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Vegetable & Fruit Headline News

The University of Maryland Extension Agriculture and Natural Resources Profitability Impact Team proudly presents this bi-weekly publication for the commercial vegetable and fruit industry.

Special Early Edition Volume 4 Issue 1 March 21, 2013

Virus Situation in the 2012-2013 Strawberry Crop

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Several different viruses were found in strawberries planted this past Fall in Maryland. Dr. Charles "Chuck" Johnson, Professor and Extension Plant Pathologist, VA-Tech, advises strawberry growers with potentially virus infected plants from Nova Scotia (Balamore Farms) on steps that they can take at this time in mid-March.

Virus Infections in 2012-2013 Strawberry Crop

Chuck Johnson, VA-Tech
Extension Plant Pathologist

Within 4 to 6 weeks of planting last fall, a number of strawberry producers in Virginia (and other growers in the Southeastern and Mid-Atlantic US) began noticing poor growth in their fields, sometimes in spots within fields, sometimes in virtually the entire field. Older leaves sometimes turned bright red in color, while the edges of leaves around the crowns of plants, and/or emerging leaves, showed a distinct yellowing, which sometimes developed into patterns of marginal necrosis (i.e., dead tissue along the margins of leaves). Roots and crowns of most of these plants showed no sign of fungal infection. Initially, the cause of these problems was thought to perhaps involve soil and/or fertility conditions, such as low soil moisture and/or pH, boron toxicity, or fertilizer burn, perhaps associated with weather and/or errors in custom-blended fertilizers. However, similar problems were observed in Florida, North Carolina, and other southern states, including Virginia. The images below were taken from strawberry fields in Virginia Beach and Chesapeake that Roy Flanagan, Watson Lawrence, and I visited on December 19th:

Because of the widespread nature of these symptoms, and an apparent association with bare-root plants or tips from the Great Village area of Nova Scotia, Dr. Barclay Poling of NCSU travelled to the area in early December to visit with Canadian strawberry plant growers and Extension staff. While there, Barclay was told that apparent strawberry virus symptoms had started showing up in fields of some strawberry cultivars in Great Valley in October (about the same time we started getting reports of problems). The Canadians had not had this problem before, and brought Dr. Bob Martin, a USDA-ARS small fruit virologist located at Oregon State University, in to help determine the cause. Dr. Martin is the top expert, as far as I know, on small fruit/strawberry viruses. He collected plant samples in early November to take back to Oregon for laboratory testing, and his results were received while Barclay was in Canada.

Dr. Martin found Strawberry Mild Yellow Edge Virus (SMYEV) and Strawberry Mottle Virus (SMoV) in samples from several matted row varieties. Barclay noted that he had never before seen strawberry viruses to be a

problem. Barclay also noted that Chandler plants in Canada looked healthier than other varieties he saw, such as Camarosa and Winter Star. Upon returning to NC, Barclay collected and submitted 7 plant samples to Dr. Martin's lab, and found one with SMoV and five with SMYEV. All infected plants were plug plants produced from tips grown by one nursery in the Great Valley area. Although four of Barclay's samples were Chandlers, one such plant that looked "good" tested negative for both viruses, while another "good" plant tested positive for SMYEV only. Dr. Martin also tested 20 strawberry samples from Florida and found SMYEV and SMoV in 15 (75%).

As many may already know, Roy Flanagan, Keith Starke, and Watson Lawrence had been monitoring this situation in the Virginia Beach/Chesapeake area. With (very) little help from me, they collected plant samples from strawberry growers in their area and sent the samples off to Dr. Martin just before Christmas. Most of the samples (15 or 43%) were the Chandler variety, but other varieties that were tested included Albion, Camarosa, Camino Real, Festival, San Andreas, and Sweet Charlie. Of the 35 samples sent, 86% were infected by SMYEV, 69% with SMoV, and 66% with both viruses. Only 17% were non-infected. All of the infected plants were originally sourced from the one nursery in the Great Valley area of Nova Scotia, but four different vendors grew-out tips from that same nursery. Whenever there were 3 or more samples of a particular variety, at least one was either not infected or only infected by SMYEV.

Based on all this information, Virginia strawberry producers with plants originally sourced from anywhere but the one nursery in the Great Valley area of Nova Scotia should not worry about possible virus infection, because, as far as I know now, no 2012-2013 plants produced from any other source have tested positive for a strawberry virus. Unfortunately, most of the plants tested so far that "traced back" to the one nursery have been infected by SMYEV, and usually SMoV as well. Growers with plug plants may not know where their plant supplier purchased the strawberry "tips" that were grown-out into plugs, and should check with their supplier.

Although this is our first experience with virus problems on strawberry, SMYEV and SMoV are very common around the world, and often occur together and with other viruses. In fact, it may be that they only cause significant problems to strawberry growers when they occur together. Yield losses (probably when 100% of plants are infected) can be expected to range from 0% to 30%, and can differ among strawberry cultivars and also depending on which "strain" of each virus may be present. These viruses are usually only a problem in matted-row strawberry production, where plants are in the field for a much longer period of time and plantings are not destroyed at the end of each growing season. Heat treatment combined with meristem tip culture usually eliminate viruses from strawberry genetic material before tips are grown-out for plugs or bare root transplants.

All of the virus-infected plants diagnosed this year had SMYEV, which is a "persistent, circulatively-transmitted" virus spread by some (but not all) aphids – *Chaetosiphon fraegolii* (the strawberry aphid), *C. thomasi*, and *C. jacobi*. "Persistent" means that these aphids need to feed for hours or days in order to "get" and spread the virus. However, "persistent" and "circulative" mean that a virus spreads through the body of an insect once the virus has been acquired, and once an aphid has the virus, the virus remains in the aphid through most or all of its life. If a grower only has a small percentage of infected plants in fields with low to moderate aphid populations, promptly spraying an insecticide that kills aphids quickly should be more likely to kill the insects before they can acquire and transmit viruses like SMYEV. Some more "good news" about SMYEV is:
1 – It infects no weeds or crop plants other than strawberry (wild *and* cultivated).
2 – It is only supposed to be a problem when other viruses are also present.

