Fruit Notes

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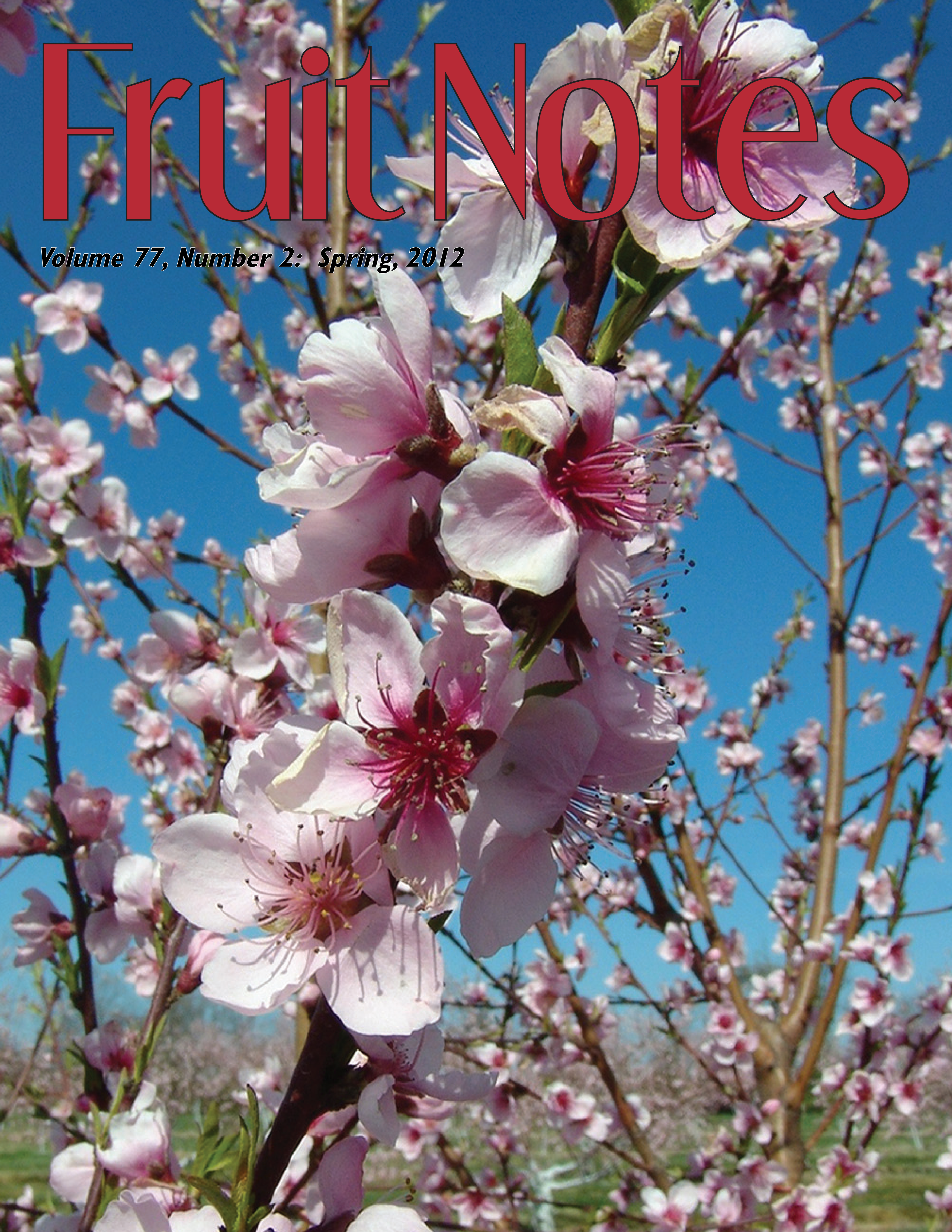

Fruit Notes

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Cover: March 2012 peach bloom at Rutgers Snyder Research & Extension Farm, Pittstown, NJ. Photo by Win Cowgill.

Blondee® (USPP 19,007) ‘Delight at First Bite’

Wanda Heuser Gale
International Plant Management

Wanda Heuser Gale of International Plant Management, Lawrence, MI, looks at new apple varieties and mutations all the time. Sent to us in boxes and bags, the discoverers are hoping they’ve found “the next new Honeycrisp™”. Blondee® arrived in one of those boxes and really caught our eye. The original tree was found nearly ten years ago at McLaughlin Orchards in Portsmouth, Ohio. There it sat high on a steep ridge overlooking the Ohio River and sticking out like a diamond in the rough; a bright, clear, yellow apple in a sea of red and green.

