Supporting Fruit Production

OHIO FRUIT NEWS

Research and Recommendations from Experts at The Ohio State University

APRIL 2021

What Causes Russetted Bumps on Apple Fruit?

By Celeste Welty- Associate Professor, Extension Entomologist, Department of Entomology

This past year, some Ohio apple growers were reporting that they were seeing an injury that was somewhat like that caused by plum curculio or tarnished plant bug, but which seemed different. The purpose of this article is to review some of the insects that can cause this type of injury. Apple growers are encouraged to keep an eye out for this possible new problem, to help us determine where and when this problem is being found, and which insect is causing it. It will be helpful to the orchard community if any of our growers who see injury like this can take a picture or send me the fruit itself so that we can try to identify the problem, figure out when it happens, and determine how to prevent it.

Most apple growers in Ohio are familiar with the early-season injury caused by plum curculio: usually a fan-shaped, light brown, russetted mark on the fruit, usually with a nick at the narrow end of the fan (Figure 1). This injury starts as a small nick when an egg is laid around petal-fall, and the injury enlarges as the fruit enlarges. The injury on apple is only on the surface of the fruit; there are no tunnels into the fruit flesh underneath. We know that there are variations on this general type of injury (Figure 2): usually the mark is flat but sometimes the mark is indented, sometimes it is raised, sometimes it is more circular.

Continued on page 4

Figure 1. Classic injury due to egg-laying by plum curculio (Photo by C. Welty).

Inside This Issue:

Grower's Corner

How can I control Botrytis on strawberries grown in the greenhouse?

Botrytis is the fungus that keeps on giving! It feeds on decaying plant tissue and produces thousands of spores, as shown in these images taken by OSU graduate student Madeline Horvat (Dept. Horticulture and Crop Sciences). A combination of cultural practices and fungicide applications are recommended for controlling Botrytis on strawberry. *Botrytis* infects at temperatures around 60-65F and when humidity is above 65%. Therefore, increasing airflow (turn on fans or add portable fans) and nighttime temperatures will slow down disease development. Thinning the plants and removing diseased plant material from the greenhouse is also recommended.

Fungicides can be used in the greenhouse, but they must be registered for greenhouse use. Read the label carefully to confirm that the fungicide can be used in the greenhouse. If the label does not state that the fungicide is prohibited for greenhouse use, then it is considered a "silent label" in the state of Ohio and is allowed. Read the label carefully (yes, I just repeated myself!). Examples of fungicides that are effective against Botrytis AND are registered for strawberry AND can be used in the greenhouse are Fontelis, Elevate, and Luna Tranquility. As with all fungicides, rotating fungicides with different modes of action (i.e., different FRAC group numbers) is recommended to prevent resistance from developing in the fungus.

Fungicides for Wine Grapes

By Melanie Lewis Ivey- Assistant Professor, Extension Fruit Pathologist, Department of Plant Pathology

Several fungicide products and a couple of biocontrol products have recently been registered for grapes. While these products are listed in the 2021-2022 Midwest Fruit Pest Management Guide, I thought I would provide a short overview of each.

Cevya (mefentrifluconazole) is a FRAC 3 fungicide manufactured by BASF. Cevya is registered for Phomopsis cane and leaf spot, powdery mildew and black rot. It provides good control of powdery mildew and Phomopsis, and good to excellent control against black rot. The current label restricts the use of Cevya on *Vitis lubrusca* and *V. lubrusca* hybrid grape varieties. Cevya should be used in a rotation program with non-FRAC 3 fungicides as FRAC 3 fungicides are high-risk for resistance development. For powdery mildew management Cevya should be mixed with a low-risk fungicide such as mancozeb or Captan.

Continued on page 3

Gatten (flutanil) is a FRAC U13 fungicide manufactured by Nichino. It is registered for powdery mildew only and provide good to excellent control. Gatten has a unique mode of action and can be used in rotation with other fungicides such as (but not limited to) Cevya (FRAC 3), Flint Extra (FRAC 11) or Endura (FRAC 7). Gatten should not be used more than twice in the season and should not be used twice in a row.

