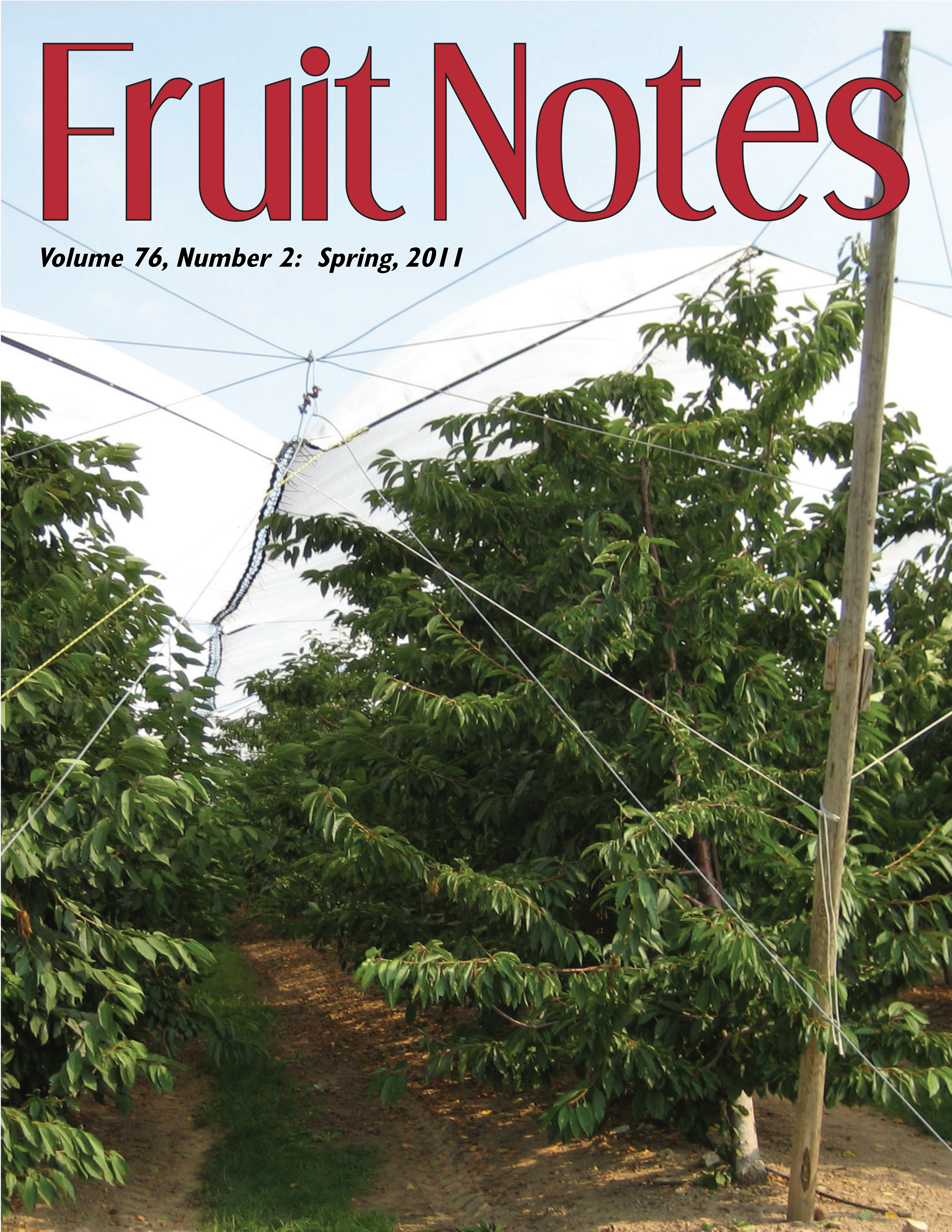
# Fruit Notes

*Volume 76, Number 2: Spring, 2011*



# Fruit Notes

Editors: Wesley R. Autio & Winfred P. Cowgill, Jr.

Fruit Notes (ISSN 0427-6906) is published four times per year by the Department of Plant, Soil, & Insect Sciences, University of Massachusetts Amherst. The cost of a 1-year subscription is $25.00. Each 1-year subscription begins January 1 and ends December 31. Some back issues are available for $6.50 each. Payments via check must be in United States currency and should be payable to the **University of Massachusetts Amherst**. Payments by credit card must be made through our website: *http://www.umass.edu/fruitadvisor/.*

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## Table of Contents



Cover: High-tunnel cherries at the New York Agricultural Experiment Station in Geneva, New York. Photo by Wesley R. Autio.

# Effects of Systemm-CAL and ProGibb on Jersey Peaches in Massachusetts and New Jersey

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Sysstem-CAL™ is a commercial formulation of calcium (4%) and copper (0.25%) intended for foliar applications. There are indications that Sysstem-CAL, additionally, may improve uptake of plant growth regulators. To study this potential with peaches, we conducted experiments in 2010 to determine if Sysstem-CAL could improve uptake of gibberellic acid for a potential reduction in peach flower bud formation.

### *Materials & Methods*

In 2010, 45 4-year-old PF14-Jersey/Lovell trees at the UMass Cold Spring Orchard (Belchertown, MA) and 63 3-year-old PF14-Jersey/Bailey trees at the Rutgers Snyder Farm (Pittstown, NJ) were selected for this trial. Nine treatments were allocated randomly among the trees at each location, giving five trees in MA and seven trees in NJ receiving each treatment. ProGibb was applied at rates of 0, 80, and 160 g per acre, and Sysstem-CAL was applied at 0, 2, and 4 quarts per acre. Nine treatments were derived from all combinations of these two chemicals: 0 ProGibb + 0 Sysstem-CAL, 80 ProGibb + 0 Sysstem-CAL, 160 ProGibb + 0 Sysstem-CAL, 0 ProGibb + 2 Sysstem-CAL, 80 ProGibb + 2 Sysstem-CAL, 160 ProGibb + 2 Sysstem-CAL, 0 ProGibb + 4 Sysstem-CAL, 80 ProGibb + 4 Sysstem-CAL, and 160 ProGibb + 4 Sysstem-CAL. All treatments were applied as tank mixes about 4 weeks before harvest (when new shoots had 20 buds), and all included 0.1% Regulaid as a surfactant. At the second

Figure 1. Leaf damage and associated leaf drop from 4 quarts Sysstem-CAL per acre applied prior to high temperatures in Massachusetts.

