Fruit Notes

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Fruit Notes

Editors: Wesley R. Autio & Winfred P. Cowgill, Jr.

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Correspondence should be sent to:

Fruit Notes
Stockbridge School of Agriculture
205 Paige Laboratory
University of Massachusetts Amherst
Amherst, MA 01003

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Raynox Plus, for the Control of Sunburn on Apples

Win Cowgill
NJ State Horticulture Society, Professor Emeritus Rutgers University

Rebecca Magron
Rutgers Cooperative Extension

Wes Autio, Jon Clements
Stockbridge School of Agriculture, University of Massachuetts

Introduction

Raynox Plus® protects fruit from sun damage by forming a thin, clear, natural wax layer that blocks damaging UV rays from harming fruit. The clear coating of *Raynox Plus* has many benefits:

- Significantly reduces the damaging effects of solar radiation on fruit
- Does not affect fruit color development or photosynthesis
- Allows for color-picking
- No cleanup of white residue in calyx or stem ends

Materials & Methods

Experiment 1. The experiment was conducted in a mature apple block of 'Honeycrisp' apples planted to a tall spindle system, spaced 5' x 14'. The plot was located at the Rutgers Snyder Research and Extension Farm, Pittstown, NJ. The experiment was set up as randomized complete block design with 4 replications. Raynox was applied four times: July 5, August 4, August 15, and August 29. Treatments were applied with a Rears

Sunburn on untreated Honeycrisp fruit in 2015, Rutgers Snyder Farm, New Jersey.

Varying degrees of of sunburn on untreated Snowsweet in 2016, Heller Orchards, Pennsylvania. Range from mild sunburn (upper right) to severe sunburn with necrosis (lower right).

Severe sunburn on Snowsweet can have a paper-like appearance.

Tower sprayer using air induction nozzles, the sprayer was calibrated at 100 GPA. The Raynox treatment rate was 2.5 gallons per acre. Treatments were evaluated on 9 September for Incidence of sunburn as a % of fruit injured. Rows were planted north-south.

Experiment 2. The experiment was conducted in a mature apple block of 'Snow Sweet' apples planted to a V-Trellis system, spaced 3' x 14' planted North to South. The plot was located at Heller Orchards in Wapwallopen, PA The experiment was set up as randomized complete block design with 4 replications. Bloom date: May 5. Raynox Plus was applied three times: July 6, 22, and August 9. Treatments were applied with an airblast sprayer, FMC 242 customized with a Cyclone tower head from Italy. Application pressure =100 PSI. Ground speed of application =2.1 mph. Treatments were evaluated on September 12 for Incidence of sunburn as a percent of fruit injured.

Results & Discussion

Experiment 1. Raynox Plus treated trees had significantly fewer percent incidence of sunburn as compared to the untreated controls (Table 1). The West side of Raynox treated trees had significantly greater incidence of sunburn compared to the east side of Raynox Plus treated trees. The incidence of Sunburn was higher on the controls on the west side as was to be expected.

Figures 1 and 2 show the temperature and rainfall data for 2015 with treatment dates. It was a hot dry summer in 2015, very little rainfall and many days over 90F in 2015.

One of the main reasons to control sun damage to the skin of Honeycrisp fruit is to assist in the control of Bitter Rot fungus, Glomerella cingulate. Bitter rot is one of the few fruit rot organisms that can penetrate the unbroken skin of the fruit.

In 2015, Bitter Rot was evaluated on the fruit. It was not significantly different in 2015 between treatments but trended higher in the untreated control (Table 1).

Experiment 2. This was the second year of Raynox Plus experiments. In 2016, all Raynox Plus treatments had significantly less sunburn than the untreated control, Table 2.

The Raynox Plus 2.5 Gal/A treatment and the Raynox Plus 1 Gal/A applied to both sides of the tree and the Raynox Plus @1.25 Gal/A to the west side resulted in significantly less sunburn than the UTC on the west sides of the trees.

Table 1. Raynox Plus evaluation for sunburn on Honeycrisp apple, 2015, Rutgers Snyder Farm, New Jersey.

	Incidence of Sunburn (%)		Incidence of
Treatment	West	East	Bitterrot (%)
UT Control	45.6 **	9.4 *	0.5
Raynox	7.5	3.8	0

Mean separation at or within columns by F test.

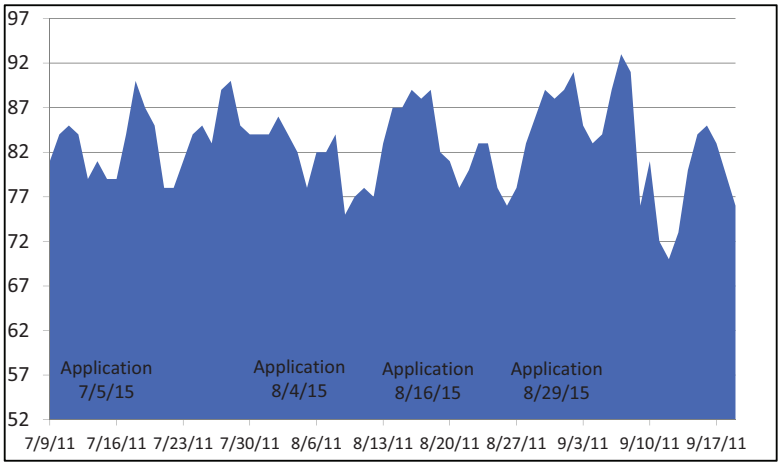


Figure 1. Temperature by Raynox application date (2015). Application dates July 5, August 4, August 15, and August 29.