Howler (*Pseudomonas chlororaphis* strain AFS009) is a biocontrol product from AgBiome Innovations. Howler is not listed in the Midwest Fruit Pest Management Guide. Howler is OMRI listed and can be applied as a foliar spray or soil drench, however, it can not be mixed with other insecticides, fungicides, surfactants, adjuvants, or fertilizers. The label lists multiple target pathogens, but Botrytis is the only pathogen listed that affects grape. There is a new 2(ee) label that permits the use of Howler for downy mildew and powdery mildew. However, there are no published data available on downy or powdery mildew efficacy and thus I don't recommend it be used during the 2021 season, especially if disease pressure is high.

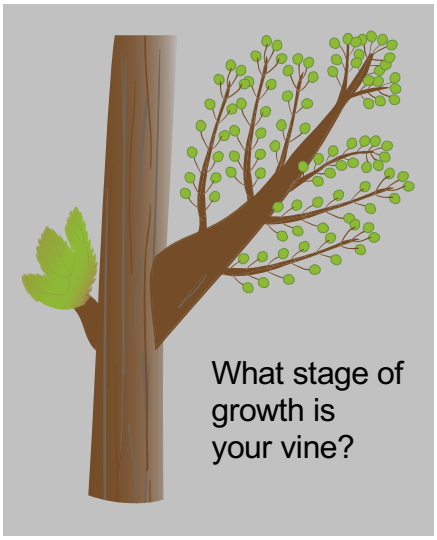
Intuity (mandestrobin) is a FRAC 11 fungicide manufactured by Valent. It is labelled for Botrytis bunch rot and powdery mildew, although it only has suppression against powdery mildew. The label restricts the use of Intuity on *Vitis lubrusca* and *V. lubrusca* hybrids, and non-*vinifera* hybrid grape varieties. Intuity should be used in a rotation program with non-FRAC 11 fungicides as FRAC 11 fungicides are high-risk for resistance development. Intuity should only be use only once or twice and consecutive applications should never be made.

Stargus (*Bacillus amyloliquefac*iens strain F727) is a biocontrol product from Marrone Bio Innovations. Stargus is not listed in the Midwest Fruit Pest Management Guide. It is OMRI listed and labeled for multiple fungal diseases including Botrytis bunch rot, black rot, downy mildew, Phomopsis fruit rot, and powdery mildew. The efficacy against Botrytis bunch rot was tested in California and found to be good. I would not recommend that Stargus be used against Botrytis or downy mildew when disease pressure is high (rainy, cool to warm weather).

When selecting a fungicide, the following factors should be considered if:

- the fungicide is registered for the target pathogen AND the state for which you are producing wine grapes,
- it is safe to use the fungicide at the growth stage that you will be spraying,
- the fungicide is effective against the target pathogen(s) and,
- there is a high-risk for fungicide resistance development in the target pathogen.

Use the Decision Tree on page 12 to help you select a fungicide.



Russetted bumps on apples continued from page 1

Plum curculio is also known to cause two other types of injuries due to feeding: early season feeding results in a circular raised bump (Figure 3), and late season feeding is a blunt puncture (Figure 4), but these are not as common as the fan-shaped injury due to egg-laying.

The apple curculio is a pest that is usually much less common than the plum curculio, but which can be found in some Ohio orchards. The injury that is caused by its feeding (Figure 5) is smaller than that of plum curculio.

Another common injury on apple fruit is caused by feeding of the tarnished plant bug, *Lygus lineolaris*. This is typically a funnel-shaped indentation in the fruit, without russetting (Figure 6). It is often quite deep but is sometimes shallow. There are several relatives of the tarnished plant bug that can injure apple fruit. Most of these species are not very common or very abundant in most orchards, but there is always a chance that this could change over time. These are true bugs (Order Hemiptera) and members of a large family (Family Miridae) called the Plant Bugs, which has over 10,000 known species.

