It is Time to Rediscover Amid-Thin®

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An important breakthrough in chemical thinning occurred in the late 1930's when it was discovered that the group of hormones known as auxins could cause fruitlet abscission. Two compounds in this hormone class that were especially effective were naphthaleneacetacetic acid (NAA) and naphthaleneacetamide (NAD, Amid-Thin). Both of these compounds ultimately were registered as thinners for use on apples and pears. Over time NAA became the preferred product, because it was a more potent thinner and appeared to perform better when used at the 7-to-14-mm fruit size stage, the time fruit are most vulnerable to chemical thinners. NAD was reserved for use as a bloom or petal-fall stages and especially on early maturing varieties. The Amid-Thin label was written in the 1950s and it remains essentially intact including use recommendations for cultivars such as Yellow Transparent, William Early Red, Early McIntosh and Wealthy, to mention just a few. The label and the use of Amid-Thin have remained essentially unchanged for the last 60 years. It has and continues to play a relatively minor role as a thinner on apples.

Why is is Important to Resurrect an old Thinner?

In years when bloom is heavy, it is important to start thinning early. The strategy of multiple times for thinner application has been emphasized by researchers and extension personnel across North America, and this approach is being embraced by the industry as a whole. The majority of thinning, however, is still done during the traditional thinning time, when fruit are at 7 to 14 mm in diameter. Successful thinning at this time is determined to a very large extent by the weather and especially how weather influences the carbohydrates present in the spurs. Development of the carbohydrate model and the fruit growth model recently have improved the precision of thinning at this time particularly when packaged in a Precision Thinning Program that has been championed by Terence Robinson and coworkers in New York, by Phil Schwallier in Michigan, and others. The weather, however, cannot be controlled, and it can only be imprecisely predicted, so considerable variability in thinning response can still be expected. Clearly, the ability to do significant and perhaps the majority of thinning earlier and safely would be advantageous and it would allow orchardists to use a less aggressive thinning program during the 7-to-14-mm fruit growth stage.

Blossom thinning has not been popular with growers in the East because weather events can occur after thinner application, such as frost or poor pollination weather, that can affect crop load. Caustic thinners can thin effectively, but phytotoxicity and the resulting damage to spur leaves may affect fruit size. Petal fall is a much more popular time to apply thinners for growers in the East, and a large percent of growers take advantage of this important thinning opportunity. Carbaryl has been the thinner of choice but its use is either being discouraged or forbidden by some retailers. Its use is not allowed in many European countries. Consequently, incorporating carbaryl in the future thinning programs is very much in question. NAA is a viable thinner that can be used at bloom and petal fall, but there is the perception that it can over thin when very warm temperatures follow application.

The biological responses of plants to NAA and NAD was studied in the 1930s. Plant responses such as epinasty and ethylene production were much less with NAD than when NAA was applied indicating that side effects, including more variable thinning due to weather, are much less likely. NAD is a stronger thinner than carbaryl, and based upon recent research, it appears to be quite safe. The goal of applying thinners at bloom and/or petal fall are to accomplish most of the thinning before fruit ever reach the 7 mm stage. The objective of research over the past couple of years has been to determine if Amid-Thin is a thinner we are looking for that can provide substantial yet safe thinning at bloom and/or petal fall.

Materials & Methods

In a block of mature Macoun/M.9 apple trees growing at the University of Massachusetts Cold Spring Orchard, 48 uniform trees were selected. At the pink

stage of flower development two limbs per tree 10 to 15 cm in diameter were selected, tagged, and the diameter measured. At the pink stage of flower development, all blossom clusters were counted and the blossom cluster density calculated by dividing the number of blossom clusters by the limb cross-sectional area. Trees were blocked into 6 groups (replications) of 7 trees each based upon limb cross-sectional area. Within each replication trees were randomly assigned to receive one of the following 7 treatments:

Untreated control
Amid-Thin 40 ppm applied at bloom (May 19)
Amid-Thin 50 ppm applied at bloom (May 19)
Amid-Thin 40 ppm applied at petal fall (May 22)
Amid-Thin 50 ppm applied at petal fall (May 22)
Amid-Thin 40 ppm applied at bloom and petal fall (May 19 and 22)
Amid-Thin 50 ppm applied at bloom and petal fall (May 19 and 22)

Two hours following the petal-fall spray trees received about 0.5 inches of rain. The spray had dried by the time the rain started. In my experience, once a droplet dries you can expect at least an 80% response (or more) to an applied thinner.

