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Nutrient Management in Apple Orchards for the 2021 Growing Season

Mike Basedow, CCE ENYCHP and Dr. Lailiang Cheng, Cornell University

Nutrient management plays a vital role in determining your orchard's tree growth, yield, and fruit quality. Here are a few things to keep in mind when developing your orchard nutrition program.

Nitrogen:

The highest demand for nitrogen in the orchard occurs from petal fall to the end of shoot growth. During this period, rapid shoot growth and fruit cell division require substantial amounts of nitrogen. Nutrition studies have shown maintaining leaf N levels between 2.0 to 2.2% balances adequate tree growth with high fruit quality.

Fertigation is the preferred application method for N, as these applications can be made from bloom to the end of shoot growth to match peak N demand. If ground applications are made, the best timing is between budbreak and petal fall for most soils. The exception would be orchards on sandy soils with low organic matter. At these sites, multiple split applications from spring through early summer would be more desirable to limit nutrient loss.

Sixth leaf Gala on M.26 rootstock grown in sand culture at 3.5x11 ft spacing at the Cornell Orchards were used to determine Gala nutrient demands in high density systems. Photo: Lailiang Cheng

The rate of N applied depends on the orchard soil organic matter content and tree N status. Because each orchard soil is unique, the best way to fine-tune your N rates would be to have your own N rate trial on your farm. Apply varying levels of N to a small subset of similar trees, and compare tree growth and fruit quality over multiple growing seasons. **However, you might consider 20-50 lbs of actual ground applied N per acre where leaf analysis indicates a deficiency as a starting point. If leaf N**

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levels are above 2.2% in Honeycrisp, we recommend skipping N applications for a year.

Foliar N application at petal fall through the early cover sprays is a good way to supply nitrogen to young fruitlets and spur leaves. **Lailiang recommends foliar urea applications at petal fall, first cover, and second cover at a rate of 5 lb. urea per 100 gallons on blocks that had marginal N status last year.** Urea can be easily tank-mixed with most fungicides and insecticides, but cannot be mixed with oil. It should be applied as dilute sprays, but if you have to make concentrated sprays, do not concentrate urea over 3X.

Potassium:

Of the macronutrients required by apple trees, K has the highest concentration in fruit. More than two thirds of the total tree K requirement is found in the fruit. As a result, harvest removes a significant amount of K from the orchard. Work on Gala/M.26 has shown trees have constant demands for K from bloom to harvest. 80 to 85 lbs of K are removed at a fruit yield of 1500 bushels/acre in Gala, which equates to about 100 lbs of potash (K2O) per acre.

However, not all varieties are equal in their K needs. Honeycrisp requires lower K inputs compared to Gala and McIntosh; about 25-30% less K is needed when at similar levels of yield. With these findings in mind, we recommend the optimal leaf K levels in Honeycrisp as 1.0 to 1.3%, while the optimal for other varieties would be between 1.3-1.8%.

If your K level was marginal in last year's leaf analysis, you should apply a higher than average amount of potassium this year in varieties such as Gala, McIntosh, and Empire.

If you use fertigation, target the period from petal fall to a couple weeks before harvest. Regular ground applications can be made at petal fall, after shoot growth has stopped, and following harvest. **Typical ground application rates range from 60 to 150 lbs of K per acre at each application timing where leaf analysis indicates a deficiency. The lower end of this range should likely be used in Honeycrisp plantings, particularly if the block is prone to bitter pit. If your soil analyses show your Honeycrisp blocks contain 350 lbs or more of K in the top six inches of soil per acre, you should skip your K fertilizer for one to two years to bring the soil K levels back down.**

The following article in this newsletter details our current understanding of the interactions between rootstock and nutrient status on bitter pit in Honeycrisp.

Boron and Zinc:

Boron and zinc are both important for fruit growth and development. A foliar spray program of Solubor is a very effective management practice to supply B to fruit, while foliar applications of zinc are the only economical way of providing this element. **We recommend applying Zinc chelate at the labeled rate, and Solubor at 1 lb per 100 gallons at petal fall and at first or second cover to promote early fruit growth**. Zinc chelate and Solubor can be tank-mixed with urea. However, Solubor should not be tank-mixed with any pesticides contained in water-soluble plastic packages because it inhibits the dissolution of the plastic. Solubor should also not be tank -mixed with oil. Solubor increases spray water pH. Keeping this in mind, the pH of the tank mix should be tested and adjusted with a suitable acidifying agent if Solubor is to be applied with pH sensitive pesticides.

Calcium:

Ca accumulation occurs during the entire fruit growth period from petal fall to fruit harvest. In addition to having proper soil pH and maintaining calm trees, **a foliar Ca spray program is essential for bitter pit susceptible cultivars**. We have been recommending the following Ca spray program: **3 to 4 cover sprays of 1 to 2 lbs of calcium chloride (78% $CaCl_2$) or its equivalent per 100 gallons (dilute basis) at 14-day intervals, beginning 7 to 10 days after petal fall, followed by 2 additional sprays of 3 to 4 lbs of calcium chloride (78% $CaCl_2$) per 100 gallons at four and two weeks prior to harvest.** It's important to keep in mind that complete coverage of fruit is essential. More frequent sprays are more important than the exact timing of the sprays. Calcium chloride cannot be mixed with oil.