Table 1. Effects of varying ProGibb application rates with varying rates of Sysstem-CAL on Jersey peach fruit quality at harvest in Massachusetts and New Jersey.

| ProGibb (g/acre)[z] | Sysstem -CAL (qts/ acre)[z] | Average fruit weight (g) | Average fruit diameter (cm) | Flesh firmness (N) | Soluble solids concentration (%) | Return bloom (no./cm of shoot) |
|---|---|---|---|---|---|---|
| | | | ***UMass Cold Spring Orchard*** | | | |
| 0 | 0 | 239 | 7.61 | 48.0 | 11.7 | 0.40 |
| 0 | 2 | 239 | 7.61 | 46.3 | 10.9 | 0.43 |
| 0 | 4 | 232 | 7.56 | 47.3 | 10.8 | 0.42 |
| 80 | 0 | 233 | 7.56 | 55.6 | 10.9 | 0.29 |
| 80 | 2 | 228 | 7.48 | 57.3 | 11.2 | 0.28 |
| 80 | 4 | 208 | 7.21 | 58.6 | 10.6 | 0.26 |
| 160 | 0 | 225 | 7.46 | 57.8 | 11.2 | 0.17 |
| 160 | 2 | 237 | 7.59 | 55.7 | 10.7 | 0.16 |
| 160 | 4 | 201 | 7.15 | 59.3 | 10.2 | 0.15 |
| *Statistical Significance* | | | | | | |
| ProGibb | | $0.1053^{ns}$ | $0.0533^{ns}$ | <0.0001** | $0.0885^{ns}$ | <0.0001** |
| Sysstem-CAL | | 0.0206* | 0.0078** | $0.5455^{ns}$ | 0.0020** | $0.2734^{ns}$ |
| ProGibb X Syss-CAL | | $0.5600^{ns}$ | $0.3398^{ns}$ | $0.8442^{ns}$ | $0.2655^{ns}$ | $0.3456^{ns}$ |
| | | | ***Rutgers Snyder Farm*** | | | |
| 0 | 0 | 132 | 6.25 | 48.8 | 11.1 | 0.31 |
| 0 | 2 | 136 | 6.29 | 49.3 | 11.0 | 0.29 |
| 0 | 4 | 139 | 6.39 | 48.3 | 10.9 | 0.28 |
| 80 | 0 | 127 | 3.16 | 52.8 | 10.8 | 0.27 |
| 80 | 2 | 129 | 6.21 | 51.7 | 10.8 | 0.21 |
| 80 | 4 | 122 | 6.10 | 53.0 | 10.6 | 0.28 |
| 160 | 0 | 131 | 6.20 | 51.1 | 11.0 | 0.21 |
| 160 | 2 | 132 | 6.21 | 50.9 | 10.8 | 0.26 |
| 160 | 4 | 134 | 6.28 | 51.5 | 10.5 | 0.23 |
| *Statistical Significance* | | | | | | |
| ProGibb | | $0.0678^{ns}$ | $0.1252^{ns}$ | 0.0098** | $0.1950^{ns}$ | 0.0057** |
| Sysstem-CAL | | $0.8322^{ns}$ | $0.6865^{ns}$ | $0.9819^{ns}$ | $0.1096^{ns}$ | $0.7307^{ns}$ |
| ProGibb X Syss-CAL | | $0.7605^{ns}$ | $0.7622^{ns}$ | $0.9470^{ns}$ | $0.9060^{ns}$ | $0.0810^{ns}$ |

[z]Treatments were applied about 4 weeks before harvest and when there were approximately 20 buds per new shoot. All treatments included 0.1% Regulaid. For Sysstem-CAL treatments in Massachusetts, overall, 4 quarts/acre resulted in significantly lower average fruit weight, average fruit diameter, and soluble solids concentration. This reduction likely was related to leaf damage which occurred as a result of the 4-quart treatment. In both Massachusetts and New Jersey, ProGibb resulted in a linear decrease in return bloom.

commercial harvest, 10-fruit samples were collected from each tree. Fruit weight, diameter, flesh firmness, and soluble solid concentration were measured. In the spring of 2011, return bloom was assessed by selecting six shoots per tree between 30 and 60 cm long and counting the number of flower buds per shoot. Bloom data are presented as the number of flower buds per cm of shoot length.

### *Results*

Sysstem-CAL had a significant negative effect on fruit size and soluble solids concentration in MA but not in NJ (Table 1). This result likely was due to leaf burn caused by Sysstem-CAL in MA (Figure 1). Application was made when temperatures were in the 70's, but later in the day, they rose to near 90°F. Clearly, application should not occur when very warm temperatures are expected. Sysstem-CAL did not affect flesh firmness or return bloom at either location (Table 1).

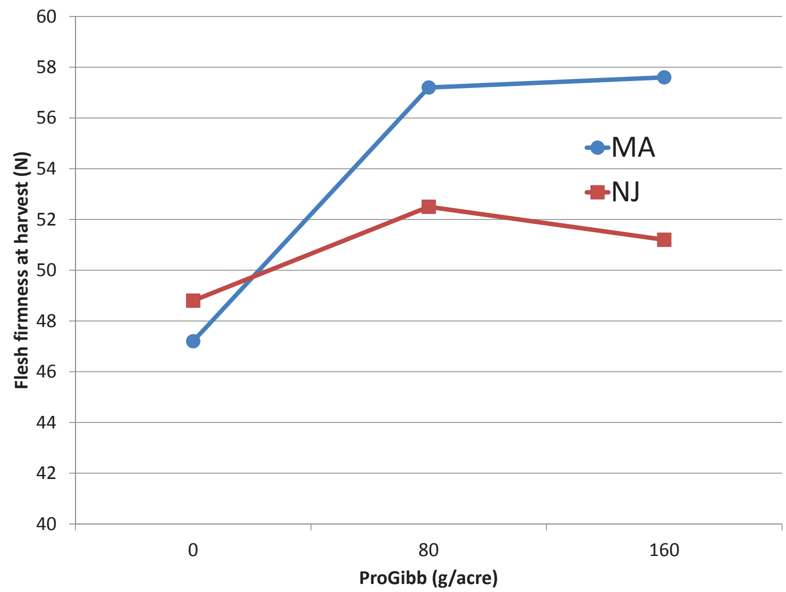


Figure 2. Effects of ProGibb on flesh firmness the year of application of PF14-Jersey peaches in Massachusetts and New Jersey.

