Fruit Notes

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Managing Fire Blight in 2018

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2017 Fire Blight Season Recap

Although the number and magnitude of fire blight outbreaks in NY was a little lighter in 2017 than in the previous few years, some growers still experienced losses due to fire blight. There were only two critical risk periods for blossom blight and these occurred around the 1st and 18th of May. In western NY, the risk period around the 1st of May was of lesser concern given the cool weather at that time, but temperatures were warmer in eastern NY, increasing risks. While the period around the 18th of May represented "extreme risk for blossom blight", many sites were at or beyond petal fall, reducing the overall risk for some locations with early flowering cultivars.

In 2017, we received many fire blight samples for antibiotic resistance testing from the western NY and Lake Champlain regions. Fortunately, no resistance to any antibiotics was observed in any of the samples. Shoot blight was the predominant type of sample received, with few places reporting blossom blight. It's important to note, however, that low or even unnoticeable levels of blossom blight could still have been the source of the late season shoot blight outbreaks in 2017. With bloom nearly upon us in 2018, it will be important to keep track of the fire blight history in apple blocks, and—where fire blight history and scion/rootstock susceptibility warrant—to protect apples during high risk weather conditions during petal fall and shoot elongation.

Present Season

Currently, only orchards in the Hudson Valley have reached bloom with the sudden warm weather. Unfortunately, this area experienced a period of high- to extreme risk over the weekend, with the first open flowers. Orchards in western NY may only begin to reach king bloom this week and may only be at low- to moderate risk of infection when the weather warms up on Thursday. Orchards in the Lake Champlain region are unlikely to reach king bloom this week. While there is risk of infection on Wednesday/Thursday with the high temperatures and rain, the risk should be somewhat tempered by the low numbers of open flowers. While regional extension specialists in the Hudson Valley are rightfully concerned about the risk of blossom blight infection over the weekend, the situation seems less dire in the other production regions of the state.

The warm weather in the middle of this week could boost inoculum levels, but several days in the mid-60s toward the end of the week will slow bacterial reproduction and reduce risk. However, risk will continue to increase throughout the following week as temperatures in the 70s and thunderstorms are predicted. In this regard, it will be important to watch forecasts, check the models, and follow extension specialist's alerts.

As you consider model outputs from NEWA or other forecasting models, here are some things to consider before making applications of antibiotics or other costly materials for blossom blight:

1. **Predictions and forecasts are theoretical.** The theoretical models predicting disease risk use the weather data collected (or forecasted) from the weather station location. These results should not be substituted for actual observations of plant growth stage and disease occurrence determined through scouting or monitoring.

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2. Consider the history of fire blight in the planting. If there was no fire blight the previous season, or if you have never had fire blight, do not let excessive model predictions or extension alerts (including this article) "intimidate" you into applying unnecessary antibiotics each time an alert is released. Consider the timing of the last application and potential for material depletion as well.

3. Consider the age of the planting and the susceptibility of variety and rootstock. These factors play a large role in the development of fire blight. None of the models consider these factors. If you have a young planting of a highly susceptible variety, it may be more important to protect these blocks based on model predictions than a 15-year-old 'McIntosh' planting on resistant rootstocks, which may not warrant the same level of protection during bloom. A listing of susceptible cultivars and rootstocks is linked from the NEWA model page for fire blight.

4. The models only identify periods of weather that are favorable for infection. All wetting events are now color-coded light blue in NEWA to draw attention to the weather factors that promote bacterial movement into the flowers. Despite words like "extreme" and "infection" colored in vibrant red, the models only predict favorable weather conditions. If favorable weather for infection is not predicted in the current forecast, if the apple variety is not highly susceptible, if there is no prior history of fire blight, and if the trees aren't being pushed into high vigor with nitrogen, the actual risk of fire blight infection may be low- to non-existent.

5. Weather forecasts can vary and change daily. When this happens, the model predictions will change drastically, and the risk will change as well. Bacterial populations double about once every 20 minutes under optimal conditions; for fire blight bacteria these are warm (>60°F), wet conditions. The models use degree hours, not degree days, to accommodate the rapid growth rate of these pathogens. Check the fire blight predictions, especially those in the forecasts, frequently. The 1- and 2-day forecasts are the most reliable; those at 3-, 4- and 5 days are less reliable as predictors. NEWA uses the National Weather Service forecasts. Compare these to your favorite local weather forecast provider.

Status of antibiotic resistance in 2018

Despite extensive screening, streptomycin resistance has not been detected in NY for the last four years. If we keep practicing resistance management by rotating bactericides and antibiotics with limited use of streptomycin application after bloom, we may never experience outbreaks of streptomycin resistance as we had in 2011 to 2013. However, sending blossom blight or trauma blight samples for screening, when they occur after streptomycin applications, is the best approach for assessing the occurrence of streptomycin resistance in your operation.

Even in the absence of streptomycin resistance, fire blight can still be difficult to control if weather favors the pathogen. Moreover, the shoot blight phase of the disease can still present a considerable problem following an apparent success in blossom blight management. In this regard, we have continued to refine and update our guidelines for managing fire blight in NY, with an emphasis on young plantings. The guidelines are broken up into three sections: general guidelines for season-long management, additional guidelines for new plantings, and guidelines for on-farm nursery production. Tables of fire blight susceptibility for popular cultivars and rootstocks are linked from the NEWA model page for fire blight.

General guidelines for season-long management.

