide for broadleaf weed control. Wait 7-8 days for weeds to absorb the herbicide.
2. Mow off the leaves as close to the ground as possible without damaging the crowns.
3. Narrow row widths to 12 inches using a cultivator or rototiller. Allow ½-1 inch of soil to cover the crown.
4. Apply topdressing with N, P and K (preferably based on soil test results, or as indicated in the "Recommended Nutrients" table above).
5. Apply preemergent herbicides and irrigate to incorporate fertilizer and herbicide (see Weed Control below).

Alternative Strawberry Production Systems

Low Tunnel Production

Low tunnels are a relatively low-cost means for providing protection to plants and fruit. Specific keys to success include using thin plastic (1 to 1.5-mil) designed for low tunnel use so that the plastic can be pulled taut to avoid slippage and water collection on top of the plastic and attaching the plastic securely. In general, yields are increased, and the percentage of marketable fruit increases as long as cover over the crop is maintained. Labor needs are increased per area, but not necessarily per unit of fruit obtained. This system probably has its greatest value for organic or low-spray growers and may be used with June-bearing or day-neutral cultivars. Additional information can be found in the "Low Tunnel Strawberry Production Guide" published by the University of New Hampshire and available for download online.

High Tunnel Production: In-Ground and Containerized

High tunnel production is feasible within the region, particularly in cooler areas. Production is more likely to be profitable when day-neutral varieties are grown, as they can be grown as an annual crop, and harvested for five months or longer during the planting year. June-bearers may be grown in a plasticulture system within a tunnel; however, growers often find that there are more profitable uses for the space. Plants may be grown in-ground in a plasticulture system similarly to how the plants would be grown in the field. Be aware that strawberries are very salt-sensitive, so if salts have accumulated over time, or a crop that uses relatively high fertilizer rates such as tomatoes precedes the strawberries, the subsequent strawberry crop can be damaged. In these cases, salt levels can be decreased greatly by keeping the plastic off the tunnel over the winter in years when it is being replaced.

Strawberries may be grown in containers. In containerized production, growers are experiencing some success with day-neutral varieties, particularly 'Albion'. Keys to success include using containers that are at least 6 inches deep; using a medium that has a good combination of water-holding capacity and drainage and that is sold as a high-porosity mix; planting as early as possible to encourage early fruiting, and fertigating with an appropriate complete fertilizer constant-feed for your water type at 100 ppm N if growing 'Albion'. Other cultivars, particularly 'San Andreas' and 'Sweet Ann', appear to have a lower N requirement. Resist the urge to crowd plants and leave at least 1' between plants within the row, 2' between rows, and space to walk as plants should grow quite large. Powdery mildew and two-spotted spider mites are two main issues to expect, though not everyone experiences difficulties with them. Be prepared to treat and/or release predatory mites when the first two-spotted spider mites are seen.

Greenhouse Production

Recommendations for greenhouse strawberry production in the Mid-Atlantic have not yet been developed; it is uncertain whether greenhouse strawberries can be grown profitably in this region at this time.

Use of "Stackers" for Production

Use of vertical potted systems for fruit production outdoors or in high tunnels in this region has been fraught with difficulty, in part because this type of production, which uses only natural sunlight, is better suited to lower latitudes of the country where the sun angle is higher, and more sunlight reaches the lower portions of the canopy. In our region, poor growth in the lower levels of the stack often occurs due to excessive shading from nearby rows, which results in a decreased need for water in lower sections of the stack. This unevenness in watering requirements is difficult to manage unless an extremely porous medium is used, which then has its own set of challenges due to low water-holding capacity. This is a different situation from vertical production systems used in greenhouse production.

Pollination (see also sections A 12. Pollination and D 6.3.1. Protection of Pollinators)

Honey bees and wild bees are important for proper pollination and fruit set. Avoid applying insecticides to flowers or weeds in bloom, as pollinators may be adversely affected. If an insecticide must be applied during bloom, observe the precautions for use. Bee toxicity ratings for pesticides are available in the pesticide tables below.

Weed Control

THE LABEL IS THE LAW-see the Pesticide Use Disclaimer on the first page of Chapter F.

Recommended Herbicides

1. Identify the weeds in each field and select recommended herbicides. More information is available in the "Herbicide Effectiveness on Common Weeds in Vegetables" (Table E-3) in Chapter E Pest Management.

2. Minimize herbicide resistance development. Identify the herbicide mode of action group number and follow recommended good management practices; **bolded group numbers in tables below are herbicides at higher risk for selecting resistant weed populations.** Include non-chemical weed control whenever possible.

1.A. New Planting: Soil-Applied (Preplant Incorporated or Preemergence)

Group	Product Name (*=Restricted Use)	Product Rate	Active Ingredient	Active Ingredient Rate	PHI (d)	REI (h)
5	Sinbar 80WDG	2 to 3 oz/A	**terbacil**	0.1 to 0.15 lb/A	110	12
-Apply after transplanting but before new runner plants start to root. If transplants are allowed to develop new foliage prior to application, the spray must be followed immediately by 0.5-1.0" of irrigation or rainfall to rinse the foliage, or unacceptable crop injury may result. -Controls many annual broadleaf weeds but may be weak on pigweed species. Use the lower rate on coarse-textured soils low in organic matter and higher rates on fine-textured soils and on soils with high organic matter. **Do not** apply Sinbar to soils with less than 0.5% organic matter. **Do not** add surfactant, oil concentrate, or any other spray additive, or tank mix with any other pesticide unless the mixture is approved on the Sinbar label. -Data have shown that more consistent weed control and less crop injury occurs when 0.05 lb/A terbacil (1.0 oz/A Sinbar) is applied at 3-week intervals. Begin applications 3-6 weeks after transplanting, when the strawberries have 3 new full size trifoliate leaves, but before weeds exceed 1 inch in height. -Maximum Sinbar application per season: 8.0 oz/A, unless otherwise directed on the label.						
15	Devrinol 2-XT 2EC Devrinol DF-XT 50DF	8 qt/A 8 lb/A	**napropamide**	4 lb/A	--	24
-Labeled for preplant incorporated application with plastic mulch production; apply and uniformly incorporate to a depth of 2 inches. -**Bareground** production: apply to weed-free soil immediately after transplanting. Activate with ½ inch sprinkler irrigation within 24 h after application. Irrigation moves the herbicide into the soil and prevents breakdown of Devrinol by the sun. -**Do not** apply from bloom through harvest. Primarily controls annual grasses and suppresses or controls certain annual broadleaf weeds. -Maximum for Devrinol 2-XT 2EC: 8 qt/A per season. -Maximum Devrinol DF-XT 50DF: 8 lb/A per season.						
27	Optogen 1.67	3.5 fl oz/A	**bicyclopyrone**	0.046 lb/A	30	24
-Apply after strawberry emergence or transplanting as either row middle treatment or as a directed spray with hooded or shielded sprayers. -**Contact with strawberry foliage will cause injury.** -Optogen will provide control of only a limited number of weed species, use in combination with other herbicides. -Do not make more than one application per crop year.						

1.B. New Planting: Postemergence

Group	Product Name (*=Restricted Use)	Product Rate	Active Ingredient	Active Ingredient Rate	PHI (d)	REI (h)
1	Shadow 3EC Select 2EC Select Max 0.97EC	4 to 5.33 fl oz/A 6 to 8 fl oz/A 9 to 16 fl oz/A	**clethodim**	0.07 to 0.125 lb/A	4	24
	Fusilade DX 2EC	8 to 16 fl oz/A	**fluazifop**	0.125 to 0.25 lb/A	14	12
	Poast 1.5EC	1 to 2.5 pt/A	**sethoxydim**	0.19 to 0.46 lb/A	7	12

1.B. New Planting: Postemergence, Shadow, Select, Select Max, Fusilade, Poast - continued next page

***1.B. New Planting: Postemergence, Shadow, Select, Select Max, Fusilade, Poast** - continued*

-**Select 2EC**: use crop oil concentrate (COC) at 1% v/v (1 gal/100 gal of spray solution).
Select Max 0.97EC: use nonionic surfactant (NIS) at 0.25% v/v (1 qt/100 gal of spray solution).
Shadow 3EC: use crop oil concentrate (COC) at 1% v/v (1 gal/100 gal of spray solution) for large or stressed grasses; use nonionic surfactant (NIS) at 0.25% v/v (1 qt/100 gal of spray solution) when crop safety is a concern.
Fusilade DX 2EC: use COC at 1.0% v/v or NIS at 0.25% v/v.
Poast 1.5EC: use COC at 1.0% v/v.
-**General comments:**
-The use of COC may increase the risk of crop injury when hot or humid conditions prevail. To reduce the risk of crop injury, switch to NIS when grasses are small and soil moisture is adequate. -Use lower labeled rates for annual grass control and higher labeled rates for perennial grass control. For best results, treat annual grasses when they are actively growing and before tillers are present. -Yellow nutsedge, wild onion, wild garlic, and broadleaf weeds will **not** be controlled with these herbicides. -These herbicides control many annual and certain perennial grasses. Clethodim is best on annual bluegrass; while Poast is preferred for goosegrass control. -Repeated applications may be necessary to control certain perennial grasses. If repeat applications are necessary, allow 14 days between applications. -Rainfastness is 1 h.
-**Do not** tank mix with or apply within 2 to 3 days of any other pesticide, unless labeled, as this may increase the risk of crop injury or reduce the control of grasses.
-**Do not** apply more than 8 fl oz/A of Select 2EC in a single application and **do not** exceed 32 fl oz/A for the season; **do not** apply more than 16 fl oz/A of Select Max in a single application and **do not** exceed 64 fl oz/A for the season.
-**Do not** apply more than 5.33 fl oz/A of Shadow 3EC in a single application and **do not** exceed 21.33 fl oz/A for the season.
-**Do not** apply more than 16 fl oz/A of Fusilade DX in a single application and **do not** exceed 1 pt/A per year.
-**Do not** apply more than 2.5 pt/A Poast in a single application and **do not** exceed 2.5 pt/A for the season.