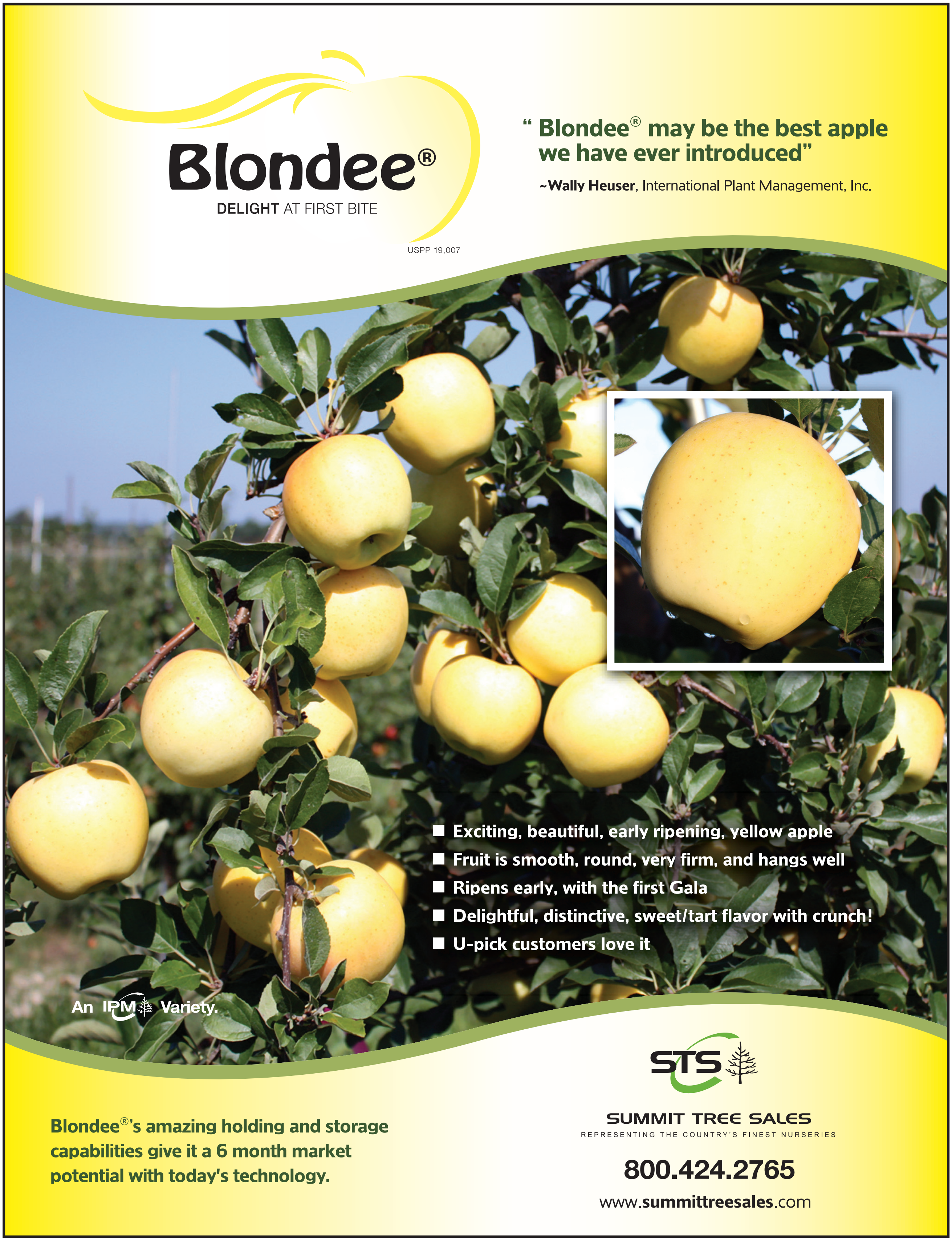
The exciting things about Blondee® are what we always look for in a new apple variety. She possesses them all: the flavor is sweet and juicy with a zing; crisp and crunchy texture, long lasting firmness, and a beautiful clear yellow color with smooth skin and very few lenticels. A bin of Blondee® has a yellow, translucent glow.