Maintaining proper soil pH

Soil pH should be maintained in the range of 6.0 to 6.5 throughout the soil profile to optimize tree growth and nutrient availability. New York orchard soils tend to acidify over time. The high annual precipitation gradually leaches calcium, magnesium, and potassium out of the soil. The loss of these elements leads to an increase in active hydrogen and aluminum, causing a decrease in soil pH. Ammonium-forming fertilizers (such as ammonium nitrate, ammonium sulfate and urea) also acidify the soil by releasing hydrogen ions as they convert to nitrate. To mitigate these acidifying effects, a soil analysis should be conducted every 2 to 3 years in mature plantings. **If pH tests low, a maintenance lime application of 1 to 2 tons per acre should be applied.**

Water/irrigation:

Dry fertilizers applied to soil cannot be taken up by the roots unless there is good soil moisture. Soil water status also affects the mineralization of organic matter, which consequently affects the amount of nitrogen available for the trees. Soil water availability also affects fruit cell division and cell enlargement, thereby affecting final fruit size. **Providing irrigation to ensure water supply and nutrient uptake is essential for sizing the fruit to achieve high yield and good quality, especially if it turns out to be a dry year.**

Further Reading

Cheng, L. 2016. Challenges and opportunities for Honeycrisp nutrient management. Proceedings of the 2016 Empire State Producers Expo. http://www.hort.cornell.edu/expo/proceedings/2016/TreeFruit.%20Challenged%20and%20opportunities%20to%20optimize%20mineral%20nutrition%20of%20Honeycrisp.Cheng.pdf

Cheng, L. and Miranda Sazo, M. 2018. Why is 'Honeycrisp' so susceptible to bitter pit? NY Fruit Q. 26(1): 19–23.

Fertilization of Honeycrisp with Consideration of Rootstock to Manage Bitter Pit

Dr. Terence Robinson & Dr. Lailiang Cheng, Cornell University; Dr. Gennaro Fazio, USDA-ARS; and Mario Miranda Sazo, CCE-LOF

In the last few years, we have studied nutrient levels in Honeycrisp fruit as influenced by rootstock and found that some rootstocks impart higher potassium and nitrogen levels in the fruit than others. It does not seem that they have less Ca in the fruit, but the ratio of K/Ca or N/Ca is elevated with some rootstocks more than others. It appears that some rootstocks are more efficient at taking up K and N than others. This leads to more bitter pit with some rootstocks than others.

The issue of K fertilization is interesting because we found in the 1990's that K was essential for large fruit size and high yield of 'Empire'. Our work in 2008-2009 on 'Gala', another small-fruited variety also showed that high K levels in leaves (1.6%) and fruit (0.8%) are needed for fruit size and yield. Thus, we promoted its annual use with both varieties and had high targets for leaf K level (1.5-1.8%). It worked well with all other varieties until 'Honeycrisp' came along. We found that 'Honeycrisp' requires less K to have large fruit size and high yield than 'Gala'. Thus, it should need lesser amounts of annual K_2O than 'Gala'. We continue to recommend annual applications of K fertilizers to 'Gala'. Our work also showed with 'Gala' that a high yield of 1500 bu/acre will remove about 100 lbs of K_2O per acre with the fruit. Thus at least that amount of annual K should be applied to 'Gala' to sustain that high yield. With the new data we recommend much lower amounts of K fertilizers with 'Honeycrisp'. In addition, we also have a much lower target for leaf K level of (1.0-1.3%) with 'Honeycrisp' than with 'Gala' (1.5-1.8%).

Another factor is the efficiency of K uptake by different rootstocks. Some rootstocks such as B.9 do not take up as much K as other rootstocks. M.9 is intermediate while G.41 and G.11 are very efficient in K uptake. The low vigor of B.9 and low uptake of K is good for bitter pit, but B.9 trees almost never fills the space well enough for high yields, while G.11 and G.41 have slightly more vigor to fill the space but are very efficient at taking up K and thus can have more bitter pit in some years. Recently, we found that G.214 has similar vigor to G.41 but poorer uptake of K and thus has low bitter pit risk (the best of both worlds).

We still don't know why some rootstocks are more efficient at taking up K and Ca than others. Probably it has a lot to do with vigor and root system size. Higher vigor usually means a greater volume of soil is explored by roots and thus the plant has access to more N and K.

Lastly, for managing 'Honeycrisp' and 'Gala' we recommend using leaf analysis, and for 'Honeycrisp' we also suggest fruit peel sap analysis, to evaluate how much K and N to add or not add. Honeycrisp by itself seems to be less efficient than other scions in the ability to transport calcium to fruit, while it is able to be very effective with potassium and nitrogen. If leaf K and N levels of 'Honeycrisp' are above 1.3% and 2.2%, respectively, then we suggest a reduction in the annual K and N applications to zero for a year. For 'Gala', if leaf K levels are less than 1.5%, we suggest additions of 100 lbs K_2O per acre per year until that level is achieved. However, for 'Honeycrisp' if K level is between 1.0 to 1.3%, reduce the K rate by 25~30% that was recommended for 'Gala' at the same yield level. In addition, with Honeycrisp fruit peel sap analysis has been very helpful in deciding how to fertilize that variety. If the peel sap K/Ca ratios are above 25 then that is also a signal to reduce K applications to zero. If peel sap levels of the K/Ca ratio are below 25 then 'Honeycrisp' should receive about 40 to 50 lbs K_2O/acre at a yield level of 1000 bushels per acre. Because 'Honeycrisp' often has 15 to 30% lower yield than 'Gala', the annual maintenance K application rate is often only about 50 to 60% of what was recommended for 'Gala'.

Table 1: New Potassium recommendations and plant tissue levels fro 'Honeycrisp' to mitigate incidence of bitter pit.

Honeycrisp orchard	K Fertilization Program for Honeycrisp	K/Ca levels in Leaves and Fruit Peel Tissues
New planting	Pre-site preparation: Reduce the input of K during pre-plant soil preparations to maintain a ratio of K to Ca at 6~7.5% instead of 9.5 to 10% for most varieties	Leaf K level Keep a low value of 1.0-1.3% (years 1-2)
Mature planting	Maintenance application: Reduce the K rate by 25~30% that was recommended for 'Gala', 'Empire' and 'McIntosh' at the same yield level. If your soil analysis indicates that there is over 350 lbs of K in the top 6" of soil per acre, we suggest skipping K fertilization for one to two years to draw down the soil K reserves and then make a decision based on leaf analysis.	Leaf K level Keep a low value of 1.0-1.3% Peel sap K/Ca ratio (July timing) Keep a ratio below 25

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Maintenance K_2O application rate is the K removal rate in the table at a given yield multiplied by 1.2. For example, at a fruit yield of 1500 bushels per acre, the maintenance K_2O rate is: 85.1 X 1.2 = 102 lbs/ acre.