Most of the virus-infected plants diagnosed so far also had SMoV, which is also aphid-transmitted (*C. fraegaefolii*, several other *Chaetosiphon* species, and the melon aphid, *Aphis gossypii*). However, SMoV is "semi-persistently" transmitted, which means that aphids can "get" and transmit the virus within only a few minutes as they probe infected plants and then move to nearby healthy plants. However, aphids also "lose" the virus within a few hours as they probe plants, potentially slowing the initial rate of virus spread if most of the plants that aphids probe are healthy, such as when only a low percentage of plants in a field are infected. In addition to wild and cultivated strawberry, SMoV also infects several species of *Chenopodium*, including common lambsquarters. Aphid control programs are also supposed to be effective in reducing SMoV spread in strawberry fields.

What are *we* to do about this situation? I have the following suggestions:

1) Growers with fields that "look good" and contain plants that weren't sourced from the one nursery in the Great Valley area of Nova Scotia should NOT be "at risk". One cautionary note: because these viruses are both transmitted by aphids, it is possible that active aphid populations in Virginia strawberry fields could cause "secondary spread" from infected to non-infected plants in the same field or in nearby fields (I doubt anyone knows exactly how close "nearby" is). However, given the time of year we're in, I think this situation should be rare.

2) Plants that *were* sourced from the one nursery of concern are likely to be infected by one or both viruses. Plants traced back to other, nearby sources in Nova Scotia could also be involved, but not as far as we know at this time. However, it's very important to remember that apparent symptoms of plant virus infection can be very misleading. Sick plants may have similar symptoms, yet can be suffering from very different causes, none of which may involve virus infection. *My experience with viruses in another crop (tobacco) suggests that* factors such as *production practices and weather conditions could have a major impact on apparent damage and yield loss.* Even if a grower knows that their plants are infected, ensuring that they are *doing everything that they possibly can to minimize stress on their crop could significantly improve their outcome this growing season.* The factors that come to my mind for strawberry are frost protection, fertility, and irrigation/moisture stress.

3) There is no cure for plant virus infection. Once infected, plants are infected for life, and every cell in an infected plant will eventually contain virus. There are no "silver bullets" or miracle cures, despite what some may claim. Infected plants can't be saved, although growers could see some improvement in their appearance and growth between now and harvest. We don't know why that is, so we don't know how to promote it. This means that growers with infected plants should focus on preventing spread to healthy plants. Since we can't test every plant, the safest assumption is that apparently symptomatic plants are infected, while those that "look good" aren't, even though we know this isn't always true. Therefore:

a. If almost all of the plants in a field are stunted and symptomatic, applying an insecticide will not help them. The *only* possible benefit from such a spray would be to minimize possible spread to nearby healthy strawberry fields. Treating severely-infected fields that are isolated is extremely unlikely to produce any benefit whatsoever.

b. If there are enough good plants in a field that look to be worth saving, application of a systemic insecticide should be an effective treatment to prevent or minimize spread of these viruses. Scientists disagree to some extent on the effectiveness of this approach, but the plant pathology literature suggests treating can reduce further disease spread. Remember that this only works if there are aphid populations in the field. If there are no aphids, what is an "aphid-killer" going to accomplish? Growers may consider treating to prevent aphid populations from developing this spring as a type of "insurance", but an alternative approach that should be cheaper and more environmentally friendly would be to scout fields more closely for aphids so that a crop is treated only if when determined necessary. *If a grower decides to treat, the systemic insecticides need to be applied at least 14 days before bloom* to avoid injuring pollinator populations. Recommended insecticides include imidacloprid (Admire Pro for drip, Provado for foliar applications) and thiamethoxam (Platinum for drip, Actara for foliar spray). There may also be some generics labeled for strawberry that have the same active ingredients, but may be cheaper.

4) Don't be too discouraged. This virus situation is yet another plant disease problem in strawberries tied to transplants that look healthy, but aren't, but should be "containable" to this year. Those involved in strawberry plant production in Nova Scotia are aggressively working to correct their virus situation. Although many growers consider carrying strawberry plants over from one season to another, 2013 looks to be a very poor year for this. If possible, all strawberry plants should be destroyed after this season's harvest is completed, to avoid potential carry-over of SMYEV and SMoV. *Leaving potentially infected plants in the field this summer risks virus spread into next years' crop.* Fields in matted-row production should be monitored for potential virus incidence as well. Southern Region strawberry research and extension folks are meeting with national experts and Canadian representatives in late March to plan methods to avoid a repeat of this past fall.

Early Strawberry Monitoring Can Pay Off Season Long

By Bryan Butler
Senior Agent, Carroll County & Mid-Maryland Tree Fruit Agent, UME

Just a quick reminder about a few strawberry pests that are much better dealt with before they become a problem than after. These pests include slugs, sap beetles and Spotted Wing Drosophila (SWD).

Damage from slugs, sap beetles and SWD tend to show up at the least opportune time as the fruit ripens and harvest begins. That is why it is a good idea to take a look at last year's records and jog your memory about fields that may have had a problem last season. Review what control measures were needed last year and begin monitoring early.

Sap beetles

Sap beetles are attracted to ripe, decaying fruit and bore into the berries. This pest can become very difficult to stop especially in Pick-Your- Own fields where clients expect a large number of ripe fruit and avoid harvesting damaged or overripe fruit. If sap beetles become well established in the field they can damage ripening fruit as well. It is important to make every effort to use sanitation to make the fields less attractive to sap beetles. Preventing the accumulation of overripe, damaged and decaying fruit on or between beds is very helpful but often management with insecticides will become necessary. The following products or other

labeled formulations can be used to manage sap beetles, (*Always be sure to read the label*):
Assail (acetamiprid) - Pre harvest interval 1-day.
Ecozin Plus (azadirachtin) - Pre harvest interval 0-days.
Brigade WSB (bifenthrin) - No pre harvest interval required.
Danitol (fenpropathrin) - Pre harvest interval 2-days
Rimon (novaluron) - Pre harvest interval 1-day.

