Northern NY Agricultural Development Program
2023 Project Report

Evaluating the New Apple Thinning Material "Accede" Under Northern New York Thinning Conditions

Project Leader
Michael Basedow, Cornell Cooperative Extension Eastern NY Commercial Horticulture Program, 6064 Route 22 Ste. 5, Plattsburgh, NY, 12901, 518-410-6823, mrb254@cornell.edu

Collaborators
- Dr. Terence Robinson, Cornell University, Geneva, NY
- Chazy Orchards, Chazy, NY
- Forrence Orchards, Peru, NY
- Gunnison Lakeshore Orchards, Crown Point, NY

Background
Apple crop load management is the single most important management practice affecting an orchard's crop value. Growers must balance between reducing crop load (yield) sufficiently to achieve optimum fruit size and return bloom in the following year. For each variety, there is an optimum number of fruit per tree where yield, fruit size, and fruit quality are balanced to bring the greatest economic return to the grower.

In Northern NY, most crop load management is performed by thinning trees when fruit are between 10-12mm in size following the petal fall period. Thinning at this timing relies primarily on the use of hormone-based plant growth regulator materials, such as NAA and 6-BA, and carbaryl, an insecticide that also acts as a mild fruit thinner. Once fruit grow larger than 15mm, their response to these chemical thinners becomes greatly reduced. Thinning at the 12mm timing is particularly challenging in Northern New York, as hormone thinners' level of activity is heavily driven by the temperature. Thinners tend to work poorly under cool, sunny conditions, which we once again had during the thinning window in May 2022. As a result, many orchards were overcropped in the Champlain Valley in 2022, reducing their crop value.

Where orchards require more thinning after the 12mm application, there have generally been only two options available. The first was to apply 6-BA and carbaryl along with oil. The oil helps the plants take up more of the thinning materials. However, many northern

New York growers do not like to use this approach, as oil applications interfere with their fungicide materials that they are also using at this time of year. The other option has been Ethephon, which is an ethylene based thinning material. Few Northern New York growers use this product for thinning, because it is also extremely temperature sensitive. If the weather is too warm at the time of application, growers are at great risk of removing all the fruit from their trees.

Once fruit grow larger than 24mm, fruit become unresponsive to chemical thinners. Where additional thinning is still necessary, growers will send crews through to hand thin the crop. However, hand thinning fruit takes a great deal of hand labor time, and high labor costs in NY make it prohibitively expensive for some growers to send crews through to do much hand thinning.

Recently, Valent Biosciences released a new thinning material called Accede. Accede's active ingredient is 1-Aminocyclopropane 1-Carboxylic Acid (ACC), which is the direct precursor of the plant hormone ethylene. It has a similar mode of action as Ethephon, but its efficacy is reported to be less sensitive to temperature swings, which should make it a more reliable material to use during the 15-20mm "rescue thinning" window.

Having a feasible rescue thinning material would be particularly valuable in Northern New York apple production, as growers across the region had poor thinning results with some hormone-based thinners in 2018, 2019, 2020, and 2022. This caused small fruit size in some varieties like Gala, and led to poor return bloom in 2019 and 2021 on their Honeycrisp trees, one of Northern New York's most valuable apple varieties.

Accede has been field-tested in other regions but only on a very small trial basis, and until this NNYADP-funded trial had not yet been tested in Northern New York. As previously mentioned, Northern New York often has cooler temperatures during the thinning windows relative to other regions of New York, making it therefore critical to evaluate this material in NNY orchards, even on a small-scale basis, before we recommend its use to growers at a commercial scale.

Having an effective late season "rescue" thinning material will bolster the profitability of Northern NY apple growers by allowing fruit growers to achieve optimum crop loads to maximize their fruit yield and quality, while reducing the amount of labor needed to hand thin the crop.

Methods

We established three replicated field trials in commercial orchards in Northern New York: (1) a Gala trial at Chazy Orchards, (2) a Honeycrisp trial at Forrence Orchards, and (3) a Macoun trial at Forrence Orchards. These three varieties are widely planted across Northern New York and are difficult to thin. Honeycrisp is also the most valuable variety grown in Northern New York.