1. All fire blight strikes and shoots with larger cankers should be removed during winter pruning. Remove any trees where the central leader or main trunk has become infected. Infected wood should be removed from the orchard and either burned or placed where it will dry out rapidly. The fire blight pathogen can withstand cold temperatures, but is intolerant of drying.

2. Copper sprays should be applied at green tip. Processing varieties can be protected with copper as late as ½-inch green, depending on requirements of the product label.

3. Although we've previously mentioned the new 2ee label for the use of Apogee at pink to mitigate spread of blossom blight into the shoot tissues, we are not recommending this use pattern as a standard practice for managing fire blight until we have a greater appreciation of the potential benefits and impacts on crop physiology. Growers using prohexadione Ca at pink for the purposes of training narrow fruiting wall plantings may have reduced risk of fire blight development following such applications.

4. During bloom, follow a blossom blight forecasting modeling system such as the ones offered in NEWA (http://newa.cornell.edu/index.php?page=apple-

diseases), Maryblyt™ 7.1 (http://grapepathology.org/maryblyt), or RIMpro (http://www.rimpro.eu/). Time applications during high risk weather only. If the operation rarely or has never had fire blight, it may not be necessary to apply antibiotic each time a high-risk period is forecast. Regardless of model predictions, it is rarely necessary to make more than three applications for blossom blight.

5. Begin antibiotic applications for blossom blight with a single application of streptomycin at 24 oz/acre. Consider including the penetrating surfactant Regulaid (1 pt/100 gal of application volume) in the first application to enhance the effectiveness of streptomycin. Regulaid would be especially beneficial when applied under rapid drying conditions. Regulaid can be omitted from subsequent applications so as to minimize the leaf yellowing that is sometimes associated with repeated applications of streptomycin. If later antibiotic applications are needed, streptomycin or kasugamycin (Kasumin 2L, 64 fl oz/A in 100 gallons of water) should be used. Consider making at least one application of Kasumin 2L for resistance management purposes. If there are concerns about the effectiveness of streptomycin or kasugamycin, contact the authors of this article to discuss the product failure and determine if it would be necessary to submit a sample for antibiotic resistance testing. The presence of shoot blight later in the season isn't necessarily an indication that antibiotics applied during bloom failed due to resistance.

6. In the two weeks following bloom, scout for and prune out fire blight strikes promptly. Destroy pruned strikes by burning or leaving them out to dry. It is best to prune well back into healthy wood, at least 12 inches behind the water-soaked margin. Take care, as summer pruning may stimulate active shoot growth, leading to the production of new susceptible tissues that could later become infected. If fire blight reaches the central leader, the tree should be removed. However, the spot in the orchard may be safely replanted.

7. Preventive applications of prohexadione-calcium (Apogee or Kudos) for shoot blight should be seriously considered, especially on highly-susceptible apple varieties during shoot elongation beginning in late bloom:
(a) Best results with prohexadione-calcium are often achieved by applying 6-12 oz/100 gal (3-6 oz/100 gal for tree <5 years) when trees have 1-2" of shoot growth. A second application should be made 14-21 days later.

(b) Programs where prohexadione-calcium is applied at low rates slowly over the period of active shoot growth are gaining popularity as a means of providing disease control and reducing impacts on tree productivity. Specific programs may vary slightly, but generally consist of three applications at 1-2 oz/100 gal on a 14-day schedule, beginning with early shoot growth in mid to late bloom. Use caution, however, as such programs have not been widely validated over many seasons and locations.

8. Preventive applications of copper can be used post-bloom and during the summer to protect against shoot blight infections. Copper must be applied before infection occurs, as it will only reduce bacteria on the surface of tissues. Copper will have no effect on existing shoot blight infections. Copper may cause fruit russet in young developing fruit. Apply with adequate drying time and use hydrated lime to "safen" copper. Terminal shoots can outgrow protective residues of copper. Hence, a low-rate fixed copper program consists of applications on a 7-10 day schedule during high risk weather until terminal bud set.

9. It may be possible to save plantings on resistant rootstocks that have a moderate amount of shoot blight. Apply a rescue treatment of prohexadione-calcium at the highest rate to the planting (6-12 oz/100 gal) and allow 5 days for the product to affect the tree. Afterwards, prune out existing and newly developing shoot blight every two weeks for the rest of the season. Remove any trees where fire blight has reached the central leader. If pruning seems to stimulate additional shoot growth, a second application of prohexadione-calcium could be warranted.

10. If you need to interplant apple trees in existing orchards where fire blight was observed, replant in late fall to better synchronize bloom with the established trees in the following season.

Additional guidelines for new plantings (1-2 years)

1. If possible, plant varieties grafted onto fire blight-resistant rootstocks.
2. Trees should be carefully examined for fire blight infections before planting. Any infected trees should be discarded.
3. Immediately after planting, and 14 days later, a copper application should be made using the lower copper rates that are labeled for use after green tip. Ensure that soil has settled to avoid phytotoxicity to roots.

4. Until we better understand the use pattern, it is not advisable to apply prohexadione Ca to young plantings.

5. Trees should be scouted at 7-day intervals for fire blight strikes until July 31st. Infected trees should be removed as described above. Plantings also need to be scouted 7-10 days after hail or severe summer storms. The NEWA fire blight disease forecast tool (newa.cornell.edu/index.php?page=apple-diseases) can assist by providing an estimate of symptom emergence following a storm or other trauma event. Also, scout the planting at the end of the season (mid-September).

6. If possible, remove flowers before they open. New plantings may have considerable numbers of flowers the first year, and blossom removal may not be practical. If practiced, the blossoms should be removed during dry weather and before a lot of heat units have been accumulated, because both factors contribute to higher risk of fire blight infection.

