Looking Into the Crystal Ball – Apple Fruit Thinning Without Carbaryl?

Jon M. Clements and Wesley R. Autio
University of Massachusetts Center for Agriculture

Introduction

Apple chemical fruit thinning programs in the Northeast have for some time now relied on Naphthaleneacetic Acid (NAA), 6-benzyladenine (BA), and carbaryl applied individually or in combination beginning at petal fall and continuing until fruitlets reach no more than 15 mm diameter. Generally, this approach has worked well, although return bloom and annual weather variability certainly affects final fruit set too.

Recently, however, carbaryl has been under scrutiny by EPA and environmental groups because of potential impacts on human health and the environment. Even more recently, Bayer CropScience, the North American manufacturer of carbaryl as Sevin® brand insecticide, announced they are closing down their carbaryl manufacturing plant in the U.S. Presumably they will source carbaryl from outside the U.S., as they have not announced any intention to discontinue the sale of Sevin. Still, the future availability of Sevin seems questionable -- considering the fact carbaryl is already illegal in United Kingdom, Austria, Denmark, Sweden, and Germany.

Northeast apple growers do not generally use carbaryl as an insecticide because of its negative impact on beneficial insects; however, it is widely used for fruit thinning and is thought to be very effective in petal-fall applications to "grease the wheels" of the fruit thinning process. It is also used in post-petal fall thinning applications by itself or in combination with NAA or BA where it seems to synergize the activity of these chemical thinners. Growers would certainly miss having carbaryl for apple fruit thinning if it is pulled from the market.

Thus, per an objective of the grant-funded project 'Development of Advanced Integrated Pest Management (IPM) for Northeastern Apples' at UMass Amherst, we have begun to look at the efficacy of apple fruit thinning programs that do not use carbaryl. Typically, this means using NAA, Naphthaleneacetamide (NAD), and BA alone or in combination at petal-fall and/or 10 mm fruitlet size vs. including carbaryl with these thinners.

Method

In spring 2010, approximately 30 trees each of

Figure 1. Fruit size of Redmax McIntosh apples at time of thinning treatments.

'Redmax' McIntosh/B.9 and Macoun/M.9 in a 9th-leaf super-spindle apple orchard at the UMass Cold Spring Orchard in Belchertown, MA were selected for use in this study.

Thinning treatments (see below) were applied May 4, 2010, when fruitlet size was about 5 mm. (Figure 1.) Our original plan was to divide the treatments up between petal-fall and another application at 10 mm fruitlet size, however, because of warm weather conditions and rapidly developing fruit size, only one application of all treatments was made at this timing. (This should be considered a petal-fall application.) At the time of application, activity of the chemical thinner was predicted to be 'moderate.'

Treatments were applied to individual trees (5 trees per treatment) using a backpack sprayer calibrated to deliver a dilute application of water (based on tree row volume) to each tree with the desired concentration of thinning chemical. Hence, the application replicated a full orchard dilute (1X) application using an air-blast sprayer.

McIntosh treatments:

1. Untreated control
2. BA 100 ppm (Maxcel®)
3. NAA 10 ppm (Fruitone-L®)
4. BA 100 ppm + NAA 10 ppm
5. NAA 10 ppm + carbaryl (Sevin® XLR+) 1 pint per 100 gallons
6. BA 100 ppm + carbaryl 1 pint per 100 gallons

Macoun treatments:

1. Untreated control
2. BA 100 ppm
3. NAA 10 ppm
4. BA 100 ppm + NAA 10 ppm
5. NAD (Amid-Thin W) 50 ppm
6. BA 100 ppm + carbaryl 1 pt per 100 gallons

Data collected included the number of flower clusters prior to treatment, the final number of fruit per tree, and the individual fruit weight at harvest. Fruit set was calculated as the number of fruit per unit of trunk cross-sectional area.

Results

Results are presented in Tables 1, 2, and Figure 2.