Most of these plant bugs are not particularly noticeable; they are small, about ¼-inch long, mostly brown, with yellow or red markings.

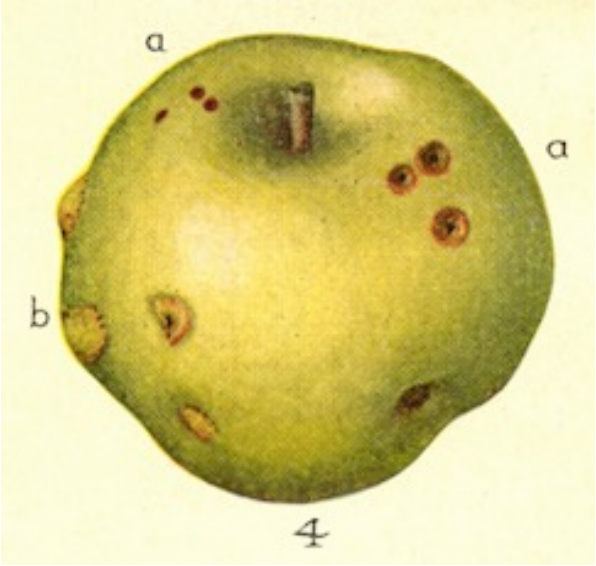


Figure 3. Plum curculio: *a*, Late feeding punctures; *b*, Scars from early feeding and egg-laying punctures. From plate II, Fig. 4, in: B. B. Fulton, 1920. Injuries on apples caused by insects. New York Agricultural Experiment Station, Geneva NY, Bulletin 475.

Figure 2. Variations in injury caused by egg-laying by plum curculio. (Photos by C. Welty).

Figure 4. Late-season feeding injury caused by plum curculio. (Photo by C. Welty)

Continued on page 5

One suspicion is that the recently seen injury in Ohio might be caused by a plant bug that has been noticed in Pennsylvania. A study done by Dave Biddinger and Neelendra Joshi in 2017 found a plant bug called *Phytocoris conspurcatus*, which was suspected to be the cause the injury being seen in Pennsylvania (Figure 7). Before their study was started, they suspected that the injury was due to the reappearance of an old orchard pest called the apple green bug (*Lygocoris communis*; Figure 8), also known as the green apple bug and the pear plant bug, however the apple green bug did not show up in their samples, whereas the mystery damage and this other species of plant bug were present. More details can be found in their report (https://extension.psu.edu/apple-insect-pest-new-plant-bug-type-injury-to-fruit).

Figure 5. Injury caused by feeding of apple curculio, *Anthonomus quadrigibbus.* (Photo by British Columbia Ministry of Agriculture)

Other species of plant bugs that are known to injure apple fruit are the apple red bug, *Lygidea mendax* (Figure 9), and the mullein bug, *Campylomma verbasci* (Figure 10). Two other known but less common species on apple are the Hawthorn dark bug (*Heterocordylus malinus*), and the apple brown bug (*Atractotomus mali*).

To make the situation even more complicated, some of these plant bugs have been observed to feed on apples during parts of the year but also act as predators that feed on other insects at other times of the year. This dual role is true of the mullein bug as well as the *Phytocoris conspurcatus* bug that is mentioned above, which is suspected as the cause of injury in Pennsylvania.

Figure 6. Classic injury caused by feeding of the tarnished plant bug, *Lygus lineolaris.* (Photo by C. Welty)

Figure 7. Injury found in Pennsylvania, thought to be due to apple green bug or to *Phytocoris conspurcatus.* (Photo by Dave Biddinger, Penn State University).