5	Sinbar 80WDG	2 to 6 oz/A	**Terbacil**	0.1 to 0.3 lb/A	110	12

-Apply in late summer or early fall to control winter annual broadleaf weeds. If the crop is not dormant at the time of application, the spray must be followed immediately by 0.5-1.0 inches of irrigation or rainfall to rinse the strawberry foliage, or unacceptable crop injury may result. Controls many annual broadleaf weeds but may be weak on pigweed species.
-Use the lower rate on coarse-textured soils low in organic matter and higher rates on fine-textured soils and on soils with high organic matter. **Do not** apply Sinbar to soils with less than 0.5% organic matter.
-**Do not** add surfactant, oil concentrate, or any other spray additive, or tank mix with any other pesticide unless the mixture is approved on the Sinbar label.
-Maximum Sinbar application per season: 8.0 oz/A, unless otherwise directed on the label.

27	Optogen 1.67	3.5 fl oz/A	**bicyclopyrone**	0.046 lb/A	30	24

- Use nonionic surfactant (NIS) at 0.25% v/v (1qt/100 gal of spray solution) or crop oil concentrate (COC) at 1% v/v (1 gal/100 gal of spray solution). Ammonium sulfate (AMS) at 8.5 to 17 lb/100 gal spray solution may be added for improved control of emerged weeds
-Apply either as row middle treatment or as a directed spray with hooded or shielded sprayers.
-**Contact with strawberry foliage will cause injury.**
-Apply to small weeds (less than 2" tall).
Optogen provides control for only a few weed species, should be used in combination with other herbicides.
-Rainfastness is not specified on the label. -Do not make more than one application per year.

1.C. New Planting: Late Fall Dormant

Group	Product Name (*=Restricted Use)	Product Rate	Active Ingredient	Active Ingredient Rate	PHI (d)	REI (h)
1	Shadow 3EC Select 2EC Select Max 0.97EC	4 to 5.33 fl oz/A 6 to 8 fl oz/A 9 to 16 fl oz/A	**clethodim**	0.07 to 0.125 lb/A	4	24
	Fusilade DX 2EC	8 to 16 fl oz/A	**fluazifop**	0.125 to 0.25 lb/A	14	12
	Poast 1.5EC	1 to 2 pt/A	**sethoxydim**	0.19 to 0.38 lb/A	7	12
-See Shadow 3EC, Select 2EC, Select Max 0.97EC, Fusilade DX, and Poast 1.5EC in listing under "New Planting: Postemergence"						
5	Sinbar 80WDG	2 to 4 oz/A	**Terbacil**	0.1 to 0.2 lb/A	110	12

-Apply just prior to mulching in late fall to extend weed control through harvest the following spring. Controls many annual broadleaf weeds but may be weak on pigweed species. Use the lower rate on coarse-textured soils low in organic matter and higher rates on fine-textured soils and on soils with high organic matter.
-**Do not** apply Sinbar to soils with less than 0.5% organic matter.
-**Do not** add surfactant, oil concentrate, or any other spray additive, or tank mix with any other pesticide unless the mixture is approved on the Sinbar label. Maximum Sinbar application per season: 8.0 oz/A, unless otherwise directed on the label.

15	Devrinol 2-XT 2EC Devrinol DF-XT 50DF	8 qt/A 8 lb/A	**napropamide**	4 lb/A	--	24

-Apply in late fall through early winter (not on frozen ground) or in early spring. Activate with ½ inch sprinkler irrigation within 24 h after application. Irrigation moves the herbicide into the soil and prevents breakdown of Devrinol by the sun.
-Primarily controls annual grasses and suppresses or controls certain annual broadleaf weeds.
-Maximum for Devrinol 2-XT 2EC: 8 qt/A per season. Maximum Devrinol DF-XT 50DF: 8 fl oz/A per season.

2.A. Bearing Year: Late Winter or Early Spring

Group	Product Name (*=Restricted Use)	Product Rate	Active Ingredient	Active Ingredient Rate	PHI (d)	REI (h)
1	Shadow 3EC Select 2EC Select Max 0.97EC	4 to 5.33 fl oz/A 6 to 8 fl oz/A 9 to 16 fl oz/A	**clethodim**	0.07 to 0.125 lb/A	4	24
	Fusilade DX 2EC	8 to 16 fl oz/A	**fluazifop**	0.125 to 0.25 lb/A	14	12
	Poast 1.5EC	1 to 2 pt/A	**sethoxydim**	0.2 to 0.4 lb/A	7	12
-See Shadow 3EC, Select 2EC, Select Max 0.97EC, Fusilade DX, and Poast 1.5EC in listing under "New Planting: Postemergence"						
4	Weedar 64	1 to 1.5 qt/A	**2,4-D amine**	0.95 to 1.4 lb acid equivalent/A	--	48
-Apply to established stands in late winter or early spring when the strawberries are dormant. -**Do not** apply 2,4-D between mid-August and winter dormancy, as it may affect flower bud formation, resulting in distorted berries. -**Do not** apply unless possible injury to the crop is acceptable. Controls many broadleaf weeds. -Rainfastness is 6 to 8 h. -Maximum number of applications per year is 1 and **do not** exceed 1.5 qt/A per application.						
4	Stinger 3SL/ Spur 3SL	5.3 to 10.5 fl oz/A	**clopyralid**	0.125 to 0.25 lb/A	30	12
-Spur is labeled in all states. Use is for perennial strawberries only. Only one application allowed per year at a rate up to 10.5 fl oz/A. -**Special Local Needs Label 24(c) for the use of Stinger to control broadleaf weeds in strawberries in NJ, MD, PA, and VA (no expiration date).** -Apply Stinger in 1 or 2 applications. When 2 applications are used to control susceptible hard-to-kill perennial weeds, spray the first application at least 30 days before harvest and the second application at renovation, after harvest -Controls weeds in the Composite and Legume families, including annuals (galinsoga, ragweed species, common cocklebur, groundsel, pineappleweed, clover, and vetch) and perennials (Canada thistle, goldenrod species, aster species, and mugwort). -Use Stinger at 5.3 fl oz/A to control annual weeds less than 3 inches tall. Increase the rate to 5.3 to 10.5 fl oz/A to control larger annual weeds. Apply the maximum rate of 10.5 fl oz/A (in 1 or split into 2 applications) to suppress or control perennial weeds. -**Do not** tank mix Stinger with other herbicides registered for use in strawberries. -**Do not** use Stinger with surfactants. -Stinger is a postemergence herbicide with residual soil activity. Observe crop restrictions or injury may occur from carryover. -Rainfastness is 6 h. -Maximum Stinger application per year: 10.5 fl oz/A.						
14	Chateau 51WDG Chateau EZ 4SC	3 oz/A 3 fl oz/A	**flumioxazin**	0.096 lb/A	--	12
-Apply to established stands of matted row strawberries in late winter or early spring when strawberries are dormant, or as a hooded or shielded spray between the rows of strawberries on plastic mulch before fruit set. -Controls many annual broadleaf weeds and suppresses or controls wild pansy. -Tank mix with 2,4-D to improve the spectrum of weeds controlled when treating dormant matted row strawberries, or tank mix with Gramoxone when applying a hooded or shielded spray between the rows of strawberries grown on plastic mulch. Crop oil concentrate at 1% v/v or nonionic surfactant at 0.25% v/v may be added to improve the control of emerged weeds but may also increase the risk of crop injury. -Maximum for Chateau: 3 oz/A per application, 3 oz/A per season.						
15	Devrinol 2-XT 2EC Devrinol DF-XT 50DF	8 qt/A 8 lb/A	**napropamide**	4 lb/A	--	24
-Apply in late fall through early winter (not on frozen ground) or in early spring. **Do not** apply from bloom through harvest -Activate with ½ inch sprinkler irrigation within 24 h after application. Irrigation moves the herbicide into the soil and prevents breakdown of Devrinol by the sun. -Primarily controls annual grasses and suppresses or controls certain annual broadleaf weeds; will not control emerged weeds. -Maximum for Devrinol 2-XT 2EC: 8 qt/A per season. -Maximum Devrinol DF-XT 50DF: 8 fl oz/A per season.						
27	Optogen 1.67	3.5 fl oz/A	**bicyclopyrone**	0.046 lb/A	30	24
-See Optogen 1.67 in listing under "New Planting-Postemergence"						