Table 2: Predicted removal rates of macro-nutrients by fruit harvest in relation to fruit yield in commercial 'Gala' orchards in New York.

Macronutrients (lbs/acre)						
Yield (bu/acre)	***N***	***P***	***K***	***Ca***	***Mg***	***S***
500	10.3	2.6	30.6	3.7	1.8	1.0
1000	20.3	5.0	57.9	7.6	3.5	2.1
1500	30.3	7.4	85.1	11.5	5.3	3.1
2000	40.3	9.7	112.4	15.4	7.1	4.2

It Is Time to Rediscover Amid-Thin®

Dr. Duane W. Greene, James Krupa, and Maureen Vezina, Stockbridge School of Agriculture, University of Massachusetts

An important breakthrough in chemical thinning occurred in the late 1930's when it was discovered that the group of hormones known as auxins could cause fruitlet abscission. Two compounds in this hormone class that were especially effective were naphthaleneacetacetic acid (NAA) and naphthaleneacetamide (NAD, Amid-Thin). Both of these compounds ultimately were registered as thinners for use on apples and pears. Over time NAA became the preferred product, because it was a more potent thinner and appeared to perform better when used at the 7-to-14-mm fruit size stage, the time fruit are most vulnerable to chemical thinners. NAD was reserved for use as a bloom or petal-fall stages and especially on early maturing varieties.

The Amid-Thin label was written in the 1950s and it remains essentially intact including use recommendations for cultivars such as Yellow Transparent, William Early Red, Early McIntosh and Wealthy, to mention just a few. The label and the use of Amid-Thin have remained essentially unchanged for the last 60 years. It has and continues to play a relatively minor role as a thinner on apples.

Why is it Important to Resurrect an old Thinner?

In years when bloom is heavy, it is important to start thinning early. The strategy of multiple times for thinner application has been emphasized by researchers and extension personnel across North America, and this approach is being embraced by the industry as a whole. The majority of thinning, however, is still done during the traditional thinning time, when fruit are at 7 to 14 mm in diameter. Successful thinning at this time is determined to a very large extent by the weather and especially how weather influences the carbohydrates present in the spurs. Development of the carbohydrate model and the fruit growth model recently have improved the precision of thinning at this time particularly when packaged in a Precision Thinning Program that has been championed by Terence Robinson and coworkers in New York, by Phil Schwallier in Michigan, and others. The weather, however, cannot be controlled, and it can only be imprecisely predicted, so considerable variability in thinning response can still be expected. Clearly, the ability to do significant and perhaps the majority of thinning earlier and safely would be advantageous and it would allow orchardists to use a less aggressive thinning program during the 7-to-14-mm fruit growth stage.

Blossom thinning has not been popular with growers in the East because weather events can occur after thinner application, such as frost or poor pollination weather, that can affect crop load. Caustic thinners can thin effectively, but phytotoxicity and the resulting damage to spur leaves may affect fruit size. Petal fall is a much more popular time to apply thinners for growers in the East, and a large percent of growers take advantage of this important thinning opportunity. Carbaryl has been the thinner of choice but its use is either being discouraged or forbidden by some retailers. Its use is not allowed in many European countries. Consequently, incorporating carbaryl in the future thinning programs is very much in question. NAA is a viable thinner that can be used at bloom and petal fall, but there is the perception that it can over thin when very warm temperatures follow application.

The biological responses of plants to NAA and NAD was studied in the 1930s. Plant responses such as epinasty and ethylene production were much less with NAD than when NAA was applied indicating that side effects, including more variable thinning due to weather, are much less likely. NAD is a stronger thinner than carbaryl, and based upon recent research, it appears to be quite safe. The goal of applying thinners at bloom and/or petal fall are to accomplish most of the thinning before fruit ever reach the 7 mm stage. The objective of research over the past couple of years has been to determine if Amid-Thin is a thinner we are looking for that can provide substantial yet safe thinning at bloom and/or petal fall.

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Materials & Methods

In a block of mature Macoun/M.9 apple trees growing at the University of Massachusetts Cold Spring Orchard, 48 uniform trees were selected. At the pink stage of flower development two limbs per tree 10 to 15cm in diameter were selected, tagged, and the diameter measured. At the pink stage of flower development, all blossom clusters were counted and the blossom cluster density calculated by dividing the number of blossom clusters by the limb cross-sectional area. Trees were blocked into 6 groups (replications) of 7 trees each based upon limb cross-sectional area. Within each replication trees were randomly assigned to receive one of the following 7 treatments:

- Untreated control
- Amid-Thin 40 ppm applied at bloom (May 19)
- Amid-Thin 50 ppm applied at bloom (May 19)
- Amid-Thin 40 ppm applied at petal fall (May 22)
- Amid-Thin 50 ppm applied at petal fall (May 22)
- Amid-Thin 40 ppm applied at bloom and petal fall
- (May 19 and 22)
- Amid-Thin 50 ppm applied at bloom and petal fall
- (May 19 and 22)

Two hours following the petal-fall spray trees received about 0.5 inches of rain. The spray had dried by the time the rain started. In my experience, once a droplet dries you can expect at least an 80% response (or more) to an applied thinner.

At the end of June drop in July all persisting fruit on the tagged limbs were counted and the fruit set was calculated. In addition, each spur on all tagged limbs was examined and the number of fruit on each spur was recorded. At the normal harvest time on September 30, a 50-apple sample was randomly harvested from the periphery of each tree and weighed, and then the diameter of each was measured using a hand-held caliper.