Continued on page 6

Russetted bumps on apples continued from page 5

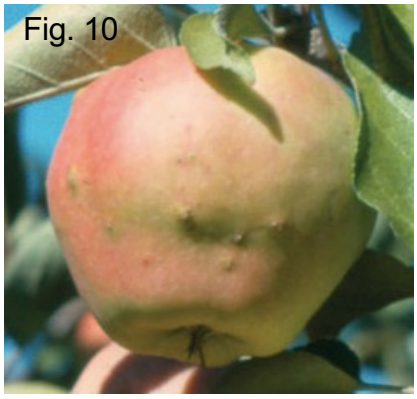


Figure 8. Injury caused by the green apple bug, also known as apple green bug and pear plant bug, *Lygocoris communis.* (Photo by Claire Fecteau, Ministry of Agriculture, Fisheries, and Food, Sainte-Foy, Quebec).

Figure 9. Injury caused by the apple red bug, *Lygidea mendax.* (Photo by Bernard Drouin, Ministry of Agriculture, Fisheries, and Food, Sainte-Foy, Quebec)

Figure 10. Injury caused by the mullein bug, *Campylomma verbasci.* (Photo by OMAFRA).

Spring Weather and Fruit Tree Bloom

By Diane Miller- Associate Professor, Department of Horticulture and Crop Science

With the warm temperatures, fruit trees across the state are progressing rapidly toward bloom. It should now be easy to see the bloom load on the varieties in your orchard. We have come through one cold night on April 1, but the reports indicate minimal freeze damage to buds from that event. And it is important to remember that only 5-7% of flowers on a loaded bloom tree are needed to set to have a full crop of apples.

Peach trees in full bloom on April 9, 2021 in Licking county, OH.

As you well know, as the buds continue to develop their cold tolerance diminishes. The authoritative reference on this is work from Washington State University. Pictures of stage of development as well as cold temperatures that result in 10% and 90% bud kill are shown on their fact sheets. The facts sheets for apples and peaches are included in this document (pages 8 and 9), so that those of you without internet access have the information available to you. At the website (link provided on page 7) there are additional fact sheets for pears, cherries and apricots. The only things outdated on these fact sheets are the average date of each stage (in Prosser, WA), and the varieties noted. Prosser (and Ohio)

Continued on page 7

Fruit tree bloom continued from page 6

are moving earlier in calendar date of spring development due to climate change. The noted varieties Red Delicious and Rome still serve as early and late standards that we can relate to from experience. We will learn how new MAIA varieties fit into the spectrum over some years of experience, so please keep your attention on relative bloom times. In my research work, I have seen that relative bloom time among varieties remains consistent year to year although absolute time of difference is impacted by each year. In other words, in a warmer year relative bloom time is condensed among varieties while in a cooler spring, the differences among varieties are spread out and more obvious.

Crop load management/ Minimizing frost events: It remains one of tree fruit growers' biggest annual challenges how to set the right number of fruit on trees. Site is the number one factor, and there's only one chance in the life of a planting to get that right. After site, crop load management becomes a progressive seasonal interaction between weather conditions, grower decisions, and tree response. The major consideration of crop load management for the next few weeks is minimizing frost events. Michigan State's Phil Schwallier and Amy Irish-Brown in 2017 put together a nice summary of how to approach minimizing frost events (link provided below). I will emphasize their key suggestions pertinent for our Ohio industry here. Running frost fans may gain 5 degrees F orchard warming. Herbicide strips and associated bare soil warming and heat release may gain 2 degrees F. A similar gain for the same reason can be obtained by mowing orchard grass short. Wet soil holds more heat to radiate than dry soil. Nutrient sprays and frost prevention sprays can be helpful but are inconsistent because overall tree health is a confounding factor. Characteristics of bloom orientation (ground pointed instead of sky pointed), range of stage of bloom development (tighter better than more open), abundant bloom and abundant foliage can bring some blossoms through.

Apple at tight cluster on April 9, 2021 in Licking county, OH.

Crop load management/ fruit thinning: After we get flowers pollinated and set, then the next consideration in crop load management is thinning to the correct crop load for optimum fruit size, tree growth and return bloom. Since using Zoom has opened the ability for us to get pertinent regional information timely, I can recommend an hour long zoom recording (April 7, 2021) by Michigan State personnel Todd Einhorn and Phil Schwallier on apple thinning models, PGR's and tree row volume (link provide below). This will help get you oriented for thinning decisions in 2021.