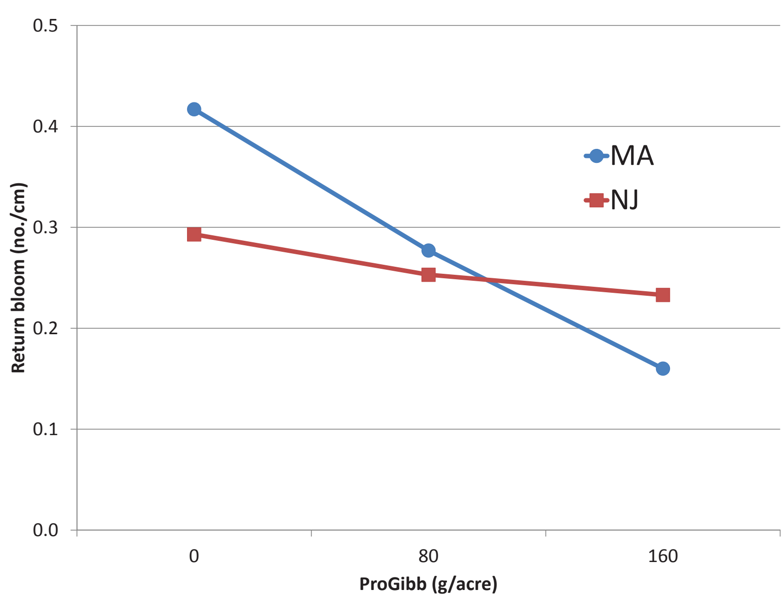


Figure 3. Effects of ProGibb on return bloom the year after application of PF14-Jersey peaches in Massachusetts and New Jersey.

ProGibb had a significant positive effect on flesh firmness (Figure 2, Table 1) and a significant negative effect on return bloom (Figure 3, Table 1) at both locations. Both effects were more pronounced in MA than in NJ. In both locations, it appears that the lower ProGibb rate is just as effective as the higher rate at increasing flesh firmness. Sysstem-CAL did not affect the trees' responses to ProGibb.

### *Conclusions*

This study confirms previous

research showing that gibberellic acid can reduce return bloom in peach, thus reducing potential thinning requirements the year following application. These data also suggest that 40g/acre rate likely will give more desirable reductions in bloom; in MA, the 160g/acre rate overthinned and resulted bare shoots with clusters of flowers near the shoot terminals. Growers should consider this approach for thinning at least some of the early ripening cultivars (earlier than Redhaven).

The additional benefit of increasing firmness the year of application may allow fruit to remain on the tree to a more advanced level of ripening.

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

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***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.

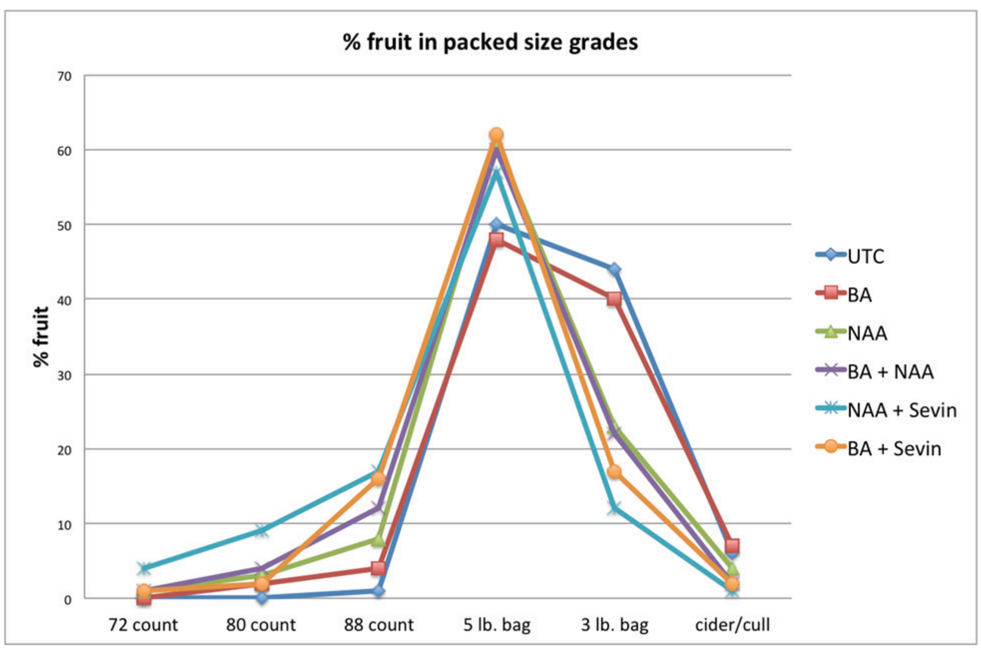


Figure 2. Fruit size distribution (packed fruit counts) by thinning treatment of harvested McIntosh apples.

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

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.

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# Efficacy of Standard and New Fungicides Against the Sooty Blotch/ Flyspeck Complex and Apple Scab

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The purpose of this project was to look at the effect of different fungicide programs on apple scab and sooty blotch/flyspeck. The difference in fungicides for scab management was fungicide selection, with a captan/mancozeb program compared to early applications of captan/mancozeb followed by applications of Luna Sensation. The sooty blotch/flyspeck program compared a standard calendar fungicide application schedule to one scheduled using a forecast model, and within the forecast model treatments, three different fungicide regimens (Topsin-M, Pristine and Flint).

## *Methods*

A block of 60 mature *Malus* x *domestica* cv. 'McIntosh' apple trees on M.7 rootstock located at the University of Massachusetts Cold Spring Orchard Research and Education Center, Belchertown, MA, were used in the study. This block has a history of heavy disease incidence. Applications were sprayed using a 50-gallon tractor-mounted airblast sprayer calibrated to apply 175 gallons per acre. Treatments were applied to five, single-tree replications for each of five treatments, including a non-sprayed control. Treatment trees were each separated by at least one buffer tree.