2.B. Bearing Year: Renovation-Summer

Group	Product Name (*=Restricted Use)	Product Rate	Active Ingredient	Active Ingredient Rate	PHI (d)	REI (h)
1	Shadow 3EC Select 2EC Select Max 0.97EC	4 to 5.33 fl oz/A 6 to 8 fl oz/A 9 to 16 fl oz/A	**clethodim**	0.07 to 0.125 lb/A	4	24
	Fusilade DX 2EC	8 to 16 fl oz/A	**fluazifop**	0.125 to 0.25 lb/A	14	12
	Poast 1.5EC	1 to 2 pt/A	**sethoxydim**	0.2 to 0.4 lb/A	7	12
-See Shadow 3EC, Select 2EC, Select Max 0.97EC, Fusilade DX, and Poast 1.5EC in listing under "New Planting: Postemergence"						
4	Weedar 64	1 to 1.5 qt/A	**2,4-D amine**	0.95 to 1.4 lb acid equivalent/A	--	48
-**Do not** apply 2,4-D between mid-August and winter dormancy, as it may affect flower bud formation, resulting in distorted berries. -**Do not** apply unless possible injury to the crop is acceptable. Controls many broadleaf weeds. -Rainfastness is 6 to 8 h. -Maximum number of applications per year is 1 and **do not** exceed 1.5 qt/A per application.						

2.B. Bearing Year: Renovation-Summer - continued next page

2.B. Bearing Year: Renovation-Summer *- continued*

4	Stinger 3SL / Spur 3SL	5.3 to 10.5 fl oz/A	**clopyralid**	0.125 to 0.25 lb/A	30	12
-Spur is labeled in all states. Use is for perennial strawberries only. Only one application allowed per year at a rate up to 10.5 fl oz/A. -**Special Local Needs Label 24(c) for the use of Stinger to control broadleaf weeds in strawberries in NJ, MD, PA, and VA (no expiration date).** Apply Stinger in 1 or 2 applications. When 2 applications are used to control susceptible hard-to-kill perennial weeds, spray the first application at least 30 days before harvest and the second application at renovation, after harvest -Controls weeds in the Composite and Legume families, including annuals (galinsoga, ragweed species, common cocklebur, groundsel, pineappleweed, clover, and vetch) and perennials (Canada thistle, goldenrod species, aster species, and mugwort). -Use 5.3 fl oz/A to control annual weeds less than 3 inches tall. Increase the rate to 5.3 to 10.5 fl oz/A to control larger annual weeds. Apply the maximum rate of 10.5 fl oz/A (in 1 or split into 2 applications) to suppress or control perennial weeds. -**Do not** tank mix Stinger with other herbicides registered for use in strawberries. **Do not** use Stinger with surfactants. -Stinger is a postemergence herbicide with residual soil activity. Observe crop restrictions or injury may occur from carryover. -Rainfastness is 6 h. -Maximum Stinger application per year: 10.5 fl oz/A.						
5	Sinbar 80WDG	4 to 8 oz/A	**terbacil**	0.2 to 0.4 lb/A	110	12
-Apply at postharvest renovation after old leaves have been removed but before new growth begins. -Controls many annual broadleaf weeds but may be weak on pigweed species. Use the lower rate on coarse-textured soils low in organic matter and higher rates on fine-textured soils and on soils with high organic matter. **Do not** apply Sinbar to soils with less than 0.5% organic matter. -**Do not** add surfactant, oil concentrate, or any other spray additive, or tank mix with any other pesticide unless the mixture is approved on the Sinbar label. -Maximum Sinbar application per season: 8.0 oz/A, unless otherwise directed on the label.						
22	Gramoxone SL 3.0*	1.3 pt/A	**paraquat**	0.5 lb/A	21	24
-Apply as a directed shielded spray to control emerged weeds between the rows after crop establishment. Add nonionic surfactant to be 0.25% of the spray solution (1.0 qt/100 gal of spray solution). **Do not** allow spray or spray drift to contact the crop (use shields) or injury may result. **Do not** exceed a spray pressure of 30 psi. See the label for additional information and warnings. -Rainfastness 30 min. A maximum of 3 applications per year are allowed. -***Restricted-use pesticide***. Only certified applicators, who successfully complete the paraquat-specific training, can mix, load, or apply paraquat. Application of paraquat "under the direct supervision" of a certified applicator is no longer allowed. Required training link (*https://campus.extension.org/enrol/index.php?id=2201*); certified applicators must repeat training every three years.						

2.C. Established Planting: Late Fall Dormant

Group	Product Name (*=Restricted Use)	Product Rate	Active Ingredient	Active Ingredient Rate	PHI (d)	REI (h)
1	Shadow 3EC Select 2EC Select Max 0.97EC	4 to 5.33 fl oz/A 6 to 8 fl oz/A 9 to 16 fl oz/A	**clethodim**	0.07 to 0.125 lb/A	4	24
	Fusilade DX 2EC	8 to 16 fl oz/A	**fluazifop**	0.125 to 0.25 lb/A	14	12
	Poast 1.5EC	1 to 2 pt/A	**sethoxydim**	0.2 to 0.4 lb/A	7	12
-See Shadow 3EC, Select 2EC, Select Max 0.97EC, Fusilade DX, and Poast 1.5EC in listing under "New Planting: Postemergence"						
5	Sinbar 80WDG	4 to 8 oz/A	**terbacil**	0.2 to 0.4 lb/A	110	12
-Apply just prior to mulching in late fall to extend weed control through harvest the following spring. Controls many annual broadleaf weeds but may be weak on pigweed species. Use the lower rate on coarse-textured soils low in organic matter and higher rates on fine-textured soils and on soils with high organic matter. **Do not** apply Sinbar to soils with less than 0.5% organic matter. -**Do not** add surfactant, oil concentrate, or any other spray additive, or tank mix with any other pesticide unless the mixture is approved on the Sinbar label. -Maximum Sinbar application per season: 8.0 oz/A, unless otherwise directed on the label.						
15	Devrinol 2-XT 2EC Devrinol DF-XT 50DF	8 qt/A 8 lb/A	**napropamide**	4 lb/A	--	24
-Apply in late fall through early winter (not on frozen ground) or in early spring. **Do not** apply from bloom through harvest -Activate with ½ inch sprinkler irrigation within 24 h after application. Irrigation moves the herbicide into the soil and prevents breakdown of Devrinol by the sun. Primarily controls annual grasses and suppresses or controls certain annual broadleaf weeds. -Maximum for Devrinol 2-XT 2EC: 8 qt/A per season. -Maximum Devrinol DF-XT 50DF: 8 fl oz/A per season.						
27	Optogen 1.67	3.5 fl oz/A	**bicyclopyrone**	0.046 lb/A	30	24
-See Optogen 1.67 in listing under "New Planting-Postemergence"						

3. Other Labeled Herbicides

These products are labeled but limited local data are available; and/or are labeled but not recommended in our region due to potential crop injury concerns.

Group	Product Name (*=Restricted Use)	Active Ingredient
3	Prowl H2O	**pendimethalin**
14	Ultra Blazer	**acifluorfen**
14	Aim (hooded or directed application only)	**carfentrazone**
14	Spartan	**sulfentrazone**
14	Zeus	**sulfentrazone**

Insect Control

THE LABEL IS THE LAW-see the Pesticide Use Disclaimer on the first page of Chapter F.

Recommended Insecticides

Note: For **premixes**, the group number (representing the mode of action) and active ingredient that contributes the most to control is generally listed first. In some cases, only one ingredient in a premix provides control.

Aphids, Spittlebugs

Aphids can vector viruses into a planting, thus tolerance for these pests is low. Aphids are usually found in the crown area on tender new growth. Spittlebugs are primarily a nuisance for harvesters and are more common in weedy fields; thus, controlling weeds in the planting can help with minimizing this pest.

