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In This Issue

Crop Conditions

(Bruce Bordelon, bordelon@purdue.edu, (765) 494-8212)

Grapes are being harvested across the state. Yields are pretty low for the early varieties that were hurt worst by the spring freezes. In Lafayette all our varieties are at veraison and harvest is nearing. Apples are sizing nicely where there is fruit. Some of Jules Janick's selections have full crops, but many varieties have a very light crop. Fall bearing red raspberries are just getting ripe as are primocane blackberries. These seem to be at least two weeks later than normal, likely due to the high temperatures earlier in the summer. We have a beautiful crop of Black Magic this year and APF-45 looks like it will also have a nice crop. Black Magic is getting ripe now and APF-45 is about 2 weeks behind.

Crimson Pearl grapes approaching harvest

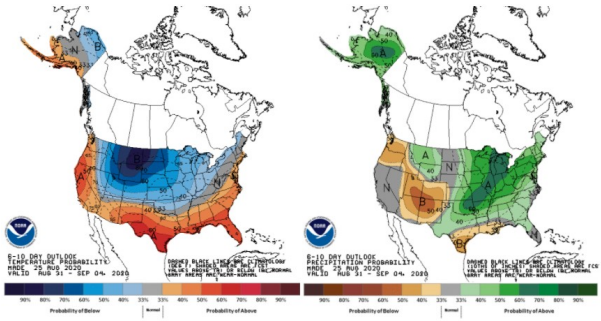
Full crop on one of Jules Janick's selections

Apple nearing harvest

Nice crop of fruit on Black Magic blackberry this year

Primocane fruiting Black Magic ready for harvest

Black Magic fruit is ripe in Lafayette



The national Climate Prediction Center's 6-10-day climate outlook for August 31 – September 4, 2020 where shading indicates probability of above- or below-normal temperature (left) and precipitation (right).

Cooler, wetter conditions expected over next several weeks

(Beth Hall, hall556@purdue.edu)

After the last several weeks of predominantly dry conditions, the national climate outlooks are finally showing confidence that temperatures should start shifting to cooler than normal and precipitation will be wetter than normal (see figure). Hurricane Laura will definitely help the precipitation side of that prediction with current tracks having the strongest rainfall amounts in the southern counties. Expect the rest of this week to stay on the warmer side, but by next week, temperatures should seem much more pleasant. From August 30th through September 7th (the period when the national Climate Prediction Center is showing confidence for these conditions), the normal amount of precipitation is between 1.25 and 1.50 inches. Average high temperatures are normally between 75°F (northern counties) and 85°F (southern counties). Therefore, keep these climatologically normal conditions in mind when interpreting the climate outlooks for below-normal temperatures and above-normal precipitation.

The probability of a La Niña developing has been increasing for the fall with moderate confidence it will continue through the winter. La Niñas can be a major driving factor for seasonal outlooks for various parts of the U.S., but not so much for the Midwest. Here, those correlations are weaker. This tends to confuse the various computer models that are run to predict the climate outlook for fall and winter in Indiana, leaving little-to-no guidance on temperature or precipitation for the next month (September) or 3-month period (September through November). Even the date of the first hard frost (*i.e.,* minimum temperature at or below 28°F) does not seem to be impacted by the strength of a La Niña, El Niño, or Neutral phase.

Late season disease management in grapes

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Late season fruit rots: Sour rot complex, Botrytis and Ripe rot are major concerns in the Midwest. Though it's been pretty dry across much of the state recently, some untimely rains can lead to disaster. Once berries split due to rain, yeasts and bacteria quickly invade damaged fruit, leading to rots that attract fruit flies. Before you know it, you have a stinking mess on your hands aka Sour Rot Complex. Recent studies have determined the importance of managing fruit fly populations as a means of slowing sour rot. Mustang Maxx, malathion, Delegate are the main insecticides we have for management and all have relatively short PHIs (1, 3, and 7 days respectively). Be sure to rotate chemistries, as resistance to Mustang Maxx and malathion is apparently widespread in the Finger Lakes. Addition of a general sanitizer such as Oxidate or Fracture should help reduce microbials responsible for the rot part of the problem, but research has shown that managing the fruit flies is key.

