The 2023 Apple Thinning Season was Difficult!

Duane W. Greene and Jacob Aliengena
Stockbridge School of Agriculture, University of Massachusetts Amherst

The 2023 growing season was probably the most challenging thinning season that we have ever experienced. April and early May were seasonably cool and breezy. The bloom and pollination periods were long and protracted and there appeared to be adequate pollination. On the night of May 18, nearly all orchards in the northeast experienced a freeze where temperature dipped down to the middle and upper 20's when fruit on the trees ranged in size from 3 to 5 mm in diameter. This event caused variable degrees of freeze damage. It was also common to have fruit severely damaged in the bottoms of trees while on the top of the same tree, less damage was sustained. The location in the orchard played an important role in determining the degree of freeze damage as well. The second factor that made thinning difficult was the generally cool sunny conditions that prevailed for nearly 3 weeks resulting in a carbon excess over the thinning season (5-18 mm).

Metamitron is a thinner that we have been evaluating for over 10 years. Initially there was a steep learning curve but in recent years it has performed very well especially when compared to the thinning caused by thinners such as NAA, carbaryl and benzyladenine. As metamitron nears registration for apple thinning in the United States, we wanted to continue to evaluate metamitron and compare its thinning capability with the thinners currently in general use.

Materials and Methods

In a block of mature Summerland McIntosh/ M.9 apples, 42 trees were selected leaving an untreated tree between each treatment tree. At the pink stage of flower development, three uniform limbs on each tree were tagged and the limbs' circumference was measured and recorded. The number of blossom clusters on each tree were counted and the blossom cluster density was calculated. The trees were grouped into six groups (replications) of seven trees based on the blossom cluster density. Weather data from the Cornell NEWA Thinning Model collected at the orchard is shown in Table 1. from one day before the first thinner applications were made (May 12) to four days after the last thinner application (May 26). BreviSmart is a thinner prediction model that was developed by Adama for use with metamitron. BreviSmart outputs were checked periodically over this period. Two of these printouts are shown for May 12 (fruit size 5 mm) and May 26 (fruit size 14.1 mm), the two dates

Table 1. Weather data prior to, on the date of, and for several days following thinner applications on Summerland McIntosh, Belchertown, MA, in 2023.

Date	Temp max	Temp min	CHO balance	Degree day accumulation	Comments
May 11	79	47	-10	89	Increase by 30%
May 12	81	51	-30	104	Increase by 30%
May 13	78	58	-20	120	Increase by 30%
May 14	66	46	30	129	Increase by 30%
May 15	71	38	33	138	Increase by 30%
May 16	78	52	-9	152	Increase by 30%
May 17	64	41	53	158	Increase by 30%
May 18	64	28	70	162	Increase by 30%
May 19	67	41	36	170	Increase by 30%
May 20	64	48	-36	179	Increase by 30%
May 21	70	52	19	191	Increase by 30%
May 22	75	47	22	203	Increase by 30%
May 23	74	45	30	214	Increase by 30%
May 24	75	46	32	226	Increase by 30%
May 25	64	44	71	234	Increase by 30%
May 26	71	37	77	243	Increase by 30%
May 27	79	41	58	255	Increase by 30%
May 28	83	50	30	271	Increase by 30%
May 29	76	53	41	284	Increase by 30%
May 30	75	42	67	296	Increase by 30%
May 31	82	43	52	308	Increase by 30%

BreviSmart®

Grower Name: Duane Greene
Plot Name: UMass Gala
Level of thinning: Moderate to thin (i.e. Gala)
Date: 26-May-2023
As soon as spraying conditions are suitable apply BREVIS® according to the following recommendation:
Expected thinning conditions are **Good**.