Results

All Amid-Thin treatments appeared to reduce fruit set (Table 1, Figure 1). The results were statistically significant when expressed as fruit per cm2 limb cross-sectional area and as fruit per 100 blossom clusters (% set). The 50 ppm treatments appeared to be slightly more effective than the 40 ppm treatments. The 40 ppm treatment applied at bloom was the least effective, and it was the not significantly different from the control trees. The thinning following application at either bloom or petal fall appeared to be very similar. It was interesting to note also that when applications were made at both bloom and petal fall, the thinner response appeared not to be additive. With the exception of trees that were treated with 40 ppm at bloom, Amid-Thin treatments reduced the number of spurs having 2 fruit per spur and increased the number of spurs carrying just one fruit (Table 2). The Amid-Thin treatments increased the weight of all fruit on treated trees although the differences were small and not statistically significant (Table 1). The weather for the 3 to 4 days following bloom and petal fall sprays was generally favorable and fell within the temperature and solar radiation range deemed acceptable.

Discussion

The results presented here show convincing evidence that significant and effective thinning can be achieved by application of Amid-Thin at either bloom or petal fall. Petal fall has been the time suggested for the application of Amid-Thin, but the bloom timing appears to be comparably effective. Since no additional Thinning was noted when Amid-Thin was applied a second time on some trees, it appears to show the carbaryl-like response of not showing a dose response. The fact that it appeared to be equally effective over different physiological stages and somewhat immune to additional sprays, it has demonstrated remarkable flexibility and safety in this investigation.

Table 1. Effect of Amid-Thin (NAD) treatments applied at bloom, at petal fall and bloom, and at petal fall on fruit set and fruit weight of Macoun/M.9 apples in 2014.

			Fruit set		
Treatment[1]	Rate (ppm)	Timing	Number per cm^2 limb cross-sectional area	Number per 100 blossom clusters	Fruit weight (g)
Control	---		11.2 a	99 a	142
Amid-thin	40	Bloom	8.5 ab	79 ab	151
Amid-thin	50	Bloom	5.7 b	55 b	146
Amid-thin	40	Petal fall	7.8 b	75 ab	151
Amid-thin	50	Petal fall	7.6 b	66 b	164
Amid-thin	40	Bloom + Petal fall	7.9 b	69 ab	154
Amid-thin	50	Bloom + Petal fall	6.7 b	63 b	154

[1]Treatments applied as a dilute tree row volume spray of 125 gal/acre at bloom, May 19, and petal fall, May 22.
[2]Mean not followed by a common letter are significantly different at odds of 19 to 1 (Duncan's New Multiple Range Test, $P = 0.05$).

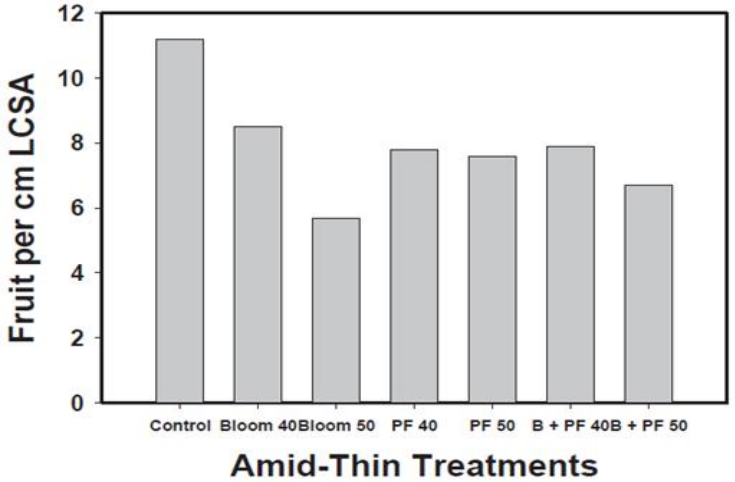

Figure 1. Influence of Amid-Thin time of application, concentration and number of applications on fruit set of Macoun/M.9 apples. 2014.

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The ideal crop load in this block is suggested to be about 6 fruit per cm2 limb cross-sectional area, and in general, this amount of thinning was not achieved in this investigation. We rarely achieve an ideal thinning job with a bloom or petal-fall spray nor do we really want to. Many weather-related events can occur that are unforeseen and not controllable. Therefore, our hope is to reduce crop load enough so that only a modest thinner application can finish the thinning job. This we have achieved in this experiment. A concern is that the fruit size was not increased as much as would have expected given the amount of thinning. It appears that both modest thinning and a further increase in fruit size could be achieved by the use of MaxCel. This is a thinner that increases fruit size directly, and it is a modest thinner when used in the absence of carbaryl. This suggestion should be tested.

Table 2. Effect of Amid-Thin (NAD) treatments applied at bloom (B), petal fall (PF) and bloom, and petal fall on the percent single, double and triple fruit on individual spurs of Macoun/M.9 apples. 2014.

Treatment[1]	Rate (ppm)	Timing	Fruit per spur (%) Single	Double	Triple
Control	---		60	37	3
Amid-thin	40	Bloom	59	35	6
Amid-thin	50	Bloom	77	18	5
Amid-thin	40	Petal fall	67	29	4
Amid-thin	50	Petal fall	75	23	2
Amid-thin	40	Bloom + Petal fall	74	24	2
Amid-thin	50	Bloom + Petal fall	79	19	2

[1]Treatments applied as a dilute tree row volume spray of 125 gal/acre at bloom, May 22, and petal fall, May 22.

The results presented here are extremely encouraging in light of the increasing pressure from various external sources to eliminate the use of carbaryl in the thinning program. The results presented here are some of the most promising so far to identify an alternative thinner for carbaryl. The most attractive aspects of this work are its time of application and the ability to achieve meaningful and safe thinning at this early stage of fruit development. Thinners applied at bloom and petal fall are less influenced by weather conditions following application. When fruit grow to the 7 to 14 mm size, relatively small changes in weather can translate into fairly large responses to thinners. An additional advantage of thinning at this time is that there is more than ample time to apply a thinner later after initial set, and subsequent need for further thinning can be assessed. Naphthaleneacetic acid (NAA), a closely related thinner, can be used at these times as well, but it appears to show a greater amount of variability due in large part to its greater response to temperature changes, thus perhaps making NAA a more tenuous choice for thinning a bloom and petal fall when compared with Amid-Thin.