Apply one of the following formulations 10 days after new growth begins or in the fall if aphids appear then:						
Group	**Product Name (*=Restricted Use)**	**Product Rate**	**Active Ingredient(s)**	**PHI (d)**	**REI (h)**	**Bee TR**
3A	Brigade 10WSB* Brigade eVo	6.4 to 32 oz/A 2.56 to 12.8 fl oz/A	bifenthrin	0	12	H
3A	Danitol 2.4EC*	10.67 fl oz/A	fenpropathrin - **spittlebugs**	2	24	H
3A	Danitol 2.4EC*	16 to 21.3 fl oz/A	fenpropathrin - **aphids**	2	24	H
3A	PyGanic EC 5.0 II (OMRI)	4.5 to 15.6 fl oz/A	pyrethrins - **aphids**	0	12	H
3A + 28	Elevest*	9.6 to 14.1 fl oz/A	bifenthrin + chlorantraniliprole	1	12	H
4A	Actara 25WDG	1.5 to 3.0 oz/A	thiamethoxam - **aphids**	3	12	H
4A	Admire Pro 4.6SC	1.3 fl oz/A	imidacloprid - **foliar**	7	12	H
4A	Admire Pro 4.6SC	10.5 to 14 fl oz/A	imidacloprid - **soil, aphids**	14	12	H
4A	Assail 30SG	1.9 to 4.0 oz/A	acetamiprid	1	12	M
4A	Assail 30SC	1.6 to 3.4 fl oz/A	acetamiprid	1	12	M
4A + 15	Cormoran 1.51DC	9.0 to 12.0 fl oz/A	acetamiprid + novaluron	1	12	M
4D	Sivanto Prime 1.67SL	7.0 to 14.0 fl oz/A	flupyradifurone - **aphids**	0	4	M
21A	Apta 1.34SC	27 fl oz/A	tolfenpyrad - **aphids**	1	12	H
29	Beleaf 50SG	2.8 oz/A	flonicamid - **aphids**	0	12	L
UNE	M-Pede (OMRI)	1 - 2% v/v	potassium salts of fatty acids	0	12	L
UN	Azatin O, Aza-Direct, Ecozin Plus, Neemix (OMRI)	Refer to individual labels for rates	azadirachtin	0	4	L

Cyclamen Mites

See below, after Two-Spotted Spider Mites.

Leafrollers

Leafrollers are a sporadic pest in most of the region. Treatment is usually not required.

The following formulations are available. Apply one spray 10 days after full bloom:						
Group	**Product Name (*=Restricted Use)**	**Product Rate**	**Active Ingredient(s)**	**PHI (d)**	**REI (h)**	**Bee TR**
3A	Brigade 10WSB* Brigade eVo*	6.4 to 32.0 oz/A 2.56 to 12.8 fl oz/A	bifenthrin	0	12	H
3A	Danitol 2.4EC*	16 to 21.3 fl oz/A	fenpropathrin	2	24	H
3A	PyGanic EC 5.0 II (OMRI)	4.5 to 15.6 fl oz/A	pyrethrins	0	12	H
5	Radiant 1SC	6.0 to 10.0 fl oz/A	spinetoram	1	4	H
5	Entrust 2SC (OMRI)	4.0 to 6.0 fl oz/A	spinosad	1	4	H
11A	DiPel DF (OMRI)	0.5 to 2.0 lb/A	*Bacillus thuringiensis kurstaki*	0	4	N
21A	Apta 1.34SC	27 fl oz/A	tolfenpyrad	1	12	H
28	Verdepryn 100SL	8.2 to 11.0 fl oz/A	cyclaniliprole	1	4	H
28 + 3A	Elevest*	7.0 to 14.1 fl oz/A	chlorantraniliprole + bifenthrin	1	12	H
UN	Azatin O, Aza-Direct, Ecozin Plus, Neemix (OMRI)	Refer to individual labels for rates	azadirachtin	0	4	L

Potato Leafhoppers

Potato leafhoppers cause leaf yellowing and distortion. There are no effective cultural controls, though damage may be worse after neighboring fields or weedy patches are mowed as leafhoppers will move to strawberry plants. *(continued next page)*

Potato Leafhoppers *- continued*

Apply one of the following formulations:						
Group	**Product Name (*=Restricted Use)**	**Product Rate**	**Active Ingredient(s)**	**PHI (d)**	**REI (h)**	**Bee TR**
1B	Malathion 57EC	1.5 to 3.0 pt/A	malathion	3	12	H
3A	Danitol 2.4EC*	16.0 to 21.3 fl oz/A	fenpropathrin	2	24	H
3A	PyGanic EC 5.0 II (OMRI)	4.5 to 15.6 fl oz/A	pyrethrins	0	12	H
4A	Actara 25WDG	1.5 to 3.0 oz/A	thiamethoxam	3	12	H
4A	Assail 30SG	1.9 to 4.0 oz/A	acetamiprid	1	12	M
4A	Assail 30SC	1.6 to 3.4 fl oz/A	acetamiprid	1	12	M
4A + 15	Cormoran 1.51DC	9.0 to 12.0 fl oz/A	acetamiprid + novaluron	1	12	M
4A + 28	Voliam Flexi 40WDG	2.0 to 4.0 oz/A	thiamethoxam + chlorantraniliprole	3	12	H

Root Weevils

Several species can damage strawberry plants; damage is often worst near wooded field edges. Generally, it is only problematic in matted-row plantings. Watch for characteristic leaf notching as a sign of active adults. Larvae should be targeted with a soil application in mid-summer.

Apply one of the following formulations (note: foliar sprays target adults, soil applications target larvae):						
Group	**Product Name (*=Restricted Use)**	**Product Rate**	**Active Ingredient(s)**	**PHI (d)**	**REI (h)**	**Bee TR**
n/a	Entomopathogenic nematodes[1]	see footnote	see footnote	--	--	--
1B	Malathion 57EC	1.5 to 3.0 pt/A	malathion **- adults**	3	12	H
3A	Brigade 10WSB* Brigade eVo*	8.0 to 32.0 oz/A 3.2 to 12.8 fl oz/A	bifenthrin - **adults**	0	12	H
3A	Danitol 2.4EC*	16.0 to 21.3 fl oz/A	fenpropathrin - **adults**	2	24	H
3A + 28	Elevest*	5.6 to 14.1 fl oz/A	bifenthrin + chlorantraniliprole	1	12	H
4A	Actara 25WDG	4.0 oz/A	thiamethoxam - **foliar, adults**	3	12	H
4A	Platinum 75SG	1.70 to 4.01 oz/A	thiamethoxam **- soil, larvae**	50	12	H

[1]Entomopathogenic nematodes (use *Heterorhabditis bacteriophora*). Apply 1-2 billion/A during evening or early morning when soil temperatures are at or above 60°F (16°C), then irrigate them into the soil.

Sap Beetles

Sap beetles are attracted to ripe, decaying fruit and bore into berries. They are a nuisance, especially in pick-your-own fields when rotting, over-ripe berries abound. Preventing the accumulation of decaying fruit on or between beds is one way of avoiding beetle buildup. Sprays may not reach adults which are protected under the berries. Sprays that target larvae should be applied when adults are first noticed.

Apply one of the following formulations:						
Group	**Product Name (*=Restricted Use)**	**Product Rate**	**Active Ingredient(s)**	**PHI (d)**	**REI (h)**	**Bee TR**
3A	Brigade 10WSB* Brigade eVo*	6.4 to 32.0 oz/A 2.56 to 12.8 fl oz/A	bifenthrin - **adults**	0	12	H
3A	Danitol 2.4EC*	16.0 to 21.3 fl oz/A	fenpropathrin - **adults**	2	24	H
3A + 28	Elevest*	5.6 to 14.1 fl oz/A	bifenthrin + chlorantraniliprole	1	12	H
4A	Assail 30SG	4.0 to 6.9 oz/A	acetamiprid - **adults**	1	12	M
4A	Assail 30SC	3.4 to 5.8 fl oz/A	acetamiprid - **adults**	1	12	M
4A + 15	Cormoran 1.51DC	12.0 fl oz/A	acetamiprid + novaluron - **adults and larvae**	1	12	M
15	Rimon 0.83EC	6.0 to 12.0 fl oz/A	novaluron - **only affects larvae**	1	12	M

Slugs

Slugs prefer a cool, wet, dark environment, and mulch, weeds, and other plant trash in beds during a wet spring provide the perfect setting. Mulch removal and adequate weed control help reduce the slug population.

Apply one of the following formulations:						
Group	**Product Name (*=Restricted Use)**	**Product Rate**	**Active Ingredient(s)**	**PHI (d)**	**REI (h)**	**Bee TR**
n/a	Deadline Bullets	up to 25 lb/A	metaldehyde	0	12	N
n/a	Sluggo (OMRI)	20.0 to 44.0 lb/A	iron phosphate	0	0	N
n/a	Bug-N-Sluggo (OMRI)	20.0 to 44.0 lb/A	iron phosphate + spinosad	1	4	N

Spotted Wing Drosophila

Spoted Wing Drosophila are mainly problematic on day-neutral strawberries during late summer and fall but can be an issue for very late cultivars of June-bearers. Choosing varieties and production methods that result in an early season harvest can help with avoiding this pest especially in cooler locations. Harvesting cleanly and frequently as well as refrigerating the fruit right after harvest can help with minimizing damage.