7. Trees should receive an application of copper at a stage equivalent to bloom. Observe the labeled REI before blossom removal.

8. To protect any remaining bloom, follow the chemical management program for your regions of streptomycin resistance risk.

Guidelines for on-farm nursery production

1. Collect budwood from orchards where fire blight is not established, or from a neighboring farm without fire blight.

2. Limit streptomycin and kasugamycin applications to 2-3 per season. These should be timed according to a disease forecast prediction or CCE alert.

3. When fire blight pressure is high and shoots are actively growing, apply copper at the lowest labeled rate to prevent shoot blight.

4. Before conducting tree management tasks in the nursery, apply a copper product at the lowest labeled rate and observe the labeled REI.

5. Any pinching or leaf twisting should be practiced on dry sunny days with low relative humidity, after the REI of a copper application has expired.

6. When working in the nursery, field workers must wear clean clothing, and should wash hands and disinfect working tools often.

7. If fire blight is found in the nursery, completely remove the infected trees (including the root system), and place them in trash bags between rows. Subsequently, remove the culled trees from between the rows and discard them. Under no circumstances should infected trees be pulled between nursery rows when trees are wet, otherwise fire blight may be spread down the rows.

8. Maintain weed control through cultivation. Apply registered post-emergence herbicides using a shielded boom. There are some residual herbicides registered for use in nurseries.

9. When trees have reached the desired height, consider applying the lowest labeled rate of Apogee (1-2 oz/100 gal) to slow growth and reduce susceptibility to shoot blight.

10. Manage nitrogen levels to balance tree growth and fire blight susceptibility.

Hail Netting, Is It Right For Your Farm?

Elizabeth Higgins, CCE-Eastern NY Commercial Horticulture Program

Increasingly tree fruit growers in NYS are looking at hail netting as a tool for reducing the impact of hail in their orchards. Hail netting is already widespread in Australia, Europe and is increasing in popularity in Washington State. Netting is used in those places, not only to protect the fruit from hail, but also from sun damage, and insect/pest damage and to increase the quality of the fruit crop. While hail netting seems to have promise, the growing conditions for tree fruit in New York are not the same as Australia, Europe and Washington. The LOFT Team has recently received a grant to study hail netting in New York and its impact on pests and disease, yields, and quality of the fruit and to better understand the costs and labor needs for managing a hail netting system in a New York orchard.

Growers considering hail netting (or any other investment to protect their crop) need to consider the following questions:

- How likely is the situation I want to avoid and how much harm would the situation cause to my farm business if it occurred? (risk assessment)
- How much would it cost to protect myself (not

just in money, but also lost opportunities) and how effective are the protection strategies? (cost benefit)

- Are there other alternative investments that would result in an improved overall situation for the same or lower investment? Make sure that you are prioritizing the "weak link" in your business.

For example, a meteor hitting your farm would be devastating but it is also highly unlikely, and your options to protect yourself are few and costly. Meteor protection is probably a low priority investment in most farming operations. Money is better spent on pest control, irrigation and improved horticultural practices. So, what do we know about hail netting now?

In research conducted in Australia[i], apple price was found to be the most influential factor determining the profitability of hail net. According to researchers "to offset high establishment costs, orchard productivity under hail netting must be maximized through the production of high yields of premium quality fruit and efficiency in tree management". However, studies did indicate that if the price of hail netting was low enough, it would be cost effective in a wider range of orchards. They also did consider benefits to hail netting such as improved apple quality (even when there is no hail), improved spray efficiency, and reduced pressure of pests and diseases.

Unfortunately, data on frequency and probability of hail affecting a specific location is not accurate and good models are not available. It turns out that hail is really hard to model because the conditions that would create hail in the atmosphere, do not necessarily result in hail on the ground. Recent research on hail in the context of global warming indicate that in the future (in the Eastern United States), hail events are likely to decrease but the hail that does fall will be more damaging[1].

Hail is certainly damaging to tree fruit growers. From 2015-2017, 993 acres of apples in the LOFT region received insurance payments for hail damage. The reimbursed loss was $4,139,880. This loss does not include: loss of market share, uninsured acres, multi-year impacts on production, the financial burden in the lag in receiving insurance payment.

If you are considering hail netting, and can't wait for the LOFT research to be completed, I have developed a quick spreadsheet that you can use to calculate the net present value of installing hail netting on your farm. You can include 1-3 hail events in the 10 year period and change the percent of fruit that goes to processing. The spreadsheet is located at this link: https://tinyurl.com/yc7jogot. The spreadsheet does not include multi-year effects, other benefits of hail netting, and labor costs only include manufacturer's estimates for application and removal at the beginning and end of the season. Once the LOFT project is completed, this tool will be refined with more accurate data and a sensitivity analysis. If you have any questions about this spreadsheet please contact me at emh56@cornell.edu.

Figure 1: Hail Netting in Clinton County, NY (photo credit: Elizabeth Higgins, ENYCH)

Figure 2: Hail Netting in Clinton County, NY (photo credit: Elizabeth Higgins, ENYCH)

[1] Whittaker and Middleton. "Profitability of Hail Netting in Apple Orchards". Contributed paper for the 43rd annual conference of the Australian Agricultural and Resource Economic Society at Christchurch, 20-22 January 1999 and Middleton and McWalters. "Hail Netting of Apple Orchards – Australian Experience". Presentation at 45th Annual IDFTA Conference February 16-20, 2002, Lekowna, British Columbia, Canada

[2] Brimelow et al. "The changing hail threat over North America in response to anthropogenic climate change". Nature Climate Change 7, 516-522 (2017).