Recommendations:
Green : Keep your common used dose of BREVIS® (-/+ 5% according green shade)

Diameter of the central "King" fruit in mm

Date	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
17-May-2023															
18-May-2023															
19-May-2023															
20-May-2023															
21-May-2023															
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28-May-2023															
29-May-2023															
30-May-2023															
31-May-2023															
01-Jun-2023															

Important: If daytime high temperature exceeds 84°F/29°C on the target day of application or 1-5 days after, do not apply Brevis until daytime temperatures are below 84°F/29°C or reduce Brevis rate

Less than good conditions | Good conditions | Strong conditions

Today's date and fruit size of 1st calculation

Refer to boundaries of the use as recommended on the label

when thinners were applied. Disregard the printout label indicating Gala, since both printouts are for the Summerland McIntosh block.

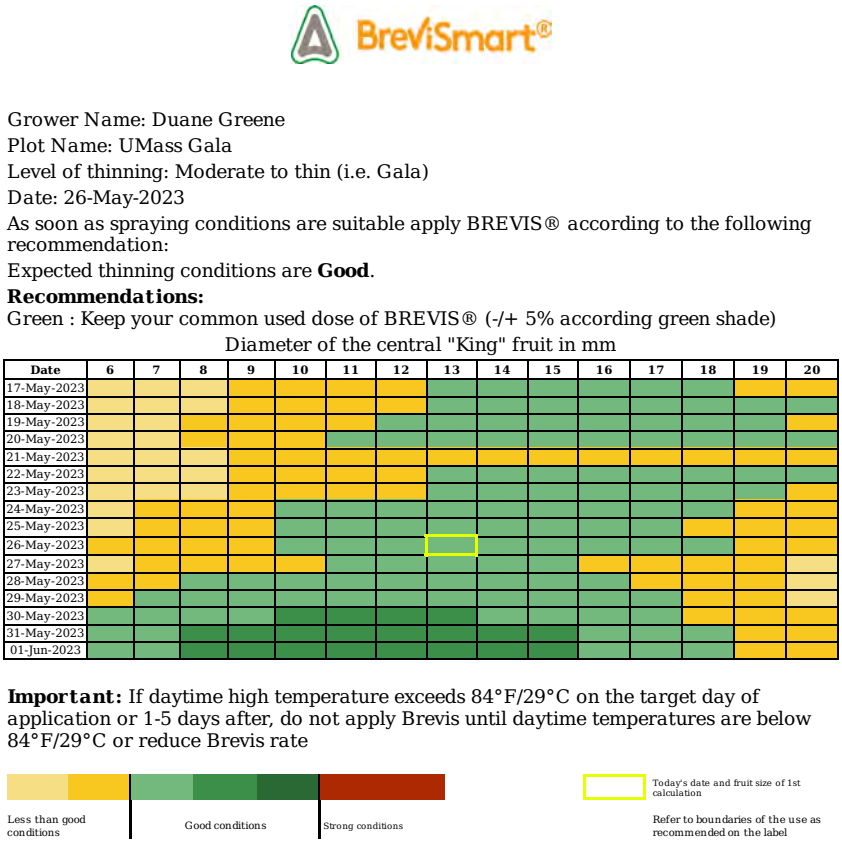
There were two grower thinner controls used in this experiment. Details of the treatments applied are shown in Table 2. Treatments were applied using a tractor-mounted speed sprayer at a TRV dilute rate of 100 gal/acre.

The bloom period was generally cool and protracted but there appeared to be adequate pollination and initial set. The first few days in May were cool and relatively sunny. On May 12, when fruit size was about 5 mm, the NEWA model indicated that there was a positive carbon balance in the trees and the NEWA model recommended increasing thinner applications by 30%. The Brevis model indicated that the conditions were less than ideal and suggested that the rate of Brevis should be increased by 25%. Our normal rate of metamitron for this block of apple trees would be 1.5 pt/acre so we opted to apply metamiatron at 2 pt/100 gal. Following the application, the weather remained cool and very unfavorable for thinners to work (Table 1.).

On the night of May 18, New England and New York orchards were hit by a hard freeze which resulted in extensive damage to trees and fruit. This was an extremely difficult situation to try to assess and even more challenging to try to decide if thinners were needed, and if so, how aggressive these applications should be. The area of the orchard where this experiment was conducted was less damaged than others, however, there was leaf and fruit damage. It was unclear how this frost damage would influence the thinner response. The BreviSmart model suggested that the thinning conditions were "Good," whereas the NEWA model suggested increasing thinner strength by 30%. Given the freeze damage to the trees, we decided

Table 2. Treatments and times of application used in the Metatron experiment on Summerland McIntosh, Belchertown MA, in 2023.