Summarizing the results of Table 1 for McIntosh:

- There were no differences among treatments in the number of flower clusters per tree.
- There were no differences among treatments in the number of fruit per tree, however, it appears that the thinning treatments, as a whole, reduced the number of fruit (by 15 to 35%) compared to the control.
- There were no differences among treatments in fruit set (number per unit trunk cross-sectional area); however, like total number of fruit per tree, it appears that most thinning treatments reduced set compared to the control. In fact, with the exception of BA alone, all the thinning treatments (with or without carbaryl) reduced fruit set by about 30%.
- There were significant differences among treatments in fruit weight. The NAA + carbaryl treatment produced fruit that were larger than the control and BA treatments; however, it did not differ in fruit size from the NAA, BA + NAA, and BA +

Table 1. McIntosh bloom, fruit set, and fruit weight in 2010.[z]

Treatment	Number flower clusters	Number fruit	Fruit set (no. per cm^2)	Fruit weight (g)
Untreated control	85	118	12.8	150 b
BA 100 ppm	84	100	11.8	155 b
NAA 10 ppm	82	77	9.3	169 ab
BA + NAA	83	99	8.9	173 ab
NAA + carbaryl	80	89	8.7	189 a
BA + carbaryl	87	79	9.0	176 ab

[z] Within column, numbers not followed by a common letter are significantly different (Tukey HSD, $P = 0.05$).

Table 2. Macoun bloom, fruit set, and fruit weight in 2010.[z]

Treatment	Number flower clusters	Number fruit	Fruit set (no. per cm^2)	Fruit weight (g)
Untreated control	87	108 ab	7.6	172
BA 100 ppm	97	125 a	8.2	171
NAA 10 ppm	88	93 b	7.3	159
BA + NAA	95	93 b	7.0	180
NAD 50 ppm	89	108 ab	9.3	141
BA + carbaryl	90	89 b	7.1	167

[z] Within column, numbers not followed by a common letter are significantly different (Tukey HSD, $P = 0.05$).

carbaryl treatments.

Because every fruit from every tree was weighed individually, we were also able to look at the fruit size distribution by packed fruit size (Figure 2.). There are two distinct sets of 'curves' for size distribution—those for the control and BA alone and those for the rest of the thinning treatments. What this suggests is that all the thinning treatments -- particularly those with a combination of thinners, and whether or not carbaryl was included -- shifted fruit packout to higher size counts (88 ct. for example) vs. lower size counts (3 lb. bags) compared to the control and the BA-only treatments. Given our experience with apple fruit thinning, this is not an unexpected outcome, but does further suggest that thinning can be accomplished without carbaryl. Fruit size distribution was not analyzed for Macoun.

Summarizing the results of Table 2 for Macoun:

- There were no differences among treatments in the number of flower clusters per tree.
- The BA thinning treatment resulted in more fruit per tree compared to the NAA, BA + NAA, and

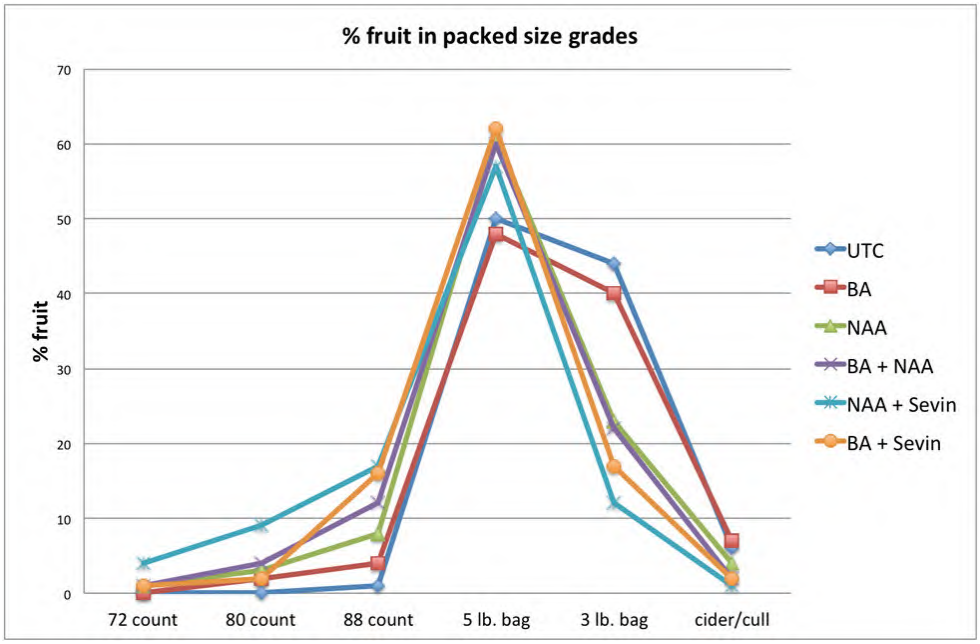

Figure 2. Fruit size distribution (packed fruit counts) by thinning treatment of harvested McIntosh apples.