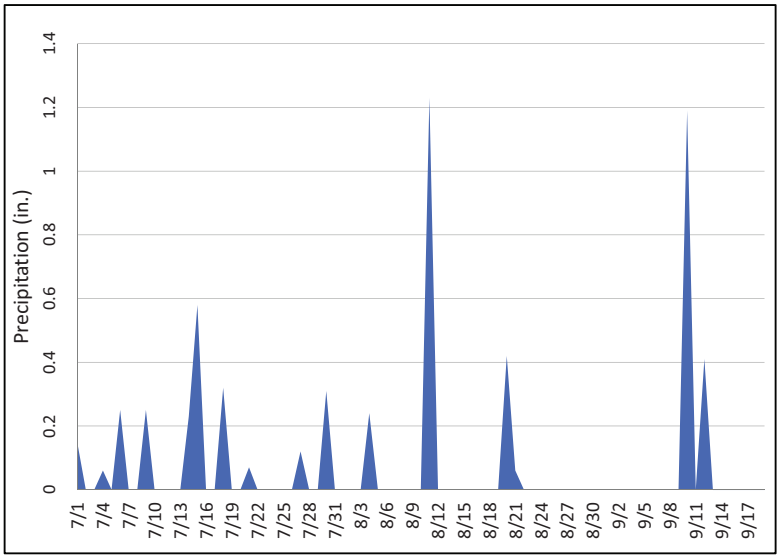


Figure 2: 2015 Rainfall and Raynox application dates date at Rutgers Snyder Farm. Application dates July 5, August 4, August 15, and August 29.

There was an insignificant amount of sunburn on the east side of any treatment (1.4% on east side and 19.2% on the west side of the tree).

There was significant treatment and row direction (east vs. west) effect (data not shown). In this orchard orientation of tree rows planted North to South, there is very little sunburn on the east side of all rows, including the UTC. This was also true in the 2015 NJ experiment.

A forth application was called for in September 2016, due to high forecasted temperatures. However, the grower was in the middle of Gala, Honeycrisp and McIntosh harvest and was not able to apply the forth application. I believe we would have had a reduced sunburn if this application could have been applied. There was no bitter rot observed in 2016 due to the dry summer

Conclusion

Raynox Plus was highly effective at preventing sunburn on Honeycrisp fruit in 2015 at the Rutgers Snyder Farm and in 2016 at the Heller Orchard in Pennsylvania.

Both years of evaluation resulted in positive results where Raynox Plus significantly reduced sunburn in both trials.

We consider 2016 a high sunburn incidence year. That being said, three applications of Raynox Plus significantly reduced sunburn on a highly prone cultivar, SnowSweet.

Two years of trials suggest that just the west side of the row in a north south orchard orientation needs to be treated. The lower rate of 1 gallon/acre appeared to provide adequate control in 2016.

Observations over the past 5 years in the Northeast indicated that fruit are subject to sunburn following temperatures of 90F or higher, particularly if temperatures are high for multiple days.

Our sense is that the first two applications should be applied fairly close together, the first approximately 7 weeks after first bloom, the second within a few weeks of the first application. This approach 'layers' the product on the fruit. Keep an eye on forecasted high temperatures. In the humid Northeast, time the 3 and 4 applications when the forecast calls for an extended period of time with temperatures over 90F. Excessive rainfall should shorten the application interval.

What is needed is a better way to time Raynox Plus applications with a forecasting model like Washington State is working on. See WSU Interactive Sunburn

Table 2. Raynox Plus evaluation for sunburn on Snowsweet apple, 2016, Hellers Orchard, Wapwallopen, PA.

Raynox treatment	Sunburn (%)
UTC	20.8 a
Raynox 2.5 Gal/A-East & West	9.6 ab
Raynox 1.25 Gal/A West Only	6.2 b
Raynox 1 Gal/A East & West	4.6 b

Model – details at: http://hort.tfrec.wsu.edu/pages/Sunburn. Our weather conditions are significantly different in the Northeast as compared to the Northwest model. Our different parameters would need to be incorporated in to a humid Northeast or Midwest model.

One of the key factors in the potential for Sunburn in the Northeast is the training system used, combined with tree vigor. On weaker trees with poor leaf cover, sunburn incidence is higher. Narrow-canopy, tall-spindle systems can be sunburn prone if there is not adequate tree vigor and foliage cover.

There is also tremendous variability in cultivar sensitivity to sunburn as well.

An Autopsy of the 2016 Growing Season

Duane W. Greene and Jon M. Clements
Stockbridge School of Agriculture, University of Massachusetts

Most tree fruit growers in New England will agree that 2016 was one of the most challenging growing season in memory. While the preferred approach would be to forget this year, I would like to reflect on it and try to glean as much information as we can so that if we are again confronted with similar environmental conditions we will have more information that we can use to help make informed management decisions.

A Review of the Weather

The weather in 2016 resulted in a great deal of damage to the tree fruit crops but not all portions of New England experienced the same degree of adversity. Consequently, this summary will include generalizations that hopefully will apply to most situations. The 2015 season was one of the best and most profitable for the majority of growers. Moisture was adequate and yields were generally among the best in the recent past. The weather was conducive to producing an excellent crop of large fruit. While most did not think of it at the time, trees may have entered the fall slightly stressed because of the heavy crop load. The heavy all-around set offered the possibility that we may experience below average return bloom in 2016. The fall was generally warm with no extremes as trees went into dormancy. For the first part of the winter, temperatures were above average and precipitation, especially snow, was almost nonexistent. There were some temperature fluctuations in late December into early January that may have stressed the trees. In the middle of February trees were exposed to temperatures that went down to -16º F to -17º F for two nights in a row. The transition between warm to the very cold was not sudden but it did occur over a relatively short period of time and this may have made the trees more sensitive to the very cold temperatures. There was no question that the peach flower buds were killed at those low temperatures but the extent of injury or stress to other tree fruit was uncertain. Relatively warm temperatures between the Arctic blast of cold in February to early April allowed buds to start to show development and loose some cold hardiness. During the first week in April another freeze occurred that resulted in significant damage to buds of nearly all trees. As flowers started to expand, varying degrees of damage were noted. In many apple flower cluster a varying number of buds were killed, while spur lea f damage manifest itself as leaves appearing to be small, crinkled, chlorotic, and generally unhealthy looking. Near bloom in May the weather turned very cool, without frost, for nearly 2 weeks. These temperatures were accompanied by clear sunny days and cool nights which favored carbohydrate accumulation. Fruit growth was very slow. There were few stresses on the trees during this time and the chemical thinning period. This postbloom period heralded the arrival of one of the worst dry periods that we have experienced in the past few years that lasted through harvest and it continues to persist.