Treatments	Applied May 12 Fruit size 5.5 mm	Applied May 26 Fruit size 14.1 mm
1 Untreated Control	------	------
2 Metamitron no Surfactant	Metamitron 2 pt/acre	Metamitron 1.25 pt/acre
3 Metamitron plus Surfactant	Metamitron 2 pt/acre Regulaid 1pt/100 gal	Metamitron 1.25 pt/acre Legal aid 1 pt/100 gal
4 Grower Standard #1 no Carbaryl	NAA 10 ppm	NAA 7.5 ppm
5 Grower Standard #1 plus Carbaryl	NAA 10 ppm + Carbaryl 1 qt/100 gal	NAA 7.5 ppm Carbaryl 1 qt/100 gal
6 Grower Standard #2 no Carbaryl	Amid-Thin 8 oz/100 gal Regulaid 1 pt/100 gal	MaxCel 75 ppm
7 Grower Standard #2 plus Carbaryl	Amid-Thin 8 oz/100 gal Regulaid 1 pt/100 gal Carbaryl 1 qt/100 gal	MaxCel 75 ppm Carbaryl 1 qt/100 gal



to apply 1.25 pt/acre metamitron. Eight days after trees were injured by cold temperatures, it was difficult to accurately assess the damage and then extrapolate this to how trees would respond to thinner application. In retrospect, we should have applied a higher rate of all thinners.

At the end of the June drop period in July, all fruit on tagged limbs were counted and recorded. The fruit set was calculated in two ways. First, as fruit per cm limb cross-sectional area and the second as the percentage of fruit set on the spurs with flowers that set. At the normal harvest time on September 12, twenty-five apple samples were randomly harvested from each tree. These were transported to the lab where the total weight was determined. The percent red color on each fruit was estimated to the nearest 10%. Flesh firmness was measured on ten fruits using a penetrometer by making two punctures per apple. A composite juice sample was collected during the pressure test and the soluble solids were measured in this sample using a temperature compensating refractometer. These ten fruits were cut in half at the equator, dipped in an iodine solution, and the residual starch in the apple was then estimated on a scale of 1-8 using the Cornell Generic Starch Chart.

Results and Discussion

No chemical thinning treatment caused thinning in this experiment (Table 3.). The lack of a response to thinner treatments can be directly linked to the weather. First, there were only four days where the carbon balance was negative and only twice did it drop below -20 grams. For thinners to work acceptably, a larger carbon deficit must exist, and the negative periods should last for at least three days to aid in the thinning process. Second, day temperatures were not high enough to allow for thinners to work effectively and to allow for the buildup of a negative carbon balance. Third, night temperatures were also too low to allow for the development of a carbon deficit. No thinner could thin under the weather conditions that the trees were exposed to. We applied metamitron at the 2 pt/acre rate and it did not have any influence on thinner efficacy. It is our understanding that the proposed label for the east coast is limited to 2.5 pt/acre per application.

The frost/freeze that occurred on the night of May 18 caused substantial damage. Most of us have never experienced a low temperature event of this magnitude on trees at this advanced stage of fruit development. Visual damage was apparent, and most growers chose to be conservative in their thinner application. Furthermore, thinners were applied on May 26, when fruit size averaged 14 mm. It would have been desirable to wait longer to assess tissue damage more accurately, but thinners would probably not have worked as well. We used both the Cornell NEWA Thinning Model and BreviSmart model in conducting this experiment. The NEWA Model was useful to summarize weather data and to calculate the carbon balance in the tree.

However, the thinning recommendations were not useful. The NEWA Model suggested that the thinner strength should be increased by 30% during the entire thinner period of the experiment. It is our opinion that the BreviSmart model gave a more realistic guidance for the rates to use, especially for the second thinner application.