Apply one of the following formulations:						
Group	**Product Name (*=Restricted Use)**	**Product Rate**	**Active Ingredient(s)**	**PHI (d)**	**REI (h)**	**Bee TR**
3A	Danitol 2.4EC*	16.0 fl oz/A	fenpropathrin	3	24	H
3A	PyGanic EC 5.0 II (OMRI)	4.5 to 15.6 fl oz/A	pyrethrins	0	12	H
4A + 15	Cormoran 1.51DC	12 fl oz/A	acetamiprid + novaluron	1	12	M
5	Radiant 1SC	6 to 10 fl oz/A	spinetoram	1	4	H
28	Exirel 0.83SE	13.5 to 20.5 fl oz/A	cyantraniliprole	1	12	H
28	Verdepryn 100SL	8.2 to 11.0 fl oz/A	cyclaniliprole	1	4	H
--	Grandevo WDG (OMRI)	2 to 3 lb/A	*Chromobacterium subtsugae* strain PRAA4-1T and spent fermentation media	0	4	H

Strawberry Rootworms

Adults are small brown beetles that hide quickly and feed at night. Watch for circular or oval holes in leaves and weak growth, which may indicate a high population. Insecticides applied in summer when new damage appears will assist in preventing egg-laying and subsequent root feeding by larvae. Broad-spectrum foliar insecticides are effective against adults.

Strawberry Bud Weevils (Strawberry Clippers)

Generally, only problematic in older matted-row plantings near wooded areas where populations build over time.

Apply one of the following formulations after new growth starts and before fruit buds are visible. Repeat 10 days later:						
Group	**Product Name (*=Restricted Use)**	**Product Rate**	**Active Ingredient(s)**	**PHI (d)**	**REI (h)**	**Bee TR**
3A	Brigade 10WSB*	6.4 to 32 oz/A	bifenthrin	0	12	H
3A	Danitol 2.4EC*	16.0 to 21.3 fl oz/A	fenpropathrin	2	24	H
3A	PyGanic EC 5.0 II (OMRI)	4.5 to 15.6 fl oz/A	pyrethrins	0	12	H
3A + 28	Elevest*	7.0 to 14.1 fl oz/A	bifenthrin + chlorantraniliprole	1	12	H

Tarnished Plant Bugs (Lygus)

Damage from feeding causes a condition known as “button-berry” where the tip of the berry fails to expand, and seeds are concentrated. Damage is worse on mid to late season June-bearers, as a second generation emerges as these berries are forming and also on day-neutral varieties in summer and fall. Attracted to weeds and certain cultivars of strawberries. Populations may increase rapidly in strawberry fields if nearby vegetation is mowed. Keep nearby weeds under control and avoid mowing nearby vegetation during bloom and harvest.

Apply one of the following formulations:						
Group	**Product Name (*=Restricted Use)**	**Product Rate**	**Active Ingredient(s)**	**PHI (d)**	**REI (h)**	**Bee TR**
1B	Malathion 57EC	1.5 to 3.0 pt/A	malathion	3	12	H
3A	Brigade 10WSB* Brigade eVo*	6.4 to 32.0 oz/A 2.56 to 6.4 fl oz/A	bifenthrin	0	12	H
3A	Danitol 2.4EC*	10.67 fl oz/A	fenpropathrin	2	24	H
3A	PyGanic EC 5.0 II (OMRI)	4.5 to 15.6 fl oz/A	pyrethrins	0	12	H
3A + 28	Elevest*	9.6 to 14.1 fl oz/A	bifenthrin + chlorantraniliprole	1	12	H
4A	Assail 30SG	4.0 to 6.9 oz/A	acetamiprid	1	12	M
4A	Assail 30SC	3.4 to 5.8 fl oz/A	acetamiprid	1	12	M
4A + 15	Cormoran 1.51DC	12.0 fl oz/A	acetamiprid + novaluron	1	12	M
4C	Transform 50WG	1.5 to 2.25 oz/A	sulfoxaflor	1	24	H
21A	Apta 1.34SC	27.0 fl oz/A	tolfenpyrad	1	12	H
29	Beleaf 50SG	2.8 oz/A	flonicamid	0	12	L
UN	Azatin O, Aza-Direct, Ecozin Plus, Neemix (OMRI)	Refer to individual labels for rates	azadirachtin	0	4	L

Thrips

Thrips cause bronzing of berries due to surface scarring of the fruit and may cause seeds to appear raised if the berry surface is sufficiently scarred. Avoid growing strawberries near greenhouses and flowering weeds where populations of thrips may be high.

Apply one of the following formulations:						
Group	**Product Name (*=Restricted Use)**	**Product Rate**	**Active Ingredient(s)**	**PHI (d)**	**REI (h)**	**Bee TR**
4A[1]	Assail 30SG	4.0 to 6.9 oz/A	acetamiprid	1	12	M
4A[1]	Assail 30SC	3.4 to 5.8 fl oz/A	acetamiprid	1	12	M
4A + 15	Cormoran 1.51DC	12.0 fl oz/A	acetamiprid + novaluron	1	12	M
5	Entrust 2SC (OMRI)	4.0 to 6.0 fl oz/A	spinosad	1	4	H
5	Radiant 1SC[2]	6.0 to 10.0 fl oz/A	spinetoram	1	4	H
15	Rimon 0.83EC (only affects larvae)	6.0 to 12.0 fl oz/A	novaluron	1	12	M
21A	Apta 1.34SC	27 fl oz/A	tolfenpyrad	1	12	H
UN	Azatin O, Aza-Direct, Ecozin Plus, Neemix (OMRI)	Refer to individual labels for rates	azadirachtin	0	4	L

[1]**Resistance concerns with tobacco thrips.** [2]Adjuvant recommended, see label.

Two-Spotted Spider Mites (TSSM)

Scout for TSSM and especially watch for leaf stippling which is an indication of a high population. Populations can build under row covers over the winter, so a treatment before row covers are applied may be warranted if mites are present. Thorough under leaf spray coverage is necessary. For resistance management, alternate materials with different modes of action. Use of broad-spectrum insecticides can kill off natural predators resulting in flare-ups of pest mites. In situations where pesticides are only minimally used or avoided, releases of predatory mites can be effective if used before populations get out of hand. If using predatory mites, avoid broad spectrum insecticides, especially pyrethroids (group 3A).

Apply one of the following formulations:						
Group	**Product Name (*=Restricted Use)**	**Product Rate**	**Active Ingredient(s)**	**PHI (d)**	**REI (h)**	**Bee TR**
6	Agri-Mek 0.7SC*[1]	3.5 fl oz/A	abamectin	3	12	H
10A	Savey 50DF[2]	6.0 oz/A	hexythiazox - **immatures**	3	12	N
10B	Zeal Miticide 72WSP[2]	2.0 to 3.0 oz/A	etoxazole - **immatures**	1	12	L
20B	Kanemite 15SC	21.0 to 31.0 fl oz/A	acequinocyl	1	12	L
20D	Acramite 50WS	0.75 to 1.0 lb/A	bifenazate	1	12	M
21A	Nexter 75WP	4.4 to 10.67 oz/A	pyridaben	1	12	H
21A	Nexter 3.75SC	7.5 to 17.0 oz/A	pyridaben	1	12	H
21A	Portal 0.4EC	2.0 pt/A	fenpyroximate	1	12	L
21A	Magister 1.7SC	32.0 to 36.0 fl oz/A	fenazaquin	1	12	H
23	Oberon 2SC	16.0 fl oz/A	spiromesifen	3	12	M
25A	Nealta 1.67SC	13.7 fl oz/A	cyflumetofen	1	12	L
UNE	Organic JMS Stylet Oil (OMRI)	3 qt/100 gal	paraffinic oil	0	4	L
UNE	M-Pede (OMRI)	1 - 2% v/v	potassium salts of fatty acids	0	12	L

[1]Use of a non-sticker adjuvant is required.
[2] Effective on eggs and immature stages but has little effect on adults.

Cyclamen Mites

Thorough coverage in the crown area is necessary. Sprays are best applied when foliage is minimal (early spring or renovation), and in high volumes of water directed to the crown. Predatory mites are effective if released when cyclamen mite populations are still low and confined to “hot spots”, and before cool temperatures occur in fall.

Apply one of the following formulations:						
Group	**Product Name (*=Restricted Use)**	**Product Rate**	**Active Ingredient(s)**	**PHI (d)**	**REI (h)**	**Bee TR**
6	Agri-Mek 0.7SC*[1]	3.5 fl oz/A	abamectin	3	12	H
21A	Portal 0.4EC	2.0 pt/A	fenpyroximate	1	12	L

[1]Use of a non-sticker adjuvant is required.