Blondee® handles well and has an unbelievable storage life. We’ve held it in our small walk-in cooler for up to ten months and it remains firm and crunchy. The apple picks at 18 to 20 pounds and holds that pressure for months, keeping longer and in better shape than any other apple we have seen.

Its early ripening time at the beginning of Gala season makes Blondee® an excellent choice for u-pick and retail operations. She has a very long ripening period, holding two to three weeks on the tree and ripening in a season when a good yellow apple is not available. A grower at one of our favorite U-pick operations in Michigan tells us that after Honeycrisp, Blondee® is the apple customers ask for more than any other variety. Both children and adults love them and have begun to ask for them.

The Blondee® tree looks and acts much like a Gala tree. It responds well to thinning and short pruning and the fruit will size better if those steps are taken. Blondee® is an annual bearer with good blossom set and hardiness. The tree has a medium susceptibility to fireblight.

We see great things for Blondee® – she’s making a name for herself. This variety has everything that a world class apple needs; flavor, quality, holding ability, a beautiful appearance and a great name. Blondee®, delight at first bite.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USPP 19,007
" Blondee® may be the best apple we have ever introduced"
~Wally Heuser, International Plant Management, Inc.
Exciting, beautiful, early ripening, yellow apple
Fruit is smooth, round, very firm, and hangs well
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Delightful, distinctive, sweet/tart flavor with crunch!
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Options, Benefits, and Liabilities for Copper Sprays in Tree Fruits

Dave Rosenberger
Hudson Valley Laboratory, Cornell University

Copper fungicide/bactericide sprays have proven useful for managing fire blight of apples and pears, peach leaf curl and bacterial spot on peaches and nectarines, and bacterial canker on cherries and apricots. Many different copper products are registered for these uses, and it is difficult to know which product to select for any given application. In this article we will explain some of the differences among copper formulations and some things to consider when choosing a copper fungicide/bactericide for controlling tree fruit diseases. Reviewing the literature for this article caused me to revise some of my own long-held perceptions about factors that impact the efficacy of copper sprays.

Copper sprays control plant pathogens because copper ions denature proteins, thereby destroying enzymes that are critical for cell functioning. However, copper ions are non-selective. If copper ions enter plant tissues they can kill plant cells as well as cells of fungal and bacterial pathogens. The outer protective layers on plants (i.e., bark woody tissues, cuticle and epidermal cells on leaves and fruit) prevent copper from penetrating and killing host tissue whereas bacterial cells and fungal spores landing on trees are more directly exposed to the copper ions on the surface of plants that have been treated with copper. Copper can kill pathogen cells on plant surfaces, but once a pathogen enters host tissue it will no longer be susceptible to copper treatments. Thus, copper sprays act as protectant fungicide-bactericide treatments, but copper sprays lack post-infection activity.

Because copper ions are broadly toxic to living cells, copper treatments applied to plants must be adjusted so that enough copper ions are present to kill the target pathogens while still keeping the concentration of copper ions low enough to avoid injury to the plants that are treated. One way of limiting the copper ion concentration on plant surfaces is through the use of copper products that are relatively insoluble in water.

The oldest copper product used in agriculture is copper sulfate, which was used in the early 1800's as a seed treatment for wheat. Copper sulfate, also known as copper sulfate pentahydrate, has a solubility in water of 320 mg/L at 68 °F. Because of its high solubility in water, copper sulfate can cause phytotoxicity even at relatively low application rates because a large quantity of copper ions will be present on treated plant surfaces anytime water is present. The high solubility also means that copper sulfate residues can be rapidly removed by rainfall.

Figure 1. A typically pale-blue formulation of basic copper sulfate (top) contrasts with the red color of copper oxide (Nordox, bottom). Both products are effective for applications on tree fruits.

Copper products registered for tree fruits are almost all "fixed coppers" that have low solubility in water. In fact, many of the fixed copper compounds are considered totally insoluble in water in their purest forms. However, tests of formulated copper products usually show water solubility in the range of 2 to 6 mg of copper per liter. When these fixed copper products are mixed with water in a sprayer, the spray solution is actually a suspension of copper particles, and those particles persist on plant surfaces after the spray dries. Copper ions are gradually released from these copper deposits each time the plant surface becomes wet. The gradual release of copper ions from the copper deposits provides residual protection against plant pathogens. At the same time, the slow release of copper ions from these relatively insoluble copper deposits reduces risks of phytotoxicity to plant tissues.