Botrytis is much less common in the Midwest than sour rot. But it does occur occasionally, especially on tight-clustered varieties. There are Botrytis-specific fungicides labeled for use in grapes and growers with problems should become familiar with their use. At this time of year, it's really too late to do much about Botrytis as applications should have been made at bloom, cluster closing, and veraison.

Ripe rot is a newer problem we've seen for the past few years, especially on Frontenac and Marquette varieties. A veraison application of FRAC 11 containing fungicides appears to be reasonably effective at managing ripe rot. A follow up application adds additional protection. Watch PHIs closely.

Leaf diseases: We are seeing a little powdery and downy mildew on grapes this year, but not nearly as bad as in recent years. These diseases often get established in the late season near or after harvest. Managing these diseases is important to maintain healthy foliage all the way until frost to maximize winter hardiness. Growers should consider a late season application of fungicides to keep these diseases under control to protect the foliage and assure adequate cold acclimation. Downy can be controlled after harvest (when PHIs are no longer a concern) with

phosphorous acid products, mancozeb, captan or one of the newer products such as Presidio, Ranman or Zampro. However, none of those fungicides will control powdery mildew. So a tank mix including one of the above with a DMI fungicide such as Rally or Tebuzol would be a good approach. There are several other options for powdery mildew such as Torino, Endura, Quintec, or Vivando, or even sulfur on sulfur-tolerant varieties.

If fruit has not been harvested yet, then options are limited to a hand full of products with short PHIs: phosphorous acid or captan for downy mildew, and Torino, Topsin-M, or sulfur for powdery mildew.

Late season fruit rot

Sour rot getting started in tight clustered grapes

Rootstock problems are neither new nor unique…" Cummings and Norton, 1974

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Modern clonal rootstocks are the foundation-and literal roots– to modern apple growing. These rootstocks ensure growers have orchards of relatively small trees that can be densely planted and result in earlier and greater bearing than what was historically possible. This is an obvious improvement over waiting multiple decades for an orchard to become profitable. However, to become profitable, the tree needs to reach maturity and continue to yield—early maturity and early death precludes long-term sustainability. Many growers have replaced the standby rootstocks of Bud 9, M.9 clones, M.26, and Mark rootstock varieties in favor of the newer 'replant tolerant' Geneva rootstocks (G.11, G.41, G.935, G.210, G.969, G.890), B.10, B118, or the Vineland series.

Unfortunately, growers need to know not just what a rootstock is capable of, but what its limitations are, as well. There are no silver bullets (and besides, they are only good for werewolves, and don't work on zombies, ghouls, vampires, etc.). University trials are limited in scope, replication, and in choice of scion. An unfortunate consequence of this is that are knowledge is limited, and there are always those situations where some scions do not perform well with certain rootstocks (I'm looking at you Honeycrisp on B9, or Rosalee on G41). On the plus side, most of the scions on most of the newer clonal stocks are smaller and begin bearing at an earlier age. This improves the bottom line by decreasing the time to produce marketable fruit and reducing the amount of pesticide required to do so, *assuming the tree lives for at least 11 years, if not longer*. That is a big assumption, and requires the recognition that with this smaller sized tree comes greater risk: A single canker can girdle a tree at the scion or rootstock, killing it (Fig. 1). There are several diseases that can cause this, including fire blight, Phytophthora collar rot, and bot canker.

Fire blight

Perhaps the best known canker pathogen is *Erwinia amylovora,* the fire blight bacterium. Historically, growers were aware of the risks posed by fire blight in orchards with large trees and blocks of susceptible varieties like Ida Red, Jonathan, or Gala, but fire blight is even more deadly to the highly susceptible Jonagold, Fuji, Gala, Ginger Gold and Pink Lady (Fig. 2; see Disease Susceptibility of Common Apple Cultivars). Worse still, smaller trees of these new varieties can be easily girdled and the disease spread to susceptible rootstocks like M.9 and M26 (Table 1). The Geneva rootstocks are reported to have good fire blight resistance, and B.9 has always been considered tolerant. Unfortunately, M.9 and M.26 are both highly susceptible, and any infections on the sucker of a rootstock could result in a girdling lesion or systemic infection by fire blight.

