Early Application of Chemical Thinners Should be Revisited

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Chemical thinning remains the most challenging management component in apple production that a grower must do. This situation has become even more challenging and difficult in recent years due to the wide variation in temperature frequently experienced during the thinning period that appear to be associated with climate change. In the past we have depended upon the thinning strategy that is termed the "Nibble" approach where several applications of thinners are applied at reduced rates over the thinning period. Yes, we have experienced some temperature fluctuations in the past, but this approach has become less useful in recent years because of unreliable and often extreme weather conditions (both hot and cold) that we have experienced with increasing frequency during the thinning period that have resulted in unsatisfactory thinning.

There are significant advantages to thinning apples early. We acknowledge the usefulness of thinning done during the dormant period and the use of caustic thinners applied at bloom but these techniques are not frequently used. However, in this experiment we focused on the application of hormone thinners at both bloom and petal fall. Thinner application at bloom and petal fall thinners in the eastern United States is not new but the hormone-type thinner rates used have been moderate at best and the end results are frequently disappointing. The purpose of this experiment was to try to identify bloom and petal fall treatments using either naphthaleneacetic acid (NAA) or naphthaleneacetamide (NAD) that would result in significant thinning and to determine if trees receiving either of these treatments would be thinned easier with a different thinner applied later at the 10-14 mm fruit size stage.

Materials and Methods

A block of mature Buckeye Gala/ Bud 9 was selected and 36 uniform trees were identified. At the pink stage of flower development all spur blossom clusters were counted on each tree. The trunk circumference was measured on these trees at 30 cm above the bud union. The blossom cluster density was then calculated by dividing the number of flowering spurs by the tree trunk cross sectional area. Trees were then blocked into six groups (Reps) based upon blossom cluster density. Within each group trees were randomly assigned to receive one of six treatments.

Treatment details. Two sets of trees received a bloom spray of 12 ppm NAA containing 1 pt/100 gal of the surfactant Regulaid®. This same group of trees was sprayed at petal fall with 12 ppm naphthaleneacetic acid (NAA) plus 1 pt/100 gal of Regulaid® and 1 pt/100 gal of carbaryl. Two other sets of trees were sprayed at bloom with 8 oz/100 gal naphthaleneacetamide (NAD) with 1 pt/100 gal Regulaid®. These trees were again sprayed at petal fall with 8 oz/100 gal of NAD plus 1 pt/100 gal of Regulaid® and 1 pt/100 gal of carbaryl. A third set of trees was sprayed with 125 ppm MaxCel® plus 1 qt carbaryl/100 gal at the 10 mm fruit size stage. One group of trees that previously were sprayed with the NAA treatments and one group of trees that received the NAD treatments were also sprayed with 125 ppm MaxCel® and 1 qt carbaryl at the 10 mm stage. All treatments were applied using a commercial airblast sprayer delivering the TRV dilute volume of 100 gal/ acre. Temperature maximum and minimum, the carbon balance and the thinning recommendation for several days before, on the day of and several days following spray application at each of these spray timings, as shown on the NEWA website, are shown in Table 1. Details of the spray applications are summarized in Table 2.

The weather conditions surrounding the bloom spray application (May 7) can be characterized as being unfavorable for thinning. In general, the high tempera-

ture averaged about 60º F and the low temperature was near 45º F. NEWA suggested that thinning recommendations should be increased by 30%. Weather conditions near the petal fall (5 mm) spray (May 17) were favorable for thinning with high temperatures hovering near 80º F. The NEWA website suggested to reduce the normal thinner application by 15%. The last thinning spray was applied when the fruit diameter averaged 10.4 mm (May 25). The weather the day of application and for the two days following was somewhat favorable for thinning but after that, low temperatures prevailed. At the time of application, the NEWA website suggested that the thinner rate should be increased by 30%. Because of the design of the experiment, it was possible only to relate weather information specifically to thinner activity for only the 10 mm fruit size spray (Treatment 6).

Table 1. Weather data prior to and following application of thinning treatments on Buckeye Gala/B.9 apples. Belchertown, MA, 2021.