BA + carbaryl treatments (i.e., BA alone did less thinning).

- Although not significantly different, the NAA, BA + NAA, and BA + carbaryl treatments reduced the number of fruit by 14 to 18% compared to the control.
- There were no differences among thinning treatments in fruit set.
- There were no differences among the thinning treatments in fruit weight at harvest.

Conclusion

For all chemical thinning treatments, fruit thinning was less than adequate. The target crop load for these trees was about 50 to 60 fruit per tree (1,000 bushels per acre), or about 5 to 6 fruit/cm^2 trunk cross-sectional area. A typical chemical thinning program uses another application when fruit size is about 10 mm -- usually after assessing the effectiveness of an earlier thinning application. This becomes problematic when the weather is warm and fruit are growing rapidly, as was the case in 2010.

Overall, BA alone appeared to be the weakest thinner. This is not surprising, as BA is typically more effective when fruitlets reach 10 mm diameter and is rarely applied as early as petal fall. Of greatest interest here is the fact the addition of carbaryl to the thinning treatments did not seem to reduce fruit numbers significantly (i.e., result in more thinning) compared to using NAA alone. The potential to use NAA without carbaryl for adequate fruit thinning needs further study. Plans are underway to do this research in 2011, using multiple treatment timings, and possibly including blossom thinning treatment(s). In addition, without using carbaryl, large-scale thinning recommendations will be made in orchard blocks by growers participating in the Advanced IPM protocol.

Targit Sales

"Specializing in Farm Market Packaging"

1-800-526-9224

Biodegradable

PLASTIC BAGS

Targit Sales is proud to introduce our line of Biodegradable plastic bags. Our bags use a proprietary additive that renders the plastic ultimately biodegradable.

We are offering the Biodegradable bag program with all of our "Custom Imprinted" plastic bags. Our Biodegradable bags have the "EPI" (the additive company) logo on the bag as proof of its biodegradable properties.

Advertise your business along with a "tag line" to express your company's efforts to keep your community and planet green.

Targit Sales can fully customize your bags to your specifications. We can make any size, strength, and style of bag to fit your needs. We can assist you with your design, setup, and artwork.

COMMON SIZES OF BAGS:

13 x 10 x 24 (Great for pies, cakes and corn)
12 x 8 x 24 (Great for your store front)
8 x 5 x 21 (Perfect size for tailgate markets)

BIODEGRADABLE PLASTIC BAG BENEFITS!

* Superior Strength!
* Less expensive to make and ship versus paper bags!
* Superior imprinting capability and quality...(looks better)!
* Easier and more affordable to store (inventory)!
* Flexibility! (customize the size, thickness, color and style to your specifications)
* Reusability!
* Biodegradable..breaks down quickly!

MOST COMMON QUESTIONS asked about biodegradable bags.

Will the bags begin to break down while being stored? No, the bags will retain its strength and integrity while properly stored. The breakdown only begins after it is directly exposed to certain environmental conditions such as: soil/landfill, heat/moisture, and sunlight.

Is this process more expensive? Not really, the cost increase is only a few percentage points higher. You will more than make this up with the goodwill you will be conveying to your community and customers.

Does the bag lose its strength or feel...does it look different? No, it is almost impossible to tell the difference between the Biodegradable bags and the traditional plastic bags. This is why we recommend putting a tag line on your printed biodegradable bags.

Can these bags be recycled and/or reused? Yes, these bags can be recycled and reused.

For more information or to order contact
Targit Sales
1-800-526-9224 • www.targitsales.com

Targit sales associates
"Specialty Food Packaging"