We gratefully thank AMVAC Chemical Company for providing the Amid-Thin® and for grant-in-aid funds which allowed us to conduct this experiment.

Petal Fall Pest Management Review

Dr. Art Agnello, retired Cornell University (with some slight edits by Mike Basedow, CCE ENYCHP)

This period is always tough to nail for timeliness of advice, so we'll be conservative and assume that everyone who isn't actually scheduling their petal fall sprays will at least want to give them some advance planning, since the one thing we can rely on is that the "old faithful" insect pests we always look out for at petal fall will continue their progress towards the newly formed fruits. To that end, this overview will help take your mind off the current fluxes in the weather and make preparations for when things settle down into a less dramatic summer pattern.

Plum Curculio

Adults move into orchards from overwintering sites in hedgerows or the edges of woods and adults are active when temperatures exceed 60°F. Adult females oviposit in fruit during both day and night but feed mostly at night. Depending on temperature, overwintering adults remain active for 2–6 weeks after petal fall. Because adults are not highly mobile, orchards near overwintering sites, woodlands, and hedgerows are most susceptible to attack. Fruit damage is usually most common in border rows next to sites where adults overwinter. Although initial postbloom sprays for plum curculio control should begin at petal fall, growers are often unsure how many additional sprays will be necessary to maintain protective chemical residues to prevent subsequent damage throughout the PC oviposition cycle, which varies according to temperatures and weather patterns after petal fall. A fact sheet with

Plum curculio adult, Photo: Peter Jentsch.

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photos and descriptions of this insect's life stages can be found at: https://hdl.handle.net/1813/43118

Following from the fact that PC activity and oviposition are largely determined by temperature, we are able to use an oviposition model to estimate when control sprays after petal fall are no longer necessary to protect fruit from PC damage. This model is based on the assumption that residues from sprays applied after petal fall need to be maintained on fruit and foliage only until PC adults stop immigrating into orchards, which happens to correspond to the time when about 40% of the oviposition cycle is complete. This is predicted by the model to occur at 308 DD (base 50°F) after petal fall of McIntosh. Most probably, this strategy works because, after 40% of PC oviposition is complete, adults usually do not move into the orchard from outside sources, or within orchards from tree to tree. Therefore, by this time, adults residing in treated trees have already been killed by insecticide residues and are unable to complete the remainder of their normal oviposition cycle.

In order to use this strategy: (1) Treat the entire orchard at petal fall with an effective insecticide (e.g., Imidan, Actara, Avaunt, Verdepryn). (2) Start calculating the accumulation of DD after petal fall of Macs (base 50°F); this is easily done from the NEWA Apple Insect Models page (http://newa.cornell.edu/index.php?page=apple-insects) by entering the petal fall date for your area. (3) No additional sprays are necessary whenever the date of accumulation of 308 DD falls within 10–14 days after a previous spray. In cherries and other stone fruits that are already at shuck fall, sprays should start (or should have started, as appropriate) at the first opportunity. Recall that, in addition to the industry standard broad-spectrum materials such as Imidan, some additional options may be considered: Avaunt and Actara are effective for plum curculio in apples and pears, and Avaunt is also labeled in stone fruit as another PC option. Delegate, Assail and Altacor all have some activity on PC, but should not be considered as the first choices in high-pressure blocks. Another option would be Exirel, a 2nd-generation diamide with better efficacy against this pest.

European Apple Sawfly

This primitive bee and wasp relative shows a preference for early or long-blooming varieties with a heavy set of fruit. This insect is generally more of a pest in eastern N.Y., although it has been gradually becoming more problematic in the more western counties, and now frequently reaches as far as Wayne Co. (and beyond). The adult sawfly emerges about the time apple trees come into bloom and lays eggs in the apple blossoms, which means they can start to be found right about now. Young larvae begin feeding just below the skin of the fruits, creating a spiral path usually around the calyx end. This early larval feeding will persist as a scar that is very visible at harvest, and which some have described as almost decorative, although fruit marketability is obviously affected. Following this feeding behavior, the larva usually begins tunneling toward the seed cavity of the fruit or an adjacent fruit, which usually causes it to abort. As the larva feeds internally, it enlarges its exit hole, which is made highly conspicuous by a mass of wet, reddish-brown frass. The frass may drip onto adjacent fruits and leaves, giving them an unsightly appearance. The secondary feeding activity of a single sawfly larva can injure all the fruit in a cluster, causing stress on that fruit to abort during the traditional "June drop" period. A fact sheet with photos and descriptions of this insect's life stages can be found at: https://hdl.handle.net/1813/43091

European apple sawfly larvae (top) and damage (bottom). Photos: Ontario Ministry of Agriculture, Food, and Rural Affairs, and Art Agnello.

Certain insecticides that control this pest also adversely affect bees, which can pose a problem at petal fall because certain apple varieties lose their petals before others. In blocks of trees where petal fall has occurred on one variety but not the others, the variety that has lost its petals is likely to sustain some curculio or sawfly injury until an insecticide is applied. Some insecticides with activity against both plum curculio and sawfly — like Avaunt and Actara — may have a slight advantage over the conventional OP Imidan in this case. Assail represents another option for controlling sawfly; it's not very active against plum curculio, but will do a good job against rosy apple aphid (and spotted tentiform leafminer, if those still can be found in your orchard), as well as sawfly, at this timing. Altacor and Exirel are both rated high in their control efficacy against sawfly. To minimize the hazard to honey bees, make sure any pesticide is applied only when no bees are actively foraging on blooming weeds (evening is better than early morning).