Fruit Size

The apple fruit size in 2016 was one of smallest in recent memory. This was completely predictable for several reasons. If a tree carries a very heavy crop load throughout the season the size of the flower buds initiated for the following year tend to be small. It is well known that there is a positive correlation between the size of flowers bud and the

Apple flower bud damage on April 8, 2016, and the UMass Cold Spring Orchard Research & Education Center, Belchertown, MA.

size of fruit that develop from these buds. Spur leaves play a critical role early in the seasons in determining fruit size. Spur leaf quality was fair to poor which undoubtedly impaired the leaf from photosynthesizing at optimum level. (However, to my knowledge the extend of this impairment was not documented so this is open to speculation.) Equally important at this time was the temperature following bloom. The period of time after bloom is when fruit are actively undergoing cell division. The low temperature during this period led to a reduction in the rate cell division which in turn resulted in fewer number of cell being produced in the apple. The final cell number in a fruit is largely determined during this period after bloom and this more or less determines the potential for a fruit to increase in size. There were just fewer cell being initiated in the fruit at this critical time. As fruit development proceeds, fruit increase in size primarily by cell enlargement of previously initiated cells. However, if cells are not present they can't increase in size. Spur leaves also play a critical role in fruit growth. Storage carbohydrates are exhausted in a tree by petal fall, therefore, fruit growth is then dependent upon photosynthesis in the spur leaves until the bourse shoot leaves can contribute when the bourse shoot reaches about 10 inches in length. Severely frost-damaged spur leaves were smaller and were incapable of providing the same amount of carbohydrate to the fruit as healthy leaves. Admittedly, there is little information in the literature documenting the photosynthetic capability of frost damaged leaves so we are left to make educated guesses about the degree of impairment. The freeze that occurred during the early part of April killed many flowers. Generally the most physiologically advanced flowers are damaged first and to the greatest extent. Consequently, many king flowers were killed. Less developed lateral flowers often survived. Further, in some instance all of the flowers in the spur were killed or severely damaged to the point where they did not set. Some cultivars produce flowers on 1-year-old wood. These flowers are frequently delayed in opening, many survived, set and developed into fruit. Fruit that develop from king flowers are usually larger than those that develop from secondary flowers in the spur cluster and fruit that develops from flowers on 1-year-old wood are generally the smallest. Finally, the drought conditions that developed during the period of fruit expansion also contributed to small fruit size. Any one of the above-mentioned factors or a combination of these are undoubtedly responsible for the unusually small fruit size we experienced this fall.

Initial Set and the Chemical Thinning Period

The pollination period was variable depending on location in New England. In general, it was cool and there was pollinator activity, although in many cases it was limited. It is well documented that emerging spur leaves play a critical role in aiding and assuring initial set. The chemical thinning strategies that we now recommend involve making thinner applications at multiple times, starting as early as bloom. If a bloom spray is not applied then we normally recommend a petal fall spray. The extensive damage to the spur leaves and the uncertainty related to injury to flowers/fruit prompted overall extreme caution in the use

Gala apple flower cluster on May 22, 2016, at the UMass Cold Spring Orchard Research & Education Center, Belchertown, MA.

of thinners. This was a big black box. We adopted a very conservative wait-and-see approach to thinning at this time. The cool sunny weather following bloom resulted in a heavier initial set than we would normally expect from trees with extensive spur leaf damage. We interpret this result as the spur leaves remained sufficiently functional to produce sufficient carbohydrate to allow fairly good initial set. The cool sunny conditions resulted in a carbohydrate excess that favored fruit set.

Preharvest Drop

The last few years we have focused on developing strategies to allow acceptable preharvest drop control until fruit can be harvested in a timely manner. Orchardist have available ReTain, Harvista and NAA . These can be used alone or in combination at various times and rates to achieve acceptable drop control on drop-prone varieties. However, there are two environmental factors that may either diminish or negate drop control efforts. High temperatures, especially those experienced in the 2-3 weeks prior to and during harvest that tend to negate or gravely diminish drop control efforts. Short of using overhead sprinkler irrigation there is little an orchardist can realistically do to counteract heat stress. The second major factor that reduces the effectiveness of drop control compounds is drought. All are acutely aware of the drought conditions that have gripped much of New England and New York. Many of the new plantings that have gone in recently include trickle irrigation. However, the drought has been so severe in recent months that many growers ran out of water for irrigation. We have experienced one of the hottest summers on record and the lack of water was so severe as to warrant declaration of a state of emergency in affected areas of New York and New England. Fruit drop when they are prematurely stressed leading to early ripening. A recent study done in Massachusetts confirms that all fruit that dropped were climacteric and they were producing significant ethylene. The ethylene given off by these early ripening fruit was sufficient to trigger drop. It was my observation this year that the most effective drop control strategy involved using ReTain at or near label limits. There was very little Harvista used in Massachusetts in 2016 so it is difficult to make meaningful observations this year. Because of the very high temperature the use of NAA should have been low except in circumstances where fruit was to be sold soon after harvest.

Flower Bud Formation- The Crystal Ball

Flower bud formation for the major tree fruit crop is or has occurred during this current drought. In advance of the 2017 growing season it may be worthwhile to at least discuss some of the possible ramifications that may result.

Apple- The trigger that generally leads to flower bud formation in apple occurs relatively early, within 5 to 6 weeks after bloom. However, the first manifestation of the bud developing into a flowers bud is generally not seen until August. During most of the critical period this summer trees experienced severe drought. It is known that drought can limit the extent of flower bud formation. This raises two questions, first, how

robust will return bloom be even with the very reduced crop load experience in many orchards? What effect will this drought have on the vigor of the flower buds that are initiated? The size of the buds entering into the winter may provide a clue to this question. Larger flower buds are generally considered stronger and more robust. How resilient will these buds be if exposed to cold temperature stress even remotely close to the temperatures these trees experienced this past winter?