Tips for Pollinator Protection

Tessa R. Grasswitz

Fruit crops in bloom attract both managed bees (such as honeybees and bumblebees) and a wide variety of native (wild) bee species (left). Both groups are important for crop pollination, with some of the native bees being more efficient than honeybees, particularly at lower temperatures and during wet conditions—growers with good populations of native bees certainly reaped the benefit during last year's cold, wet bloom period.

In recent years, the widespread occurrence of honeybee Colony Collapse Disorder (both in the US and elsewhere) has stimulated considerable research on how to protect wild bees and honeybees from risks associated with pesticide use, and also on how to create on-farm habitat for native bees. This article summarizes some of the most important points to consider in reducing pesticide-associated risks to pollinators.

Grower-Beekeeper Communication: Hive location & placement timing

- Select safe locations for hives that are protected from potential spray drift, with an appropriate buffer between hives and treated areas to prevent accidental spraying of hives.
- When choosing placement sites, consider possible pesticide use on adjacent properties; avoid low-lying areas to minimize the possible impact of drift and temperature inversions.
- Ensure that hives are readily visible (e.g. to applicators), and that the beekeeper's contact details are readily available to applicators as well as the farm manager.
- Inform neighboring growers & applicators of hive locations. Provide beekeepers with contact information for pesticide applicators, renters and neighbors.
- If possible, notify beekeepers 48 hours in advance of pesticide applications so that they do not enter during Restricted Entry Intervals and have time to move hives (if necessary).
- Remove bees from orchards when 90% of the last blooms are at petal fall. After this, little or no pollination will be occurring.
- Time placement of hives to avoid exposing bees to toxic residues from pre-bloom sprays. Inform beekeepers of any products applied prior to hive placement.

Pesticide applications

- Use IPM and correct monitoring procedures to ensure that pesticides are applied only when needed.
- Wherever possible, choose pesticides with the lowest bee toxicity ratings (see Items 1 & 2 under 'Further resources'). Note that some fungicides (either alone or in tank mixes) can have negative effects on bees, including disrupting normal foraging behavior, or interfering with larval development if transferred to the brood in the hive. Similarly, some adjuvants (e.g. surfactants and oils) can disrupt the waxy surface cuticle of bees and thereby increase the toxic effects of other spray components.
- Choose the least hazardous formulations wherever possible: try to avoid microencapsulated products, dusts, wettable powders and flowables, as their particle sizes are similar to those of pollen grains, which increases the risk of them being carried back to the hive on the hairs of foraging bees.
- Follow all label instructions regarding pollinator protection (see "Environmental Hazards" and "Pollinator Safety" sections of the label).
- Avoid spraying pesticides when bees are foraging in the crop. For any products that are permitted during bloom, try to spray in the evening when bees are less likely to be foraging; keep in mind that abnormally warm temperatures may extend bee foraging times

during the day. Do not apply pesticides toxic to bees until flowering is complete and petals have fallen.

- If possible, avoid insecticide applications when low temperatures and high humidity are forecast: such conditions favor dew formation that slows pesticide drying & hence prolongs the risk to bees.
- Bees will also forage on flowering weeds: control or mow flowering weeds in orchards prior to spraying any pesticides with a long residual risk to bees.
- Avoid drift by using the correct nozzles and pressure. Check wind speed prior to, and during application and keep in mind that hot, dry conditions can increase evaporation rates and hence the risk of drift.
- Verify with your beekeeper that the bees will have access to clean water and, if necessary, supplemental food sources.

Further resources:

1. Minimizing pesticide risks to bees in fruit crops (2015): A comprehensive, illustrated guide from Michigan State University. Includes tables of acute toxicity to bees of many commonly used orchard pesticides (both insecticides and fungicides): http://msue.anr.msu.edu/uploads/resources/pdfs/Minimizing_Pesticide_Risk_to_Bees_in_Fruit_Crops_(E3245).pdf
2. How to reduce bee poisoning from pesticides (2013). From the Pacific Northwest. Contains tables of commonly used pesticides (insecticides, fungicides and miticides) that include residual toxicity to bees: https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/pnw591.pdf
3. Additional resources on pollinator protection (several links): https://pesticidestewardship.org/pollinator-protection/
4. New York State Pollinator Protection Plan (2016): Includes best management practices for growers, pesticide users and beekeepers: http://www.dec.ny.gov/docs/administration_pdf/nyspollinatorplan.pdf
5. Wild pollinators of Eastern apple orchards and how to conserve them (2012): A short guide to some common groups of wild bees, with tips on how to conserve them: http://ento.psu.edu/publications/wild-pollinators-of-eastern-apple-orchards

Apogee at Pink for Suppression of Bitter Pit in Honeycrisp

Dan Donahue, CCE-ENYCHP

An ARDP-funded study was initiated in Eastern New York in 2016 to investigate the hypothesis that competition between shoots and fruits for calcium plays a role in BP development in Honeycrisp. The concept our group explored was that shoots have a natural advantage due to a stronger transpiration stream driven by evapo-transpiration from the extensive area of leaf tissue, as well as a more complete and effective system of xylem tissue. As an example, it is thought that poor development of xylem tissue in the calyx end of the apple contributes to the explanation of why BP symptoms are more likely to be found in the calyx end. Our group was also interested in looking at the status of calcium early in fruitlet development, during the cell division (mitosis) phase. Due to its proven ability to reduce shoot extension, and its mode of action as a GA inhibitor, prohexadione-calcium was selected for testing. Several prohexadione-calcium rates and application timings were evaluated in replicated trials conducted in 2016 and 2017, along with three commercial airblast trials in 2017. Data was collected on incidence and severity of BP, horticultural characteristics of the fruit, terminal and bourse shoot extension, as well as peel mineral analysis. In both 2016 and 2017, our group observed a statistically significant reduction of 45% (2016) and 54% (2017) in BP incidence when prohexadione-calcium (Apogee) was applied at pink stage, at a rate of 6 oz/acre to trees that ranged in size from 100 to 180 gallons per acre tree-row volume, applied at 2X or 3X concentration along with a water conditioner, and surfactant such as LI-700.