The primary goal of the experiment was to compare different fungicides and scheduling options for management of the summer blemish disease complex sooty blotch and flyspeck, with a secondary goal of comparing standard fungicides with Luna Sensation (fluopyram plus trifloxystrobin). During early primary apple scab season, two applications at half-inch green and tight cluster were identical in treatments 1 – 9, a captan plus mancozeb mix (Captan 80 WDG 2 lbs/A plus Penncozeb 80WP 3 lbs/A). For the remainder of primary scab season, two applications of the same mix was applied on treatments 1 – 8, while Luna Sensation (5 oz/A) was applied at the same times to treatment 9. Treatment 10 was an untreated control.

For summer applications, the first application of summer fungicide in treatments 1 – 6 and 9 were determined by a sooty blotch/flyspeck forecast model based on accumulated leaf wetness, with a threshold of 270 accumulated leaf wetness hours starting from the petal fall spray, the NY/New England model. These treatments were divided into two groups. Treatments 1 – 3 used remote weather data from a nearby airport (Westover, Chicopee, MA) and a fuzzy logic model to determine accumulated leaf wetness hours. Treatments 4 – 6 on-site data from a Hobo weather station to measure leaf wetness. Fungicides were also varied in these two groups, where treatments 1 and 4 received Topsin M 70WP 9 oz/A plus Captan 80WDG 2 lbs/A; treatments 2 and 5 received Pristine 38 WP 18.5 oz/A; and treatments 3 and 6 received Flint 50WG 2 oz/A. Treatment 7 was sprayed during primary scab season but was not sprayed with summer fungicides, treatment 8 was sprayed in summer when the orchard manager applied standard covers on production blocks, treatment 9 used the same timing as treatment 8 but used Luna Sensation, and treatment 10 was not sprayed.

Applications were made as indicated in Table 1. For primary scab, all treatments were the same, except treatment 9 received two applications of Luna Sensation instead of the Penncozeb/Captan combination for the pink and petal fall sprays. For summer diseases treatments, the treatments timed using the on-site 170 wet hour threshold received one more summer fungicide application than the treatments that were applied at a 353 wet hr. threshold, three and four applications, respectively. The grower standard treatment, 8, received five summer fungicide applications.

Table 1. Application materials and schedule.

| Growth stage or summer spray determination method & date | Trts. applied: number | Fungicide and rate per 100 gal.* |
|---|---|---|
| 1/2" Green | 1-9 | Pennconzeb 80WP 3lbs/A + Captan 80WDG 2lbs/A |
| 4/8/10 | | |
| Tight cluster | | |
| 4/15/10 | 1-9 | Pennconzeb 80WP 3lbs/A + Captan 80WDG 2lbs/A |
| Pink, 1st bloom | 1-8 | Pennconzeb 80WP 3lbs/A + Captan 80WDG 2lbs/A |
| 4/22/10 | 9 | Luna Sensation 5 oz./A |
| 95% P.F. | 1-8 | Pennconzeb 80WP 3lbs/A + Captan 80WDG 2lbs/A |
| 5/3/10 | 9 | Luna Sensation 5 oz/A |
| Grower standard | | |
| 5/9/10 | 8 | Pennconzeb 80WP 3lbs/A + Captan 80WDG 2lbs/A |
| | 9 | Luna Sensation 5 oz/A |
| Remote weather, | 1 | Topsin M 70WP 9 oz/A + Captan 80WDG 2lbs/A |
| SBFS model | 2 | Pristine 38WP 18.5 oz/A |
| 6/2/10 | 3 | Flint 50WG 2 oz/A |
| On-site weather | 1 | Topsin M 70WP 9 oz/A + Captan 80WDG 2lb./A |
| plus | 2 | Pristine 38WP 18.5 oz/A |
| Remote weather | 3 | Topsin M 70WP 9 oz/A + Captan 80WDG 2lb./A |
| SBFS model | 4 | Topsin M 70WP 9 oz/A + Captan 80WDG 2lb./A |
| Plus | 5 | Pristine 38WP 18.5 oz/A |
| Grower standard | 6 | Flint 50WG 2 oz/A |
| 6/22/10 | 8 | Topsin M 70WP 9 oz/A + Captan 80WDG 2lb./A |
| | 9 | Luna Sensation 5 oz/A |
| Grower standard | | |
| 7/8/10 | 8 | Captan 80WDG 3 lbs/A |
| On-site weather | 1 | Topsin M 70WP 9 oz/A + Captan 80WDG 2lb./A |
| plus | 2 | Pristine 38WP 18.5 oz/A |
| Remote weather | 3 | Topsin M 70WP 9 oz/A + Captan 80WDG 2lb./A |
| SBFS model | 4 | Topsin M 70WP 9 oz/A + Captan 80WDG 2lb./A |
| plus | 5 | Pristine 38WP 18.5 oz/A |
| Grower standard | 6 | Flint 50WG 2 oz/A |
| 7/21/10 | 8 | Topsin M 70WP 9 oz/A + Captan 80WDG 2lb./A |
| | 9 | Topsin M 70WP 9 oz/A + Captan 80WDG 2lb./A |
| Final cover | 1-6,8,9 | Captan 80WDG 2lb./A |
| 8/11/10 | | |

* Calculated from per acre rates based on 300 gal/A. Tree row volume was 175 gal/A.

Table 2. Apple scab incidence after primary scab season.

| Trt. no. | Treatment<br>Primary scab → summer* | Scab incidence % 20 May**<br>Terminal | <br>Cluster | <br>Fruit |
|---|---|---|---|---|
| 1. | Mancozeb/captan → Topsin/captan ............ | 70 ab | 31 b | 2 bc |
| 2. | Mancozeb/captan → Pristine ....................... | 54 b | 25 b | 1 bc |
| 3. | Mancozeb/captan → Flint............................ | 56 b | 27 b | 5 b |
| 4. | Mancozeb/captan → Topsin/captan ............ | 68 b | 27 b | 2 bc |
| 5. | Mancozeb/captan → Pristine ....................... | 56 b | 13 b | 5 b |
| 6. | Mancozeb/captan → Flint............................ | 63 b | 29 b | 8 b |
| 7. | Mancozeb/captan → none ........................... | 61 b | 25 b | 3 bc |
| 8. | Mancozeb/captan → standard ..................... | 51 b | 25 b | 3 bc |
| 9. | Luna Sensation ............................................ | 30 c | 15 b | 0 c |
| 10. | Unsprayed check .......................................... | 89 a | 75 a | 31.3 a |

*Refer to Table 1 for treatment details.
**Numbers followed by different letters indicate a significant difference by Tukey-Kramer HSD (*P* = 0.05).