Peach- Peaches differ from many other tree fruit in that they produce their flowers on one-year-old wood. Therefore, all flower buds initiated for a crop in 2017 were initiated under drought conditions. Essentially there were no peaches produced in New England in 2016. During the spring there were discussion revolving around how to handle peach trees without a crop. A prominent scenario was to cut the nitrogen in half in response to the lack of a crop. However, as the season progresses many peach trees did not look very healthy and in some situations additional nitrogen was required to bolster green color in the leaves and make their foliage appear somewhat normal. This raises the question of how much unseen tissue injury in the wood was sustained due to cold last winter. As we approach the winter months there are questions. Did the peach trees suffer some type of tissue damage from last year that may extend into 2017? What are the characteristics of flower buds initiated under drought conditions? How vigorous and robust will these flower buds as we enter the winter? How much cold will they be able to withstand to survive?

Lessons Learned from the Record-Breaking Drought Experienced in Western NY in 2016: A Nutritional Perspective

Mario Miranda Sazo
Cornell Cooperative Extension, Lake Ontario Fruit Program

Lailiang Cheng
Horticulture Section, School of Integrative Plant Science, Cornell University

In 2016, the western New York fruit production region experienced a summer like no other. We had one of the warmest and driest growing seasons in record in Western NY. In the first four months (April-July), we only had a total average of 6.43" rainfall, with only 1.66" and 1.03" rainfall June and July, respectively. The minimum and maximum temperatures in the month of August were 53.6˚F and 93.3˚F, respectively. There were 22 days with temperatures above 85˚F in July and August. Comparisons of weather conditions of the 2016 growing season with the most recent warm and dry growing seasons in 2011 and 2012 are summarized in Table 1.

In an average growing season in the northeast, rainfall is usually less than required for optimal tree performance during critical periods of tree establishment and growth. In addition in 3 out of 10 years, severe water shortages occur during the months of June, July and/or August. A mature tall spindle orchard in the early season requires about

Table 1. Summary of weather conditions experienced in Western New York during the growing seasons of 2011, 2012, and 2016.

Growing Season	Weather Conditions (June – August)
2011[1]	• Cool/wet spring, followed by a hot/dry summer • **15 days at 85˚F** or above during June and July • Total average rainfall from April-July: **13.75"**
2012[2]	• Hot/dry year with infrequent rains at the end of the season • **19 days at 85˚F** or above during June and July • Total average rainfall from April-July: **9.96"**
2016[3]	• Extensive warm and dry season, with a record-breaking drought across NY State • **22 days at 85˚F** or above during July and August • Total average rainfall from April-July: **6.43"**

[1] Spring was one of the wettest. We had a late and frustrating tree planting season.

[2] In 2012 the abnormally high temperatures of March 12-22, 2012, resulted in accelerated bud development in tree fruit crops. We recorded green tip in McIntosh on March 17-19 across the Lake Ontario Fruit region, initiating the beginning of the growing season 3-4 weeks ahead of normal.

[3] On April 5 the WNY region experienced temperatures in the low 10's. Orchards located in the West side of Rochester escaped the bitter cold, or were less affected, than orchards in Wayne. The southern-most sites in Wayne had the lowest temperatures.

1,000 gallons/acre/day and about 4,000-5,000 gallons/acre/day in mid-summer. A newly planted tall spindle orchard requires much less water (never exceeding 500 gallons/acre/day) due to smaller trees with a fraction of the leaf area of mature trees. Therefore, it is essential to have irrigation for tall spindle plantings to ensure tree establishment and maximize fruit size at any given crop load. Water stress at any time of the season reduces fruit growth rate with permanent loss in fruit size, which is difficult to recover later. Also, very dry soil conditions can reduce the availability of nitrogen, phosphorous, potassium, calcium, and boron to tree roots.

So far we have been fortunate in establishing, training, growing, and nourishing high density apple orchards with less than optimal rainfall during the last eight growing seasons. What was more unusual this year for NY apple growers without irrigation was that several growers had to set up moveable sprinkler pipes, big gun sprinklers, or simply water trees individually with a tank and a hose. We saw even growers tapped into town water supplies using a fire hydrant, installed improvised and moveable irrigation lines for sets of 4 rows, in an effort to increase fruit size on small fruited varieties by the middle of August. These temporary setups may have made a difference during the droughty summer supporting the growth of newly planted trees and in sizing apples for harvest. But these mitigation responses clearly showed how unprepared we were to respond and quickly to more severe drought events.

Drought Implications on Availability of Important Nutrients and Fall Recommendations for Optimal Tree Growth

Nitrogen (N) availability was reduced: Low soil moisture conditions decreases soil microbe activity. Microbes play an important role in breaking down organic matter and converting organic nitrogen to inorganic nitrogen, a process called mineralization. In dry soils with low nitrogen mineralization, there could be less plant available nitrogen in the form of either ammonium (NH_4^+) or nitrate (NO_3^-) nitrogen. In dry soils, the risk of NO_3^- loss through leaching or denitrification is reduced, partially compensating for the low mineralization of organic nitrogen in dry years. When significant rain fall occurs at the end of the season, there is a sudden increase in soil nitrogen. A good orchard soil can generate enough N through the breakdown of organic matter and can release 15 to 20 lbs N/Acre by the end of the growing season.

Phosphorous (P) availability was also reduced: Reduced soil microbial activity in soils with low moisture can reduce organic matter descomposition and the mineralization of organic P to inorganic P. Phosphorous moves from higher concentrations in the soil to lower concentrations in tree roots by diffusion. As soils become drier, less diffusion occurs. This is because the water film around the soil particles becomes thinner, making diffusion to the tree roots more difficult.

Potassium (K) and calcium (Ca) moved less in the soil profile: Decreased movement of K and Ca to the tree roots occurs in dry soil. As soil dries, clay minerals become dry and shrink, trapping K and Ca tightly between mineral layers. Once trapped, K and Ca are unavailable to plant roots for uptake. This K and Ca are released and plant-available again when the soil moisture increases

Boron (B) shortages occurred particularly on coarse-textured soils: When boron is inadequate various types of corking disorders may develop in or on the fruit. Shortages of boron are associated with impaired growth of dieback of roots and shoots, premature ripening of fruit, and accentuated preharvest fruit drop.