Chazy Orchards: Gala Variety Trial

Our Gala experiment consisted of a block of Buckeye Gala on M.9-337, initially planted in 2013 at 3x14-foot spacing. We selected 10 trees in April 2023 (five

replications of two trees) within the orchard to receive one of four thinning treatments at bloom (Table 1).

Treatment	Petal fall Whole tree	10-12mm 75% top of tree	20mm 80% to upper 2/3 of tree
1	7.5ppm NAA + 100ppm Maxcel	7.5ppm NAA + 100ppm Maxcel	
2	7.5ppm NAA + 100ppm Maxcel		400ppm Accede + Regulaid
3		7.5ppm NAA + 100ppm Maxcel	400ppm Accede + Regulaid
4	7.5ppm NAA + 100ppm Maxcel	7.5ppm NAA + 100ppm Maxcel	400ppm Accede + Regulaid

Table 1. Thinning treatments, Gala trial, Chazy Orchards, Chazy NY; NNYADP Evaluating the New Apple Thinning Material "Accede" Under Northern New York Thinning Conditions, 2023.

Working with the grower, we determined the target crop load for the block was 125 fruit per tree.

On May 27, 2023, Treatments 1, 2, and 4 received a petal fall application of Pomaxa (an NAA product) at the rate of 3 fl oz. per 100 gallons dilute tree row volume (TRV) and Maxcel (a 6-BA product) at the rate of 64 fl oz per 100 gallons dilute TRV.

On June 5, Treatments 1, 3, and 4 received a 12mm application of Pomaxa at the rate of 3 fl oz. per 100 gallons dilute tree row volume (TRV) and Maxcel at the rate of 64 fl oz per 100 gallons dilute TRV.

On June 11, Treatments 2, 3, and 4 received a 20mm application of Accede at the rate of 13.4 oz Accede and 16 fl oz Regulaid (a surfactant) per 100 gallons.

All thinner applications were applied with the grower's airblast sprayer, calibrated to deliver 100 GPA. We estimated tree TRV at 188 GPA, using a concentration factor of 1.9. We concentrated thinners for the petal fall and 12mm applications. The rate was not concentrated up for the 20mm applications.

Fruit were harvested on October 4 and 5, 2023. As fruit were harvested, we recorded the total fruit count and fruit weight per tree. From these measurements, average fruit size per tree was also tabulated. A subsample of 50 fruit per treatment will be shipped to Dr. Terence Robinson at Cornell AgriTech in Geneva, New York, and will be sorted over a color and size grader. These data will then be used to tabulate % color, russet, and total crop value per acre of each treatment. Due to a storage error, we were unable to get these fruit to Geneva prior to the writing of this report.

Return bloom data will be assessed in May of 2024.

Forrence Orchards: Honeycrisp Trial
Our Honeycrisp experiment consisted of a block of Cameron Select Honeycrisp on G.935 rootstock, initially planted in 2016 at 4x16-foot spacing. We selected 10 trees in April 2023 (five replications of two trees) within the orchard to receive one of four thinning treatments at bloom (Table 2).

Treatment	Bloom Whole tree	Petal fall Whole tree	10-12mm 75% top of tree	20mm 80% to upper 2/3 of tree
1	2 x 2.5% ATS			
2	2 x 2.5% ATS			400ppm Accede + Regulaid
3	2 x 2.5% ATS		1 pt Carbaryl / 100	
4	2 x 2.5% ATS		1 pt Carbaryl / 100	400ppm Accede + Regulaid

Table 2. Thinning treatments, Honeycrisp trial, Forrence Orchards, Peru NY; NNYADP Evaluating the New Apple Thinning Material "Accede" Under Northern New York Thinning Conditions, 2023.

Working with the grower, we determined the target crop load for the block was 108 fruit per tree.

On May 13, 2023, all treatments received a bloom application of ammonium thiosulfate (ATS) at the rate of 2.5 gallons per 100 gallons of water. A second application was applied on May 15.