Date	Temp max	Temp min	CHO daily balance	Degree day accumulation	Thinning recommendations
May 3	68	50	-26	10	Increase by 30%
May 4	58	49	-16	21	Increase by 30%
May 5	53	46	-15	36	Increase by 30%
May 6	62	44	+13	42	Increase by 30%
May 7 (Bloom)	61	42	+2	49	Increase by 30%
May 8	57	43	+4	55	Increase by 30%
May 9	61	40	+15	61	Increase by 30%
May 10	59	45	+1	68	Increase by 30%
May 11	59	45	+22	76	Increase by 30%
May 12	62	41	+17	82	Increase by 30%
May 13	69	41	+21	91	Increase by 30%
May 14	75	43	+2	102	Increase by 30%
May 15	75	48	-6	114	Apply standard rate
May 16	70	55	-23	128	Increase by 30%
May 17 (PF, 5 mm)	74	47	-13	140	Apply standard rate
May 18	80	51	-24	154	Decrease by 15%
May 19	84	54	-35	173	Decrease by 15%
May 20	81	51	-16	185	Decrease by 15%
May 21	82	52	-23	201	Decrease by 15%
May 22	86	58	-60	219	Apply standard rate
May 23	81	57	-40	236	Apply standard rate
May 24	68	50	+16	246	Apply standard rate
May 25 10 mm	74	47	+21	258	Increase by 30%
May 26	87	58	-28	277	Increase by 30%
May 27	75	58	+6	292	Increase by 30%
May 28	59	44	+26	299	Increase by 30%
May 29	47	42	+4	302	Increase by 30%
May 30	48	45	-15	306	Increase by 30%

Results

Bloom and petal fall thinner applications containing either NAA (Treatment 2) or NAD (Treatment 5) thinned comparably but neither reduced the crop load enough to be commercially acceptable (Table 3). Application of 125 ppm MaxCel® plus 1 pt of carbaryl per 100 gal at the 10 mm fruit size stage resulted in some reduction in crop load, but the thinning intensity was not sufficient be commercially acceptable. When trees that were previously sprayed at bloom and petal fall with either NAA or NAD containing sprays, and were also sprayed with MaxCel® plus carbaryl, the resulting thinning was significantly improved and there were no statistical differences between trees that received the different bloom and petal fall

Table 2. Influence of thinner combinations (NAA, NAD, Carbaryl, MaxCel) applied at 3 fruit growth stages on fruit of Buckeye Gala/B.9 apples. 2021.

Treatment[1]		Time of application[2]			Fruit Set	
		Full bloom	Petal fall	10 mm	Fruit/cm LCSA	Percent set
1	Control	---	---	---	15.4 a	128 a
2	NAA 12 ppm + Regulaid 1 pt/100 + Carbaryl 1 pt/100 (PF only)	+	+		9.9 bc	85 bc
3	NAA 12 ppm + Regulaid 1 pt/100 + Carbaryl 1 pt/100 (PF only) + MaxCel 125 ppm + Carbaryl 1 qt/100	+	+	+	10.1 bc	87 bc
4	NAD 50 ppm + Regulaid 1 pt/100 + Carbaryl 1 pt/100 (PF only)	+	+		11.6 b	88 bc
5	NAD 50 ppm + Regulaid 1 pt/100 + Carbaryl 1 pt/100 (PF only) + MaxCel 125 ppm + Carbaryl 1 qt/100	+	+	+	8.0 c	67 c
6	MaxCel 125 ppm + Carbaryl 1 qt/100			+	11.0 bc	95 bc
Significance					***	***

[1]Treatments applied on May 7 (Bloom), May 17 (PF, 5.1 mm) and May 25 (10 mm).

Table 3. Influence of thinner combinations (NAA, NAD, Carbaryl and MaxCel) applied at 3 fruit growth stages on fruit quality parameters at harvest of Buckeye Gala/B.9 apples in 2021.

		Time of application[2]			Fruit	Flesh	Soluble	Starch
Treatments[1]		Full bloom	Petal fall	10 mm	weight (g)	firmness (lb)	solids (%)	rating (1-8)
1	Control	---	---	---	116 d	16.6 a	10.5 a	4.7 a
2	NAA 12 ppm + Regulaid 1 pt/100 + Carbaryl 1 pt/100 (PF only)	+	+		140 c	16.0 ab	10.4 a	5.3 a
3	NAA 12 ppm + Regulaid 1 pt/100 + Carbaryl 1 pt/100 (PF only) + MaxCel 125 ppm + Carbaryl 1 pt/100	+	+	+	156 ab	16.1 ab	10.7 a	5.5 a
4	NAD 50 ppm + Regulaid 1 pt/100 + Carbaryl 1 pt/100 (PF only)	+	+		136 c	15.9 b	10.2 a	5.5 a
5	NAD 50 ppm + Regulaid 1 pt/100 + Carbaryl 1 pt/100 (PF only) + MaxCel 125 ppm + Carbaryl 1 qt/100	+	+	+	165 a	16.2 ab	10.9 a	5.4 a
6	MaxCel 125 ppm + Carbaryl 1 qt/100			+	145 bc	16.4 ab	10.7 a	5.2 a
Significance					***	NS	NS	NS