Spring Weather and Fruit Tree Bloom Links

Critical Temperatures and Bud Stages Factsheets: go.osu.edu/wsubudstages

Minimizing frost events in the orchard from MSU: **go.osu.edu/msuapplefrostguide**

Apple thinning models webinar from MSU: go.osu.edu/msuapplethinningwebinar

Continued on page 8

Fruit tree bloom continued from page 7

1—SILVER TIP

2—GREEN TIP

3—HALF-INCH GREEN

4—TIGHT CLUSTER

5—FIRST PINK

6—FULL PINK

7—FIRST BLOOM

8—FULL BLOOM

9—POST BLOOM

APPLES

CRITICAL TEMPERATURES FOR BLOSSOM BUDS*

Bud Development Stage	1	2	3	4	5	6	7	8	9
Old Standard Temp.[1]	16	16	22	27	27	28	28	29	29
Ave. Temp. for 10% Kill[2]	15	18	23	27	28	28	28	28	28
Ave. Temp. for 90% Kill[2]	2	10	15	21	24	25	25	25	25
Average Date (Prosser)[3]	—	3/20	3/27	4/3	4/8	4/11	4/18	4/25	—

* For Red Delicious, Golden Delicious and Winesap approximately 1 degree hardier; Rome Beauty, 2 degrees hardier; except after petal fall, when all varieties are equally tender.
[1] Critical temperatures as previously published.
[2] Average temperatures found by research at the WSU Research and Extension Center, Prosser, to result in 10% and 90% bud kill.
[3] Average date for this stage at the WSU Research and Extension Center.

Reprinted from
extension.wsu.edu

Fruit tree bloom Continued from page 8

1—FIRST SWELLING

2—CALYX GREEN

3—CALYX RED

4—FIRST PINK

5—FIRST BLOOM

6—FULL BLOOM

7—POST BLOOM

PEACHES

CRITICAL TEMPERATURES FOR BLOSSOM BUDS*

Bud Development Stage	1	2	3	4	5	6	7
Old Standard Temp.[1]	23	—	—	25	—	27	30
Ave. Temp. for 10% Kill[2]	18	21	23	25	26	27	28
Ave. Temp. for 90% Kill[2]	1	5	9	15	21	24	25
Average Date (Prosser)[3]	3/7	3/16	3/19	3/29	4/3	4/11	4/18

* For Liberta.
[1] Critical temperature as previously published.
[2] Average temperatures found by research at the WSU Research and Extension Center, Prosser, to result in 10% and 90% bud kill.
[3] Average date for this stage at the WSU Research and Extension Center.

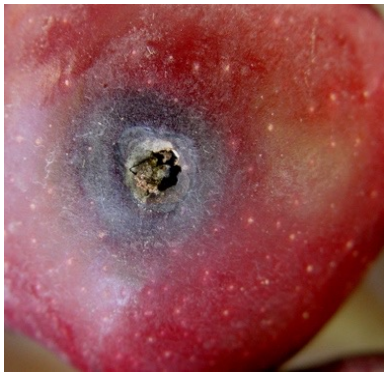
Reprinted from
extension.wsu.edu

Ready to Prevent Worms in Apples?

By Celeste Welty- Associate Professor, Extension Entomologist, Department of Entomology

For growers who plan to use insecticides to control codling moth, the general target time for the first spray is at first cover (7 to 10 days after petal-fall), but a more specific time can be determined in orchards where pheromone traps are set up to monitor the activity of the adult moths. It is best to use three traps per orchard, set them out at bloom, and check them every 1 to 2 days until the first moths are caught. On the day that traps start catching at least one moth per trap per night, that is called the biofix date. Then degree-days need to be followed each day, starting on that biofix date, to determine the best date to spray. As shown on page 51 of our current Midwest fruit guide, the best timing of the first spray is once the cumulative count of daily degree-days (DD) after the biofix date is 50-75 DD for Rimon, 100-200 DD for Intrepid or Confim, 150-250 DD for Altacor, Assail, Belay, Delegate, and Exirel, and 250 DD for Imidan, Avaunt, pyrethroids (Asana, Baythroid, Danitol, Mustang Max, Proaxis, Warrior) and virus (Cyd-X, Madex, Virosoft CP4). For apple growers who have Oriental fruit moth (OFM) as well as codling moth present in the orchard, the best time to control the first generation of OFM is at petal-fall.