Due to a frost that occurred on May 18, the grower elected not to apply any thinners at petal fall this season.

On June 6, treatments 3 and 4 received a 12mm application of carbaryl at the rate of 1 pt per 100 gallons.

On June 11, treatments 2 and 4 received a 20mm application of Accede at the rate of 13.4 oz Accede and 16 fl oz Regulaid per 100 gallons. This application was applied at 100 gallons per acre of water to the acre.

All thinner applications were applied with the grower's airblast sprayer, calibrated to deliver 80 GPA. We estimated tree TRV at 135 GPA, using a concentration factor of 1.7. Rates were not concentrated up for any of the applications.

Fruit were harvested according to red color development over the following dates: September 6, September 15, September 22, September 29, October 6, 2023. As fruit were harvested, we recorded the total fruit count and fruit weight per tree. From these measurements, average fruit size per tree was also tabulated. A subsample of 50 fruit per treatment was shipped to Dr. Terence Robinson at Cornell AgriTech in Geneva, New York, and were sorted over a color and size grader. Fruit were also rated for the percent of

russeted fruit. These data were then used to tabulate total crop value per acre of each treatment.

Return bloom data will be assessed in May of 2024.

Forrence Orchards: Macoun Trial

Our Macoun experiment consisted of a block of Macoun on M.26 rootstock, initially planted in 2005 at 6x14-foot spacing. We selected 10 trees in April 2023 (five replications of two trees) within the orchard to receive one of four thinning treatments at bloom (Table 2).

Treatment	Bloom Whole tree	Petal fall Whole tree	10-12mm 75% top of tree	20mm 80% to upper 2/3 of tree
1	2 x 2.5% ATS			
2	2 x 2.5% ATS			400ppm Accede + Regulaid
3	2 x 2.5% ATS		1 pt Carbaryl / 100	
4	2 x 2.5% ATS		1 pt Carbaryl / 100	400ppm Accede + Regulaid

Table 3. Thinning treatments, Macoun trial, Forrence Orchards, Peru NY; NNYADP Evaluating the New Apple Thinning Material "Accede" Under Northern New York Thinning Conditions, 2023.

Working with the grower, we determined the target crop load for the block was 132 fruit per tree.

On May 12, 2023, all treatments received a bloom application of ATS at the rate of 2.5 gallons per 100 gallons of water. A second application was applied on May 14.

Due to a frost that occurred on May 18, the grower elected not to apply any thinners at petal fall this season.

On June 3, treatments 3 and 4 received a 12mm application of carbaryl at the rate of 1 pt per 100 gallons.

On June 11, treatments 2 and 4 received a 20mm application of Accede at the rate of 13.4 oz Accede and 16 fl oz Regulaid per 100 gallons. This application was applied at 100 gallons per acre of water to the acre.

All thinner applications were applied with the grower's airblast sprayer, calibrated to deliver 80 GPA. We estimated tree TRV at 160 GPA, using a concentration factor of 2.0. Rates were not concentrated up for any of the applications.

Fruit were harvested on October 3. As fruit were harvested, we recorded the total fruit count and fruit weight per tree. From these measurements, average fruit size per tree was also tabulated. A subsample of 50 fruit per treatment was shipped to Dr. Terence Robinson

at Cornell AgriTech in Geneva, New York, and were sorted over a color and size grader. Fruit were also rated for the percent of russeted fruit. These data were then used to tabulate total crop value per acre of each treatment.

Return bloom data will be assessed in May of 2024.

Gunnison Orchards: Gala Trial
On May 11, 2023, a demonstration trial was set up on a mature block of Gala at Gunnison's Orchard in Crown Point. However, the orchard was hit severely by the frost event on the morning of May 18. At which point, the owner decided to discontinue the study, as he was very concerned that he was not going to have fruit in the orchard.

Statistical Analysis
Treatment differences in number of fruit per tree, yield per tree (kg), and fruit size (kg) were analyzed in JMP statistical software using the fit model function for our Gala trial. Where the model determined significant treatment differences, differences between individual treatments were assessed using Tukey's Honest Significance Test in JMP statistical software.