- Presently, Apogee is the only formulation of prohexadione-calcium labeled for use at pink in apples.
- The 2EE label can be found at the new NYSPAD site: (http://www.dec.ny.gov/nyspad/products?0). At the site, type "Apogee" in the product name field and press search. The second result will take you the new 2EE label.
- Please follow the 2EE label, and **you must have a copy in your possession at the time of application**.
- For bitter pit suppression, the 2EE label

specifically states to apply at a rate of 6 oz./acre and do not adjust for tree-row volume. The reason for this strict language is that 3 oz./acre at pink was not found to be effective, and 9 oz./acre resulted in a significant reduction in fruit size.

- If suppression of fire blight is NOT a concern, and BP suppression is your target, then limit prohexadione-calcium to a single pink application. For both 2016 and 2017, our results demonstrated that three applications starting at petal fall increase the incidence of BP. Data from 2016 indicated that three applications starting at pink did reduce BP incidence; however, the combination was not re-tested in 2017. If multiple applications of prohexadione-calcium are planned for improved control of vegetative growth, our current recommendation is to start at pink, not petal fall.
- You should see limited vegetative growth suppression with a single application at pink.
- It is strongly recommended that you leave an untreated control somewhere within the treated block. Rating BP, either by formal counts or "eyeball" at harvest is unlikely to provide good efficacy data. Samples of both treated and untreated fruit should be stored together and evaluated after 60 days (or more).
- Bitter pit can be a problem in other New York State-grown varieties, especially Cortland and Braeburn, sometimes Golden Delicious and Red Delicious. The 2EE label for BP suppression is restricted to Honeycrisp simply because other varieties have not been tested.
- Funds for this research was provided by the NYS Apple Research and Development Program for their support.

Nitrogen: A Key Element for Fruit Production

Lailiang Cheng and Mario Miranda Sazo

Nitrogen is an essential element necessary to form the large group of chemicals known as amino acids and proteins. Large amounts are necessary for the formation and enlargement of new cells and tissues. The use of N promotes growth. The rapid response of trees to all forms of N make the use of N fertilizer a useful tool to regulate shoot growth and the development of heavy crops of large fruit. The difficulty arises in the use of nitrogen to promote fruiting without stimulating excessive and competing vegetative growth.

Growers should target N supply based on the two phases of plant growth: (1) first phase is **cell division**, a time when amino acids and protein are needed for all the new cells, (2) the second phase is **cell expansion**, a time when high concentrations of carbohydrates (sugars) rather than protein are required. With these carbohydrates, the cell is able to pull in water and expand.

<u>For blocks where you expect a normal crop load this year</u>:

1) **Nitrogen management:** The highest demand for nitrogen is from **petal fall to the end of shoot growth**. During this period, both rapid shoot growth and fruit cell division require substantial amount of nitrogen. The total annual requirement by high density Gala trees is about 50 lbs. actual nitrogen per acre, 70% of which occurs from bloom to the end of shoot growth. Foliar N application at petal fall and early cover sprays is a good way to supply nitrogen to the young fruitlets and spur leaves. Dr. Cheng recommends using foliar urea application at petal fall, first cover, and second cover at a rate of 5 lb. urea per 100 gallons on blocks that have marginal N status last year. Urea can be easily tank-mixed with most fungicides and insecticides, but cannot be mixed with oil. We recommend dilute sprays, but if you have to make concentrate sprays, do not concentrate over 3X.

2) **Potassium management**: If your tree **K level** was marginal in last year's leaf analysis and you expect a normal or a heavy crop this year, you need to apply a higher than average amount of potassium this year if you have not done so. This is because fruit harvest removes significant amount of potassium from your orchard, for example, if you had a fruit yield of 1500 bushels per acre last year, 80 lbs of potassium (equivalent to 100 lbs of potash (K_2O) was removed from your orchard in the harvested fruit, and you need to replace at least the same amount to sustain your orchard productivity. Fertigation is a great way to deliver potassium. If you use fertigation, target the period

from petal fall to a couple weeks before harvest.

For blocks where you expect a light crop load due to low return bloom, frost damage or poor fruit set this year:
1) **Reduce nitrogen application or even don't apply any nitrogen at all** to mitigate vigorous shoot growth as a result of a low cropload.
2) **Reduce or even eliminate potassium application** because much less potassium is required for supporting a light crop.
3) **Adequate fruit Ca and its balance with potassium is critical for minimizing bitter pit development for Honeycrisp and other bitter pit-susceptible varieties**. Dr. Cheng's work in 2015 clearly showed that Honeycrisp fruit had a much lower level (only about 50%) of Ca than Gala in the flesh, but significantly higher concentration of potassium in the peel, which makes Honeycrisp more susceptible to bitter pit development. Under low crop load conditions, fruit gets bigger, diluting the fruit Ca concentration. Even for fruit of the same size, fruit on light cropping trees have lower Ca level. This is closely related to higher K concentrations. So, controlling potassium supply under low crop load conditions is critical for mitigating bitter pit. Of course, increasing Ca supply is equally important. 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 such as Honeycrisp. We have been recommending 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 per 100 gallons at four and two weeks prior to harvest. It is important to keep in mind that complete coverage of fruit is essential and more frequent spray is more important than exact timing of spray. Calcium chloride cannot be mixed with oil.