Slugs

Depending on how the spring unfolds, slugs can be a very frustrating pest to deal with. Slugs prefer a cool, wet, dark environment which basically describes the conditions found in a matted row strawberry field perfectly in the spring. They can also be an issue in plasticulture systems so it is important to monitor the fields and conditions before harvest begins.
You can monitor for slug activity by making covered pits that provide a humid, sheltered hiding place for slugs during daylight hours. Pits four inches in diameter and six inches deep can be dug in the field and a shingle or a board can be used as a cover to provide shade from the sun. Options for control include:
Deadline Bullets (Metadehyde) - Use a band treatment between the rows after formation of edible parts. Do not apply directly to or contaminate edible portions of the plant.
Sluggo (Iron Phosphate) - May be used up to and including day of harvest.

Spotted Wing Drosophila

Spotted Wing Drosophila (SWD) will more than likely not be a problem on strawberries in May or June but will almost definitely be a problem on everbearers later in the season. In the last two seasons SWD has not really become a problem in soft fruit until mid to late June. However, it is a good idea to keep an eye out early. Traps can be helpful but are really not effective enough to tell you when your infestation is getting started; thus, it is important to be sampling fruit to be sure SWD has not moved in, particularly toward the end of the season. One reason for SWD not appearing to be a problem in strawberries in Maryland may be that the materials being used to control sap beetles are also usually effective for SWD control. The following products or other labeled formulations can be used to manage SWD:
Danitol (fenpropathrin) - Pre harvest interval 2-days.
Brigade WSB (bifenthrin) - No pre harvest interval required.
Malathion - Pre harvest interval 3-days.
Pyganic (pyrethrin) - No pre harvest interval required.
Entrust SC (spinosad) - Pre harvest interval 1-day.

Vegetable Fungicide Update for 2013

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We hope that everyone has purchased the current version of the Commercial Vegetable Recommendation Guide for 2013 (CVRG-2013). The CVRG-2013 includes new information on insecticides, herbicides and cultivars. The following is a brief overview of some of the changes and updates to fungicides that are included in CVRG-2013. Some of these additions represent newly registered products. Other fungicides were added because reevaluation of trial data indicated that they were effective. This summary is not comprehensive. Also, many of these products have not been tested in replicated trials, therefore comparisons of efficacy with existing labeled fungicides is difficult. Remember to follow all label safety guidelines, rates, resistance management guidelines, and tank mix incompatibilities.

Beans-(snap and lima):

- **Phosphonate fungicides (ProPhyt, K-Phite, Rampart, Phostrol)** are included in the CVRG-2013 for downy mildew and cottony leak.
- **Priaxor** is now labeled for anthracnose and web blight.
- **Fontelis** is now approved for common snap bean rust.
- **Uniform** is now labeled for root rot. Avoid direct seed contact as delayed emergence may occur.

Cucurbits-(squash, muskmelon, pumpkin, watermelon, cucumber):

- **Fontelis** is labeled for gummy stem blight, powdery mildew, *Sclerotinia* stem rot on **allabove listed cucurbits**.
- **Luna Experience** is labeled for gummy stem blight and powdery mildew on**watermelon**.
- **Uniform** is labeled for *Pythium* damping off and *Rhizoctonia* for **all above listed cucurbits**.
- **Torino** is now labeled for powdery mildew on **all above listed cucurbits**.

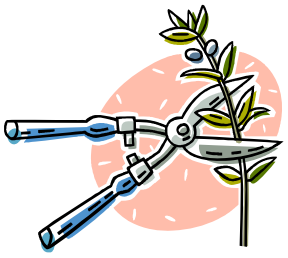
• **Zampro** has been added to the previously labeled products Forum, Ranman, and Tanos for downy mildew on **cucumber.**
• **Zampro** is now labeled for downy mildew on **pumpkin**.

Tomato:
• **Fontelis, Priaxor, and Quadris Top** are now labeled for foliar pathogens (Septoria leaf spot, early blight) and fruit rots (early blight, anthracnose).

Potato:
• Vydate was added for management of nematodes. Pre-plant or foliar applications are allowed.

Sweet Corn:
• **Headline AMP and Priaxor** are now labeled for leaf spots and blights plus rust.

Pepper:
• **Priaxor** is now labeled for Anthracnose fruit rot.
• **Ranman** was added under *Phytophthora* blight.



Pruning Season

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March is the major month for pruning tree fruits, grapes, and cane fruits. Pruning earlier than March often stimulates plants too early and can result in later cold damage; pruning after plants have leafed out can result in loss of plant vigor.

On young fruits, pruning is used to develop the plant architecture and to allow for good root systems to develop. On bearing fruits, pruning is used to maintain productivity. In commercial orchards, pruning is done to create maximum fruit bearing surface, to allow sunlight to enter, to allow air to circulate throughout the tree canopy, to promote good spray penetration, to renew fruiting wood, and to maintain growth or vigor in all parts of the tree. Pruning is also a way of regulating the fruit load on the tree in the current season and from season to season.

On bearing tree fruits, the first step is to remove any suckers from the base of the plant. The second step would be to remove damaged or diseased wood. Remove this back to a main branch or scaffold limb and make the pruning cut at the branch collar (do not flush cut). Next, remove any watersprouts. These are rapidly growing upright shoots that form along the trunk or scaffold branches. Depending on the training system, additional pruning or training will be needed to maintain proper plant shape or height. For example, in fruits trained to an open center, remove any inward growing material. For central leader systems, remove excess branches to the main trunk. Finally, thin out flowering wood or spurs as necessary to reduce fruit load and make pruning cuts to encourage future fruiting wood development (this step varies considerably depending on the type of fruit).

In bearing grapes (generally starting the third year after planting), pruning is used to set the fruiting area for the season and for renewing young canes for the next year. Cane pruning is the usual system for Vinifera types but is also appropriate for some hybrids and American types. In this system a permanent trunks is established (often two trunks are established) to the wire, and every year two canes arising from the trunk, each 8-10 buds long, are selected and tied to the wire (one each direction), and all other canes are cut out. Canes should be about the thickness of your little finger and should come out from the trunk as close to the wire as possible. These canes should have buds fairly close together (avoid large thick canes with buds spaced far apart). Another system, often used with hybrid grapes, is the cordon or spur pruning system. With this system, in the second season, one cane is trained to each side of the trunk, and they become permanent arms that remain as the base on which short spurs are established to produce new fruiting canes each year. These spurs are two or three buds long.