Treatment differences in number of fruit per tree, yield per tree (kg), fruit size (kg), russeting, fruit color, and crop value were analyzed in SAS statistical software using the Generalized Linear Model (GLM) procedure. Two reps from our Macoun trial were removed from the data analysis, as we saw freeze damage in treatments 4 and 5 that impacted treatment 1 more than treatments 2, 3, and 4. Where the model determined significant treatment differences, differences between individual treatments were assessed using Duncan's Multiple Range Test in SAS statistical software.

Results

Chazy Orchards: Gala
We did not observe any significant differences in total fruit per tree at harvest (p=.0894). While our target crop load for this block was 120 fruit per tree:

- Treatment 1 averaged 209 fruit per tree,
- Treatment 2 averaged 183 fruit per tree,
- Treatment 3 averaged 209 fruit per tree, and
- Treatment 4 averaged 140 fruit per tree.

Yield per tree did not differ significantly between treatments (p=0.291). Yield per tree averaged:

- 26.50 kg in Treatment 1,
- 25.50 kg in Treatment 2,
- 27.90 kg in Treatment 3, and
- 21.10 kg in Treatment 4.

Average fruit size significantly differed between treatments (p=0.0005). Fruit size averaged:

- 0.13 kg in Treatment 1
- 0.14 kg in Treatment 2
- 0.13 kg in Treatment 3, and
- 0.15 kg in Treatment 4.

Gala					
Treatment	Applications	# Fruit Per Tree	Yield Per Tree (kg)	Fruit Size (kg)	Fruit Per Bushel
1	Petal Fall + 12mm	209	26.50	0.13 B	147
2	Petal Fall + 20mm	183	25.50	0.14 B	138
3	12mm + 20mm	209	27.90	0.13 B	143
4	PF + 12mm + 20mm	140	21.10	0.15 A	125
P-value		0.0894	0.2910	0.0005	

Table 4. Harvest data from the Chazy Orchards Gala trial. Differing letters show statistically significant differences between treatments at p value < 0.05; Evaluating the New Apple Thinning Material "Accede" Under Northern New York Thinning Conditions, 2023.

Forrence Orchards: Honeycrisp

We did not observe any significant differences in total fruit per tree at harvest (p=0.4260). While our target crop load for this block was 108 fruit per tree:

- Treatment 1 averaged 197 fruit per tree,
- Treatment 2 averaged 182 fruit per tree,
- Treatment 3 averaged 165 fruit per tree, and
- Treatment 4 averaged 159 fruit per tree.

Yield per tree did not significantly different in our trial (p=0.2660). Yield per tree averaged:

- 34.73 kg in Treatment 1,
- 33.56 kg in Treatment 2,
- 29.61 kg in Treatment 3, and
- 29.40 kg in Treatment 4.

Average fruit size did not significantly different in our trial (p=0.8733). Fruit size per tree averaged:

- 0.18 kg in Treatment 1,
- 0.19 kg in Treatment 2,
- 0.19 kg in Treatment 3, and
- 0.19 kg in Treatment 4.

Fruit color significantly differed between treatments (p=0.0131). Fruit percent color averaged:

- 39% in Treatment 1,
- 47% in Treatment 2,
- 48% in Treatment 3, and
- 50% in Treatment 4.

Crop values did not significantly differ between bloom thinning treatments (p=0.4477) Taking into account the yield, fruit quality, and russeting data, we estimated the value of the crop in:

- Treatment 1 as $17,607 per acre,
- Treatment 2 as $22,557 per acre,
- Treatment 3 as $19,300 per acre, and
- Treatment 4 as $21,383 per acre.