Too much nitrogen can be counterproductive if looking for increased Gala fruit size: Applying more than 80 pounds per acre of N is luxury and does not contribute to increased fruit size; instead it will decrease quality. In addition, there are several disadvantages of using too much N: (1) increased shoot growth can result in an increase in fire blight susceptibility. Gala trees are already sensitive enough without help from extra N. And high N applied early would only increase shoot growth, and (2) Gala fruit quality can be reduced through "Stem End Cracking" and "Ring Bowl Cracking". These disorders may also be related to high N and vegetative growth.

Nitrogen for all cultivars:
Years 1 and 2
Provide high nitrogen supply. 60-120 lb N/Acre. @ 1/4lb. Ca nitrate per tree after the soil settles carefully applied in a doughnut shaped band around each tree.

Year 3
N should be lowered. 30-80 lb N/Acre. When tree starts to produce fruit and has grown enough, N must be reduced to improve fruit color. Ideally, by the end of the third year trees should get to the top of the wire.

Year 4, 5, and beyond
N supply should be strictly controlled. 20-50 lb N/Acre. To avoid bitter pit in susceptible cultivars as Honeycrisp. To improve yield and fruit quality.

Precision Chemical Thinning in 2018 for Gala and Honeycrisp

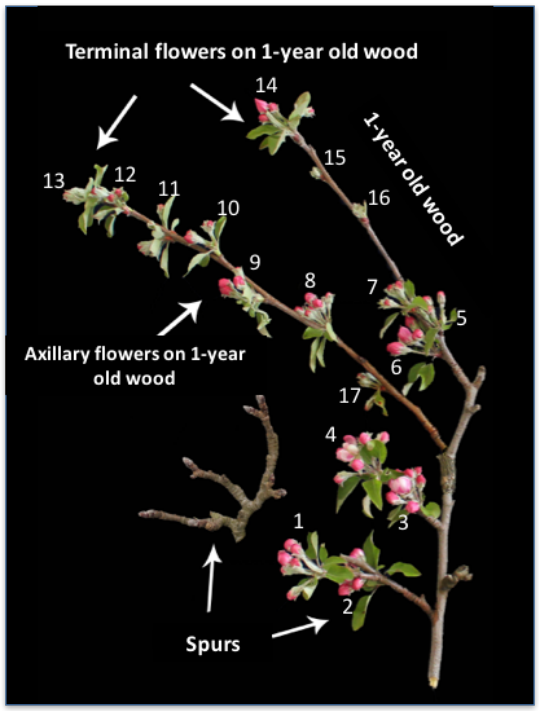
Poliana Francescatto

2018 Precision Thinning Protocol

1 - Select a mature orchard of either Gala or Honeycrisp (or any other cultivar).

2 - From pink to petal fall, mark and tag 5 representative trees (Tree#1 - Tree#2 - Tree#3 - Tree#4 - Tree#5) and count ALL flower clusters (flower buds) on each tree (the earlier you count the better to see the clusters)

3 - Calculate target crop load for a high yield = desired number of fruit per tree.



4 - Tag 15 spurs (flower clusters) per tree on each of 5 representative trees (75 total spurs) (preferable at pink, otherwise at bloom). Make sure you do not mark clusters on terminal or axillary buds on 1-year wood. Try to choose the 15 clusters according to the cluster distribution on the tree. For instance, if you have more flower clusters on the top part, mark more clusters there and so on.

5 - It is not necessary to number the individual fruitlets in each cluster (it is optional), however each fruitlet has to be measured. IF you opt for not numbering the fruitlets you HAVE to be careful when taking the measurements not to measure the same fruitlet twice within the cluster. Each cluster has to be numbered (1 to 15) and the measurements (fruit diameter) from that cluster have to correspond to that cluster. We recommend you to buy a caliper with a dial read-out in millimeters to take the measurements.

6 - Apply one of two spray protocols of thinning sprays from Terence's recommendation list (see below) or follow your own thinning program.

7 - Use the carbohydrate model to adjust rates up or down based on model recommendations and the amount of thinning to be done (http://newa.cornell.edu/index.php?page=apple-thin)

IF you decide not to apply a bloom and/or a petal fall thinning spray you still can follow the protocol and measure the fruitlets, however it is up to you. In this case, the model will tell you the potential number of fruit per tree and how much thinning needs to be done at the later stages. Take the first measurement when fruitlets reach 5-6mm (usually the king fruitlet). Then 3-4 days after the first measurement take a second measurement.

8 - Measure fruit diameters (3-4 and again 7-8 days after petal fall spray, and/or 3-4 and 7-8 days after 10-12mm spray and/or 3-4 and 7-8 days after 18 mm spray). The number of times to measure will depend on when you reach the target number.

9 – Enter the data and all the information needed in an Excel spreadsheet that will be provided to you. Send the data within 24 hours after each 8-day measurement to Poliana Francescatto (pf246@cornell.edu) copying your regional cooperative extension agent:

Craig J. Kahlke (cjk37@cornell.edu), 585-735-5448
Mario Miranda Sazo (mrm67@cornell.edu), 315-719-1318

We will get back an assessment within 24 hours of thinning progress. Based on the results you will be able to decide to spray or not.

