Precision Chemical Thinning in 2017 for Gala and Honeycrisp

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As a new season is approaching it is time to set up your precision thinning program. Precision thinning is a strategy to increase the efficacy of chemical thinning.

The apples are the most important fruit crop in New York. The New York State is the second most important apple producing state in the United State. Over the last 40 and 50 years, particular in the last 15, NY apple growers have re-invested huge sums of money into new model high density orchards. In addition to this they have invested in new varieties, varieties that command higher price in the market place, like Gala and Honeycrisp. Over the years Terence Robinson has helped fruit growers manage an important aspect to apple orchard management called crop load - meaning managing the number of fruit on the tree. This particular aspect has a large economic impact on the returns the growers get from a particular acre of apples. If they do a very good job and every apple is perfect and they have a high yield and perfect apple that could mean a gross income of about $15,000 per acre. Growers spend a lot of time trying to manage the crop load on the tree, primarily by the application of plant growth regulator chemicals. Unfortunately, this process is not perfect and has a considerable maneuverability built into it: growers can either make or break their crop with this one effort.

Since 2000, Terence Robinson began working with Alan Lakso to try to explain this variability in thinning from the chemicals we get year to year. Alan developed a model that is based on environmental factors, mainly temperature and sunlight. It allows us to calculate for each day of the year how much carbohydrate or photosynthesis the tree has produced.

If we know how much carbohydrate the tree produced and know when it is not producing enough we can predict chemical thinning. Through this model it was possible to show by doing field studies with chemical thinning that in periods of the year when there was too low carbohydrate produced we got excessive thinning. Then, next goal was to make this model available for fruit growers through the Internet to know when they should be applying chemicals and they should not.

As this project progressed our group developed the precision crop load management. It was built into three aspects: 1) pruning - to manage the number of fruit on the tree, 2) chemical thinning, and 3) hand thinning - to finish the job.

General pruning is done to try to manage the shape of the tree, however a new aspect of pruning is to manage the number of flower buds on that tree. So, we developed a specific stepwise protocol for fruit growers - to select five representative trees in their orchard, to count the number of flower buds on that tree and then determine the number of flower number should remain. The target number is a calculated number based upon the desired yield for that orchard and the desired fruit size. That can be determined somewhat by experience with that orchard in the past, but in general high density orchards can produce somewhere around 1,500 bushels to the acre. If the grower has a desired fruit size such as 100 count fruit it is a simple mathematical calculation to finally to come up with the number of fruit that tree should have at harvest.

After calculating the desired number of fruit on the tree we then incorporate an ensure factor and leave additional buds as insurance buds. The factor we have been recommending is 1.5 to 1.8.

With that step accomplished the fruit growers then prepare for the second process of precision crop load management and that begins when the trees are flowering and for the next three weeks after full bloom. This step is called as precision chemical thinning. One of our studies has

shown that when growers do not do the previous step of reducing the number of flowers bud through pruning it is very difficult to accomplish our target with chemical thinning.

This process precision chemical thinning also incorporates several simple steps. The first is to have a target fruit number in mind and have also an initial flower bud number in mind. This requires the fruit grower to count five representative trees after pruning and know the number of flower buds on those five trees. Since each flower bud has five flowers it is simple to calculate the potential number of fruitlets to start with. Our process is very specific and we try to help growers have confidence when to apply chemical thinners or when not to apply.

Each day when the grower has planned to put on one of these chemical sprays he would login into the Newa website and follow the steps. Then a recommendation would then come up for him whether he should apply a full dose that day or reduce the concentration to avoid over thinning situations.

For this second step we use a separate model called fruit growth rate model that requires more effort. It requires growers to go out and tag some spurs, and then measure the diameter of the little fruitlets in each spur twice – one exactly three days after application and secondly eight days after application. With those two measurements this model can estimate how many of those fruitlets are still growing and how many are not growing. Those that are not growing we categorize as being the ones that will fall off in about one week. For those that are still growing fast we categorize as the ones will persist and continue to grow. With this process the growers can have confidence if he is going to get close to the target fruit number.

We hope to continue to improve these two models and our protocol on how to manage crop load such that we can avoid any over thinning.