At the end of June drop in July all persisting fruit on the tagged limbs were counted and the fruit set was calculated. In addition, each spur on all tagged limbs was examined and the number of fruit on each spur was recorded. At the normal harvest time on September 30, a 50-apple sample was randomly harvested from the periphery of each tree and weighed, and then the diameter of each was measured using a hand-held caliper.

Results

All Amid-Thin treatments appeared to reduce fruit set (Table 1, Figure 1). The results were statistically significant when expressed as fruit per cm^2 limb cross-sectional area and as fruit per 100 blossom clusters (% set). The 50 ppm treatments appeared to be slightly more effective than the 40 ppm treatments. The 40 ppm treatment applied at bloom was the least effective, and it was the not significantly different from the control trees. The thinning following application at either bloom or petal fall appeared to be very similar. It was interesting to note also that when applications were made at both bloom and petal fall, the thinner response appeared not to be additive. With the exception of trees that were treated with 40 ppm at bloom, Amid-Thin treatments reduced the number of spurs having 2 fruit per spur and increased the number of spurs carrying just one fruit (Table 2). The Amid-Thin treatments increased the weight of all fruit on treated trees although the differences were small and not statistically significant (Table 1). The weather for the 3 to 4 days following bloom and petal fall sprays was generally favorable and fell within the temperature and solar radiation range deemed acceptable.

Table 1. Effect of Amid-Thin (NAD) treatments applied at bloom, at petal fall and bloom, and at petal fall on fruit set and fruit weight of Macoun/M.9 apples in 2014.

			Fruit set		
Treatment[1]	Rate (ppm)	Timing	Number per cm^2 limb cross-sectional area	Number per 100 blossom clusters	Fruit weight (g)
Control	---		11.2 a	99 a	142
Amid-thin	40	Bloom	8.5 ab	79 ab	151
Amid-thin	50	Bloom	5.7 b	55 b	146
Amid-thin	40	Petal fall	7.8 b	75 ab	151
Amid-thin	50	Petal fall	7.6 b	66 b	164
Amid-thin	40	Bloom + Petal fall	7.9 b	69 ab	154
Amid-thin	50	Bloom + Petal fall	6.7 b	63 b	154

[1]Treatments applied as a dilute tree row volume spray of 125 gal/acre at bloom, May 19, and petal fall, May 22.
[2]Mean not followed by a common letter are significantly different at odds of 19 to 1 (Duncan's New Multiple Range Test, $P = 0.05$).