Table 3. Apple scab incidence at harvest.

| Trt. no. | Treatment<br>Primary scab → summer* | First summer fungicide timing | Scab incidence % harvest**<br>Terminal | |
|---|---|---|---|---|
| 1. | Mancozeb/captan → Topsin/captan ....... | SBFS model, on-site | 43 | b,c |
| 2. | Mancozeb/captan → Pristine ................. | SBFS model, on-site | 21 | d |
| 3. | Mancozeb/captan → Flint....................... | SBFS model, on-site | 20 | d |
| 4. | Mancozeb/captan → Topsin/captan ....... | SBFS model, remote | 44 | bc |
| 5. | Mancozeb/captan → Pristine ................. | SBFS model, remote | 49 | bc |
| 6. | Mancozeb/captan → Flint....................... | SBFS model, remote | 52 | bc |
| 7. | Mancozeb/captan → none ...................... | none applied | 56 | b |
| 8. | Mancozeb/captan → standard ............... | commercial standard | 29 | d |
| 9. | Luna Sensation ........................................ | SBFS model, on-site | 24 | d |
| 10. | Unsprayed check .................................... | none applied | 74 | a |

*Refer to Table 1 for treatment details.
**Numbers followed by different letters indicate a significant difference by Tukey-Kramer HSD (*P* = 0.05).

On May 20, each treatment tree was evaluated by arbitrarily selecting ten terminals, clusters or fruit (depending on the tissue being evaluated) in four quadrants of the tree, corresponding approximately to north, south, east and west. Each tissue type was evaluated for disease incidence on a presence/absence basis. Percent disease in each quadrant was calculated, and treatments were compared using analysis of variance and the Tukey-

Kramer HSD mean comparison test ($P$ = 0.05; JMP 7.0.2, SAS Institute, Inc.). The harvest fruit rating was done similarly on September 2.

## *Results*

Results for primary scab are shown in Table 2. The highest incidence rates for scab were on terminal leaves relative to cluster leaves and fruit. On terminal leaves, the treatment that included two Luna Sensation applications performed significantly better than the treatments that used Penncozeb/Captan combinations exclusively. On cluster leaves, all fungicides treatments had significantly less scab than the unsprayed control, but there were no significant differences between fungicides. On fruit scab at the end of primary scab there were not always significant separations between the Penncozeb/Captan combinations and Luna Sensation, though there were some. This may be related to the overall low rates of primary fruit scab. It is worth noting that scab pressure was low in 2010. Table 5 shows that the most significant infection period in terms of rain came at bud break, and very little inoculum was mature. Later infection periods were light.

Harvest scab results are shown in Table 3. All fungicides performed better than the unsprayed control. Differences between fungicides appear to be related to the number of applications and the type of material used in the summer fungicide program. Treatments that included Luna Sensation, used four applications of either Pristine or Flint, or the five application commercial standard all had significantly less scab than the other treatments which used Topsin/Captan or applied only three applications.

Table 4 shows the incidence of sooty blotch and flyspeck at harvest. The pressure from SBFS was quite low in 2010, as determined by incidence on the unsprayed check. Normally, incidence between 50 and 100% would be seen. This was probably related to dry weather during the summer, and the relatively early harvest on the cultivar used in the test, McIntosh.

All treatments had significantly less flyspeck than the untreated control, with the exception of the standard mancozeb/captan treatment for primary scab followed by no summer fungicides. Both treatments that received no summer fungicide had high levels of flyspeck. There was no significant difference in terms of flyspeck between the no-summer fungicide check and the treatments that received only three fungicide applications as directed by the on-site leaf-wetness model. However, the remote model directed sprays did have significantly less flyspeck (0%) than either check or the on-site directed sprays. There was no difference between the types of summer fungicide within each

Table 4. Sooty blotch and flyspeck incidence at harvest.

| Trt. no. | Treatment Primary scab → summer* | First summer fungicide timing | Sooty blotch & flyspeck incidence % harvest: Flyspeck | | Sooty blotch | |
|---|---|---|---|---|---|---|
| 1. | Mancozeb/captan → Topsin/captan | SBFS model, remote | 0 | c | 0 | b |
| 2. | Mancozeb/captan → Pristine | SBFS model, remote | 0 | c | 0 | b |
| 3. | Mancozeb/captan → Flint | SBFS model, remote | 0 | c | 0 | b |
| 4. | Mancozeb/captan → Topsin/captan | SBFS model, on-site | 8.8 | b | 0 | b |
| 5. | Mancozeb/captan → Pristine | SBFS model, on-site | 1.3 | bc | 0 | b |
| 6. | Mancozeb/captan → Flint | SBFS model, on-site | 3.8 | bc | 0 | b |
| 7. | Mancozeb/captan → none | none applied | 13.0 | ab | 0.7 | ab |
| 8. | Mancozeb/captan → standard | commercial standard | 0 | c | 0 | b |
| 9. | Luna Sensation | SBFS model, standard | 0 | c | 0 | b |
| 10. | Unsprayed check | none applied | 17.6 | a | 2.3 | a |

*Refer to Table 1 for treatment details.
**Numbers followed by different letters indicate a significant difference by Tukey-Kramer HSD ($P$ = 0.05).

Table 5. Weather data at the UMass Cold Spring Orchard, Belchertown for primary apple scab season, 2009.