In blueberries, a cane fruit, the philosophy behind pruning is to constantly renew the older, decreasingly productive canes by cutting them out and forcing new canes. Plants are continually replacing old canes with new canes while most canes are in a productive, intermediate stage. For mature bearing blueberries, plants should produce at least three to five new canes

per year. Start by pruning out all dead wood. Keep the three best one-year-old canes and remove the rest. Locate the oldest canes and prune out one of every six canes, starting with the oldest. Prune out all low branches and then detail prune by remove twiggy wood on older canes to increase fruit size.

GMO CORN: TO STACK, OR NOT TO STACK, THAT IS THE QUESTION!

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Corn and caterpillar pests

In Maryland, corn is the favorite host plant of several caterpillars that feed on the leaves, stalk and developing ear at different stages of plant growth. European corn borer (ECB) is the most yield-reducing caterpillar because it bores into the stalk and ear shank, causing physiological stress, lodging and ear drop. The corn earworm (CEW) is the most destructive pest attacking the developing ear; and the majority of their eggs are deposited on fresh corn silks from mid-July through August. Upon hatching, young caterpillar feed on the silk tissue while making their journey to the ear tip. Fall armyworm (FAW) does not overwinter here but adult moths move northward from the Gulf and usually appear around early July. These caterpillars concentrate first on corn plantings not yet in silk and later in the season, move to ear shoots and bore into developing ears. Another caterpillar pest worth mentioning is the western bean cutworm (WBCW), which has been spreading eastward from the Corn Belt and was first detected in sweet corn on the Eastern Shore in 2012. This pest invades the ear and causes kernel damage, similar to the CEW. Once inside the ear, these caterpillars cannot be controlled and their feeding damage reduces yield and increases the chances of ear rots and subsequent mycotoxin contamination of the grain. Though sap beetles are minor pests that can invade and feed on kernels of undamaged ears, kernel injury by caterpillars may further attract sap beetles. Generally, ear-damaging caterpillars have always caused yield losses in field corn; however, the narrow window of opportunity for control action during silking and ear development has made insecticide sprays impractical due to the inability to achieve good coverage with a single application.

The transgenic plant delivery of insecticidal proteins from the bacterium *Bacillus thuringiensis* (Bt) provides an effective way to control caterpillars in corn. However, selection of the most appropriate Bt hybrid or gene combination for pest protection on a given farm has become more challenging. With funding provided by the Maryland Grain Producers Utilization Board (MGPUB), we collaborated on a project to collect ear damage and associated yield data on single and stacked Bt corn hybrids that were tested in state corn hybrid trials during 2010, 2011 and 2012. Each hybrid was planted at five University of Maryland Research and Education Research facilities (Salisbury, Poplar Hill, Wye, Clarksville and Keedysville). A summary of the results of the three year study is presented in this article.

Do stacked hybrids provide better ear protection?

The CEW, which caused the majority of ear damage during the three years, was the major focus of the study. One corn earworm can consume 8 to 10 cm^2 of kernel area during its entire development within an ear. On an average-size ear, this amounts to 11 to 14 kernels consumed per ear or approximately 3.2 to 4 bushels lost per acre. However, not every ear is infested and many caterpillars are cannibalized or die due to diseases before they can complete their development. In general, CEW infestations and the resulting ear damage have been below historical levels in recent years and there is evidence of regional suppression of CEW due to Bt corn adoption. Pooled over years and sites, 28 to 36% of the ears in the conventional hybrids were damaged, showing an average 0.52 to 0.72 cm^2 of kernels consumed per ear. This amounted to an estimated loss of 0.21 - 0.29 bushels per acre (based on one cm^2 equaling 1.4 kernels removed, 26,000 plants per acre, and 90,000 medium-sized kernels per bushel). Levels of ear damage were significantly different among farm sites, with the highest

levels in both years at the Eastern Shore farms. The highest average level of 1.7 cm^2 of kernel area consumed per ear at the Salisbury farm in 2011 equals a loss of ~ 0.69 bushels per acre.

Ear damage evaluations in 2011 and 2012 showed significant differences in the percentage of ears damaged and the amount of kernel area consumed between single and stacked Bt hybrids. Of the stacked hybrids, Agrisure Viptera consistently provided the highest level of ear protection (88-97% reduction), followed by Genuity SmartStax and Genuity VT Pro (82-85% reduction). Of the single protein hybrids, YieldGard CB, YieldGard VT3, and Agrisure hybrids provided 60% reduction in kernel damage, followed by the Herculex hybrids which consistently provided the least protection against CEW injury (45-50% reduction). However, yield gains from ear protection between single and stacked Bt corn were relatively small if one considers that the potential savings are less than a half bushel per acre.

Do Bt corn hybrids always result in higher yield?

A total of 103 and 99 corn hybrids were tested in 2011 and 2012, respectively. Though we did not directly compare non-Bt isolines with every Bt hybrid, the large pool of entries tested in each Bt trait group represented the average performance of the many single gene and stacked hybrids that producers are growing in Maryland. By comparing yields among different Bt trait groups, the aim was to provide producers with information on the productivity gains, irrespective of whether due to insect protection traits, genetic backgrounds or combination of both. For the most part, seed companies have done well at introducing genes into hybrids while keeping yield and other key agronomic characteristics intact. There is some concern that the multiple genes inserted in the "super stacked" corn hybrids may cause a "yield drag". SmartStax hybrids which are considered high yielders performed poorly in 2011 but this may have been largely contributable to the drought conditions that occurred at three of the five farm sites. In 2012, SmartStax yields were more comparable to other stacked hybrids.