Phytophthora

Succulent young suckers aren't only an infection court for fire blight, but for *Phytophthora spp*., as well. Excess fertilizer results in succulent growth that cannot resist Phytophthora from infecting the root and crown of the tree. When coupled with wet conditions and pooling water (remember the flooding of 2019?), Phytophthora can become a problem (Fig. 3). Collar rot, as evaluated in trials at Geneva and other sites, refers to *Phytophthora cactorum* primarily, along with *P. cambivora* and *P. cryptogea*. In Indiana, *Phytophthora citricola/plurivora* has been a more significant problem of new plantings as well as older orchards, and there is no data regarding the resistance of Geneva rootstocks to this species. There are many *Phytophthora* species capable of infecting apples, and resistance to one species, like *P. cactorum*, doesn't guarantee resistance to the many other species found throughout the United States.

Cutting suckers or removing them chemically provides entry courts to the Phytophthora pathogen, and could even predispose a tolerant or resistant rootstock to infection, and may explain particularly severe 'outbreaks' of blocks or rows of Phytophthora infection (Fig. 3). Suckers need to be removed; This is best done in warmer, drier weather that is not conducive to Phytophthora infection. Contact herbicides like glufosinate, carfentrazone or paraquat are recommended for this purpose; applications of herbicides should also occur during warmer dry weather to minimize the risk of Phytophthora infection. Unfortunately, a lot of sucker management occurs in the early spring, when trees are more likely to continue suckering, and get infected by Phytophthora.

Cankers

In orchards of smaller trees with tighter spacing, reduced airflow and thin-barked scions, some newer problems have emerged, with increases in 'opportunistic' canker pathogens like *Phoma* spp., bitter rot (*Glomerella spp*.), white rot and black rot (*Botryosphaeria dothidea* and *B. obtusa*, repectively). These infections may be due to poor grafting between the scion and rootstock, herbicide drift creating an injury, other predisposing conditions (poor site, deep planting, poor quality nursery stock, etc.), but we've received multiple reports from all over the state all exhibiting cankers. Many of these cankers are understandably misdiagnosed as fire blight (Fig. 1). Unlike fire blight, these fungal diseases cannot be managed with streptomycin, and fungicides will only protect new growth. In examining these problems, excavation of the roots usually show a failure of new growth and establishment as the main problem. In other instances, herbicide drift created an injury that the canker fungi colonized (Fig. 4).

Management

How do we prevent these problems from happening? Like anything, our choices have so much to do with the problems we encounter in the orchard (or in life). Choosing fire blight resistant scions and rootstocks need to mentioned first. This is probably the best approach for new or backyard growers to start, and then expand into more challenging varieties. The Disease susceptibility of Common Apple Cultivars provides a list of fire blight resistant varieties. Within the table, highlighted in green are the PRI varieties (Purdue, Rutgers, University of Illinois) that were bred for apple scab and other disease resistances. Paired with B.9 provides a semi-dwarf tree with good anchorage AND resistance to fire blight and some crown rots, and a greater likelihood for success. For disease resistance of root stocks, see Table 1.

The next issue is fertilizer. In the push for fast growth and reaching that top trellis wires, growers are actually producing trees with softer, more disease susceptible tissue. This results in trees that grow quickly, but not strong. The Ontario Ministry of Agriculture, Food and Rural Affairs has a great publication on Fertilizing the New Apple Orchard.

Sucker management is an interesting problem. Like so many, it is one of our own choosing, by rootstock choice and management. Cutting suckers down to ground level (or deeper) results in a fresh crop of succulent suckers—and injuries that are still susceptible to pathogens and may even promote insect pest activity (Fig.4). Lightly trimmed suckers produce more weak shoots that are just as susceptible to virulent and opportunistic pathogens, be it fire blight, Phytophthora, or bot canker. So what is a grower to do?

Tre-Hold Sprout Inhibitor A112 (15% ai), can be applied during the dormant season (for dilution in water or mixed with latex paint) or 4 weeks after petal fall when regrowth is 6–12 inches tall. Do not apply to very young or stressed trees as injury, failure to establish and stand loss may result. In young trees, suckering is often a symptom of a bigger problem.