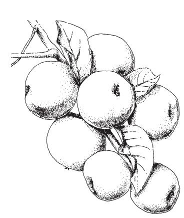
| Date | High | Low | Wet hours | Scab ascospore maturity | Growth stage | Mills | Cornell |
|---|---|---|---|---|---|---|---|
| 03/29 | 51.7 | 42.3 | 24.0 | 0 | | Medium | Infected |
| 03/30 | 48.8 | 39.3 | 18.8 | 0 | | Heavy | Infected |
| 03/31 | 48.8 | 44.5 | 16.0 | 1 | | Heavy | Infected |
| 04/01 | 66.3 | 42.3 | 4.0 | 2 | GT | Heavy | Infected |
| 04/02 | 73.9 | 40.0 | 0.3 | 2 | | None | None |
| 04/03 | 74.6 | 44.5 | 0.0 | 3 | | None | None |
| 04/04 | 71.8 | 43.7 | 3.0 | 4 | | None | None |
| 04/05 | 71.1 | 44.5 | 0.0 | 6 | | None | None |
| 04/06 | 71.8 | 48.8 | 1.3 | 8 | HIG | None | None |
| 04/07 | 87.4 | 41.5 | 0.0 | 11 | | None | None |
| 04/08 | 73.9 | 49.6 | 0.8 | 16 | | None | None |
| 04/09 | 51.7 | 38.5 | 10.0 | 18 | | None | None |
| 04/10 | 56.6 | 34.6 | 0.0 | 20 | | None | None |
| 04/11 | 64.9 | 42.3 | 0.0 | 23 | | None | None |
| 04/12 | 57.3 | 38.5 | 0.0 | 26 | | None | None |
| 04/13 | 59.4 | 32.2 | 0.0 | 29 | | None | None |
| 04/14 | 65.6 | 31.4 | 0.0 | 32 | | None | None |
| 04/15 | 67.0 | 42.3 | 0.3 | 35 | TC | None | None |
| 04/16 | 48.1 | 36.2 | 11.8 | 37 | | None | None |
| 04/17 | 48.1 | 36.9 | 16.3 | 39 | | None | Infected |
| 04/18 | 50.3 | 34.6 | 1.0 | 40 | | None | None |
| 04/19 | 57.3 | 36.9 | 0.0 | 43 | PINK | None | None |
| 04/20 | 67.7 | 37.7 | 0.0 | 47 | | None | None |
| 04/21 | 69.7 | 38.5 | 0.0 | 51 | | None | None |
| 04/22 | 69.7 | 45.2 | 5.8 | 56 | | None | None |
| 04/23 | 64.9 | 38.5 | 1.0 | 59 | BLOOM | None | None |
| 04/24 | 69.7 | 37.7 | 0.0 | 63 | | None | None |
| 04/25 | 57.3 | 47.4 | 4.8 | 67 | | None | None |
| 04/26 | 62.8 | 44.5 | 6.8 | 70 | | None | None |
| 04/27 | 50.3 | 33.0 | 13.8 | 72 | | Light | Infected |
| 04/28 | 43.0 | 31.4 | 5.8 | 73 | | None | None |
| 04/29 | 60.8 | 34.6 | 0.0 | 76 | | None | None |
| 04/30 | 74.6 | 39.3 | 0.0 | 80 | | None | None |
| 05/01 | 85.9 | 51.7 | 0.0 | 85 | | None | None |
| 05/02 | 87.4 | 60.8 | 0.0 | 90 | | None | None |
| 05/03 | 78.8 | 59.4 | 9.5 | 94 | 95% PF | Light | Infected |
| 05/04 | 78.8 | 48.8 | 2.8 | 96 | | None | None |
| 05/05 | 79.5 | 46.7 | 0.8 | 98 | | None | None |
| 05/06 | 73.9 | 51.0 | 2.5 | 99 | | None | None |
| 05/07 | 70.4 | 42.3 | 0.0 | 99 | | None | None |
| 05/08 | 66.3 | 43.7 | 11.5 | 99 | | None | Infected |
| 05/09 | 50.3 | 35.4 | 0.0 | 99 | | None | None |
| 05/10 | 56.6 | 32.2 | 0.0 | 99 | | None | None |
| 05/11 | 59.4 | 32.2 | 0.0 | 99 | | None | None |
| 05/12 | 46.7 | 39.3 | 10.5 | 99 | | None | None |
| 05/13 | 67.7 | 32.2 | 6.8 | 99 | | None | None |
| 05/14 | 73.9 | 46.7 | 8.8 | 99 | | None | None |
| 05/15 | 69.7 | 49.6 | 1.0 | 99 | | None | None |
| 05/16 | 71.8 | 43.7 | 0.0 | 99 | | None | None |
| 05/17 | 76.7 | 41.5 | 0.5 | 99 | | None | None |


Figure 1. Accumulated leaf wetness hours from petal fall from an on-site weather station with a leaf wetness sensor (Hobo, Onset Computer Corp., Pocassett, MA) and a remote data source (Westover Air Base, Chicopee, MA) using a fuzzy logic model to estimate leaf wetness. The horizontal line indicates 270 ALWH.

treatment regimen. Sooty blotch incidence over all treatments was extremely low, and all fungicide treatments showed no sooty blotch.

The difference between the on-site and off-site directed summer sprays was a single spray, applied to remote treatments on June 2. The first on-site monitoring spray was applied on June 22. Figure 1 shows the accumulated leaf wetness hours for each of the two methods, and shows that the two data sources differed significantly. The off-site fuzzy logic model reached a 270 threshold on May 25, while the on-site data did not reach 270 ALWH until June 19, over three weeks later. Note that the off-site fuzzy logic directed application was not made until a week after the threshold, as there was a change in the model made during May, and there were difficulties getting remote data until 1 Jun.

The results indicate that the fuzzy logic directed sprays were conservative in terms of disease management, while the on-site data was not conservative enough. One should not expect the 270 ALWH threshold, developed using on-site string-based equipment, to work with either the on-site electronic sensor or the remote fuzzy logic model. While the data correlate, the absolute values for the thresholds in each case would be expected to be different. Others have found that electronic sensors work well with a threshold of 170 ALWH, and in this work that would have generated an application date for the on-site model of June 6. Based on the efficacy of the June 2 applications, these would be expected to have been very effective. It is not clear what an appropriate threshold might be for the fuzzy logic model. A similar model used by SkyBit has a threshold of 350 ALWH. This issue will need to be addressed next year.



# Blackberry Variety Selection Opportunities

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### *Introduction*

Blackberries offer another small fruit option for eastern US growers for a range of markets. The major issues for Pennsylvania and Mid-Atlantic growers when considering blackberry varieties include winter hardiness, maturity date, quality, yield, berry size, and overall adaptation. I will share some information in general about blackberries, some market and production changes in the US, and finally some variety thoughts for Mid-Atlantic growers.

Blackberry and raspberry plants are rather unique in the fruit world in that they have a perennial root system but have biennial canes. This means the canes live two years and then die. The two cane types are primocanes, or first-year canes, and floricanes, which are second-year canes. In red raspberry, primocane- and floricane-fruiting varieities exist and both have substantial commercial value. In blackberries, floricane-fruiting has been the basis of all blackberry production and commercial primocane-fruiting varieties did not exist prior to the release of Prime-Jim®, Prime-Jan®, and Prime-Ark® 45 by the University of Arkansas. Primocane fruiting offers the opportunity for late summer and fall production, to complement summer production of blackberries. However, there is much to be done in the improvement of primocane blackberries and all the answers are not in place yet for Mid-Atlantic growers.