Disease Control

THE LABEL IS THE LAW-see the Pesticide Use Disclaimer on the first page of Chapter F. Recommended Fungicides (State registration may vary for use of some fungicides in strawberry.)

Nematodes The main nematode of concern in strawberry production is lesion nematodes, which are known to be associated with the black root rot complex. See sections E 1.5. Soil Fumigation and E 1.6. Nematode Control.

Dip Treatments for New Plantings

Only use products registered as plant dips to control diseases just before planting. Root dip waste needs to be disposed of properly.

For Phytophthora Crown and Root Rot management Treatment is most likely to be needed if planting Phytophthora-susceptible cultivars (*e.g.*, Sweet Charlie), especially if the field history includes strawberries. Avoid poorly-drained sites. Use one of the following and dip plants for 15 to 30 minutes[1], then plant as quickly as possible (within 24 hours). See individual diseases below for additional treatments that may be applied after planting and through harvest.

FRAC Code	Product Name (*=Restricted Use)	Rate (pre-plant dip)	Active Ingredient(s)	PHI (d)	REI (h)	Bee TR
P07	Aliette 80WDG[2]	2.5 lb/100 gal water	fosetyl-Al	0.5	24	N
P07	ProPhyt	2.0 pt/100 gal water	phosphite salts	0	4	N
P07	Phostrol	2.5 pt/100 gal water	phosphite salts	n/a	4	N
P07	K-Phite 7LP	1-2 qt/100 gal water	phosphite salts	0	4	N
P07	Fungi-Phite	1 qt/100 gal water	phosphite salts	n/a	4	N

[1]Detailed instructions may vary with the fungicides; refer to the product label for confirmation.
[2]Not all products with this formulation are labeled for use on strawberries.

For Anthracnose Crown Rot (ACR) management If planting susceptible cultivars (*e.g.*, Chandler, Camarosa, others) that are known or strongly suspected to have latent infections, use one of the following as a dip and see sections below for additional treatments that may be used. Use these dip treatments only if planting materials are suspected to have ACR. Dip plants for 2 to 5 minutes, then plant as quickly as possible. Abound has been effective in the past, but about 90% of isolates of the ACR-causing fungus exhibit resistance to category 11 fungicides. The dip treatment with Switch or Abound, if these products are still effective on your farm, may also reduce the inoculum available to cause Anthracnose Fruit Rot (AFR) during fruit ripening. See individual diseases below for additional treatments that may be applied after planting and through harvest.

FRAC Code	Product Name (*=Restricted Use)	Rate (pre-plant dip)	Active Ingredient(s)	PHI (d)	REI (h)	Bee TR
9 + 12	Switch 62.5WG	5.0 to 8.0 oz/100 gal water	cyprodinil + fludioxonil	0	12	L
11	Abound 2.08F	5.0 to 8.0 oz/100 gal water	azoxystrobin	0	4	N

Bacterial and Fungal Diseases

Diseases are categorized below by the plant parts where symptoms are most commonly found and first noticed. However, many diseases affect more than one part of the plant; instances where this occurs are mentioned under individual diseases below.

Fruit Rots

Anthracnose Fruit Rot (*Colletotrichum acutatum* species complex)

Anthracnose Fruit Rot (AFR), caused by *C. nymphaeae* (mostly) belonging to *C. acutatum* species complex, is a major disease in strawberries. Nursery transplants latently infected with *C. acutatum* are thought to be the primary source of inoculum. The pathogen is mainly dispersed by rain or water-splash. Any production system, such as tunnels, that can keep the rain off the plants will certainly reduce disease incidence.

If plants are diagnosed with Anthracnose, fungicides need to be applied immediately. Keep in mind that FRAC 11 fungicides offer better efficacy for Anthracnose control than fungicides in other categories, however, resistance is a concern (frequency of resistance is about 30 to 50% in the AFR pathogen). Note that control efficacy can be

substantially lower when 10% of the isolates obtained from any given field are resistant. Captan and products containing fludioxonil (Switch or Miravis Prime) have good efficacy when resistance is suspected against FRAC 11 products. Thiram also offers some efficacy and may be useful early in the season. Certain FRAC code 3 fungicides containing difenoconazole (*e.g.*, Inspire) and propiconazole (*e.g.*, Tilt) are also effective. Except for Captan or Thiram, try not to apply the same FRAC code products more than twice in a row or a season. Maintain continuous coverage of Captan or Thiram, and tank mix with a site-specific fungicide, such as Switch or Tilt, when disease pressure is high.

High risk can be estimated with weather-based models as recommended by the Strawberry Advisory System (*http://agroclimate.org/tools/strawberry/)* and NEWA (*https://newa.cornell.edu/strawberry-diseases/*): Note that any disease forecasting system requires on-site weather data to be most accurate and effective.

Fungicide applications should be made in the spring from bloom through harvest at 7- to 10-day intervals.						
FRAC Code	**Product Name (*=Restricted Use)**	**Product Rate**	**Active Ingredient(s)**	**PHI (d)**	**REI (h)**	**Bee TR**
Maintain continuous coverage of Captan from bloom to harvest when disease pressure is moderate or high.						
M04	Captan 50W	6.0 lb/A	captan	0	24	N
M04	Captan 80WDG	3.7 lb/A	captan	0	24	N
M04	Captan Gold 4L	3.0 qt/A	captan	0	24	N
M03	Thiram SC	2.0 to 2.5 qt/A	thiram	1	24	--
Use the following fungicides when disease pressure is high. Application with a tank-mix partner (captan or thiram) may help with resistance management. Do not apply the same FRAC code more than twice in a row or in a season (*e.g.*, Cabrio and Pristine contain the same FRAC code).						
3	Tilt 3.6EC	4.0 fl oz/A	propiconazole	0	24	N
3	Inspire 2.08EC	7.0 fl oz/A	difenoconazole	0	12	--
3 + 9	Inspire Super 2.82EW	16.0 to 20.0 fl oz/A	difenoconazole + cyprodinil	0	12	--
3 + 11	Quadris Top 1.67SC	12.0 to 14 fl oz/A	difenoconazole + azoxystrobin	0	12	--
3 + 11	Quilt Xcel 2.2SE	14.0 fl oz/A	propiconazole + azoxystrobin	0	12	N
7 + 11	Luna Sensation 4.25SC	4.0 to 7.6 fl oz/A	fluopyram + trifloxystrobin	0	12	--
7 + 11	Merivon Xemium	5.5 to 8 fl oz/A	fluxapyroxad + pyraclostrobin	0	12	N
7 + 11	Pristine 38WG	18.5 to 23.0 oz/A	boscalid + pyraclostrobin	0	12	--
7 + 12	Miravis Prime	11.4 to 13.4 fl oz/A	pydiflumetofen + fludioxonil	0	12	--
9 + 12	Switch 62.5WG	11 to 14 oz/A	cyprodinil + fludioxonil	0	12	L
11	Abound 2.08F (and others)	6.0 to 15.5 fl oz/A	azoxystrobin	0	4	N
11	Cabrio 20EG	12 to 14 oz/A	pyraclostrobin	0	12	N
11	Aftershock (and others)	2.0 to 5.7 fl oz/A	fluoxastrobin	1	12	--
11	Flint Extra 500SC	2.5 to 3.0 fl oz/A	trifloxystrobin	0	12	N

Gray Mold (Botrytis Fruit Rot)

Start spraying at 10% bloom, because most fruit infections occur through the flower. Repeat every 7-10 days. Spray less frequently during prolonged dry periods but every 5-7 days during very wet periods. The risk of resistance to fungicides other than FRAC codes M is generally high. If a product like Pristine is used for Anthracnose Fruit Rot control, this can also reduce Gray Mold because it contains boscalid, if resistance is not suspected on your farm. Similarly, Switch has good efficacy against both Botrytis and Anthracnose Fruit Rot. High risk of Botrytis infection is estimated with weather-based models recommended by the Strawberry Advisory System (*http://agroclimate.org/tools/strawberry/*) and NEWA (*https://newa.cornell.edu/strawberry-diseases/*).