Going forward, many of the growers I've worked with have been relying on Rely 280 (glufosinate) or Gramoxone (paraquat) for sucker control. For both, *do not allow spray to contact green tissue* (except suckers!). I cannot emphasize this enough! For glufosinate, be sure to follow the split application as per the label. Treated suckers should not exceed 12 inches in length, to minimize the risk of injury to the tree. Another option is Aim/Shark (carfentrazone-ethyl) an HRAC Group 14 Herbicide that is labeled for all tree fruits to suppress root suckers. Do not allow spray to come in contact with **ANY** green tissue. Trees should be established in the orchard at least one year or their trunks should be protected with an impervious trunk wrap or latex paint as any of these herbicides can cause injury if they get in contact with young bark (conservatively guessing at least 5years based upon what I've seen this year). Allow at least 7 (or up to 14 days, depending upon label) before reapplication. Some of these herbicides are slow to burn down, and problems with excess damage may occur if the grower impatiently reapplies trying to kill suckers before the timeframe provided in the label.

Protecting the rootstock is as important as protecting the scion, if not more so! Be sure to get the rootstock that works best for your orchard, production system, disease history, and management style to put your roots and rootstocks down in a way to establish long-term success.

Table 1. Common apple rootstock and reported disease resistances (citations 1-5, personal observations, NC-140 trial).

Apple rootstock cultivar	Fire Blight Resistance Rating	Phytophthora Resistance Rating*
Bud.9	VR	R
Bud. 10	R	U
Bud.118	U	VR
EMLA 106	S	VS
Geneva 11	S	MR
Geneva 16	MS	MR
Geneva 30	R	R
Geneva 41	R	U
Geneva 65	R	R
Geneva 935	R	U
Mark	S	R
MM.106	MS	VS
MM.111	R	S-MR
M.7 EMLA	MS	MR
M.26 (EMLA, NAKB)	VS	S-VS
M.27	S	MR
M.7	S	S
M.7a	S	S
M.9	S	VR
M.9 EMLA	S	R
M9 NAKBT337	VS	S
M9Nic29, Burg756S	S	U
Ottawa 3	VS	R
P.2	VS	R
P.22	VS	R
Vineland 3	MS	U
Vineland 4	VS	U

VR=very resistant> MR=moderately resistant> R=resistant> MS=moderately susceptible> S=susceptible > VS=very susceptible. U = unknown/no data found.

*There are many *Phytophthora* species capable of infecting

apples, and resistance to any one species, like *P. cactorum*, doesn't guarantee resistance to the many other species found throughout the United States.

Figure 1. A single canker can kill a young tree or rootstock. This year, bot canker was mistaken for fire blight by several growers.

Figure 2. Fire blight can kill young trees before they ever get established.

Figure3.Phytophthora canker (confirmed). Replanting should include use of more Phytophthora resistant rootstocks and fungicides, including the active ingredients mefenoxam and phosphorous acid.

Figure 4. Sucker removal, weed management, and burr knots have reinforced an unhealthy rootstock situation into a fatal one.

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Using low tunnel is promising to increase yield of annual plasticulture strawberry production

(Wenjing Guan, guan40@purdue.edu)

Strawberries are primarily grown in matted row system in Indiana, in which bare-root strawberry plants are set in the spring. Runners are established. Fruit is first harvested in the second year and plantings are renovated each year for 2-3 seasons. Growers in the southern part of the state expressed interest in growing strawberries in plasticulture system, in which plants are set on raised beds covered with plastic mulch. Strawberries may be planted in fall with plug plants, or in summer with bare-root plants. Runners are removed. Fruit is harvested the following year from mother plants.

Using plug plants is more feasible for large-scale production as plants can be set with a transplanter and water wheel. However, plug plants are typically not available until the end of Aug. The growing window is often short in the fall so that it is difficult for the plants to develop enough side crowns. As a result, yield in the following spring is often unsatisfactory; hard to justify production cost.

We have been testing the plasticulture strawberry production system at the Southwest Purdue Ag Center in Vincennes, IN thanks to supporting from a Purdue AgSEED grant and a Rice grant. In order to increase heat accumulation, we used both high tunnel and low tunnel systems. Although we are far from coming to a conclusion about the production system, our preliminary studies did show promising results. In this article, I will discuss the results of using low tunnels to increase strawberry yield.