### *Aspects of Blackberry Production History*

A survey of eastern U.S. (east of the Rocky Mountains) production in 1990 indicated blackberries were marketed in the following ways: 62% pick-your-own, 36% pre-picked fresh market (mainly on-farm or local fruit stand sales), and 2% processed. The survey results did not indicate that any production was for shipping to distant markets or grocery stores. In this survey, production area increased 56% from 1980 to 1990, with a further projected 66% increase in production area from 1990 to 2000. Again, this increase was envisioned to be largely marketed locally. In the early 1990s, blackberries were not found on grocery store shelves across the U.S (some were present on the west coast), due mainly to the lack of postharvest handling capability of varieties released prior to that time, but also because blackberries had never made much headway into the competition for commercial grocery shelf space.

Some of the new varieties beginning to be planted in the early 1990s were found to have fruit firmness adequate for shipping. Chester Thornless displayed a good level of firmness and shelf life, and in the world picture became a major shipping berry later in the decade. The Arkansas-released Navaho was found to have excellent shelf life. Subsequent releases from Arkansas included 'Arapaho' and 'Apache', each of which had fruit capable of withstanding shipping. These varieties contributed to a major shift in the production outlook for shipping of blackberries from that of a local-marketed crop to one shipped for retail marketing.

A major development occurred during the 1990s: the shipping of blackberries to the U.S. from Chile and Guatemala. Soon thereafter, the development of production technology in Central Mexico increased availability of eastern US-developed blackberries. Mexican production is centered in the highlands of the state of Michoacan and Jalisco, and utilizes a number of techniques to force the Brazilian variety Tupy (an offspring of the Arkansas variety Comanche) to flower and fruit in an area of no chill. The fruit is harvested from mid October until May or early June in this region, and currently provides fresh blackberries for U.S.

grocery shelves during the winter months. Mexican production has supplanted Chilean blackberry shipping to the U.S. due to less expensive transportation costs of trucking fruit from Mexico compared to air freight required to move blackberries from Chile. Production area in Mexico is estimated to be 6000-8000 acres. The presence of berries in the marketplace in the winter and late spring enhanced the consumer's awareness of blackberries as a grocery item rather than a local item picked on a farm or from wild plants. The bottom line is that now blackberries are a year-around produce item!

American berry shippers (in the eastern and western US) also took note of the expanded potential of blackberries in the shipping market, spurred by the success of the Mexican berries shipped and marketed during the "off" season. These marketers felt that if off-season sales could be this successful, why not have expanded marketing during the "normal" US berry production seasons? This has led to an expansion in acreage grown for shipping since the early to mid 2000s, particularly in southern Georgia, Arkansas, Texas, and North Carolina. California greatly increased production in recent years also.

Local production for pick-your-own, farmers markets, or on-farm sales has also increased recently, though it is difficult to determine trends in this area due to few production statistics being available. However, the expanding number of thornless variety options, enhanced fruit quality, and increased interest in berry consumption for human health benefits should positively impact this type of production.

## Primocane-Fruiting in Blackberries

The first recorded occurrence of a primocane-fruiting blackberry that I am aware of was a wild plant found by L.G. Hillquist of Ashland, Va. There is no record of breeding with this plant until Dr. Jim Moore obtained it in the mid-1960s while accumulating germplasm for the University of Arkansas breeding program. Although primocane fruiting was not pursued for many years in Arkansas breeding, seedlings evaluated in 1997 resulted in Prime-Jim® and Prime-Jan®, released in 2004. Primocane fruiting has been vigorously pursued in Arkansas breeding since the late 1990s, and great headway has been made in improving fruit quality, incorporating thornlessness, and shifting the fruiting period to both earlier and later ripening.

## Blackberry Varieties to Consider

*Chester Thornless.* Although I would like to recommend an Arkansas variety as my top choice for Mid-Atlantic growers, this variety has provided sustained high yields and good hardiness. The main disadvantage of the USDA-ARS-developed Chester Thornless is overall flavor and quality. It ships exceptionally well, but percent soluble solids is not as high as most fresh-fruit consumers desire and a tart taste is normally noted unless fully ripe. This is a semi-erect-caned type. There are other varieties of this cane type such as Hull Thornless, Black Satin, Thornfree, Dirksen Thornless, and Smoothstem, and all are likely adapted to the Mid Atlantic (they originated in southern Illinois or Maryland), but concerns of tart flavor are often expressed. These varieties tend to be later than Arkansas developments, fruiting in late June to early July in Arkansas.

*Triple Crown.* The last release of the USDA-ARS varieties, Triple Crown is renowned for exceptional flavor. Some consider this the best-tasting eastern US blackberry. It is moderate to high yielding, appears to have adequate hardiness for the Mid-Atlantic (maybe not quite as hardy as Chester Thornless?), and is earlier in ripening than Chester Thornless (ripens about June 25-30 in Arkansas). The biggest drawback to Triple Crown is berry firmness, and it is not considered a shipping berry. For local markets with short holding times, and pick your own, it is a winner.

*Ouachita.* If you consider one Arkansas variety, consider this one. It is successful coast to coast in the US, although I have not heard confirmations of its hardiness potential across the entire Mid-Atlantic region. Ouachita produces high yields of high quality berries (6-7 g) with soluble solids of 10-11%. It has erect canes, and ripens about June 10 in Arkansas. It has shown broad adaptation, and has been a major variety in expansion of the domestic shipping blackberry industry.

*Navaho.* The first Arkansas thornless, Navaho is considered by some to be the best shipping blackberry available. It has medium berry size (5 g) and moderate yield capacity. Sweetness is very good, usually 11-12% soluble solids. Its hardiness has been found to be good in the lower Midwest, and in some areas of the Mid-Atlantic. It is susceptible to orange rust, a fungal disease. It has erect canes, and ripens about June 20 in Arkansas.

*Apache.* The large-fruited Apache (10-11 g) is admired by some growers, and it has high vigor, productive, and healthy plant characteristics. It averages 11% soluble solids, and ripens about June 25 in Arkansas. Hardiness is not fully known for the Mid-Atlantic, but possibly information exists on this in trials in the region. The major negative attribute of Apache is that white drupes are often seen on some berries, particularly early in the season. This is a very serious defect for shipping, but local sales are usually not impacted as greatly. Concerns among grower reports vary from major to none on this trait.