Honeycrisp								
Treatment	Applications	# Fruit Per Tree	Yield Per Tree (kg)	Fruit Size (kg)	Fruit Per Bushel	Fruit Color (%)	Russet Free Fruit (%)	Crop Value Per Acre ($)
1	Bloom	197	34.73	0.18	108	39 b	86	17607
2	Bloom, 20mm	182	33.56	0.19	102	47 a	91	22557
3	Bloom, 12mm	165	29.61	0.19	103	48 a	88	19300
4	Bloom, 12mm, 20mm	159	29.40	0.19	102	50 a	90	21383
P-Value		0.4260	0.2660	0.8733		0.0131	0.8135	0.4477

Table 5. Harvest and crop value data from the Forrence Orchards Honeycrisp trial. Differing letters show statistically significant differences between treatments at p value < 0.05; Evaluating the New Apple Thinning Material "Accede" Under Northern New York Thinning Conditions, 2023.

Forrence Orchards: Macoun

We observed significant differences in total fruit per tree at harvest (p<0.0001). While our target crop load for this block was 132 fruit per tree:

- Treatment 1 averaged 291 fruit per tree,
- Treatment 2 averaged 185 fruit per tree,
- Treatment 3 averaged 329 fruit per tree, and
- Treatment 4 averaged 156 fruit per tree.

Yield per tree was significantly different in our trial (p=0.0003). Yield per tree averaged:

- 37.71 kg in Treatment 1,
- 24.45 kg in Treatment 2,
- 39.77 kg in Treatment 3, and
- 21.38 kg in Treatment 4.

Average fruit size did not significantly differ in our trial (p=0.0832). Fruit size per tree averaged:

- 0.13 kg in Treatment 1,
- 0.13 kg in Treatment 2,
- 0.12 kg in Treatment 3, and
- 0.14 kg in Treatment 4.

Fruit color did not differ significantly between treatments (p=0.8946). Fruit percent red color averaged:

- 72% in Treatment 1
- 71% in Treatment 2
- 73% in Treatment 3, and
- 69% in Treatment 4.

Crop values did not significantly differ between bloom thinning treatments (p=0.6848). Taking into account the yield, fruit quality, and russeting data, we estimated the value of the crop in:

- Treatment 1 as $6,037 per acre,
- Treatment 2 as $4,476 per acre,
- Treatment 3 as $5,034 per acre, and
- Treatment 4 as $4,380 per acre.

Macoun								
Treatment	Applications	# Fruit per tree	Yield Per Tree (kg)	Fruit Size (kg)	Fruit Per Bushel	Fruit Color (%)	Russet Free Fruit (%)	Crop Value Per Acre ($)
1	Bloom	291 B	37.71 A	0.13	147	72	100	6037
2	Bloom, 20mm	185 C	24.45 B	0.13	144	71	97	4476
3	Bloom, 12mm	329 A	39.77 A	0.12	157	73	99	5034
4	Bloom, 12mm, 20mm	156 C	21.38 B	0.14	139	69	99	4380
P-Value		<.0001	0.0003	0.0832		0.8946	0.4042	0.6848

Table 6. Harvest and crop value data from the Forrence Orchards Macoun trial. Differing letters show statistically significant differences between treatments at p value < 0.05; Evaluating the New Apple Thinning Material "Accede" Under Northern New York Thinning Conditions, 2023.

Discussion

In our Gala trial, the various thinning treatments did not differ in terms of number of fruit per tree or yield. There was a significant increase in fruit size in Treatment 4, when thinners were applied at all three timings of petal fall, 12mm, and 20mm. These findings suggest that Accede at 20mm provided similar levels of efficacy as the grower's standard petal fall and 12mm applications of 3oz NAA + 64 fl oz 6-BA. Our data suggest Accede at 400ppm may help growers reduce their crop load further if they had poor application weather or thinning conditions at the petal fall or 12mm thinning windows.

A trial in Idaho (Fallahi and McArtney, 2021) found Buckeye Gala treated with 350ppm ACC had a lower fruit set and improved fruit size over an un-thinned control in two separate study years, and an Ethephon treatment in one of two years. A 2015 study out of Ontario found 300ppm and 450ppm applications of Accede were effective at reducing crop load of Gala when applied at 17mm, and 400ppm was ineffective when applied at 22 and 25mm (Cline J, personal communication). Our study differs somewhat from these previous studies, as we were applying Accede at 20mm, complementing other hormone thinner applications made at petal fall, 12mm, or a combination of the two.