For growers who plan to use pheromone mating disruption for control of codling moth and Oriental fruit moth, a table of product options is included in our 2021 Midwest fruit guide on page 27. Mating disruption should be deployed before the first moths are expected to emerge, which means by petal-fall for codling moth, or by pink for Oriental fruit moth. Mating disruption products dispense a species-specific sex attractant that does not kill moths but prevents male moths from locating females for mating, which results in elimination of egg-laying in fruit. Mating disruption is most likely to succeed in blocks of at least five acres where initial populations of codling moth are low.



Coddling moth injury on apple. (Photo by C. Welty)

If you attempt a mating disruption program in smaller blocks, or where infestation is moderate or high, then you also need to make border sprays or at least one or two insecticide cover sprays. Remember that controlling these moths by mating disruption does not control other insect pests that insecticide applications manage, such as plum curculio and apple maggot. Many of these are products are deployed manually but aerosol emitters and sprayable products are also available. The manual products last for several months, while the "sprayables" last for several weeks.

A one-page description of how to use traps for codling moth is posted here: **go.osu.edu/codlingmothtraps**

A detailed 10-page document about codling moth and Oriental fruit moth is here: **go.osu.edu/applefruitworms**

A summary about insect traps that can be used in apples is here: **go.osu.edu/insecttrapsforapples**

Several short videos about trapping orchard pests are posted here: **go.osu.edu/insecttrappingvideos**

On-farm Demonstration Trials Show that 'Proof is in the Pudding' (Or Apples)

By Melanie Lewis Ivey- Assistant Professor, Extension Fruit Pathologist and Lianna Wodzicki, MS Candidate, Department of Plant Pathology

** This article was first published as a blog on the Smart Apple Spray website*

The proverb "the proof of the pudding is in the eating" is thought to date back to the early 14th century and is used to say that the worth or effectiveness of something can only be determined by putting it to the test. While I'm not sure I would want to test the worthiness of a pudding from the 14th century (haggis anyone?), I'm happy to taste an Ohio grown apple, especially one produced using sustainable agricultural practices!

During the 2020 season, the scientists at The Ohio State University and USDA teamed up with a local apple producer to test the efficiency and effectiveness of intelligent sprayer technology in controlling fruit diseases and insect pests. Without sounding like a broken record, the intelligent sprayer is a new, innovated technology that is revolutionizing the fruit tree industry. Using a scanning laser, the tree shape and canopy density are determined, and combined with the tractor speed. An embedded computer within the tractor cabin uses this information to automatically calculate the volume of pesticide needed to cover the tree and penetrate the canopy. It then dispenses the pesticide based on the architecture of the tree by controlling which nozzles are opened. The result is targeted pesticide applications, reduced drift and ground drop-off, and the potential for extensive cost savings.

Figure 1. Fruit rot symptoms (left) and apple scab (right) on an apple at harvest.

Figure 2. Plum curculio adult with egg on an apple. (Photo by Peter Jentsch, Cornell University)

A demonstration trial was conducted on a farm in Rittman, OH and consisted of side-by-side plots that were either sprayed using conventional airblast technology or intelligent sprayer technology. The plots contained a variety of cultivars including 'Red Delicious', 'Granny Smith', 'Gala', and 'Fuji', although data were only collected from the 'Red Delicious' apples. Each plot contained 300 trees (on trellises). The grower used their standard fungicide and insecticide spray program to treat the trees. Their program was developed to target major apple diseases and insect pests in the region including apple scab, fruit rots (Figure 1), plum curculio (Figure 2) and codling moth.