FRAC Code	**Product Name (*=Restricted Use)**	**Product Rate**	**Active Ingredient(s)**	**PHI (d)**	**REI (h)**	**Bee TR**
Apply Captan or Thiram solely when disease pressure is low to moderate. Captan is a better choice if Anthracnose is a concern or is present.						
M03	Thiram SC	1.5 to 2.5 qt/A	thiram	1	24	--
M03	Thiram Granuflo	4.4 lb/A	thiram	3	24	--
M04	Captan 50W	3.0 to 6.0 lb/A	captan	0	24	N
M04	Captan 80WDG	1.8 to 3.75 lb/A	captan	0	24	N
M04	Captan 4L	1.5 to 3 qt/A	captan	0	24	N
Use the following fungicides when disease pressure is high. Apply them with a tank-mix partner (captan or thiram) may help with resistance management. Do not apply the same FRAC code more than twice in a row or in a season (*e.g.*, Cabrio and Pristine contain the same FRAC code) except for FRAC codes starting with M (i.e., captan and thiram).						
1	Topsin M WSB	0.75 to 1.0 lb/A	thiophanate-methyl	1	24	N

Gray Mold (Botrytis Fruit Rot) - continued next page

Gray Mold (Botrytis Fruit Rot) *- continued*

2	Meteor[1]	1.5 to 2.0 pt/A	iprodione	n/a	24	N
2	Rovral 4F[1]	1.5 to 2.0 pt/A	iprodione	n/a	24	N
7	Fontelis 1.67SC[2]	16.0 to 24.0 fl oz/A	penthiopyrad	0	12	L
7	Kenja 400SC	13.5 to 15.5 fl oz/A	isofetamid	0	12	--
7 + 9	Luna Tranquility 4.16SC	16.0 to 27.0 fl oz/A	fluopyram + pyrimethanil	1	12	--
7 + 11	Luna Sensation 4.25SC	6.0 to 7.6 fl oz/A	fluopyram + trifloxystrobin	0	12	--
7 + 11	Pristine 38WG	18.5 to 23.0 fl oz/A	boscalid + pyraclostrobin	0	12	--
7 + 11	Merivon Xemium	8.0 to 11.0 fl oz/A	fluxapyroxad + pyraclostrobin	0	12	N
7 +12	Miravis Prime	9.1 to 13.4 fl oz/A	pydiflumetofen + fludioxinil	0	12	--
9	Scala 5SC	18.0 fl oz/A, if alone	pyrimethanil	1	12	--
9 + 12	Switch 62.5WG	11.0 to 14.0 oz/A	cyprodinil + fludioxonil	0	12	L
17	Elevate 50 WDG	1.5 lb/A	fenhexamid	0	12	N
19	Ph-D	6.2 oz/A	polyoxin D zinc salt	0	4	--
19	OSO 5% SC	6.5 to 13.0 fl oz/A	polyoxin D zinc salt	0	4	--

[1]Do not make more than 1 application/season. Do not apply these products after first fruiting flower.
[2]Except for the varieties Clancy, Jewel, and L'Amour.

Root and Crown Rots

Anthracnose Crown Rot (ACR)

ACR is primarily caused by the *C. gloeosporioides* species complex, but AFR pathogens can also cause root and crown rot. This issue is problematic mainly in plasticulture plantings. FRAC 11 containing products, such as Pristine, are the primary materials for both ACR and AFR, however, resistance to FRAC 11 is widespread in both pathogens.

The *C. gloeosporioides* species complex is sensitive to Topsin M (thiophanate methyl, FRAC 1), whereas the *C. acutatum* species complex is naturally insensitive to Topsin M. However, while Topsin M has some efficacy against ACR, resistance is very common in *C. gloeosporioides* from strawberries. Upon confirmation of the disease, plants may need to be treated every 7 to 10 days during fall and spring through foliar or drip application according to the label. Materials effective for ACR, except for Topsin M, are largely the same as for treating AFR, thus the foliar application made in spring for this disease will also cover fruit rot. A higher water volume may be needed to drench the soil to get the materials into the crown. For resistance management, do not apply the same FRAC code more than twice in a season, except for captan and thiram. Removal of infected and dying plants in the field may help decrease disease.

FRAC Code	Product Name (*=Restricted Use)	Product Rate	Active Ingredient(s)	PHI (d)	REI (h)	Bee TR
Maintain continuous coverage of Captan.						
M04	Captan 50W	6.0 lb/A	captan	0	24	N
M04	Captan 80WDG	3.75 lb/A	captan	0	24	N
M04	Captan Gold 4L	3.0 qt/A	captan	0	24	N
Use the following fungicides when disease pressure is high. Application with a tank-mix partner (captan or thiram) may help with resistance management. Do not apply the same FRAC code more than twice in a row or in a season (*e.g.*, Cabrio and Pristine contain the same FRAC code) except for FRAC code M (i.e., captan and thiram).						
1	Topsin M WSB[1]	0.75 to 1.0 lb/A	thiophanate-methyl	1	24	N
3 + 11	Quadris Top 1.67SC	12 to 14 fl oz/A	difenoconazole + azoxystrobin	0	12	--
3 + 11	Quilt Xcel 2.2SE	14 fl oz/A	propiconazole + azoxystrobin	0	12	N
7 + 11	Luna Sensation 4.25SC	4.0 to 7.6 fl oz/A	fluopyram + trifloxystrobin	0	12	--
7 + 11	Merivon Xemium	5.5 to 8 fl oz/A	fluxapyroxad + pyraclostrobin	0	12	N
7 + 11	Pristine 38WG	18.5 to 23.0 oz/A	boscalid + pyraclostrobin	0	12	--
7 +12	Miravis Prime	11.4 to 13.4 fl oz/A	pydiflumetofen + fludioxinil	0	12	--
9 + 12	Switch 62.5WG	11 to 14 oz/A	cyprodinil + fludioxonil	0	12	L
11	Abound 2.08F	6.0 to 15.5 fl oz/A	azoxystrobin	0	4	N
11	Cabrio 20EG	12 to 14 oz/A	pyraclostrobin	0	12	N

[1]For *Colletotrichum gloeosporioides* only (accurate species identification is needed to ensure effective control).

Black Root Rot (BRR)

Black root rot is caused by cultural stresses (*e.g.*, soil compaction) coupled with the effects of many different fungi and nematode feeding injury. BRR is the main reason for pre-plant fumigation of strawberry. Winter injury is also a factor that facilitates BRR. *(continued next page)*

***Black Root Rot (BRR)** - continued*

The most prevalent fungi associated with BRR are *Rhizoctonia*, *Pythium,* and *Fusarium* etc. Rotating a field out of strawberries for 4-5 years may reduce the incidence of BRR. In fields with a high water table, the use of raised beds and/or pre-plant fumigation will provide some control. If rotation is not an option, pre-plant fumigation may be helpful. Fumigants are listed in section E 1.5. Soil Fumigation. In the absence of synthetic fumigation, integrated management of BRR may be considered. For example, growing strawberry plug plants in beneficial bacteria-treated planting mix followed by planting in anaerobically disinfested (ASD) field soil may reduce BRR incidence and severity.

Red Stele and Phytophthora Crown Rot

Prevent spread of the red stele pathogen via cultivation equipment and/or surface runoff water. Selecting fields with well-drained soils and planting on high, raised beds will help reduce disease. Crop rotation may be of little value, as the red stele pathogen persists in soil for many years, and length of persistence of the crown rot pathogen is unknown. However, disease is very unlikely when clean plants are introduced to soil with no history of strawberry production. If red stele is present in the soil, consider using varieties that are resistant to several races such as 'Allstar' or 'Earliglow'. For crown rot, cultivars have differential susceptibility but no cultivars are completely resistant. For example, 'Sweet Charlie' is highly susceptible whereas 'Albion' and 'Chandler' offer some tolerance.

The following fungicides can be applied as pre-plant dips as discussed above, and depending on the product, as foliar sprays or with ground application equipment or by drip irrigation for additional control. See labels for how application rates should be determined for each product.