In our Honeycrisp trial, the various thinning treatments did not differ in terms of number of fruit per tree, yield, or fruit size. Accede alone improved fruit color relative to the bloom-only treatment; however, Accede alone did not differ from either of the treatments that also received carbaryl at 12mm. We also saw no significant increases in overall crop value. We had little additional thinning from either the carbaryl at 12mm, the Accede at 20mm, or the combination of the two compared to bloom thinning alone. We know that carbaryl alone is a very mild thinner, and the grower chose this application at 12mm due to concerns that

fruit might be more sensitive to thinning with the freeze on May 18. Our findings suggest that Accede at 400ppm was a very mild thinning product on Honeycrisp this season. While we saw limited thinning efficacy on Honeycrisp in terms of crop value in 2023, Honeycrisp is particularly susceptible to biennial bearing, so we are curious to see how our treatments impact return bloom in spring 2024.

In our Macoun trial, we saw significant differences between treatments in terms of fruit per tree and yield. Trees treated with Accede had significantly fewer fruit per tree than trees treated at bloom alone or at bloom and 12mm with 1 pt carbaryl. However, these differences did not translate to a significant gain in fruit quality in terms of either fruit size or red color development, which led to no improvements in crop value per acre from the treatments.

Our Macoun data suggest Accede had more efficacy at 20mm than the carbaryl application at 12mm. This suggests Accede was at least a mild thinner on Macoun, and stronger than carbaryl alone at 12mm. Our cooperator chose not to use a stronger "standard" thinning program at petal fall and 12mm due to the freeze that had occurred earlier on May 18. This illustrates another potential advantage of using Accede at late thinning times. Where thinning applications at petal fall and 12mm applications may be too soon after a bloom freeze to assess the extent of the damage, a somewhat clearer extent of fruit damage could be ascertained by 20mm, and would allow growers the ability to make an additional thinner application where they deem necessary.

A study conducted on Macoun in 2022 (Greene D, personal communication) found Accede applications had little efficacy when compared to a "grower standard" application of NAA + carbaryl + Regulaid at petal fall, followed by MaxCel + carbaryl at 12mm. We did not apply a petal fall thinner, and used only carbaryl at 12mm in our study, due to the freeze concern. Our results may have been less significant if the grower had used their standard thinning program of NAA + carbaryl at 12mm.

Economics

The thinning received from Accede applications may somewhat help reduce the amount of hand thinning required in these varieties. However, growers will need to carefully consider if the amount of additional thinning received from Accede will justify the expense of its application.

We estimate Accede costs approximately $260 per acre to apply. This includes the costs of Accede, the surfactant, and the labor. When looking at our crop values in the Honeycrisp study, we saw a non-significant increase in crop value from our Accede applications, but the difference was greater than $260. This slight increase was likely from the improved fruit color. In this case, it was perhaps advantageous to apply Accede.

Although not significant, crop value was lowest in our Bloom + 12mm + 20mm Accede-treated fruit in the Macoun study. This is likely due to the decreased fruit yield, with no increase in fruit quality. This suggests we may need to adjust our target crop load for this orchard block, and that it was not economical to use Accede on our Macoun trial this year.

The crop value data for our Gala trial will not be available until spring 2024 due to the fruit still being in storage.

Hand thinning is labor-intensive, and labor costs are one of the largest expenses in managing an orchard in northern New York. If Accede can be used to get the trees closer to the target crop load without hand thinning, we believe there could be significant cost savings from utilizing Accede in some years where there was insufficient thinning from the bloom, petal fall, and 12mm applications.

Weather Impacts

As in most years, the weather must always be taken into consideration when we investigate thinning efficacy with any material. The weather conditions in 2023 were particularly important considering the freeze on May 18.

Conditions were relatively good for bloom thinning in 2023. Weather forecasts were dry and temperatures were favorable, allowing growers the opportunity to bloom thin where they wanted to. In the case of these field studies, both the Honeycrisp and Macoun trials were bloom thinned with ATS.