As a group, yields of conventional hybrids tested in 2011 were significantly lower by 6 to 18 bushels/acre than yields of Bt hybrid groups. This may be due to the lack of stalk protection but also some seed companies have not incorporated their best germplasm into conventional hybrids. Interestingly, conventional yields in 2012 were not significantly different from yields of Bt hybrids, except for Genuity VT3 Pro and SmartStax hybrids. In fact, many conventional hybrids out-performed single traited Bt hybrids, which had 50% less ear damage and no stalk damage. Among Bt group comparisons, most hybrids expressing single Bt proteins yielded similar to stacked hybrids with two or three Bt proteins. Considering the low levels of kernel injury in conventional hybrids, yield differences among Bt hybrids were probably the result of their genetic background and agronomic performance, rather than their insect protection Bt traits.

Overall, the yield results suggest that stacked Bt hybrids do not necessary perform significantly better than the older single gene Bt hybrids or even better than some high yielding conventional hybrids. If only ear protection is considered at the current level of corn earworm activity, it would appear that the higher seed cost of stacked hybrids is not a practicable investment. However, higher pest pressure from CEW, along with fall armyworm and western bean cutworm, would likely result in more positive gains from the broader spectrum of protection provided by stacked hybrids.

Do any conventional hybrids express natural resistant to ECB?

All hybrids with single or stacked Bt traits provided 100% control of ECB feeding injury to stalks and ears. Clearly, if ECBs are the only pest of concern, any Bt hybrid will work. Corn borers were only found in the non-Bt conventional hybrids, and infestations were much lower than levels experienced in corn prior to Bt corn adoption. The presence of corn borer injury was found in 60-70% of the stalks of all conventional hybrids but the extent of tunneling per stalk was relatively low. Results showed little evidence of any one conventional hybrid exhibiting consistent levels of tolerance to ECB stalk injury.

Do rootworm Bt traits have value in Maryland corn production?

Most single gene and stacked hybrids tested during the three years expressed Bt proteins for corn rootworm control, particularly the Genuity VT3Pro and SmartStax hybrids. These rootworm genes presumably come with an added monetary cost. They may provide a positive yield gain from rootworm protection but only in continuous corn production systems. The majority of corn acreage in Maryland is rotated with soybeans or other crops, and this cultural practice effectively controls rootworms. Moreover, the hot, sandy soils on the Eastern Shore are unfavorable for rootworm development. Thus, for most corn plantings, there is simply no value to the stacked genes for rootworm control. Alternatively, producers can use Bt hybrids without the rootworm traits, including YieldGard CB, Herculex I, VT Double Pro and Agrisure Viptera 3110.

Closing remarks

The Bt technology has revolutionized the way caterpillars and other insect pests are managed in corn. Over 70% of the corn in Maryland was planted in Bt transgenic hybrids in 2012. This technology is here to stay and there is no turning back, so it is important that corn producers understand the technology and its benefits. Several things are clear. First, seed corn companies will continue to develop and introduce new Bt hybrids with genes expressing multiple proteins for insect control. Recently, the refuge-in-the-bag (RIB) technology has been approved for several stacked hybrids which will allow producers to reduce refuge size and more easily comply with refuge requirements. Second, the spectrum of insect protection and cost of the new Bt hybrids have increased significantly with the addition of multiple traits. Thirdly, though all Bt hybrids effectively control ECB, different Bt events and combinations of genes vary widely in their efficacy against CEW, FAW and other caterpillar pests.

Based on the study findings, one might conclude that yield and ear protection benefits of the stacked Bt hybrids may not justify the higher seed cost, assuming that CEW remains the major ear-invading pest and at its current level of activity. In general, yield differences among the single and stacked Bt hybrid groups were not significant and largely the result of genetic backgrounds and agronomic characteristics of hybrids, rather than yield gains due to increased insect suppression. Thus, use of the stacked hybrids can be viewed as a preventative pest management strategy, which may not conform to the IPM principle. However, stacked hybrids have broader spectrums of activity that allow them to effectively control other caterpillar pests (e.g., armyworms and cutworms) and thus should help reduce ear rots. Furthermore, they have several other advantages over single protein hybrids, including a 5% refuge requirement for certain stacks, more convenient deployment of the refuge by using the refuge-in-the bag technology, dual herbicide tolerance traits, and enhanced trait durability due to multiple modes of action. Obviously, many producers are willing to overlook the cost issue for the peace of mine and additional convenience and advantages afforded by these multiple trait hybrids.

Clearly, there are a lot of corn seed choices out there, and selection of the most appropriate gene combination for pest protection on a given farm has become more challenging. There are some true lemons (e.g., high priced hybrids with limited yield potential) and real deals (e.g., low priced hybrids with great yield prospective). Indeed, this study uncovered some conventional and single Bt traited hybrids that performed as well as the higher priced stacked corn hybrids. Thus, time spent studying the state corn hybrid trial data collected in your area is time well spent. Do not assume that the newest and most expensive corn hybrids are more likely to produce the highest yields. The important thing is to choose a proven corn hybrid with traits that match your soil, climate, production system and targeted pest complex. Once you have considered these factors, the decision to stack or not to stack may be an easier one to make.

Acknowledgements

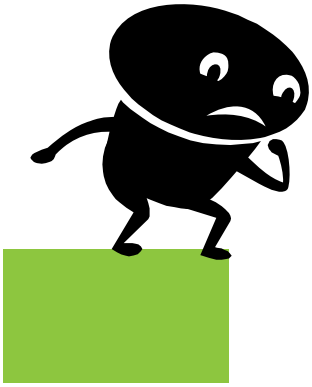
The authors thank the Maryland Grain Producers Utilization Board (MGPUB) for funding this project.

Commercial 2013 Vegetable Production Recommendations Maryland EB 236

On-Line at:

http://mdvegetables.umd.edu/files/EB-236_2013RecGuide.pdf

Also available in a new very interactive format at the Delaware Extension site at:
http://extension.udel.edu/ag/vegetable-fruit-resources/commercial-vegetable-production-recommendations/



See the Attachments!

1) Multi-Fruit Spray Guide.