Bitter pit affected more orchards in the East side than the West side of Rochester and its incidence varied among rootstocks: In general a higher incidence of bitter pit was observed in Honeycrisp orchards in Wayne County this season. One Honeycrisp site on M.26 with a soil pH of 7.32 showed a 50% incidence of bitter pit. At the VanDeWalle rootstock trial located in Alton, the higher incidence of bitter pit (BP) in Honeycrisp was observed with G.11 (24% BP), followed by G.41 (19% BP), and M.9 (16% BP). The lower incidence was measured with B.9 (10% BP). Thus it appears that the use of B.9 did largely decrease the incidence of bitter pit on Honeycrisp at the rootstock trial this season (results based on 4 replications by rootstock). We believe rootstock selection will play an important role in bitter pit susceptibility the following years. Based on data analyzed in the NC-140 rootstock trials, Honeycrisp trees on B.9 seem to have less bitter pit than those on M.9 or M.26.

Management Practices You Should Consider for Long Term Impacts of Extreme Drought

First of all, all new plantings that have gone in recently should include trickle irrigation. Trickle (or drip) irrigation has its largest impact in the first few years

(1-5) and so should be installed early in the first year. In a dry season like this year, the application of water should have begun in early-mid May (if you recall new plantings suffered higher water stress levels in the West side of Rochester than in Wayne by the end of May). In other more rainy years, the application of water can be delayed until early June. Growers who have used irrigation say that short, but frequent, irrigation helps promote tree growth (shoot and root development). Small amounts of water (and nutrients) applied twice weekly is a good fertigation strategy for the first three years (5 gallons per tree per week in year 1 and 10 gallons per tree per week in year 2).

Another good strategy is to increase the soil organic matter of your orchards. Soil organic matter can be increased from long-term addition of crop residues, organic amendments such as manures and composts or including cover crops. Increasing organic matter helps improve soil structure. Improved soil structure helps balance soil drainage in the wet years, and water holding capacity in the dry years, improving conditions for achieving consistent and high yields of high quality fruit over the long term.

A third way to improve soil conditions may be through the use of mycorrhizal fungi to help colonize absorptive roots (located within the top 12 to 15 inches of the soil). Mycorrhizae are created by a union of roots and specific soil-born fungi. They aid in improving plant growth, water and mineral absorption, disease suppression and drought resistance.

Regardless of whether you irrigated or not this summer, the increase of soil organic matter via crop residues, organic amendments, or the use of mycorrhizae will help enhance root growth, improve soil health, and reduce water stress, if another severe drought is experienced in Western NY the following years.

What to do now in the fall?

Now is a good time to take soil samples. By doing so you can compare the results in a dry year like this with those in more normal years. This can provide valuable information as to what to expect if future dry years occur again. Moreover, taking a representative soil sample is important to determine lime and fertilizer requirements and avoid costly over or under fertilization. Most soils should be sampled every 2 - 3 years; more often for sandy soils, or problem areas. Fall is generally considered to be the most reliable time to pull samples, especially when it comes to pH. Soil pH fluctuates and tends to be lower in the summer when temperatures are higher and soils are dryer. Soil pH determination is more reliable in the Fall when soil moisture is a bit higher. Please make sure you maintain an optimal soil pH around the target value of 6 to 6.5.

Finally, we would like to emphasize the following message for Honeycrisp growers who experienced bitter pit issues this year. Until now, we have been recommending to Gala, Empire, and McIntosh growers that for blocks producing 1,000 or 1,500 bushels per acre, they needed to apply 70 to 100 pounds of potash per acre to replenish what the trees took from the soil. However, for Honeycrisp we suggest growers lower the potassium rate by 25 to 30 percent this fall, because a lower potassium uptake will results in higher levels of calcium in Honeycrisp fruit next year. Potassium should not be reduced by more than 50%, because it is a critical nutrient for fruit development and sugar accumulation.

An Association with the Rutgers Tree Fruit Breeding Program Starting 50 Years Ago

Jerome L. "Jerry" Frecon
Professor Emeritus, Rutgers University & Consultant for Adams County Nursery

There are many that could tell you about Rutgers tree fruit varieties in New Jersey and around the world. Currently, Dr. Joe Goffreda is Director of the Rutgers NJAES Fruit Breeding Program. Dr. Dan Ward is the Rutgers NJAES NJ tree fruit specialist that works with new varieties at Rutgers today.

I am Professor Emeritus and former South Jersey Tree Fruit Agent. I do consulting work for the New Jersey Peach Promotion Council and Adams County Nursery (ACN). Jen and Phil Baugher at ACN have an excellent web site www.acnursery.com that is a good source of information on Rutgers varieties. ACN nursery sells more fruit trees of Rutgers varieties world wide than any other nursery. Our Peach Promotion Council website http://jerseypeaches.com. has a lot of information on NJ peaches.

Saturn flat peaches at a farmers market in London, England.

Win Cowgill, Professor Emeritus and former North Jersey Tree Fruit Agent has also worked with and tested Rutgers apple, peach and apricot varieties in northern NJ for the past 35 years. Win is now a private consultant for fruit growers, www.wincowgill.com. Win would not have become involved in the fruit research and extension profession if it had not been for Dr. Hough offering him a Gerber Baby food assistance ship at Rutgers to get his masters and work in fruit breeding in 1975.

Dr. Goffreda is the current source for information on Rutgers varieties. The New Jersey Agricultural Experiment Station breeding program was started about 1908 and has been going strong for the last 108 years. My association with

the program began almost 50 years this spring when I began working as a graduate student for Dr. L Fredric Hough and Dr. Catherine Bailey.

Many fruit breeders from around the world were trained at Rutgers by Hough and Bailey. Probably more than from any other educational institution. When these students went home, they often shared germplasm and pollen from their home country breeding programs from around the world with Hough and Bailey. Much of this Rutgers germplasm collected by Dr. Hough, his predecessor Professor Blake and maintained by Dr. Goffreda has been distributed to breeders worldwide. This sharing has indeed had a world wide impact on the development of new fruit varieties. Dr. David Byrne at Texas A&M was trained at Rutgers, Dr. David Ramming of California and Dr. Connie Feliciano of Brazil were all trained at Rutgers and the varieties of stone fruit and grapes in California Texas, Mexico and Central America. Many of these have lower chilling varieties that have expanded peach cultivar establishment and if we were to continue to have changes in our climate we may see more of these grown in the Middle Atlantic.