NEW PLANTINGS						
FRAC Code	**Product Name (*=Restricted Use)**	**Product Rate**	**Active Ingredient(s)**	**PHI (d)**	**REI (h)**	**Bee TR**
Foliar sprays of phosphite products should begin 14 to 21 days after planting and continue on a 30- to 60-day interval as long as favorable disease conditions occur. These products include:						
P07	Aliette 80WDG[1]	2.5 to 5.0 lb/A	fosetyl-Al	0.5	24	N
P07	ProPhyt	2.0 to 4.0 pt/A	phosphite salts	0	4	N
P07	Phostrol	2.5 to 5.0 pt/A	phosphite salts	n/a	4	N
P07	K-Phite 7LP	1.0 to 4.0 qt/A	phosphite salts	0	4	N
P07	Fungi-Phite	1.0 to 2.0 qt/A	phosphite salts	n/a	4	N
Fungicides may be applied after transplanting as a banded spray with ground application equipment and/or through drip irrigation depending on the product. See individual labels for details.						
4	MetaStar 2E	2.0 qt/*treated* A	metalaxyl	n/a	48	N
4	Ridomil Gold 4SL	1.0 pt/*treated* A	mefenoxam	0	48	N
4	Ultra Flourish 2E	2.0 pt/*treated* A	mefenoxam	0	48	N
49 + 4	Orondis Gold	20.0 to 62.0 fl oz/A	oxathiapiprolin + mefenoxam	14	48	--
ESTABLISHED PLANTINGS						
FRAC Code	**Product Name (*=Restricted Use)**	**Product Rate**	**Active Ingredient(s)**	**PHI (d)**	**REI (h)**	**Bee TR**
Spring applications should begin when plants start active growth and before 1st bloom. Foliar sprays of phosphite products should be repeated every 30 to 60 days according to the label. These products include:						
P07	Aliette 80WDG[1]	2.5 to 5.0 lb/A	fosetyl Al	0.5	24	N
P07	ProPhyt	2.0 to 4.0 pt/A	phosphite salts	0	4	N
P07	Phostrol	2.5 to 5.0 pt/A	phosphite salts	n/a	4	N
P07	K-Phite 7LP	1.0 to 4.0 qt/A	phosphite salts	0	4	N
P07	Fungi-Phite	1.0 to 2.0 qt/A	phosphite salts	n/a	4	N
Fungicides may be applied as a banded sprays with ground application equipment and/or through drip irrigation depending on the product. Three applications may be made per yearly crop cycle. Applications may be made in the spring, though exact timing varies with the product, production system, and target disease. In perennial systems, one of the three allowable applications per crop year may be made after harvest in the fall. See individual labels for details. Apply one of the following:						
4	MetaStar 2E	2.0 qt/*treated* A	metalaxyl	n/a	48	N
4	Ridomil Gold 4SL	1.0 pt /*treated* A	mefenoxam	0	48	N
4	Ultra Flourish 2E	2.0 pt /*treated* A	mefenoxam	0	48	N
49 + 4	Orondis Gold	20.0 to 62.0 fl oz/A	oxathiapiprolin + mefenoxam	14	48	--

[1]Not all products with this formulation are labeled for use on strawberries.

Leaf and Calyx (Cap) Diseases

Angular Leaf Spot

Angular (bacterial) leaf spot, caused by the bacterium *Xanthomonas fragariae* is characterized by water-soaked, translucent spots on lower leaf surfaces. During the fruiting stage, the sepals of the caps turn brown or black resulting in unmarketable fruit. Planting disease-free plants is critical. If symptoms appear on established plants, applying fixed copper products can help, but not if weather conditions are highly favorable to the disease. Repeat applications at 7- to 10-day intervals. Discontinue fixed copper applications if plant injury occurs, usually after 4-5 sprays. Overhead irrigation for frost protection will make angular leaf spot worse. Applying Actigard (FRAC P01) early in the season may also help, but there is no solid data regarding effectiveness.

Fungal (Phomopsis and Gnomonia) Leaf Blight, Leaf Scorch, and Common Leaf Spot

In the fall or early spring, leaf diseases are not usually problematic in strawberries, but prolonged warm, wet weather favors the disease in the late spring and summer.

FRAC Code	Product Name (*=Restricted Use)	Product Rate	Active Ingredient(s)	PHI (d)	REI (h)	Bee TR
M04	Captan 50W	3.0 to 6.0 lb/A	captan	0	24	N
M04	Captan 80WDG	1.8 to 3.75 lb/A	captan	0	24	N
M04	Captan 4L	1.5 to 3.0 qt/A	captan	0	24	N
Do not apply the same FRAC code more than twice in a row or in a season except for FRAC code M.						
1	Topsin M WSB	0.75 to 1.0 lb/A	thiophanate-methyl	1	24	N
2	Meteor[1]	1.5 to 2.0 pt/A	iprodione	n/a	24	N
2	Rovral 4F[1]	1.5 to 2.0 pt/A	iprodione	n/a	24	N
3	Rally 40WSP	2.5 to 5.0 oz/A	myclobutanil	0	24	N
11	Cabrio 20EG	12.0 to 14.0 oz/A	pyraclostrobin	0	12	N
3 + 11	Quadris Top 1.67SC	12.0 to 14.0 fl oz/A	difenoconazole + azoxystrobin	0	12	--
3 + 11	Quilt Xcel 2.2SE	14.0 fl oz/A	propiconazole + azoxystrobin	0	12	N
7 + 11	Merivon Xemium	4.0 to 7.0 fl oz/A	fluxapyroxad + pyraclostrobin	0	12	N
7 + 11	Pristine 38WG	18.5 to 23.0 oz/A	boscalid + pyraclostrobin	0	12	--

[1]Do not make more than 1 application/season. Do not apply these products after first fruiting flower.

Neopestalotiopsis (Aka 'NeoPest' or 'Neo_P')

In the Mid-Atlantic region, Neopestalotiopsis has been found primarily in plasticulture strawberry plantings since 2020. Plug plants are considered the source of infection. Foliar symptoms may occur first (*i.e.*, on plug plants or soon after planting), consisting of tan leaf lesions that progress rapidly under moist conditions that may produce black acervuli (small, raised bumps) in the lesion. The fungus may invade the crown area, causing plant wilting and death. Fruit lesions start out tan but develop black acervuli (asexual fruiting bodies) in the center and could be mistaken for Anthracnose Fruit Rot.

Cultivars have shown differential susceptibility to this disease. Based on field trials, cultivars such as Florida Brilliance, Florida Radiance, Albion, Ruby June, and Camino Real are highly susceptible. In contrast, cultivars such as Fronteras, Camarosa, Rocco, Flavorfest, Keepsake, and Chandler are more tolerant to the disease. It is advisable to avoid planting highly susceptible cultivars. Growers are encouraged to communicate with their plant suppliers regarding plant health and possible disease infections. Fungicides are only partially effective. Apply fungicides at 7- to 10-day intervals starting when symptoms appear.

FRAC Code	Product Name (*=Restricted Use)	Product Rate	Active Ingredient(s)	PHI (d)	REI (h)	Bee TR
Rotate between the following fungicides with different modes of action (FRAC code):						
M03	Thiram SC	2.5 qt/A	thiram	1	24	--
9 + 12	Switch 62.5WG	14.0 oz/A	cyprodinil + fludioxonil	0	12	L
3	Inspire 2.08EC	7.0 fl oz/A	difenoconazole	0	12	--
3	Tilt 3.6EC	4.0 fl oz/A	propiconazole	0	24	N
3	Rhyme 2.08 SC	7.0 fl oz/A	flutriafol	0	12	--

Powdery Mildew

Unless symptoms are severe, crop losses are rare. Also, the fall disease infection may not reappear in the spring. Check both sides of leaves in the spring for disease pressure. Severe disease during the spring or on day-neutral cultivars in the summer may justify fungicide application on a 14-21 day interval. Do not apply any fungicides in

the table below more than twice in a row. Switch to another product to reduce the chance of fungicide resistance development.

FRAC Code	Product Name (*=Restricted Use)	Product Rate	Active Ingredient(s)	PHI (d)	REI (h)	Bee TR
Rotate between the following fungicides with different modes of action (FRAC code):						
U06	Torino 0.85SC	3.4 fl oz/A	cyflufenamid	0	4	--
U13	Gatten 5EC	6.0 to 8.0 fl oz/A	flutianil	0	12	--
3	Mettle 125ME	3.0 to 5.0 fl oz/A	tetraconazole	0	12	--
3	Procure 480SC	4.0 to 8.0 fl oz/A	triflumizole	1	12	N
3	Rally 40WSP	2.5 to 5.0 oz/A	myclobutanil	0	24	N
3 + 9	Inspire Super 2.82EW	16.0 to 20.0 fl oz/A	difenoconazole + cyprodinil	0	12	--
7	Fontelis 1.67SC[1]	16.0 to 24.0 fl oz/A	penthiopyrad	0	12	L
7	Kenja 400SC	13.5 to 15.5 fl oz/A	isofetamid	0	12	--
7 + 9	Luna Tranquility 4.16SC	16.0 to 27.0 fl oz/A	fluopyram + pyrimethanil	1	12	--
7 + 11	Luna Sensation 4.25SC	4.0 to 7.6 fl oz/A	fluopyram + trifloxystrobin	0	12	--
7 + 11	Merivon Xemium	4.0 to 7.0 fl oz/A	fluxapyroxad + pyraclostrobin	0	12	N
7 + 11	Pristine 38WG	18.5 to 23.0 oz/A	boscalid + pyraclostrobin	0	12	--
7 +12	Miravis Prime	9.1 to 13.4 fl oz/A	pydiflumetofen + fludioxinil	0	12	--
11	Cabrio 20EG	12.0 to 14.0 oz/A	pyraclostrobin	0	12	N
11	Flint Extra 500SC	2.5 to 3.0 fl oz/A	trifloxystrobin (**Do not apply near Concord grapes**, see label)	0	12	N
13	Quintec 2.08SC	4.0 to 6.0 fl oz/A	quinoxyfen	1	12	--

[1]Except for the varieties Clancy, Jewel, and L'Amour.

Viruses

Use certified, virus-free plants. Remove symptomatic plants to prevent disease spread in the field and control potential vectors such as aphids and nematodes.