Fixed coppers include basic copper sulfate (e.g., Cuprofix Ultra Disperss), copper oxide (e.g., Nordox), copper hydroxide (e.g., Kocide, Champ), copper oxychloride sulfate (e.g., COCS), and copper ions linked to fatty acids or other organic molecules (e.g., TennCop, Cueva). Note that basic copper sulfate behaves differently than copper sulfate because the addition of hydroxyl ions (i.e., OH ions) changes copper sulfate into a relatively non-soluble fixed copper. With traditional Bordeaux mix, which is a mixture of copper sulfate plus lime, the chemical change occurs in the spray tank as the hydroxyl ions from the lime complex with the copper sulfate to form a fixed copper. Note also that not all copper compounds are blue. Nordox, a copper oxide product, is a rusty red color (Fig. 1).

Efficacy of copper sprays is dependent on the amount of elemental copper (sometimes listed on the label as percent metallic copper) that is applied and on how finely the copper ingredient has been ground. Very little work has been done to compare effectiveness of different copper formulations applied to apples, pears, and stone fruits at the delayed dormant or green tip bud stages. Therefore, we are forced to derive our conclusions about copper efficacy from studies on other crops such as citrus, tomatoes, olives, and walnuts. For many years, the preponderance of evidence indicated that efficacy of copper applications was directly related to the amount of elemental copper actually applied. This simplified purchasing decisions because one could conclude that a copper product containing 50% elemental copper would be directly comparable to another product containing 25% elemental copper so long as the latter was applied at double the rate of the former.

However, other research has shown that finely ground copper formulations are more active than coarsely ground formulations. Hardy et al. (2007) listed some of the copper products available in Australia and reported that their median particle sizes ranged from 0.7 microns to 3.1 microns. Many of the products listed are not available (at least under those trade names) in the United States, but the copper products that we use probably have a similar range of particle sizes. Note that the median particle size cannot be determined just by looking at the formulated products because the granule size of the final formulation is not directly related to how finely the copper was ground prior to being formulated.

The difference between 0.7 and 3.1 microns may sound rather insignificant, but the potential impact of particle size becomes more obvious if one calculates how particle diameter relates to particle volume. A sphere with a diameter of 2.8 microns will contain 64 times more volume than sphere with a diameter of 0.7 microns. Therefore, copper products with a median 0.7-micron particle size would theoretically have 64 times more copper particles distributed across and adhering to treated plant surfaces than would occur following application of a copper product with a 2.8-micron particle size if rates of both products were adjusted so as to generate the same rate of metallic copper per acre. (I realize that copper particles in aqueous solutions may not be true spheres, but the general principle still applies.) Thus, one should be able to achieve more complete coverage with a finely ground copper compared to a coarsely ground copper. Furthermore, research as shown that the larger copper particles are more subject to removal by wind or rainfall acting on the leaf surfaces after sprays have dried. Therefore, finely ground copper products have better residual activity.

Not surprisingly, finely ground copper formulations are usually more expensive and are labeled for use at lower rates. Unfortunately, I am not aware of any good studies that explain how to adjust rates of elemental copper to compensate for the increased efficacy of finely-ground compared to more coarsely ground copper products. Without that data it is difficult to know whether it is better to pay less for a coarsely ground copper that will end up supplying a higher rate of elemental copper/A (i.e., the traditional way of thinking) or whether to pay more per pound of elemental copper for a finely ground formulation that may have better residual activity even when it is applied at lower rates of elemental copper per acre.

The finely ground coppers may be preferable for delayed dormant and dormant applications for several reasons. We have already noted that, at any given rate of elemental copper, finely ground products will provide more copper particles per acre and the finely ground copper formulations will be less subject to removal by wind and rain. The objective of delayed-dormant and green-tip applications on tree fruits is to generate a copper residue in the tree that will persist and provide disease control that extends through leaf development stages where further applications of copper would cause excessive phytotoxicity. Thus, having a copper formulation that provides extended residual activity should be an advantage so long as the rate is properly adjusted so as to avoid the phytotoxicity that can result if excessive copper residues persist when trees come into bloom. Using lower rates of finely ground copper will also help to avoid toxic accumulations of copper in soils. Copper in soils can suppress earthworm populations and may also adversely affect other soil microorganisms.