Continued on page 12

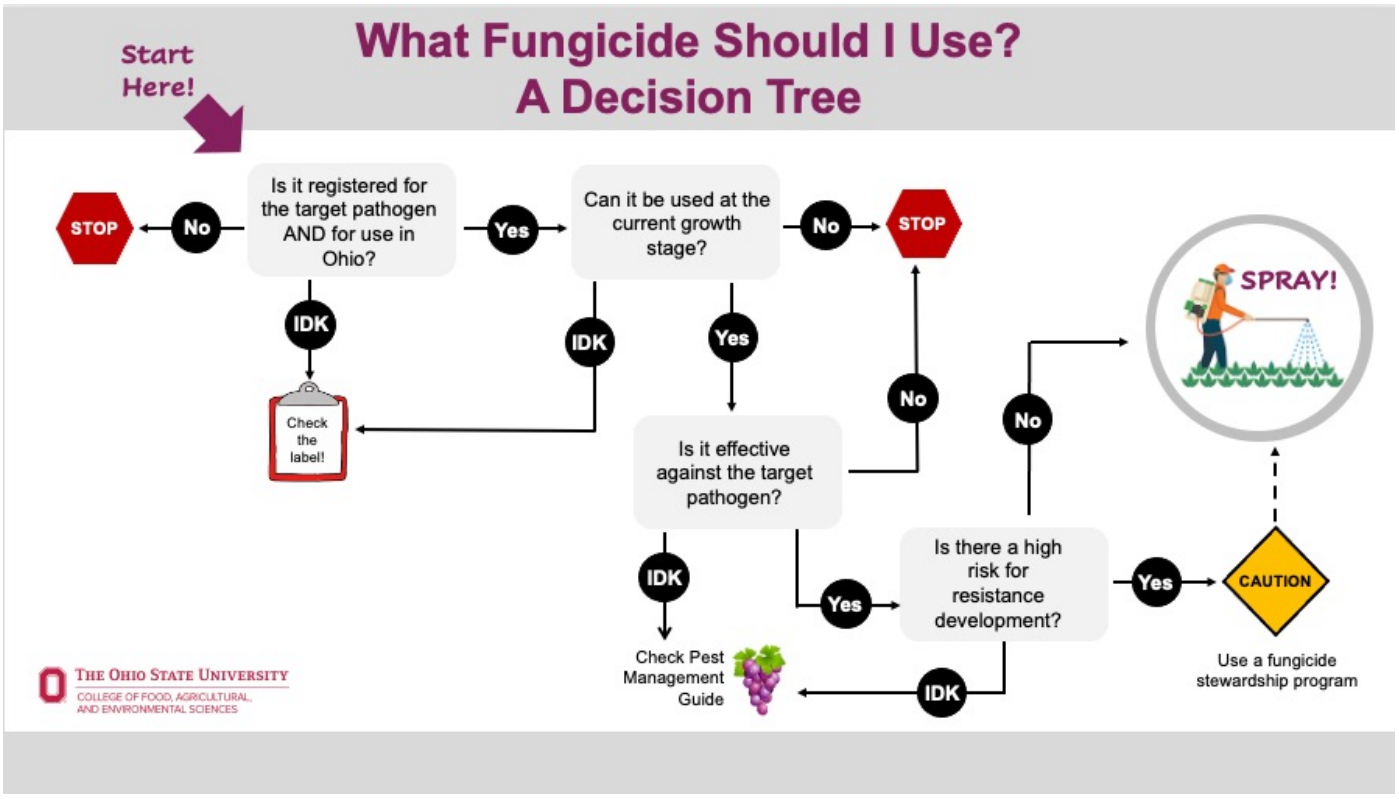
On-farm demonstration trials from page 11

At harvest, apples were collected from 15 randomly selected trees from each plot and sorted by disease, the type of insect injury and marketability. So, is the proof of the pudding in the eating?