Please feel free to contact Poliana Francescatto, Craig Kahlke, or Mario Miranda Sazo if you would like to get more information or any assistance on training your farm employees to conduct fruit measurements this year.

Things you HAVE to pay attention at every time you take the measurements

– Take data "precisely":
- Make sure you are ALWAYS taking measurements from the right cluster. You might get confused if there are two clusters too close or if you used a long ribbon (flag) that can twist around nearby clusters. Try to avoid marking those too close clusters and do not use a too long ribbon.
- Fruit are not round so ALWAYS pick the largest

OR the narrowest size of the fruit to measure. If you choose to measure the largest side, then all the subsequent measurements have to be taken from the largest side as well - at day 1, day 2 day 3 and so on.

- If you opt for not marking the fruitlets, please make sure you will not measure the same fruitlet twice at the same day.

- Make sure you are writing the measurements in the right position (tree and cluster) in the datasheet provided. However, fruitlets within each cluster do not need to be in order.

- If you find more than 5 fruitlets within the cluster just remove the weakest fruitlet. It will come off later anyways.

- If you break a cluster please remove all the previous measurements.

Spray and Timing Options for Precision Thinning of MATURE Gala:

Option 1	Option 2
Apply a Bloom Spray NAA (4oz/100 gal TRV dilute basis - see below for TRV)	
Apply a Petal Fall Spray (5mm) NAA (3oz/100 gal TRV dilute basis) + Sevin (1pt/100 gal TRV dilute basis) Or Maxcel (64oz/100 gal TRV dilute basis) + Sevin (1pt/100 gal TRV dilute basis)	**Apply a Petal Fall Spray (5mm)** NAA (3oz/100 gal TRV dilute basis) + Sevin (1pt/100 gal TRV dilute basis) Or Maxcel (64oz/100 gal TRV dilute basis) + Sevin (1pt/100 gal TRV dilute basis)
Apply a 12 mm Spray Maxcel (64oz/100 gal TRV dilute basis) + Sevin (1pt/100 gal TRV dilute basis)	**Apply a 12 mm Spray** Maxcel (64oz/100=96oz/acre) + Sevin (1pt/100=2pt/acre)
Apply an 18 mm spray (if needed) Maxcel (64oz/100 gal TRV dilute basis) + Sevin (1pt/100 gal TRV dilute basis) + Oil (1pt/100gal water) **don't concentrate oil** (directed to the upper part of the tree)	**Apply an 18 mm spray (if needed)** Maxcel (64oz/100 gal TRV dilute basis) + Sevin (1pt/100 gal TRV dilute basis + Oil (1pt/100gal water **don't concentrate oil**) (directed to the upper part of the tree)

Spray and Timing Options for Precision Thinning of MATURE Honeycrisp:

Option 1	Option 2
Apply a Bloom Spray NAA (4oz/100 gal TRV dilute basis - see below for TRV)	
Apply a Petal Fall Spray (5mm) NAA (3oz/100 gal TRV dilute basis) + Sevin (1pt/100 gal TRV dilute basis)	**Apply a Petal Fall Spray (5mm)** NAA (3oz/100 gal TRV dilute basis) + Sevin (1pt/100 gal TRV dilute basis)
Apply a 12 mm Spray NAA (3oz/100 gal TRV dilute basis) + Sevin (1pt/100 gal TRV dilute basis)	**Apply a 12 mm Spray** NAA (3oz/100 gal TRV dilute basis) + Sevin (1pt/100 gal TRV dilute basis)
Apply an 18 mm spray (if needed) Sevin (1pt/100= gal TRV dilute basis) + Oil (1pt/100gal water) **don't concentrate oil** (directed to the upper part of the tree)	**Apply an 18 mm spray (if needed)** Sevin (1pt/100 gal TRV dilute basis) + Oil (1pt/100gal water) **don't concentrate oil** (directed to the upper part of the tree)

*TRV = Tree row volume

Spray Mixing Instructions Considering Tree Row Volume - TRV

• Plant Growth Regulator response is a function of the amount of chemical deposited on the leaves of the tree. The amount of chemical that is sprayed per acre should consider tree size to not over-apply chemical to small trees and under-apply chemical to large trees.

• Tree size can be used to adjust the amount of chemical added to the spray tank by calculating the size of the tree canopy (tree row volume). The tree row volume of an orchard is defined as the volume of water to spray the trees to runoff, which is termed a full dilute spray.
• The amount of chemical can then be adjusted to the size of the trees with fully-grown trees receiving a full amount (100% dose) and smaller trees receiving an appropriate fraction of a full dose.
• The volume of water used to carry the chemical to the leave can be less than the full dilute volume but if less than the full dilute volume is used then the amount of chemical in the tank must be concentrated to allow the proper amount of chemical to be applied to each tree.
• The concentration factor is determined by dividing the full dilute volume of water (TRV) by the actual amount of water to be sprayed.