Obliquebanded Leafroller

As your looking through your buds this time of year, it would be prudent to have a quick look for later-stage larvae in problem blocks to determine whether a treatment against the overwintered brood should be included in your petal fall plans. Scout the blossom clusters or foliar terminals for larvae feeding within both the flowers and rolled leaves; a 3% infestation rate could justify an application to minimize overwintered fruit damage and help reduce summer

Obliquebanded leafroller larvae. Photo: Art Agnello

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populations; there's a sequential sampling chart to facilitate this process on p. 75 of the 2021 Recommends). A fact sheet with photos and descriptions of this insect's life stages can be found at: https://hdl.handle.net/1813/43111

Among the selective insecticides available, Intrepid and Rimon have been successful at this timing, and B.t. products, which can be used while blossoms are still present, include Agree, Biobit, Deliver, Dipel, and Javelin. Additionally, Proclaim has been shown to be very effective at the petal fall timing, and also provides activity against early season mite populations. Delegate, Altacor, Exirel, and Verdepryn all offer very good efficacy against not only OBLR, but also the internal leps. Grandevo is a newer biological that is also effective against this broad group of leps. Pyrethroids such as Baythroid, Danitol, Warrior, or Leverage may also be effective, depending on past use history, but be aware of their broad-spectrum effects, which can work both for and against you, according to your approach towards conserving beneficial mites and insects.

Oriental Fruit Moth

Use the NEWA Apple Insect Models page to chart current degree day (base 45°F) progress towards the recommended totals of 170 (in peaches) and 350 (in apples) as the timing at which to apply a protective spray. To maximize the efficacy of 1st brood control, peach growers should use one of the suggested options from the Recommends starting at petal fall, backed up 10–14 days later. In apples, in addition to Delegate, Altacor, Exirel, and Verdepryn, a number of the petal fall selection of insecticides will do an acceptable job of controlling this generation, including Imidan, the pyrethroids, Intrepid, Assail, Avaunt and Grandevo. A fact sheet with photos and descriptions of this insect's life stages can be found at: https://hdl.handle.net/1813/43112

European Red Mite

Where prebloom conditions were too difficult for allowing applications of oil or even ovicides, it would be prudent at petal fall to have a look at your rapidly expanding terminal shoots for evidence of hungry motile mites, and consider an early "summer"

European red mites. Photo: Art Agnello

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OFM flagging (top left), OFM fruit damage (top right), OFM larva (bottom left, and OFM adult (bottom right). Photos: OMAFRA

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application of a suitable material to head off problems before they get out ahead of you. There are numerous choices of products available at this time, including the traditionally considered ovicides such as Apollo, Savey and Onager (if not already used this season), as well as Agri-Mek, which can still easily get into the tender leaf tissue to do its work, plus a host of moderate- and quicker-acting maintenance/rescue materials such as Zeal, Kanemite, Nexter, Portal, Acramite, Envidor, Nealta, and Banter. Additionally, if you're planning to apply Proclaim for OBLR, you'll get some miticidal activity too. Be aware of seasonal use limits and IRAC rotational considerations with anything you use now. A fact sheet with photos and descriptions of this pest's life stages can be found at: https://hdl.handle.net/1813/43092

Looking for more pest management info? This article was originally published in Scaffolds, Volume 29, No. 10 last spring. Electronic versions of volumes 4 (1994) through 29 (2020) can be found at the following link: http://www.scaffolds.entomology.cornell.edu/

For additional Apple IPM, we highly recommend reviewing the videos available at https://www.youtube.com/playlist?list=PLoNb8lODb49vifrm9Tla4GmAVhlIL0527.

For stone fruit information, visit our video playlist on Youtube at https://www.youtube.com/playlist?list=PLk2Q-bw9Aiu5NUJa7IwI_Obs1V5-RSUGb

Introducing NEWA 3.0: Updated Models and Resources for Fruit Growers

Dan Olmstead, New York State IPM

The Network for Environment and Weather Applications (NEWA) is an important resource in the IPM toolbox for apple growers. 2021 is bringing long-awaited updates and improvements that were designed specifically with grower needs in mind. This article will quickly get you started with NEWA 3.0 during this period of transition.

Where can I find the updated NEWA 3.0 website?

NEWA 3.0 is at https://dev.newa.cornell.edu. Note this website address has **dev** in the front indicating it is a 'development' website, meaning there could be some occasional bugs or issues. If you discover a glitch, have a problem, or want to ask questions, contact the NEWA Help Desk right away by sending an email message to support@newa.zendesk.com. We need your help to catch these last bumps in the road.

Is the old NEWA website still available?

YES. The old NEWA is available for all of 2021 at http://newa.cornell.edu. Note this website address does not have **dev** in the front. This old version will not be retired until after the 2021 growing season because we want to minimize frustration or anxiety that comes with learning new technology. For example, please feel free to rely on old NEWA for day to day management while you set aside time off-hours to learn NEWA 3.0.

How do I get started with NEWA 3.0?

There are three important steps to complete before using NEWA 3.0 apple models. Quickstart video tutorials are available for each on the NEWA Help Desk. See Table 1 for details and links.

Title	Link
How to start using NEWA	https://newa.zendesk.com/hc/en-us/articles/360054268454
How to customize your NEWA dashboard	https://newa.zendesk.com/hc/en-us/articles/360054268354
How to use your NEWA dashboard	https://newa.zendesk.com/hc/en-us/articles/360057357553

Table 1: Watch these short Quickstart video tutorials to get started with NEWA 3.0

I found a glitch! What do I do?

Please report a NEWA 3.0 bug or issue to https://newa.zendesk.com/hc/en-us/requests/new?ticket_form_id=1500000353601. Or send a message to support@newa.zendesk.com with lots of details and a screenshot or two of your problem. We need your help finding and working out these final bugs.

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Are all the same NEWA apple models and resources available?

A majority of apple models are available now on NEWA 3.0 at https://dev.newa.cornell.edu. Plans are in place to complete the rest by June of this year. Be sure to create and sign in to your NEWA 3.0 user account for the best experience. Table 2 provides a complete listing of availability.