Vegetable & Fruit Headline News

A bi-weekly publication for the commercial vegetable and fruit industry available electronically in 2013 from April through September on the following dates: March 21; April 18; May 9 & 23; June 6 & 20; July 11 & 25; August 15; September 12.

Published by the University of Maryland Extension Agriculture and Natural Resources Profitability Impact Team

Submit Articles to:

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Article submission deadlines for 2013: March 20; April 17; May 8 & 22; June 5 & 19; July 10 & 24; August 14; September 11.

Note: Registered Trade Mark® Products, Manufacturers, or Companies mentioned within this newsletter are not to be considered as sole endorsements. The information has been provided for educational purposes only.

Spray Program for Multi-Tree Fruit Orchards

Many local orchards are composed of multi-fruit combinations producing for fresh market apples, peaches, pears, plums, nectarines, and cherries. Aggressive fruit tree spray programs are required to achieve high quality fruit. These multi-fruit orchards create many spray management challenges for the achievement of good pest control in accordance to label guidelines.

Therefore, the following multi-fruit orchard spray program for the control of major tree fruit pests and diseases may offer some assistance: **Labeled as noted in 2013 for All Tree Fruit – Pomes: Apples & Pears Stones: Peaches, Plums, Nectarines, and Cherries.**

FUNGICIDES: [FRAC]	*RATE	NOTES
Captan® 80WDG [M4] (Not Labeled for Pears; Reduce Rates for Cherries)	3-5.0 lbs	General Protectant
Dormant Oil [NC]	4.0 gal	Apply Temp 35-85° F
Kocide® DF [M1] (Stones: Dormant Spray Only)	6.0 lbs	Other Fixed Coppers
Rally®40W [3]	4.0 ozs	Powdery Mildew
Sulfur 95W [M2]	3.0 lbs	General Protectant
Gem® 500 SC [11] (Stones Only) **or**	3.0 ozs	Brown Rot & Peach Scab
Adamant® 50WG [3/11] (Stones Except Plums)	6.0 ozs	Brown Rot, Peach Scab & Powdery Mildew
Pristine® [7/11] or (Limited to 4 Sprays/Season With Only 2 Consecutively)	14.5 ozs	Brown Rot, Powdery Mildew, Scab, Rusts & Fruit Spots
Indar® 2F [3]	6.0 ozs	Powdery Mildew & Rusts
Topsin-M® 70W [1]	8.0 ozs	General Protectant
Ziram 76DF [M3] (Captan Substitute for Pears)	5.0 lbs	Dormant Peach Leaf Curl General Protectant
Agrimycin® 17 W (Apples & Pears Only)	24.0 ozs	Fireblight Control

INSECTICIDES: [IRAC]	*RATE	NOTES
Imidan® 70W [1A]	2.0 lbs	Curculio, Scale & Fruit Moths
Warrior® [3] **or**	4.0 ozs	Borers, Curculio & Fruit Moths
Tombstone® [3]	2.0 ozs	
Actara® [4A]	4.5 ozs	Aphids & Curculio
Lorsban® 4E [1B]	1.5 qts	Dormant & Trunk Borer
Acramite® 50WS [25]	1.0 lbs	Mites Only
Sevin® 50W [1A] (Apple Thinning Agent)	4.0 lbs	Japanese Beetles, Hornets & Sap Beetles

***Rate for 50-100gal Acre Concentrate Spray**

****Be sure to follow all labels closely for PHI and REI!**

Multi-Fruit Spray Calendar*

March 15 - Dormant Spray
- Dormant Oil 4.0 gal (Scales & Mites)
- Kocide® DF 6.0 lbs
- Lorsban® 4E 1.5 qts (Mites)

April 5 - Peach Bloom
Apple Tight Cluster
- Captan® 80WDG 3.0 lbs

April 15 - Peach Petal Fall
Apple Bloom
- Captan® 50W 3.0 lbs
- Indar® 2F 6.0 ozs
- Agrimycin® 17 W 24.0 ozs (Fireblight Control Add for Apples & Pears Only)

April 25 - Peach Shuck Split
Apple Petal Fall
- Pristine® 14.5 ozs
- Warrior® 4.0 ozs (Curculio)
- Agrimycin® 17 W 24.0 ozs (Fireblight Control Add for Apples & Pears Only)

May 5 - 1st Cover Spray
- Captan® 80WDG 4.0 lbs (Cedar Apple Rust - Higher Rates for Wetter Conditions)
- Indar® 2F 6.0 ozs (Powdery Mildew & Rusts)
- Actara® 4.5 ozs (Curculio & Aphids; PHI: 35- Days Pomes, 14-Days Stones)

May 15 - 2nd Cover Spray
- Captan® 80WDG 3-4.0 lbs
- Rally® 40W 4.0 ozs (Peach Rusty Spot Only)
- Warrior® 4.0 ozs (Curculio; PHI 21-Days Pomes, 14-days Stones)

June 1 - 3rd Cover Spray
- Captan® 80WDG 3-4.0 lbs
- Topsin-M® 70W 8.0 ozs(Apple Scab Resistance Likely)
- Imidan® 70W 2.0 lbs (Curculio, Scale & Fruit Moths; PHI: 7-Days Pomes, 14-Days Stones)
- Acramite® 50WS 1.0 lbs (For Mites if Required PHI: 7-Days Pomes, 3-Days Stones)

June 15 - 4th Cover Spray
- Captan® 80WDG 3-4.0 lbs
- Sulfur 95W 3.0 lbs (0-day PHI; Stones Only)
- Tombstone® 2.0 ozs (Borers, Curculio & Fruit Moths – 7-day PHI)

July 1- 5th Cover Spray
Early Peach Harvest
- Captan® 80WDG 3-4.0 lbs (0-day PHI; 1-day REI); or
- Pristine® 14.5 ozs (Early Stones 0-day PHI; Limited to 4 Sprays/Season With Only 2 Consecutively)
- Tombstone® 2.0 ozs (Borers, Curculio & Fruit Moths – 7-Day PHI)