Jerry looking at flat white peaches in Bergan, Norway.

Dr. Hough turned his fireblight resistant germplasm collection over to the USDA in Kerneysville, WV. Many new European pear cultivars have been released from the USDA program in recent years by Dr. Richard Bell some with fireblight resistance and some with psylla resistance.

Dr. Hough and Bailey introduced the peach variety Blake in the 1950's which is still planted and was for many years a major peach variety in South Carolina and the southeast in the big peach growing areas. It was also planted in New Jersey. Of course there were hundreds of varieties before and after this that were grown. In the early 1960 the peach variety Sunhigh was a standard for flavor and quality and is still grown for local sales today. Jerseyqueen was a popular variety introduced in the 1960's and is still grown. Encore was a peach I selected and bought in 1974 from Drs. Hough and Bailey in the Rutgers program when I was Director of Research and Product Development at Stark Bros. Nurseries in Missouri. It was and is widely grown throughout the Midwestern US because of it ability to withstand cold winters. During the last tree fruit survey done in 1999 in New Jersey Encore was the number one peach in the state but since late maturing peaches have lost favor and is not planted much today but may still be in the top 15 in production.

At that same time, I bought the variety Saturn for Stark Bros for home garden sales because of its novel (flat or bagel) shape and exquisite flavor. An enterprising grower and marketer in California started promoting it as a donut peach and trademarked the name. The variety is widely marketed in super markets as a Donut peach because of the freedom of the small pit which pops out and people can eat it like a doughnut. Practically every grower in NJ grows Saturn or the variety Galaxy which is later and larger. Galaxy is an offspring of Saturn.

Dr. Goffreda has introduced other flat or donut like peaches with Adams County. One called TangOs I has made quite an impact in California. I could go on and on about Rutgers Peach, Nectarine and Apricot varieties that I have seen and evaluated all over the US and world including Canada. The recently introduced variety Desiree is very popular in Ontario and the peach varieties Gloria and Messina are doing well and planted all over the eastern peach areas. There are many new and novel

Gloria Peach –Tested as NJ351 – Mid-season yellow peach (+25) resistant to bac spot.

peaches and apricots being developed by Dr. Goffreda and will be introduced by Adams County Nursery. Six are being patented this year and 5 were introduced in 2014 that included Silvergem, low acid white fleshed nectarine, Avalon yellow fleshed nectarine, Scarlet Rose slow ripening cream red fleshed peach: July Rose low acid white fleshed peach and August Rose a late mid season low acid white fleshed peach. These new varieties are both somewhat novel and with withstand the climate changes of the next 10-15 years.

Not to be overlooked is the apple breeding program. Dr. Goffreda has some exciting new varieties of apples that will be introduced. In 1947 Dr. Hough identified a gene in crab apples that had resistance to the major apple disease called apple scab. That variety with the gene has been carefully selected and crossed with many other apples and today there are varieties with immunity and resistance to apple scab that have been introduced through the PRI breeding program; the Purdue University, Rutgers and the University of Illinois.

The Vf gene has been incorporated in a series apples have been introduced including the most popular Red Free, Enterprise, Goldrush and Crimson Crisp. I am sitting here eating a Goldrush, my favorite winter apples, as I write this.

Many of the other scab immune apples have these cooperative Rutgers varieties in their parentage developed all over the world. Jerseyred was the first apple developed at Rutgers and when I came to NJ in 1981 to work on the Rutgers faculty it was the number one processing apple for slicing and whole canned apples, Britemac tested as NJ 3 looks like a McIntosh and was a favorite of north Jersey Orchardists.

This industry has disappeared. An apple introduced shortly before I worked in the apple program in the 1960 was Mollies Delicious and late summer early fall apple is still planted for its late season flavor. Suncrisp tested as NJ55 is also very popular today in the northeast and in British Columbia. It is a late season yellow skinned apple with great storage quality

I will close by saying one of the best pieces of fruit I have ever eating in 50 years of evaluations is a white fleshed apricot called Sugar Pearls, recently introduced by Dr. Goffreda. Dr. Goffreda continues to work with apricots and has many promising advanced selections. Early Blush and Orangered are two of his yellow fleshed introductions

I am sure all of the people I have mentioned could more information on the fantastic program that has meant so much to the Eastern fruit industry.

Jerry is a Professor Emeritus from Rutgers University and a consultant for Adams County Nursery. He can be reached at Jerry@acnursery.com. Win is private consultant, owner of Win Enterprises International, LLC. He can be reached at wincowgill@mac.com and http://wincowgill.com. Joe Gofredda can be reached at Rutgers University goffreda@aesop.rutgers.edu.

University of Massachusetts Amherst Fruit IPM Report for 2016

Daniel Cooley, Arthur Tuttle, Jon Clements, Sonia Schloemann, and Elizabeth Garofalo
University of Massachusetts

Diseases

Apple scab -- there were 7 primary apple scab infection periods according to NEWA (http://newa.cornell.edu) at the UMass Orchard with 100% ascospore maturity occurring on 23-May. Research at UMass suggests that ascospore maturity was delayed beyond 23-May, and there was one additional primary infection event in early June. Scab was quite manageable by most, however, an exception or two was noted. In addition to the apple scab model being available on 48 NEWA sites in Massachusetts, there were 4 RIMpro (http://www.rimpro.eu/) sites using either NEWA weather data or Meteoblue, plus 9 experimental RIMpro sites using HRDPS. There were also 6 AgRadar (http://agradar.info) locations available. All DSS's (Decision Support Systems) provide valuable IPM decision support through the use of apple scab, fire blight and insect models, among others.