The protocol incorporates a third step and that is precision hand thinning. If things go well in precision pruning and precision chemical thinning what would be left is a relative small job of hand thinning. If we couple that small job to the new high-density orchard system, the job can be done relatively quickly with low labor cost but relatively precisely. Through these process growers can end up with a value of the crop close to $15,000 per acre.

The whole concept precision orchard management involves a substantial amount of effort. Sometimes fruit growers have viewed this as a too complex or too much work even knowing that the dollars involved are so large that justify this intensive effort to manage crop load in a very precise manner.

Among the technologies invented in the past few decades, smartphones have gained large market shares among various user sectors due to their usefulness, ease-of-use, and affordability. So, in 2017 we are starting a new project that will focus on the development of a more innovative, faster and easy-to-use tool for growers: an in-field data collection app using Bluetooth wireless caliper for fruit measurement. The project has been funded by the New York Farm Viability Institute to attend growers demand on managing their orchards more efficiently and effectively. This tool will replace paper and pencil data collection requiring two people with one person using the wireless caliper and smartphone app; in addition, it will eliminate the need to enter data into a computer spreadsheet; the app will auto-calculate a result that will advise the grower if their thinning application is working or not, therefore either saving or requiring another chemical thinner application.

2017 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 on each tree (the earlier you count the better to see the clusters).

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

5 - 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.

6 - 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 twice the same fruitlet within the cluster. Each cluster has to be numbered (1 to 15) and the measurements (fruit diameter) from that cluster have to be correspondent to that cluster. We recommend you to buy a caliper with a dial read-out in millimeters to take the measurements.

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

8 - 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. 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.

9 - 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.

11 – 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 Poli Francescatto (pf246@cornell.edu) copying your regional cooperative extension agent:

- Anna Wallis (aew232@cornell.edu)
- Craig J. Kahlke (cjk37@cornell.edu)
- Dan Donahue (djd13@cornell.edu)
- Mario Miranda Sazo (mrm67@cornell.edu)

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 Poli Francescatto, Anna Wallis, Craig Kahlke, Dan Donahue or Mario Miranda Sazo of the Cornell Cooperative Extension Eastern New York Commercial Horticulture Program if you would like to 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.
- If the fruit is not round please try to ALWAYS measure the largest size of the fruit.
- And make sure you are writing the measurements in the right position (tree and cluster) in the datasheet provided. The fruitlets within each cluster do not need to be in order.
- If you opt for not marking the fruitlets, please make sure you will not measure the same fruitlet twice at the same day.

Spray and Timing Options for Precision Thinning of MATURE Gala:

Option 1	Option 2
Apply a Bloom Spray NAA (4oz/100=8oz/acre if you adopt the TRV method – see below)	
Apply a Petal Fall Spray (5mm) NAA (3oz/100=6oz/acre) + Sevin (1pt/100=2pt/acre)	**Apply a Petal Fall Spray (5mm)** NAA (3oz/100=6oz/acre) + Sevin (1pt/100=2pt/acre)
Apply a 12 mm Spray Maxcel (48oz/100=96oz/acre) + Sevin (1pt/100=2pt/acre)	**Apply a 12 mm Spray** Maxcel (48oz/100=96oz/acre) + Sevin (1pt/100=2pt/acre)
Apply an 18 mm spray (if needed) Maxcel (48oz/100=96oz/acre) + Sevin (1pt/100=2pt/acre) + Oil (1pt/100gal water) **don't concentrate oil** (directed to the upper part of the tree)	**Apply an 18 mm spray (if needed)** Maxcel (48oz/100=96oz/acre) + Sevin (1pt/100=2pt/acre + 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=8oz/acre if you adopt the TRV method – see below)	
Apply a Petal Fall Spray (5mm) NAA (4oz/100=8oz/acre) + Sevin (1pt/100=2pt/acre)	**Apply a Petal Fall Spray (5mm)** NAA (4oz/100=8oz/acre) + Sevin (1pt/100=2pt/acre)
Apply a 12 mm Spray NAA (3oz/100=6oz/acre) + Sevin (1pt/100=2pt/acre)	**Apply a 12 mm Spray** NAA (3oz/100=6oz/acre) + Sevin (1pt/100=2pt/acre)
Apply an 18 mm spray (if needed) Sevin (1pt/100=2pt/acre) + 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=2pt/acre) + 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

• 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)