July 15 - 6th Cover Spray
Peach Harvests
- Captan® 80WDG 3-4.0 lbs (0-day PHI; 1-day REI); **or**
- Pristine® 14.5 ozs (Stones 0-day PHI)
- Sevin® 50W 4.0 lbs (Japanese Beetle & Moths – 3-Day PHI for All Fruit)

August 1- 7th Cover Spray
Peach Harvests
- Captan® 80WDG 4.0 lbs (0-day PHI; 1-day REI); **or**
- Pristine® 14.5 ozs (Early Pomes 0-day PHI)
- Sevin® 50W 4.0 lbs (Japanese Beetle & Hornets – 3-Day PHI for All Fruit)

August 15 - 8th Cover Spray
Early Apple Harvests
Late Peach Harvest
- Captan® 80WDG 4.0 lbs (0-day PHI; 1-day REI); **or**
- Pristine® 14.5 ozs (Pomes 0-day PHI)

September 1 - 9th Cover Spray
Apples and Pears Only
- Captan® 80WDG 4.0 lbs (0-day PHI; 1-day REI); **or**
- Pristine® 14.5 ozs (Pomes 0-day PHI)
- Sevin® 50W 4.0 lbs (Japanese Beetle & Hornets – 3-Day PHI for All Fruit)

September 15 - Trunk Bore Spray
- Lorsban® 4E 1.5 qts (Post Harvest for Borers)

HERBICIDES: [HRAC]	*RATE	NOTES
Gramoxone ® [22]	1.0 qts	Burndown, Directed Spray
Roundup ® [9]	1.0 qts	Burndown, Shielded & Directed Spray
Devrinol ® 50 DF [15]	4.0 lbs	Spring/Summer 35-day PHI
Princep ® 4L [5]	1.0 qts	Spring Dormant, Avoid High pH Soils
Solicam® [12]	2.5 lbs	Spring/Fall Dormant, 1-yr Established
Goal ® [14] or Galigan® [14]	2.0 pts	After Harvest to Spring Bud Swell
Aim® [14] or Shark® [14]	2.0 ozs	Directed Spray to Weeds, 3-day PHI
Matrix ® [2]	4.0 ozs	Late Spring, 1-yr Established
Prowl ® [3] or Surflan® [3]	2.0 qts	Spring/ Summer, Prowl 60-day PHI
Poast® [1]	1.5 pts	Summer Grasses, Variable PHI
Karmex ® [7] or Diuron® [7]	1.6 qts	Spring/Fall Dormant, 3-yr Established

***Lowest Use Rate Recommended Initially**

Organic Approach Substitutions:

Conventional Product	Organic Certified Product
Captan® & Topsin-M®	Surround® (?) or Sulfur or Lime Sulfur
Rally®	Kaligreen (Powdery Mildew Eradicant)
Listed Insecticides	Neem® or Pyganic® or Entrust® (Stone Fruits Only)
Agrimycin®	Agrimycin® or Fixed Copper (Apples & Pears Except During Bloom)
Gramoxone® or Roundup®	Scythe®

*** Important Note: The calendar spray dates given are an average estimate for Anne Arundel and Prince George's County Orchards, and may vary by location in Southern Maryland. Be sure to adjust your spray schedule application dates accordingly. The above recommendations very closely reflect the current spray program utilized at the University of Maryland Research and Education Center, Upper Marlboro Facility for its research orchards. Remember to always "Read the Label**

R. David Myers
Extension Agent, Agriculture
Reviewed by Alan R. Biggs, Professors, Extension Pathologist, WVU

Spray Program for Multi-Small Fruit Plantings

Many local farms are composed of multi-small fruit combinations producing for fresh market blackberries, raspberries, blueberries, strawberries and grapes. Aggressive fruit spray programs are required to achieve high quality fruit. These multi-small fruit plantings create many spray management challenges for the achievement of good pest control in accordance to label guidelines.

Therefore, the following multi-small fruit spray program for the control of major small fruit pests and diseases may offer some assistance:

Labeled as noted in 2013 for All Small Fruit – Strawberries, Brambles: Blackberries, Raspberries, Blueberries, and Grapes.

FUNGICIDES: [FRAC]	*RATE	NOTES
Lime Sulfur [M2]	10.0 gals	Dormant Fall Sanitizer
JMS® Stylet Oil [NC]	1.0 gal	Apply Temp 35-85° F
Kocide® DF [M1]	2.0 lbs	Other Fixed Coppers
Captan® 50W [M4]	2.0 lbs	General Protectant
Ziram® 76DF [M3] (Except for Strawberry use **Thiram®**)	5.0 lbs	General Protectant
Sulfur 95W [M2] (Grape variety sensitivity)	3.0 lbs	General Protectant
Rally®40W [3] (Except for blueberry use **Tilt®**)	4.0 ozs	Powdery Mildew & Black Rot
Pristine® [7/11]	14.5 ozs	Fruit Rots, Fruit Spots, Powdery & Downy Mildew & Cane Blight
Elevate® 50 WG [17]	1.5 lbs	Botrytis & Powdery Mildew
Switch® 62.5 WG [9/12]	11.0 ozs	Anthracnose, Mummy Berry, Phomopsis, Sour Rot & Botrytis
Phostrol® [33]	4.0 pts	Downy Mildew & Red Stele

INSECTICIDES: [IRAC]	*RATE	NOTES
Provado® Admire® [4A] or Actara® [4A]	4.0 ozs	Grubs, Aphids, Hoppers & Curculio
Brigade® WSB [3]	12.0 ozs	Clipper Beetle, Plant Bug, Mites Root Weevil,
Malathion [1B]	2.0pts	Scale, Fruit Moths & Whitefly
Sevin® 50W [1A]	4.0 lbs	Japanese Beetles, Hornets & Sap Beetles

***Rate for 50-100gal Acre Concentrate Spray**

****Be sure to follow all labels closely for PHI and REI!**

Multi-Small Fruit Spray Calendar*

March 5 - Spring Dormant Spray
- JMS® Stylet Oil 1.0 gal (Scales & Mites)

April 10 - Early Strawberry Bloom
- Captan® 50W 2.0 lbs
- Thiram® 75WDG 5.0 lbs (Strawberry Only)