Because we lack experimental evidence concerning rate adjustments for finely ground coppers, we suggest that growers proceed with caution when switching from older coarsely ground copper formulations to newer finely ground formulations. Rates should be adjusted to stay within the rates indicated on product labels, but most copper labels list a broad range of rates. In general, the upper end of labeled rates are suggested for applications that are made at silver tip or green tip, especially when those bud stages occur early and one can therefore expect a long, drawn-out timeframe for bud development. The lower ends of labeled rates are suggested for applications at green tip (or even at half-inch green, in an emergency), especially if one expects trees to advance rapidly from bud break to bloom. Using excessive rates of copper, especially finely ground coppers that have good residual properties, could result in fruit russetting on some apple cultivars if copper ions are splash-dispersed to developing fruit tissue after flowers reach pink or bloom.

Copper products such as TennCop (which is no longer being produced) and Cueva contain very low concentrations of elemental copper because the copper is linked to other organic compounds. Although we have not tried using these compounds in green-tip sprays, we doubt that the low amounts of elemental copper provided by the labeled rates will provide sufficient residual activity for controlling the pathogens targeted by these early copper applications. These products are better suited for applications later in summer when low rates of copper are desired so as to minimize phytotoxicity. In fact, TennCop was used for many years by peach growers who applied it in a carefully specified regimen to control bacterial spot.

Following are a few additional concepts relevant to using copper products on tree fruits:

1. Solubility of fixed coppers increases under acidic conditions. As a result, copper sprays will become more phytotoxic if they are applied in an acidic solution. Acidifiers such as LI-700 and non-buffered phosphite fungicides should not be tank-mixed with copper fungicides.

2. Copper sprays generally cause more phytotoxicity to the sprayed foliage when applied under slow-drying conditions as compared to rapid-drying conditions. This concern is not relevant for delayed dormant or green-

tip applications. However, if copper is used to control bacterial spot during summer or if it is applied to non-bearing apple trees to control fire blight after leaves have emerged, then phytotoxicity can be minimized by applying the copper with relatively low volumes of water and under conditions where droplets dry quickly.

3. When buds are already showing green tissue, do not apply copper just prior to predicted frosts because the cells ruptured by frost crystals may resorb and be killed by the copper on the bud surfaces.

4. The literature on the benefits of using adjuvants with copper suggests that adjuvants have highly variable and largely unpredictable effects on the efficacy of copper sprays. We know from years of experience that copper products can be combined with oil in delayed dormant or green-tip sprays if oil is being applied to control mites. Otherwise, using one quart of spray oil per 100 gallons of finished spray solution may enhance coverage of the wood in these early-season sprays, but using higher rates of oil does not "lock in" the copper deposits to enhance residual activity. No other adjuvants are necessary or recommended on tree fruits.

5. As noted earlier, Bordeaux mixture was made by mixing copper sulfate and spray lime. With the fixed copper products, there is no published evidence that adding spray lime will either reduce phytotoxicity or extend the residual activity of the copper. However, at a recent meeting, several sweet cherry growers in the Cumberland-Shenandoah region told me that they achieved much better control of bacterial canker when they added spray lime to copper sprays even though they were using a fixed copper that theoretically did not need any additional lime. At this point, I have no hypothesis to explain their observations.

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Final Report of the 2002 NC-140 Apple Rootstock Trial in Massachusetts and New Jersey

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The NC-140 Multi-State Research Committee, with research pomologists from the US, Canada, and Mexico, has assisted tree-fruit growers with rootstock decisions for more than 35 years by evaluating performance of both old and new rootstocks in a range of climates and soils. This article describes the Massachusetts and New Jersey results from the 2002 NC-140 Apple Rootstock Trial, which is planted at a total of ten locations in the US, Canada, and Mexico.

This trial had a number of rootstocks. The first group included different strains of commonly used rootstocks. Several strains of M.9 have been identified, and results, generally, have shown differences in vigor but similar orchard productivity among the M.9 strains. This trial includes M.9 Burgmer 756, M.9 NAKBT337, and M.9 Nic 29. M.9 Burgmer 756 (from Burgmer Nurseries in Germany) has not had significant evaluation in North America:. M.9 NAKB T337 (from the virus indexing program in the Netherlands) has had extensive testing and is the most commonly planted M.9 in North America. M.9 Nic 29 was tested in a NC-140 trial from 1994-2003 and was found to be more vigorous than M.9 NAKB T337.