*Natchez.* The newest of the Arkansas thornless , Natchez ripens about June 5 in Arkansas. It has large, long berries, and is eye catching on the vine or in the clamshell. Hardiness is not known on this 2007 release, so care should be taken to determine if it is adapted to the Mid-Atlantic. It averages about 9.5% soluble solids, and berries can be tart if crop load is excessive as it can be in some southern plantings.

*Prime-Ark® 45.* The first shipping-quality primocane-fruiting blackberry released in 2009, it is hoped that Prime-Ark® 45 will provide the basis for developing a late summer to fall-fruiting blackberry production season in the US. It has large berries (up to 10 g) with good soluble solids (10% commonly) that stay black in storage along with good firmness retention. The floricane crop ripens June 5 in Arkansas, and the primocane crop in mid-August. However, the primocane crop ripe date depends on location. Along the Central Coast of California, first ripe is usually Sept. 1, and in Oregon's Willamette Valley mid-September. This variety has been tested at Penn State Univ. by Kathy Demchak, and a limitation has been getting good yields before cold temperatures develop. High tunnels have helped, but trials are continuing to determine if adequate yields can be attained in the region. Only trials of the variety are suggested at this time.

*Prime-Jan®*. Released as one of the first primocane-fruiting blackberries in 2004, this variety was originally intended for home garden use. However, limited trials have found it to have some commercial potential. Quality is acceptable, with moderate storage capability and soluble solids on average about 9%. It ripens earlier than Prime-Ark® 45 by about 2 weeks, so has a potential of maturing more of the fall crop prior to frost. However, its crop has not fully ripened (non-high tunnel grown) in upstate New York. Again, testing the variety for specific locations and management (high tunnel or not) is recommended prior to full commercial use is considered.

John R. Clark is a university professor of horticulture at the University of Arkansas. His research responsibilities are his primary appointment, where he directs the University's Division of Agriculture fruit breeding program and manages the intellectual property rights of the program's developments. Crops he works with include blackberries, table grapes, muscadine grapes, blueberries, and peaches/nectarines. His research activities are carried out in Arkansas, several US states, and various countries in the world. He also teaches in the areas of plant breeding and fruit production and advises graduate and undergraduate students. A native of Mississippi, he has BS and MS degrees from Mississippi State Univ. and a PhD from the Univ. of Arkansas.

# Remembering "Doc" Childers: 1911 - 2011

**Dick Meister**
***Chairman Emeritus and Editor-At-Large, MeisterMedia***

Reprinted from *American Fruit Grower*, June 2011 issue.

The "grand old man of horticulture" is gone. Dr. Norman Franklin Childers was 100 years old when he passed away on April 24, 2011 after a lifetime of achievement educating, training, and researching fruit growers and fruit scientists.

Childers was a product of the land grant college system and its greatest supporter and defender. He is one of a remarkable line of leaders who devoted their lives to fruit science, and whose ranks are being thinned as more funding goes to the new sciences of biotechnology, genomics, and nanotechnology. He fought against the decrease in funding for workers involved in the personal and practical development of the art and science of horticulture; continually emphasizing that on-site research, training, and help are still vitally needed.

He was energetic, hardly ever took a vacation, and not only was a leader in applied research, but also got great enjoyment in working in the orchards with growers.

He had the genes of an editor. His book, *Modern Fruit Science*, was translated into four languages and went through many editions. When his *The Strawberry* book sold out, he brought out a new edition. His *The Blueberry* book is a classic and has stimulated a growing blueberry industry across the country. He also edited *Fruit Nutrition*, *The Peach*, and *The Pear*, and was editor of the Proceedings for the Florida State Horticultural Society for 12 years.

Childers was born in Moscow,

ID, where his father was head of the Soil Science Department at the University of Idaho. His father was also one of the first county agricultural Extension agents, and Norm followed in his footsteps, getting his B.S. and Master's degrees at the University of Missouri, and a Ph.D. in Pomology under Professor A.J. Heinicke at Cornell University.

After spending four years on tropical ag research in Puerto Rico, he moved to Rutgers University in New Jersey in 1947, where for 18 years he headed the Horticulture Department. After retirement in 1981, he moved to Gainesville and the University of Florida where he was adjunct professor for many years. Even as an adjunct professor at Florida, he was able to create enthusiasm for the practice of horticulture. He started a course for all students called Growing Fruits for Fun and Profit and at one time had more than 400 registered from all over the university.

In the 70s, Childers, who believed in getting out and seeing people and places, took a sabbatical and visited many former students in a trip around the world. A byproduct of that trip was that he was able to bring new technology and stimulated new fruit production programs, particularly blueberries and strawberries in South Africa, and peaches in southern Romania.

He won numerous awards, and his favorite association was the American Society for Horticultural Science, where he missed only three meetings in 65 years. He has endowed awards for horticulture students and grad students to encourage people to get into horticulture and homology in order to keep the art and science and practice available to everyone. He often said he would like to be remembered for the students he taught and trained and supported with scholarship awards and endowments. He is proud of the fact that these efforts will continue as he provided for them in his estate plan.

When asked what the secret was to his longevity, he said, "There is no secret. I think the reason is that I have kept busy. No sitting around.

***Editors Note:*** Doc Childers was one of my fist mentors as a graduate student at Rutgers University, Cook College. I began my graduate studies in the Department of Horticulture on a partial scholarship from Gerber Baby Foods with Drs. Hough and Bailey. Money was tight and Doc gave me work moving and organizing all his published books, like *Modern Fruit Science* and *Fruit Nutrition*. Doc published his own books and filled the orders. He provided tremendous mentorship, guidance and support during my studies and encouraged me to take my first career job as a Rutgers Cooperative Extension Agent. As a grad student, Doc encouraged us to attend American Society of Horticultural Science meetings. I chauffeured Doc and the other students in one of his old, big, black Cadillacs that he loved to own. I attended my first International Dwarf Fruit Tree Association Meeting with Doc Childers and Ernie Christ in NH in the summer of 1978. What an introduction to this fine organization that made for me! Traveling with Doc and Ernie jumpstarted my 33-year career as a fruit extension agent. I will always be grateful to Doc for his wisdom, guidance, encouragement and humor. I know thousands of others will as well. -- Win Cowgill

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