1. Calculate Tree Row Volume
(Tree height X Tree width X 43,560 X 0.7) / (Between row spacing X 1000)

• Example of a Tall Spindle Orchard
For many mature Tall Spindle Orchards this is ~200 gallons/acre
Example (11' X 7' X 43560 X 0.7) / (12' X1000) = 196 gallons/acre
2. Set sprayer up to spray ½ of Tree Row Volume (100 gallons/acre)
This is a 2X application
3. Concentrate the chemicals in the tank 2X
Add the rate/100 gallons X 2 of each chemical (**except oil or surfactants**)

Adjusting the Spray Pattern
• Often the bottoms of trees show over-thinning while the tops of trees show under-thinning.
• Our standard recommendation is to nozzle the sprayer so that 2/3 of the spray volume is directed to the top half of the tree and only 1/3 is directed to the bottom half of the tree.
• Recent studies have shown that this still gives 65% of the fruit in the top half of a tall spindle tree and only 35% of the fruit in the bottom half of the tree.
• **Our new recommendation is that for the bloom and petal fall sprays that spray pattern direct 2/3 of the spray to the top of the tree and 1/3 to the bottom of the tree.** However, **for a third spray at 10-12mm or a fourth spray at 18mm that all of the spray be directed to the top half of the tree** and no spray be directed to the bottom half of the tree.
• Please note that when you shut off the nozzles you need to adjust up the rate per acre. We still want to keep the same rate per acre, even though you are spraying only the top of the trees. The bottom part of the trees will get some drift and no need to be directly sprayed. More chemical has to go in the tank to account to the factor you shut off nozzles, because now one sprayer instead off covering five acres goes ten acres. For instance, if your sprayer is going to cover 4 acres, you have to put the normal amount per acre four times in there. The reason for that is because the upper part of the tree gets so much light and produces much more carbohydrate, so those fruit have much greater carbohydrate supply than fruit from the bottom of the tree where you have more shade.

Perennial or Annual Crops Stewards

Cornell AgriTech at the New York State Agricultural Experiment Station

These two positions function from within the Field Research Unit. We are seeking two individuals to provide lead responsibilities over FRU Staff in collaboration with the Unit Leader. The crop stewards are responsible for farm stewardship and management. Provide expertise on diverse agricultural research-specific practices. Keep up to date on new advances in technology and the application of that technology within farm operations. Associates Degree or equivalent field coordinator experience required.

To Apply: Visit the following website https://cornell.wd1.myworkdayjobs.com/CornellCareerPage and search for postings # WDR-00014624 and # WDR-000146

Mark Your Calendars

Meeting title	**2018 CCE LOF PGR Orchard Tour**
Date	Friday June 29
Time	8:30am-4pm
Location	Touring 2-3 farms in Orleans (TBA) And/or, touring plots at the Geneva Research Station (TBA)
Cost	Free
Brief description of meeting	There will be a tour of commercial orchards and/or research plots to understand how plant growth regulators affect vegetative, reproductive, and fruit growth of apple with invited speakers Duane Greene and Poliana Francescatto.
Registration/Contact for information	More details will be provided via LOF Newsletter and Fruit Facts the next weeks. In the meantime, please contact Mario Miranda Sazo, cell 315-719-1318, mrm67@cornell.edu

Meeting Title	**LOF Summer Tour**
Dates	Thursday, July 12
Time	All Day
Location	Wayne County
Cost	Free, Thanks to our Sponsors
Brief description of meeting	Annual tour featuring cutting edge farms
Registration/ Contact for	TBA, Stay tuned to our website and newsletter

Meeting Title	**LOF Young Fruit Farmer Study Tour**
Dates	August 2-4
Time	Depart (via bus) WNY Thursday morning, travel home Saturday AM
Location	Adams County Region, Pennsylvania
Cost	TBA, Partially subsidized by sponsors
Brief description of meeting	Annual tour to other commercial tree fruit production regions for future farm owners and leaders
Registration/ Contact for information	TBA, Stay tuned to our website and newsletter. For more info or to be put on the "Young Growers" email list, contact Craig at cjk37@cornell.edu, 585-735-5448

Meeting Title	**Western NY Hard Cider Tour**
Dates	Monday, August 6
Time	All Day
Location	3 Farms in Niagara and Orleans Counties, ending (optional) with a tasting at Mullers Cider House, Rochester.
Cost	Orchard Tours and Lunch Free with Pre-registration
Brief description of meeting	Come visit the orchards of the first NY growers of European and American Hard Cider varieties.
Registration/ Contact for information	TBA, Stay tuned to our website and newsletter. For more info or to be put on the Cornell Hard Cider list, contact Craig at cjk37@cornell.edu, 585-735-5448

Cornell Cooperative Extension
Lake Ontario Fruit Program
12690 Rt. 31
Albion, NY 14411

Fruit Notes

YOUR TRUSTED SOURCE FOR RESEARCH-BASED KNOWLEDGE

Fruit Specialists

Craig Kahlke I 585-735-5448 I cjk37@cornell.edu
Team Leader, Fruit Quality Management

Areas of Interest: Fruit Quality and factors that affect fruit quality before, during, and after storage,

Mario Miranda Sazo I 315-719-1318 I mrm67@cornell.edu
Cultural Practices

Crops: Blueberries, Raspberries / Blackberries, Strawberries, Apples, Apricots, Asian Pears, Cherries, Currants, Gooseberries, Nectarines, Peaches, Pears, Plums

Tessa Grasswitz I 585-261-0125 I tg359@cornell.edu
Integrated Pest Management (IPM)

Areas of Interest: IPM of tree fruit and berry pests, biological control, pollinators, and impact of climate change.
Crops: Blueberries, Raspberries / Blackberries, Strawberries, Apples, Apricots, Asian Pears, Cherries, Currants, Gooseberries, Nectarines, Peaches, Pears, Plum

Mark Wiltberger I 315-272-8530 I mw883@cornell.edu
Business Management

Crops: Apples, Cherries, Nectarines, Peaches, Pears, Plums

For more information about our program visit us at lof.cce.cornell.edu