Fire blight -- while bloom was a long, drawn out affair for most of the state, drought conditions prevailed through most of this time creating conditions that were not particularly favorable for FB, except very late in the bloom period. Some strikes were found here and there, but seriously a pretty much a "no-show" in 2016. Orchards with a previous recent history of fire blight saw more strikes. FB will be back in force we are afraid one of these years, largely a consequence of earlier bloom combined with warmer early spring temperatures.

Rust diseases -- Cedar apple rust lesions were prevalent on foliage in orchards where fungicide management was not sufficient to arrest this disease; fortunately, there was little fruit infection.

Summer diseases -- sooty blotch/fly speck/fruit rots were definitively hampered by the dry weather in late summer. Really not much news to report here, we suspect minimal summer fungicide sprays were necessary. Golden Delicious trees in at least one orchard were seriously afflicted by necrotic leaf blotch.

Peach leaf curl -- With a total crop loss throughout the entire state, not many people were thinking about pesticide applications in peaches this year. As a result peach leaf curl was seen in several orchards.

Powdery mildew -- not a bad year, although some was certainly observed (in Honeycrisp in particular); growers need to be sure to include a PM-effective fungicide (SDHI's in particular, or sulfur) every year beginning at pink bud stage.

White pine blister rust on 'immune' black currant cv 'Titania'. *Cronartium ribicola* was found in Massachusetts on the black currant cultivar 'Titania', which has been considered to be immune to this disease. A breakdown of this immunity was first reported in a limited number of plants in Connecticut in 2008. See here for more information on this. Since that time, incidence have increased in CT but *C. ribicola* infection of 'Titania' had not appeared in MA until 2014 and then again this year. There has not been a reported increase of the disease on White Pine trees, the alternate host.

Insects

San Jose scale -- we are seeing ongoing issues with SJS. Softer insecticide use (aka Assail) may be contributing to this and/or warmer winters. (Or a decline in spring oil/Lorsban applications.) Aggressive management, including a good dose of spring oil (with or without Lorsban, depending on your inclinations), and effective insecticides such as Esteem, Centaur, and Movento/Sivanto are being recommended.

Plum curculio -- an early influx of PC with warm and wet conditions (on or about 24-May and the days after) caught some growers off-guard as fruit were only 5-6 mm in size and significant damage resulted here and there. Overall it was a pretty high-pressure year for plum curculio, but still easy to control with timely effective insecticide application. (Emphasis on timely and effective. And Imidan.)

European apple sawfly -- Yet another one of those pests that is usually well managed by a petal fall (or pre-bloom) spray that was dicey to get on this year due to the prolonged bloom period. Above average EAS activity and damage was noted this year.

Lepidoptera moths/worms -- despite significant pheromone trap catches, little damage observed from these worms. Some growers are effectively controlling these leps either with targeted sprays (of Delegate, or Altacor among others) where a known, historical problem exists or they are still being effectively controlled by insecticides (Imidan, Assail) targeting other pests (like plum curculio). The lack of a peach crop made Oriental Fruit Moth control less urgent, but late-season tip injury to peach trees was noted. (Although no shoot tip invasion was to be found earlier in the year.) Just in -- reports of either codling moth or Oriental fruit moth damage to harvested fruit are increasing.

Mites -- dry weather favored mites, most likely both European red mite (ERM) and two spotted spider mite (TSSM). Spot or whole orchard treatments with miticides became necessary, however, with some control failures. One report of significant damage to pear foliage by TSSM. Rust mites on apple foliage were also documented in late July, they may be an under-rated problem on some susceptible varieties, however, generally don't warrant treatment.

Gypsy moth -- caterpillars were observed in young trees and treatment was needed; by late-summer, gypsy moth adults were being caught in pheromone traps (for other moths) in at least one orchard, however, no damage reported; anecdotal report of complete defoliation of small/organic orchard in south-central MA by GM; young plantings, which are often not sprayed with insecticide, will need to be monitored in 2017 if GM has another banner year.

Spotted tentiform leafminer -- only a problem in a few orchards, however, letting it get out of hand can cause pre-harvest drop and some tree health issues. Monitor flight(s) beginning in April, and treat the sap-feeding mines with effective insecticide(s) applied according to degree-day model and scouting for mines. Foliar urea applications and leaf chopping will go a long way to reducing the pupae overwintering in orchard leaf litter.

Apple maggot fly -- surprisingly heavy pressure given the dry weather. Still generally easily controlled. A Delicious tree near an abandoned orchard was really hammered. Growers are advised to monitor AMF populations through the use of sticky traps to ascertain if and when treatment is necessary.

Pear psylla -- we have had to become better managers of this pest where pear growers continue to have issues. Spring and summer oil applications are your best friend here, followed by applications of Centaur, Movento/Sivanto, etc. Conventional insecticide resistance is likely, and many generations/overlapping life stages makes pear psylla a tough one to master. Aggressive management, use of effective

insecticides (lead by oil), and timeliness of insecticide applications are the only effective approach, but well worth it to clean up this sticky (literally) situation.

Winter moth – Warm weather in early spring prompted concern about early emergence of Winter Moth in 2016. In the end, emergence was approximately 'normal' in early April, coinciding with the April 4-6 freeze temperatures. These cold temperatures did not, however, have a noticeable impact on caterpillar survival. Damage reports from Winter Moth varied among blueberry growers with some achieving good control with timely oil/insecticide applications and others suffering significant losses. This continues to be a difficult pest to manage. We published 9 Massachusetts IPM Berry Blasts (often in collaboration with Heather Faubert in RI) with information about winter moth.

Spotted wing drosophila (SWD) – Early reports from Pennsylvania and Ontario prompted worries about an early onset of SWD in New England. We monitored SWD emergence with a trapping network of 9 locations around the state. Traps were monitored weekly in most cases. First capture occurred on 7/8 but sustained captures did not occur until 7/18. Population levels seemed to remain relatively low through August. Drought conditions that prevailed during this time seemed to suppress population development. Primocane fruiting raspberries and blackberries continue to be the most significantly impacted. Late season blueberries are also affected. Wine and table grapes have mixed reports with the main issue coming where fruit damage has occurred from either bird depredation or fruit cracking following sudden rainfall. Modifying the crop canopy to allow for open air-flow and light penetration to the base of the plants has been recognized by growers as a critical component to successful SWD management. Seven issues of Massachusetts IPM Berry Blast contained information on pest status and management recommendations.