Table 2: Availability of NEWA apple models on NEWA 3.0

Model	Available	Model link	Tutorial link
Apple maggot	Yes	https://dev.newa.cornell.edu/apple-maggot	https://newa.zendesk.com/hc/en-us/articles/1500003972962
Codling moth	Yes	https://dev.newa.cornell.edu/codling-moth	https://newa.zendesk.com/hc/en-us/articles/1500003853361
Obliquebanded leafroller	Yes	https://dev.newa.cornell.edu/obliquebanded-leafroller	https://newa.zendesk.com/hc/en-us/articles/1500003852501
Oriental fruit moth	Yes	https://dev.newa.cornell.edu/oriental-fruit-moth	https://newa.zendesk.com/hc/en-us/articles/360062425274
Plum curculio	Yes	https://dev.newa.cornell.edu/plum-curculio	https://newa.zendesk.com/hc/en-us/articles/1500003851361
San Jose Scale	Yes	https://dev.newa.cornell.edu/san-jose-scale	https://newa.zendesk.com/hc/en-us/articles/1500003973622
Spotted tentiform leafminer	Yes	https://dev.newa.cornell.edu/spotted-tentiform-leafminer	https://newa.zendesk.com/hc/en-us/articles/1500003971902
Apple scab	Pending	June 2021	June 2021
Fire blight	Pending	June 2021	June 2021
Sooty blotch fly speck	Pending	June 2021	June 2021
Apple carbohydrate thinning	Yes	https://dev.newa.cornell.edu/apple-carbohydrate-thinning	May 2021
Pollen tube growth model	Yes	https://dev.newa.cornell.edu/pollen-tube-growth-model	May 2021
Apple irrigation	Yes	https://dev.newa.cornell.edu/apple-irrigation	May 2021
Blueberry maggot	Yes	https://dev.newa.cornell.edu/blueberry-maggot	https://newa.zendesk.com/hc/en-us/articles/1500003972722
Strawberry diseases	Pending	May 2021	May 2021
Grape berry moth	Yes	https://dev.newa.cornell.edu/grape-berry-moth	https://newa.zendesk.com/hc/en-us/articles/360062426534
Grape diseases	Pending	May 2021	May 2021
Degree day calculator	Pending	June 2021	June 2021
Weather summaries	Pending	June 2021	June 2021

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I still have questions or concerns. Who can I contact?

Please reach out to the NEWA Help Desk with a message to support@newa.zendesk.com or by submitting a request here https://newa.zendesk.com/hc/en-us/requests/new?ticket_form_id=360003631693. We generate a unique work ticket number and try to respond within 1 or 2 business days at most. Your ticket will remain open until we find a solution for you.

Where can I learn more?

Be sure to follow NEWA on Twitter @NetworkforEnvi2 and Facebook @nysipm.newa. Also check out the NEWA blog at https://dev.newa.cornell.edu/blog.

NEWA is part of the New York State IPM Program and Cornell Cooperative Extension at Cornell University. NYSIPM partners closely with the Northeast Regional Climate Center to make NEWA available to growers statewide.

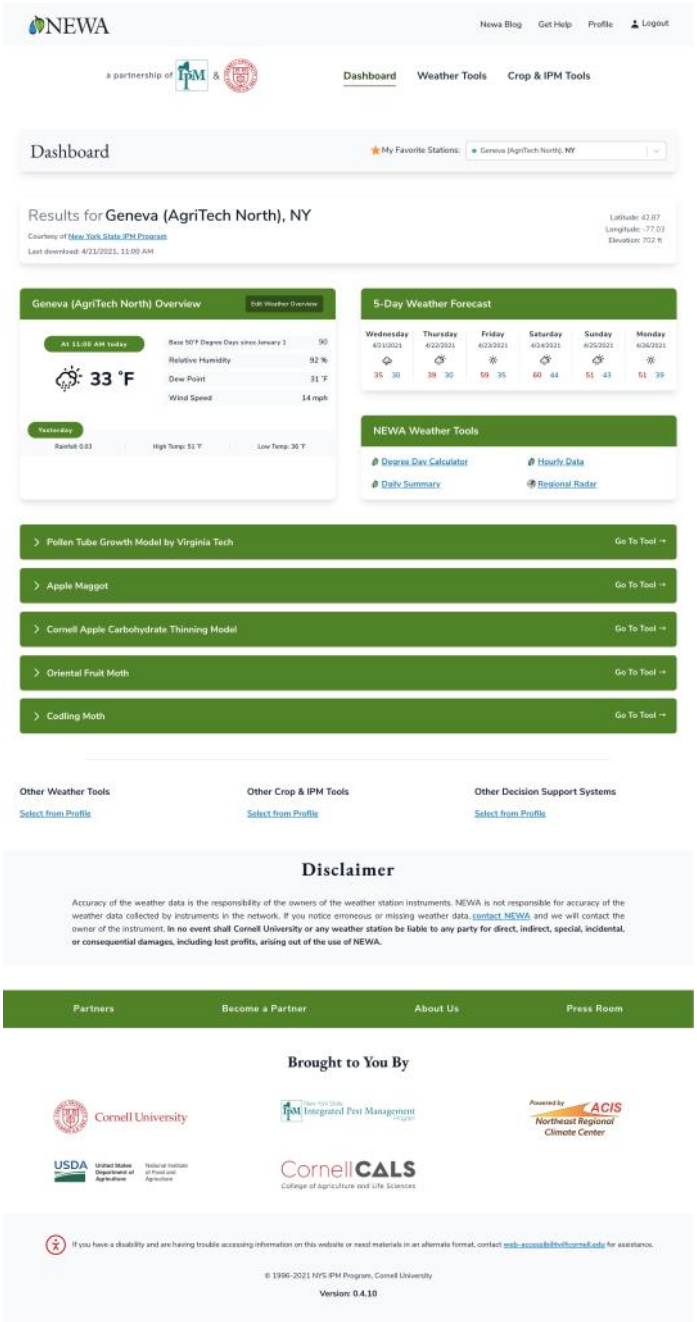

***Figure 1**: A screenshot of the NEWA 3.0 user dashboard from which you can choose preferred stations and models. A Quickstart video for dashboard navigation is available at https://newa.zendesk.com/hc/en-us/articles/360057357553.*