April 15 - Strawberry Bloom / Blueberry Early Bloom
- Captan® 50W 2.0 lbs
- Ziram 76DF 5.0 lbs (Except Strawberry)
- Brigade®WSB 12.0 ozs (Clipper Beetle, 0-3-day PHI)

April 25 - Strawberry Full bloom/Blueberry Mid-Bloom/ Grape Bud Break
- Captan® 50W 2.0 lbs
- Pristine® 14.5 ozs
- Brigade®WSB 12.0 ozs (Clipper Beetle, 0-3-day PHI)

May 5 - Strawberry 1st Cover & Early Harvest Spray/ Blueberry Full Bloom/Grape & Bramble Shoot Growth
- Captan® 50W 2.0 lbs (0-3 Day PHI & 4-Day REI)
- Elevate®1.5 lbs (0-day PHI)
- Provado® 4.5 ozs (Curculio & Aphids; 7-Day PHI)

May 15 - Strawberry 2nd Cover & Harvest Spray/ Blueberry 1st Cover/Grape Bloom Spray/Bramble Cane Development
- Captan® 50W 2.0 lbs (0-3 Day PHI & 4-Day REI)
- Switch® 11.0 ozs (0-day PHI)
- Malathion® 2.0 pts (Curculio, Scale & Fruit Moths; 0-3-day PHI)

June 1 - Strawberry 3rd Cover & Harvest Spray/Blueberry 2nd cover/Grape 1st Cover/Bramble Bloom
- Captan® 50W 2.0 lbs (0-3 Day PHI & 4-Day REI)
- Pristine® 14.5 ozs (0-day PHI)
- Malathion® 2.0 pts(Curculio, Scale & Fruit Moths; 0-3-day PHI)

June 15 - Strawberry 4th Cover & Harvest Spray/Blueberry 3rd Cover & Early Harvest/ Bramble 1st Cover/ Grape 2nd Cover
- Captan® 50W 2.0 lbs (0-3 Day PHI & 4-Day REI)
- Elevate®1.5 lbs (0-day PHI)
- Sevin® 50W 4.0 lbs (sap beetle, 3-Day PHI)

July 1- Strawberry Renovation/Blueberry 4th Cover & Harvest/ Bramble 2nd Cover & Early Harvest/ Grape 3rd Cover
- Captan® 50W 2.0 lbs (0-3 Day PHI & 4-Day REI)
- Pristine® 14.5 ozs (0-day PHI)
- Rally 40 W 4.0 ozs (Except Blueberry, 0-day PHI))
- Brigade®WSB 12.0 ozs (0-3-day PHI)

July 15 - Strawberry Post Harvest/ Blueberry 5th Cover & Harvest/ Bramble 3rd Cover & Harvest/ Grape 3rd Cover & Veraison
- Captan® 50W 2.0 lbs (0-3 Day PHI & 4-Day REI)
- Switch® 11.0 ozs (0-day PHI)
- Sulfur 95W 3.0 lbs (0-day PHI)
- or Kocide DF 2.0 lbs (0-day PHI)
- Malathion 2.0 pts (0-3-day PHI)

August 1- Strawberry Post Harvest/ Blueberry 6th Cover & Harvest/ Bramble 4th Cover & Harvest/ Grape 4th Cover & Early Harvest
- Captan® 50W 2.0 lbs (0-3 Day PHI & 4-Day REI)
- Pristine® 14.5 ozs (0-day PHI)
- Sevin® 50W 4.0 lbs (Japanese Beetle, 3-Day PHI)

August 15 - Strawberry, Blueberry & Bramble Post Harvest/ Grape 5th Cover & Harvest
- Captan® 50W 2.0 lbs (0-3 Day PHI & 4-Day REI)
- Elevate®1.5 lbs (0-day PHI)
- Phostrol® 4.0 pts (0-day PHI)
- Sevin® 50W 4.0 lbs (Hornets – 3-Day PHI for All Fruit)

September 1 - October 30 Strawberry Post Harvest/ Grape 6th Cover & Harvest
- Captan® 50W 2.0 lbs (0-3 Day PHI & 4-Day REI)
- Phostrol® 4.0 pts (0-day PHI)
- Sevin® 50W 4.0 lbs (Hornets – 3-Day PHI for All Fruit)

November 25 Fall Dormant
- Lime Sulfur 10.0 gals
- Kocide DF 2.0 lbs (0-day PHI)

HERBICIDES: [HRAC]	*RATE	NOTES
Gramoxone® [22]	1.0 qts	Burndown, Directed Spray
Roundup® [9]	1.0 qts	Burndown, Shielded & Directed Spray
Devrinol® 50 DF [15]	4.0 lbs	Spring/Summer 35-day PHI
Princep® 4L [5]	1.0 qts	Spring Dormant, Avoid High pH Soils
Solicam® [12] (Except strawberry)	2.5 lbs	Spring/Fall Dormant, 1-yr Established
Aim® [14] or Shark® [14]	2.0 ozs	Directed Spray to Weeds, 3-day PHI
Surflan® [3] (Except strawberry)	2.0 qts	Spring/ Summer, Prowl 60-day PHI
Poast® [1]	1.5 pts	Summer Grasses, Variable PHI
Sinbar® [5]	4.0 ozs	Fall Dormant, 1-yr Established

***Lowest Use Rate Recommended Initially**

Organic Approach Substitutions:

Conventional Product	Organic Certified Product
Captan®	Surround® & Sulfur
Rally®	Kaligreen (Powdery Mildew Eradicant)
Listed Insecticides	Neem® or Pyganic® or Entrust® or Dipel®
Gramoxone® or Roundup®	Scythe®

*** Important Note: The calendar spray dates given are an average estimate for Anne Arundel and Prince George's County small fruit production, and may vary by location in Southern Maryland. Be sure to adjust your spray schedule application dates accordingly. The above recommendations very closely reflect the current spray program utilized at the University of Maryland Research and Education Center, Upper Marlboro Facility for its research fruit plots. Remember to always "Read the Label".**

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Extension Agent, Agriculture