Things changed quickly; however, on the morning of May 18. We usually expect to see some freeze damage to apple flowers when temperatures of 28°F or lower are sustained for 30 minutes or longer. On that morning, low temperatures were recorded with the duration of time below 28°F in one trial orchard location of four hours (Table 8).

May 18th Freeze Summary		
Trial	Minimum Temperature (°F)	Hours Below 28°F
Gala	29.3	0
Honeycrisp	34.7	0
Macoun	26.5	4

Table 8. Summary of May 18, 2023 freeze conditions. Evaluating the New Apple Thinning Material "Accede" Under Northern New York Thinning Conditions, 2023.

Given this freeze event, we expected trees would likely thin more easily, which led us to thin less aggressively in the Honeycrisp and Macoun trial than the grower ordinarily would have.

Weather conditions were conducive to mild thinning at the petal fall, 12mm, and 20mm thinning windows in 2023. The carbohydrate balance was growing more negative by 20mm though, so overall we suspect thinning conditions were best at the 20mm window this season between the three timings.

In our Gala trial, we saw more thinning in our petal fall + 20mm treatment compared to the 12mm + 20mm application. This can partially be explained by the weather data, as the petal fall application was made when the carbohydrate model was closer to neutral, and on a day with a higher daily temperature compared to the 12mm application (Tables 9 and

10). With many hormone-based thinners like NAA and 6-BA, we expect efficacy to increase as temperatures are warmer and carbohydrate balances are more negative.

The Accede applications were applied on relatively favorable days, as daily highs were in the mid- to upper 70ºFs, and carbohydrate balances were close to neutral.

Accede is believed to also work well under cooler temperatures, so it will be interesting to see how conditions will be on the day of application in future years. The manufacturer has also suggested (Clarke G, personal communication) that Accede efficacy appears to be maximized when it is applied under slower drying conditions to maximize leaf uptake. Most of our applications were made in the middle of the day, so we expect we may have seen even greater efficacy if applications were made early in the day or late in the evening. However, when large commercial growers need to thin hundreds of acres, it is unlikely they are going to be able to spray all their acreage at the perfect timing.

Petal Fall Thinning Conditions				
Trial	Date	Daily High Temp (°F)	6-Day Weighted Carb Status Average (g/day)	Carbohydrate Model Predicted Thinning Conditions
Gala	27-May	80	11.24	Mild Thinning
Honeycrisp	N/A			
Macoun	N/A			

Table 9. Summary of petal fall thinning conditions. Evaluating the New Apple Thinning Material "Accede" Under Northern NY Thinning Conditions, 2023.

12mm Thinning Conditions				
Trial	Date	Daily High Temp (°F)	6-Day Weighted Carb Status Average (g/day)	Carbohydrate Model Predicted Thinning Conditions
Gala	5-Jun	72	24.45	Mild Thinning
Honeycrisp	6-Jun	69	16.87	Mild Thinning
Macoun	3-Jun	65	29.51	Mild Thinning

Table 10. Summary of 12mm thinning conditions. Evaluating the New Apple Thinning Material "Accede" Under Northern NY Thinning Conditions, 2023.

20mm Thinning Conditions				
Trial	Date	Daily High Temp (°F)	6-Day Weighted Carb Status Average (g/day)	Carbohydrate Model Predicted Thinning Conditions
Gala	11-Jun	77	-0.99	Mild Thinning
Honeycrisp	11-Jun	74	2.51	Mild Thinning
Macoun	11-Jun	78	3.76	Mild Thinning

Table 11. Summary of 20mm thinning conditions. Evaluating the New Apple Thinning Material "Accede" Under Northern NY Thinning Conditions, 2023.

Conclusions

Accede has shown some efficacy as an apple thinner at the 20mm fruit size, though efficacy appears to be somewhat variety dependent. Our data currently suggest Accede, when applied under current label recommendations, is likely a relatively mild thinner on Gala and Honeycrisp, and a somewhat stronger material on Macoun. Growers may be able to use these materials at 20mm to remove some additional fruit off their trees, potentially decreasing the amount of hand thinning needed on their farm.