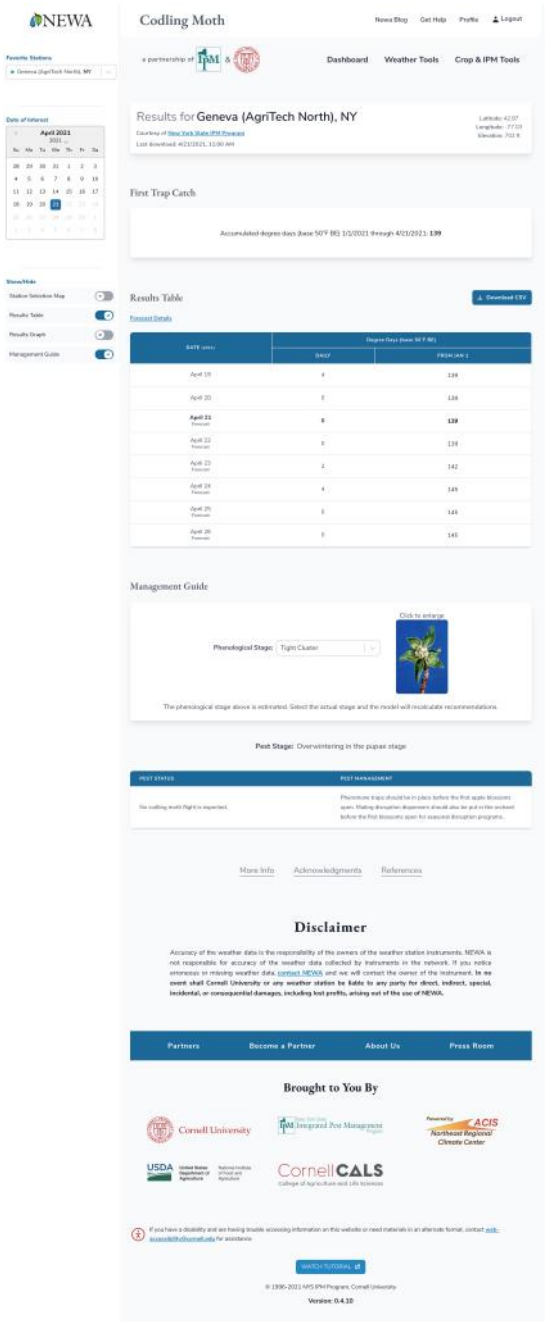

***Figure 2:** A screenshot of the NEWA 3.0 codling moth user interface. A Quickstart guide for this model is available at https://newa.zendesk.com/hc/en-us/articles/1500003853361.*

Miss our virtual pink and bloom meetings?
You can still watch them online at the following links!

Cornell Statewide Virtual Pink Meeting: https://www.youtube.com/watch?v=fnF6y_fCdqw&t=1719s

In this meeting, Dr. Terence Robinson reviewed his precision pruning strategies, and gave a brief overview of the pollen tube growth model. Dr. Lailang Cheng discussed nutrition, and Dan Donahue discussed the use of Apogee at pink for bitter pit suppression. We then heard from Dr. Kerik Cox on fire blight management, and Dr. Jaime Piñero (UMass) on insect management at pink.

Cornell Statewide Virtual Bloom Meeting: https://www.youtube.com/watch?v=pro_Cnsrqvk

Dr. Terence Robinson (Cornell) presented his detailed and practical implications for bloom thinning with and without the use of the Pollen Tube Growth Model in apples. In addition, Mr. Dan Olmstead (Cornell NYSIPM) presented on the functionality of the Pollen Tube Growth Model on the updated NEWA 3.0.

Orchard Soil Health Bulletin

Interested in learning more about soil health in the orchard? A very thorough review of what is currently known about orchard soil health, and some potential management practices to improve soil quality, can be reviewed in the following publication from Washington State University: http://s3.us-west-2.amazonaws.com/treefruit.wsu.edu/wp-content/uploads/2020/11/23134102/EM120E_Soil-Health-in-Orchards.pdf.

The authors note that **significant research** is still needed to determine best practices for improving soil health within the orchard, and this is certainly true for our local conditions. Shoot me an email at mrb254@cornell.edu if you might be interested in hosting a soil health demo site in the future.

Precision Thinning with the Fruit Growth Rate Model in 2021

The fruit growth rate model is one of the many precision crop management tools available on Malusim.org. This model can help you track which fruitlets are going to stay and which ones will fall off following your thinner applications, and help you determine if additional thinning is necessary.

To use this model, you will need to:

- ✓ Set up a Malusim.org account.
- ✓ Count the number of fruit clusters on 5 representative trees per block and variety.
- ✓ Tag 15 clusters on each of these 5 trees (75 clusters total), and determine your target crop load per tree. Enter these values on Malusim.
- ✓ Following your petal fall application, you would then measure each fruitlet on each of those 75 clusters at 50 DD Base 4C and again at 120 DD Base 4C following your thinner application. Measurements should be taken with digital calipers, which an inexpensive one can be purchased from a hardware store for $15.
- ✓ Enter these measurements to Malusim directly through the phone app, or if you're more old school like myself, you can write them down and then transfer them over to Malusim on your computer.
- ✓ Once these values are added to Malusim, email Dr. Robinson at tlr1@cornell.edu, cc'ing me or Dan, and you will get an estimate of how many fruit are still on the tree and follow-up thinning recommendations within 24 hours.
- ✓ Repeat the measurements at the same degree day intervals following the 10-12mm application and the 18mm application (if these are needed), until you hit your target crop load.

The best time to tag clusters is generally from pink to petal fall. If you'd like to give this a try this year, you can find the detailed directions here: https://rvpadmin.cce.cornell.edu/uploads/doc_974.pdf

The Eastern New York Commercial Horticulture Program is a Cornell Cooperative Extension partnership between Cornell University and the CCE Associations in these seventeen counties: Albany, Clinton, Columbia, Dutchess, Essex, Fulton, Greene, Orange, Montgomery, Putnam, Rensselaer, Saratoga, Schenectady, Schoharie, Ulster, Warren & Washington.

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