Fruit quality parameters were measured on fruit in this experiment (Table 4.). In no circumstance did treatments influence any of the parameters. If thinning treatments, including metamitron, influence fruit ripening parameters it is always due to a secondary effect caused by differences in crop load due to thinning. We would be surprised if any thinning treatment affected any fruit parameters in this experiment this year.

Table 3. Influence of metamitron and grower thinner checks applied at petal fall (5 mm) and at 14 mm on fruit set of Summerland McIntosh/M.9 in Massachusetts, in 2023.

Treatment[1]	Thinner and rate May 12	Time of application May 26	Bloom/cm LCSA	Fruit/cm LCSA	Percent set
1 Untreated Control	------	------	12.2 a	13.2 a	117
2 Metamitron no Surfactant	Metamitron 2 pt/acre	Metamitron 1.25 pt/acre	12.1 a	9.8 a	84
3 Metamitron plus Surfactant	Metamitron 2 pt/acre Regulaid 1pt/100 gal	Metamitron 1.25 pt/acre Legal aid 1 pt/100 gal	11.9 a	10.3 a	87
4 Grower Standard #1 no Carbaryl	NAA 10 ppm	NAA 7.5 ppm	12.1 a	11.5 a	102
5 Grower Standard #1 plus Carbaryl	NAA 10 ppm + Carbaryl 1 qt/100 gal	NAA 7.5 ppm Carbaryl 1 qt/100 gal	11.9 a	9.8 a	82
6 Grower Standard #2 no Carbaryl	Amid-Thin 8 oz/100 gal Regulaid 1 pt/100 gal	MaxCel 75 ppm	12.0 a	12.0 a	101
7 Grower Standard #2 plus Carbaryl	Amid-Thin 8 oz/100 gal Regulaid 1 pt/100 gal Carbaryl 1 qt/100 gal	MaxCel 75 ppm Carbaryl 1 qt/100 gal	12.1 a	10.6 a	86
Significance			NS	NS	NS

[1]Spray applications made on May 12 (5 mm) and on May 26 (14 mm).

Table 4. Influence of metamitron and grower thinner checks when applied on May 12 (5 mm) and May 26 (14 mm) on fruit quality parameters of Summerland McIntosh/M.9 in Massachusetts, in 2023.

Treatment[1]	Thinner and rate May 12	Time of application May 26	Fruit weight (g)	Flesh firmness (lb)	Soluble solids (%)	Red color (%)	Starch rating (1-8)
1 Untreated Control	------	------	159 a	14.1 a	10.8 a	54 a	5.4 a
2 Metamitron no Surfactant	Metamitron 2 pt/acre	Metamitron 1.25 pt/acre	162 a	14.1 a	10.9 a	54 a	5.4 a
3 Metamitron plus Surfactant	Metamitron 2 pt/acre Regulaid 1pt/100 gal	Metamitron 1.25 pt/acre Legal aid 1 pt/100 gal	172 a	14.1 a	11.2 a	51 a	5.1 a
4 Grower Standard #1 no Carbaryl	NAA 10 ppm	NAA 7.5 ppm	169 a	14.2 a	11.2 a	5.6 a	5.6 a
5 Grower Standard #1 plus Carbaryl	NAA 10 ppm + Carbaryl 1 qt/100 gal	NAA 7.5 ppm Carbaryl 1 qt/100 gal	160 a	14.3 a	11.1 a	5.8 a	5.5 a
6 Grower Standard #2 no Carbaryl	Amid-Thin 8 oz/100 gal Regulaid 1 pt/100 gal	MaxCel 75 ppm	162 a	14.0 a	11.0 a	5.9 a	5.3 a
7 Grower Standard #2 plus Carbaryl	Amid-Thin 8 oz/100 gal Regulaid 1 pt/100 gal Carbaryl 1 qt/100 gal	MaxCel 75 ppm Carbaryl 1 qt/100 gal	177 a	14.1 a	11.2 a	5.8 a	5.3 a
Significance			NS	NS	NS	NS	NS

[1]Spray applications made on May 12 (5 mm) and on May 26 (14 mm).

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