Horticulture

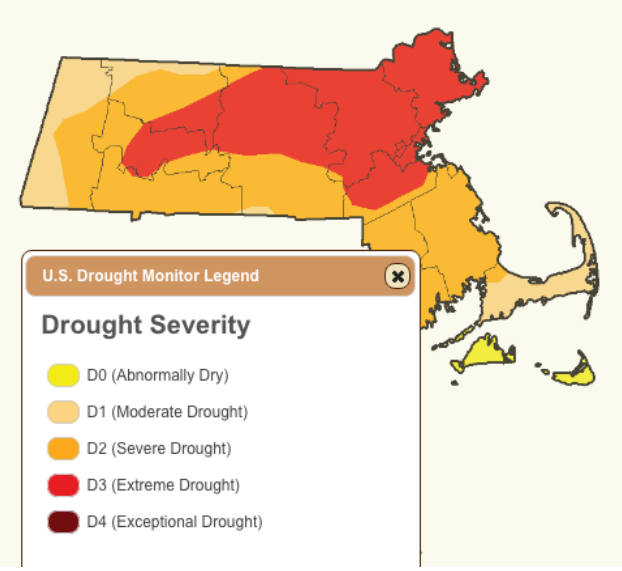
April freeze -- which occurred at early green tip clearly damaged flower buds, resulting in significant variability in bloom, fruit set, and crop load largely depending on location; some orchards ended up with a very minimal crop whereas some were close to "average." Keep in mind a lighter crop was likely in 2016 following a heavy apple crop in 2015. Bloom

was extended and flower buds were showing crinkled spur leaves and flower petals, thus significant damage; somewhat surprisingly, fruit set was remarkably good for some varieties like Honeycrisp and Macoun, whereas some McIntosh blocks appeared to be in trouble. A pretty much non-aggressive approach to chemical thinning was common, however, in retrospect it would have been advised to do more chemical thinning as fruit was clustered and in some cases heavily set; hand thinning was necessary, but not always done.

Blueberry and raspberry buds were affected. The impact on yield was less than feared. Some varieties of blueberry were more heavily impacted than others. Impact on raspberries was varied depending on location and variety. Overall, the summer crop of raspberries was good.

Weeds -- maintaining effective weed management throughout the growing season is a critical piece to keeping your orchard healthy. A weed free strip in row and well mowed aisles will not only reduce competition between weeds and crop plants but will reduce safe harbors for voles and many insect pests. This practice can also help reduce pesticide exposure for pollinators, provided weeds are prevented from blooming in the orchard when insecticide sprays are made.

Drought -- at this point in the season, just over 50% of Massachusetts is in a state of extreme drought (90% in severe drought). Compared to the precipitation average of the last five years in Belchertown, as of September 28, we are down about 10" of rain this year. This has caused many issues in the orchard from weeds

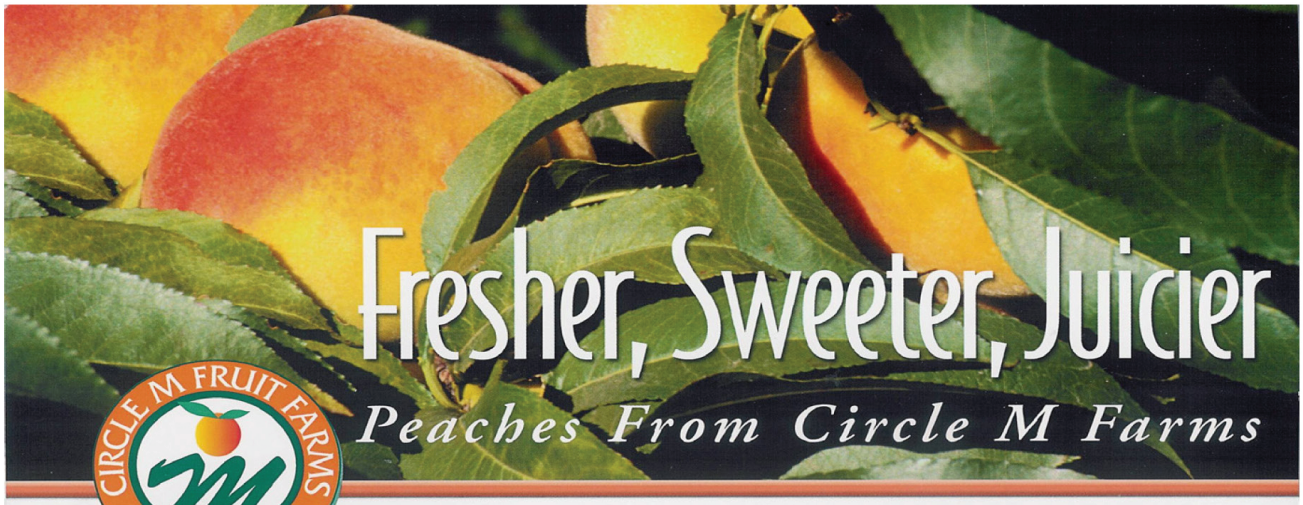


that are less susceptible to herbicides to uneven fruit sizing. Short of beefing up your irrigation systems (and maybe a rain dance) there is not much that can be done about this. Well, except the fact Massachusetts has been declared a primary disaster area because of the drought by USDA and there are numerous state and federal low/no interest loan programs available to farmers who need financial assistance. Let us know if you have trouble finding those programs.

Other

Northeast Regional Berry Call-in: we participated in the weekly Berry Call in conference calls organized by Cornell University which brought together Extension and Industry and Growers from the Northeast (PA to Ontario) to discuss current observations and timely topics together. These calls are extremely useful for problem solving and general awareness of growing conditions and challenges. Calls started in mid-April and ran through July.

IPM Fact Sheets – two new IPM fact sheets were published in 2016, Blueberry IPM – Cherry/Cranberry Fruitworm and Strawberry IPM – Tarnished Plant Bug. More are planned for 2017.



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