[1]Treatments applied on May 7 (Bloom), May 17 (PF, 5.1 mm) and May 25 (10 mm).

[2]FB – Full bloom, PF – Petal Fall and 10 mm – fruit size 10.4 mm.

sprays. Fruit weight at harvest was the only harvest parameter that was significantly improved or changed by the thinning treatments. Fruit size increase mirrored the extent of thinning; the greater the thinning, the larger the final fruit size.

Discussion

In recent months there has been a great deal of discussion about climate change and how it affects many aspects of our lives. Fruit growing and apple production are no exceptions. Discussion often centers around global warming. Fruit growers have the capacity to adapt to changes that will allow them to grow fruit under warmer conditions. Therefore, from a cultural standpoint, production of fruit under warmer conditions may not be a barrier for growers in New England. However, the erratic and unpredictable weather that is occurring is posing enormous challenges. Chemical thinning is one area that is particularly influenced by temperature. This situation is further exacerbated by the relatively short time that chemical thinners may be used effectively. For chemical thinners to work effectively, they must be applied when warm temperatures occur following application. Cold temperatures following application generally result in little or no thinning.

The experiment that is reported on here was designed, in part, to determine if the use of more aggressive thinner combinations at bloom and petal fall would lead to a reduction in crop load close to the final desired level. The choice of thinners was made with the hope that the rates selected would not be too high to preclude grower use. Clearly, in this experiment these sprays under-thinned, so more aggressive rates would have been required under the weather conditions that prevailed at the time to achieve more acceptable thinning.

NAD presented a challenge since the label limits the application rate to 8 oz/100 gal (50 ppm), and by nature it is a mild thinner. The addition of the surfactant Regulaid® at 1 pt/ 100 gal was used in an attempt to increase NAD activity. No adverse effects were noted. NAD has been reported to cause pygmy fruit to form on some varieties if applied during the 10 mm or later fruit size stages. Although pygmy fruit were not counted, none were noted at harvest time on trees receiving any of the thinner sprays. The rate of NAA could be increased to 15 or 20 ppm but there may be some reluctance on the part of growers to do that.

MaxCel® at 125 ppm plus 1 pt/100 gal of carbaryl was applied at the 10 mm stage. That rate is higher than is recommended in the spray guide. Only modest thinning resulted and the final crop load on trees was nearly identical to the crop load on trees receiving the bloom and petal fall treatments containing either NAA or NAD. Additional thinning resulted when the 10 mm MaxCel® plus carbaryl spray was combined with either of the bloom and petal fall treatments.

The thinning results from bloom and petal fall applications of the NAA or NAD containing sprays appear to be identical or at least not statistically different. However, before suggesting that the treatment can be used interchangeably, we must wait until next spring. We will then be able to quantify return bloom in this experiment. We did a thinning experiment using NAA and NAD as the thinners on Macoun in 2016. When return bloom was taken the following spring, trees that received NAD as a thinner had significantly less return bloom, even though final crop load at harvest was similar to the crop load on trees receiving other thinning treatments.

Each thinning season is different. It is not possible to look into a crystal ball to learn what thinning opportunities or barriers you will face. If the return bloom appears to be good and no winter injury or frost damage has occurred, we suggest that you should be as aggressive as you feel that you can possibly be early. This may include doing some thinning with dormant pruning after first estimating the blossom cluster density on the trees. It may be prudent to be very aggressive with bloom and petal fall sprays. Historically, there has been reluctance on the part of growers to thin aggressively at bloom and the petal fall sprays and frequently an early application is a petal fall spray containing only the mild thinner carbaryl. **Keep in mind that trees are far less sensitive to thinners at bloom and petal fall.** I have never over-thinned an apple tree by applying hormone-type thinners at either bloom or petal fall or at both of these times of application.

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