However, due to the freeze, additional work is required to fully understand how we can best incorporate this new thinning material into the crop load management toolbox. While it is difficult to make assumptions on product efficacy after a single season, it is even more difficult in years following a late season freeze such as the one we had in 2023. For this reason, we plan to repeat these trials over the next two years.

Next Steps: Moving Forward in 2024

The freeze we experienced in 2023 leaves a large question mark on how well we can interpret the 2023 year's data. We expect the freeze increased thinning sensitivity to all of the thinners we applied; therefore, we cannot consider this to be a representative year as to what we can expect in the orchard in the future. Freeze aside, one year of thinning data is not enough to feel confident in recommending a new product to growers, as thinners behave differently under different weather scenarios. While we were generally pleased to see Accede working as a mild to good thinner in 2023, we plan to continue this trial a few more years to get a better sense of its full potential under Northern New York's differing weather scenarios. This additional data will increase grower confidence in the range of thinning they might expect to see in their orchards if they choose to use Accede and to adapt to year-to-year differences.

Education and Outreach

- 2023 Statewide Pre-Bloom Thinning Webinar, April 19, 2023, virtual; Dr. Terence Robinson discussed thinning strategies for the 2023 thinning season. Participants: 78. Video on Lake Ontario Fruit Program YouTube page, 393 views as of January 25 2024.

- Thinning Meetings, May-June 2023, online and in person for Northern New York growers. Dr. Robinson and project leader Mike Basedow discussed thinning conditions online at petal fall, and at an in-person field meeting in Peru, NY, on May 26. Weekly attendance:12-24 growers. Video recording of the petal fall meeting was posted on ENYCHP YouTube page. Has 44 views as of January 25, 2024.

- 2023 Champlain Valley Orchard Field Afternoon, July 20 2023, Chazy, NY; Mike Basedow provided an overview of Accede thinning trials, showing growers his Gala field research trial. Attended by 24 growers.

- E-mail Alerts: following each thinning meeting, growers were emailed a recap of the discussed thinning recommendations, along with additional details from model outputs from test sites in Peru, NY, reaching 678 Eastern/Northeastern NY fruit growers.

- One-on-One Outreach: growers participating in the thinning projects received frequent personalized emails, text messages, phone calls, and farm visits to discuss the models, and were given thinning advice based on these model recommendations.

Acknowledgments

This project was funded by the Northern New York Agricultural Development Program. Thank you to ENYCHP program aide Jennifer Stanton for her technical assistance throughout this project, and to the collaborating orchards: Chazy Orchards, Forrence Orchards, and Gunnison Lakeshore Orchard.

For More Information

- Michael Basedow, Cornell Cooperative Extension Eastern NY Commercial Horticulture Program, 518-410-6823, mrb254@cornell.edu
- NNYADP Apple/Precision Orchard Research Reports (2013-2021): https://nnyagdev.org/index.php/horticulture/nny-horticultural-research

Reference: Fallahi, E., McArtney, S.J. 2022. Impacts of 1-aminocyclopropane-1-carboxylic acid as a late post-bloom thinner on fruit set, yield, and fruit quality in "Gala" and "Fuji" apples. American Journal of Plant Science. 13:481-493.

Photos *credit: Mike Basedow:*

Above: Fruitlets dropping under Treatment 4 at Chazy Gala orchard site, 2023 NNYADP trial, observed on June 28, approximately a month after Accede applications were applied.

Left: Fruit on two Treatment 4 trees at the Honeycrisp trial on August 29, 2023, about a week before first harvest. No statistical differences in fruit per tree were observed between treatments in NNYADP 2023 Honeycrisp trial. **Right: Left:** Fruit on two Treatment 4 trees at the Honeycrisp trial on August 29, 2023,about a week before first harvest. No statistical differences in fruit per tree were observed between treatments in NNYADP 2023 Honeycrisp trial.

Left: Bin of Honeycrisp picked from NNYADP 2023 in-orchard trial, showing our scale for fruit yield, and sample bag later sent to Geneva to determine fruit % red color.