The experiment was conducted in 2019-2020 season with ten strawberry cultivars. Plug plants were planted on Sep. 10. Low tunnels were installed in half of the field with a mechanical transplanter low tunnel layer on Oct. 10 . The low tunnel layer set hoops 4.5' apart, and covered with 1 mil perforated clear plastic (Figure 1). The low tunnel plastic was removed on Jan. 2. The field

was covered with floating row covers for a short period in Nov., and for most of the time in Jan. and Feb (Figure 2). In spring, floating row covers were also used to protect flowers against the freeze damage in Apr. and May. Harvest started around May 10, and lasted for about a month.

Figure 1. Low tunnels were installed with a mechanical transplanter low tunnel layer.

Figure 2. Floating row covers were used for cold protection

The highest yield cultivar was Liz under low tunnels (0.84 lb/plant) (Figure 3), followed by Camarosa under low tunnels (0.77 lb/plant). Chandler under low tunnels had the third-highest yield (0.61 lb/plant). The other cultivars grown under low tunnels had significantly lower yields compared to the top-yielding cultivars.

Figure 3. Cultivar Liz growing with (top) and without (bottom) low tunnel. The photo was taken on Jan 2 after low tunnel plastic was removed.

Without low tunnels, most cultivars had lower yield compared with the same cultivar with low tunnels, except 'Beauty' (a day-neutral cultivar) that yielded higher without low tunnels; and 'Radiance' that yielded similar with and without low tunnels. The yield was generally very low without low tunnels (ranged from 0.27 -0.59 lbs/plant), and no significant difference among cultivars.

The past strawberry production season was full of challenges. It was no exception for our trial. Deer visited the field shortly after planting. Although low tunnels effectively stopped the damage, deer had cleaned most leaves of the newly planted plug plants prior to setup of the low tunnels. The damage dramatically delayed plant growth in Sep. An unusually cold event happened in middle Nov. that dragged temperatures to single digits at SWPAC. In April and May, we encountered late frosts. Although the frost damage was minimized by using floating row covers, a small percentage of primary flowers were killed when temperatures dropped below 30 °F on April 16.

After harvest, the plants may be kept for another year for a second-year harvest. But labor required to remove runners from summer to fall in the second year can be overwhelming. As runner removing has to be conducted by hand at this stage, it may not be feasible for large-scale production. In addition, weeds in row middles, and pest control in the summer can also be challenges.

Double cropping, use the same plastic for a second crop, is an alternative approach. Since planting the second crop may not be possible until the end of June; pumpkin, winter squash, and brassica crops (broccoli, cauliflower, cabbage, etc.) are the most promising second crop. In our trials, we planted kabocha squash on the same plastic after strawberry on July 1. Things are looking great at this point. We are expecting to harvest the squash in another month.

Figure 4. Winter squash was planted after strawberry on the same plastic.

The experiment is continuing in the 2020-2021 season at the SWPAC. Hopefully, after a few seasons, we will have a solid idea of the feasibility of the production system, and generate economic data to help growers make decisions. Please stay tuned for the additional update of strawberry research at SWAPC.

Video High Tunnel Strawberry Production

(Wenjing Guan, guan40@purdue.edu)

This video guides you for a tour of strawberry production in high tunnels in Indiana. Additional videos addressing specific production practices will be available in the future. Please stay tuned for the update of plasticulture strawberry research from Purdue.

Extension Events

(Bruce Bordelon, bordelon@purdue.edu, (765) 494-8212)

Due to the COVID crisis, most Purdue Extension meetings will be held virtually. Most Purdue Extension staff are working from home and are available to answer your questions by email, phone or through social media. Our contact information is at the end of the newsletter.

September 10-12, 2020 Purdue Extension Master Gardener State Conference
Sponsored by the Hamilton and Howard County Master Gardener Associations
Hamilton County Fairgrounds, Noblesville, IN (September 10 and 11)
Tours of Howard County gardens, Kokomo, IN (September 12)
https://hcmga.org/2020sc
(Registration open to Purdue Extension Master Gardener volunteers and Extension staff only)

September 10, 2020 Hydroponics Workshop
Hosted virtually
Contact Lori Jolly-Brown, ljollybr@purdue.edu

January 19-21, 2021 Indiana Green Expo
Indiana Convention Center, Indianapolis, IN
Contact Brooke Ponder, bponder@purdue.edu

January 20 & 21, 2021 Indiana Horticultural Conference & Expo
Indianapolis Marriott East
Contact Lori Jolly-Brown, ljollybr@purdue.edu

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