The answer is yes! Percent marketable yield was greater than 95% in both plots **(Table 1)**. Less than 4% of the fruit were diseased and insect injury was negligeable in both plots. Plum curculio was the only insect for which injury was observed. Apple scab and fruit rot were the only disease symptoms observed. The biggest and most noteworthy difference between the two sprayer technologies was in the amount of pesticide used. The intelligent sprayer used approximately 30 gals/acre less pesticide than the airblast sprayer. This is a 42% decrease in pesticide use to achieve the same level of disease and insect pest control. That is some good pudding!

Table 1. Percent diseased, insect injured and marketable fruit in a commercial Ohio apple orchard when using intelligent or airblast sprayer technology.

Pesticide Application	% Diseased	% Insect injured	% Marketable
Intelligent Sprayer Technology	3.78	0.53	95.69
Airblast Sprayer Technology	1.84	0.24	97.91
P-value	0.2898	0.2466	0.2794



Phytophthora root rot on blueberry plants. (Photo by Jerry Weiland, USDA-ARS.)

Phytophthora root rot is one of the first diseases to show up in blueberry in the spring. The disease is caused by *Phytophthora cinnamomic,* a fungal-like pathogen that loves wet soils. The pathogen overwinters in the soil and releases spores in the spring when the soil is saturated, and temperatures are between 68°F and 90°F. Early above ground symptoms include yellowing leaves, tip burn and minimal new leaf growth. As the disease progresses the plants may defoliate and may be stunted. Fungicides can also be applied to the root zone in the early spring (delayed dormant) but will not cure the plant of the disease. Fungicide recommendations begin on page 145 of the 2021 – 2022 Midwest Fruit Pest Management Guide.

Grower Resources:

- OSU Fruit Pathology website (u.osu.edu/fruitpathology)
- OSU Fruit and Vegetable Safety website (https://producesafety.osu.edu)
- OSU Fruit and Vegetable Pest Management website (entomology.osu.edu)
- OSU Fruit and Vegetable Diagnostic Laboratory (u.osu.edu/vegetablediseasefacts/)
- OSU Bramble: Production Management and Marketing Guide (Bulletin 782) (extensionpubs.osu.edu)

How to get a copy of the 2021 – 2022 Midwest Fruit Pest Management Guide?

Download for free. To download a free digital copy of the 2021-2022 guide, click here (go.osu.edu/2021fruitpestguide).

Purchase from Purdue Website. A Print copy can be purchased directly from Purdue University at a cost of $15 (plus shipping) per copy.

Purchase from OSU. Print copies can be purchased directly from OSU at a cost of $15 per copy. There is no charge for shipping. Due to state mandated COVID-19 restrictions in-person pick-ups are not permitted at this time.

You can request a print copy of the guide by contacting your county OSU Extension office or Dr. Melanie Lewis Ivey (ivey.14@osu.edu; 330-263-3849). Cheques should be made out to "The Ohio State University" and mailed to Melanie Ivey, Department of Plant Pathology, 1680 Madison Avenue, Wooster, OH 44691. *Please do not send cash through the mail.* The postal service has been very slow. Please contact us if you do not receive your guide within two weeks. Thank you for your patience.

OSU Upcoming Events-2021

June 29 – OPGMA Summer Tour; Link here
September 21-23 – Farm Science Review; Link here

For a list of all CFAES events and schedule changes go to the CFAE Events Page

Contributors:

Dr. Melanie Lewis Ivey Assistant Professor, Department of Plant Pathology; 224 Selby Hall, 1680 Madison Ave, Wooster, OH, 44691; ivey.14@osu.edu; 330-263-3849 (office)

Diane Doud Miller Associate Professor, Department of Horticulture and Crop Science; 211 Williams Hall, 1680 Madison Ave, Wooster, OH 44691; miller.87@osu.edu; 330-263-3824 (office)

Dr. Celeste Welty Associate Professor, Department of Entomology; Rothenbuhler Bee Lab, 2501 Carmack Rd. Columbus OH, 43210; welty.1@osu.edu; 614-292-2803 (office)