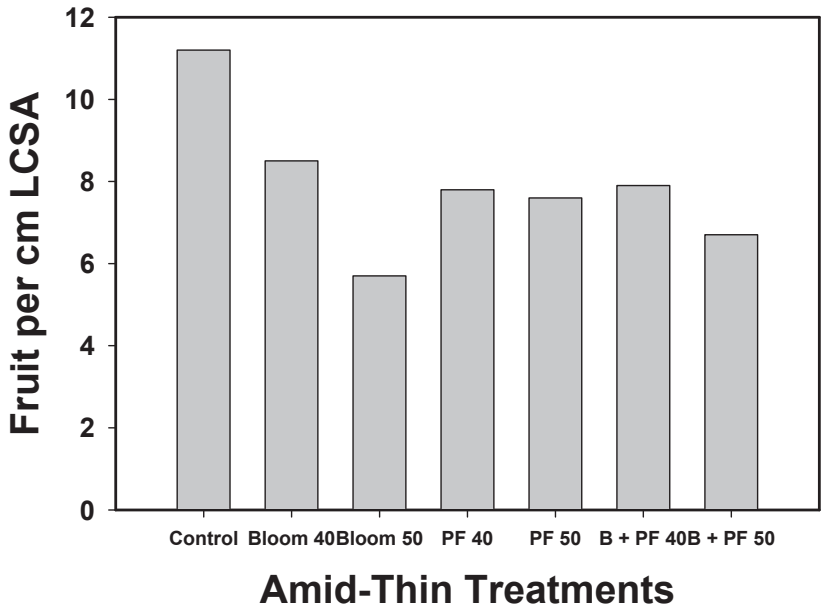

Figure 1. Influence of Amid-Thin time of application, concentration and number of applications on fruit set of Macoun/M.9 apples. 2014.

Discussion

The results presented here show convincing evidence that significant and effective thinning can be achieved by application of Amid-Thin at either bloom or petal fall. Petal fall has been the time suggested for the application of Amid-Thin, but the bloom timing appears to be comparably effective. Since no additional thinning was noted when Amid-Thin was applied a second time on some trees, it appears to show the carbaryl-like response of not showing a dose response. The fact that it appeared to be equally effective over different physiological stages and somewhat immune to additional sprays, it has demonstrated remarkable flexibility and safety in this investigation. We hope to confirm this in the 2015 thinning season.

The ideal crop load in this block is suggested to be about 6 fruit per cm^2 limb cross-sectional area, and in general, this amount of thinning was not achieved in this investigation. We rarely achieve an ideal thinning job with a bloom or petal-fall spray nor do we really want to. Many weather-related events can occur that are unforeseen and not controllable. Therefore, our hope is to reduce crop load enough so that only a modest thinner application can finish the thinning job. This we have achieved in this experiment. A concern is that the fruit size was not increased as much as would have expected given the amount of thinning. It appears that both modest thinning and a further increase in fruit size could be achieved by the use of MaxCel. This is a thinner that increases fruit size directly, and it is a modest thinner when used in the absence of carbaryl. This suggestion should be tested.

Table 2. Effect of Amid-Thin (NAD) treatments applied at bloom (B), petal fall (PF) and bloom, and petal fall on the percent single, double and triple fruit on individual spurs of Macoun/M.9 apples. 2014.

	Rate		Fruit per spur (%)		
Treatment[1]	(ppm)	Timing	Single	Double	Triple
Control	---		60	37	3
Amid-thin	40	Bloom	59	35	6
Amid-thin	50	Bloom	77	18	5
Amid-thin	40	Petal fall	67	29	4
Amid-thin	50	Petal fall	75	23	2
Amid-thin	40	Bloom + Petal fall	74	24	2
Amid-thin	50	Bloom + Petal fall	79	19	2

[1]Treatments applied as a dilute tree row volume spray of 125 gal/acre at bloom, May 22, and petal fall, May 22.

The results presented here are extremely encouraging in light of the increasing pressure from various external sources to eliminate the use of carbaryl in the thinning program. The results presented here are some of the most promising so far to identify an alternative thinner for carbaryl. The most attractive aspects of this work are its time of application and the ability to achieve meaningful and safe thinning at this early stage of fruit development. Thinners applied at bloom and petal fall are less influenced by weather conditions following application. When fruit grow to the 7 to 14 mm size, relatively small changes in weather can translate into fairly large responses to thinners. An additional advantage of thinning at this time is that there is more than ample time to apply a thinner later after initial set, and subsequent need for further thinning can be assessed. Naphthaleneacetic acid (NAA), a closely related thinner, can be used at these times as well, but it appears to show a greater amount of variability due in large part to its greater response to temperature changes, thus perhaps making NAA a more tenuous choice for thinning a bloom and petal fall when compared with Amid-Thin.

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