Other comparisons in this trial included two strains of B.9 (one that is commonly used in Europe and one that is commonly used in North America). It also included two strains of M.26: M.26 NAKB (from the virus indexing program in the Netherlands) and M.26 EMLA (from the virus indexing program in Great Britain).

The new rootstocks in this trial were P.14, (an open-pollinated seedling of M.9, is from the Research Institute of Pomology, Skierniewice, Poland) and Supporter 4, PiAu 51-4, and PiAu 51-11 (all three from the Institut für Obstforschung Dresden-Pillnitz, Germany).

Materials & Methods

In spring, 2002, an orchard trial of apple rootstocks was established under the coordination of NC-140 Multi-State Research Committee in Arkansas, British Columbia (Canada), Chihuahua (Mexico), Illinois, Kentucky, Massachusetts, Michigan, New Jersey, and New York. Data reported here are from Massachusetts (UMass Cold Spring Orchard Research & Education Center, Belchertown) and New Jersey (Rutgers Snyder Research and Extension Farm, Pittstown) only.

Buckeye Gala was used as the scion cultivar, and rootstocks included B.9 Treco (the strain commonly used in North America and propagated in stool beds at Treco Nursery, Woodburn, OR), B.9 Europe (the strain commonly used in Europe), M.26 EMLA, M.26 NAKB, M.9 Burgmer 756, M.9 Nic 29, M.9 NAKB T337, P.14, PiAu 51-11, PiAu 51-4, and Supporter 4. Trees were spaced 8.2 x 14.8 feet and trained as vertical axes. Pest management, irrigation, and fertilization followed local recommendations at each site.

Each year of the trial, trunk cross-sectional area was assessed and root suckers were counted an removed. Beginning with the third season, yield and average fruit size were determined for each tree. At the end of the 2011 growing season (10th leaf), tree height and canopy spread were measured for each tree.

Results

Tree and yield characteristics are presented for Massachusetts in Tables 1 and 2 and for New Jersey in Tables 3 and 4.

After ten growing seasons, relative tree response

Table 1. Trunk cross-sectional area, tree height, canopy spread and root suckering in 2011 of Gala trees on several rootstocks in the Massachusetts planting of the 2002 NC-140 Apple Rootstock Trial.[z]

Rootstock	Trunk cross-sectional area (cm^2)	Tree height (m)	Canopy spread (m)	Root suckers (no./tree, 2002-11)
B.9 (Europe)	30.4 f	3.4 d	2.5 d	22.4 b
B.9 (North America)	37.8 ef	3.8 cd	3.0 cd	15.7 b
M.26 EMLA	75.6 cd	4.3 bcd	3.7 abc	3.6 b
M.26 NAKB	93.2 bcd	4.6 bcd	4.0 ab	5.1 b
M.9 Burgmer 756	75.4 d	4.9 bc	3.6 bc	17.0 b
M.9 Nic 29	61.3 de	4.2 bcd	3.4 bc	53.9 a
M.9 NAKBT337	64.1 de	4.3 bcd	3.4 bc	21.4 b
P.14	122.2 b	5.4 ab	4.2 ab	8.4 b
PiAu51-11	112.9 bc	5.3 ab	4.0 ab	18.4 b
PiAu51-4	174.5 a	6.4 a	4.6 a	24.8 b
Supporter 4	93.2 bcd	5.4 ab	4.1 ab	5.9 b

[z] Means within column not followed by a common letter are significantly different at odds of 19 to 1 (Tukey=s HSD, P = 0.05).

to rootstock was similar in Massachusetts and New Jersey. Comparing the two locations, however, we found that trees were more vigorous (+22%) in Massachusetts than in New Jersey, with more root suckers (+110%). Massachusetts trees were slightly more productive in terms of cumulative yield per tree (+3%) but were less cumulatively yield efficient (-15%) than those in New Jersey. Fruit size was smaller (-10%) in Massachusetts than in New Jersey.

Tree size, measured as trunk cross-sectional area (TCA), tree height, and canopy spread, was largest with PiAu 51-4 as the rootstock (Tables 1 and 3). Trees on P.14 and PiAu 51-11 also were larger than those on M.26. Trees

Table 2. Yield per tree, yield efficiency, and fruit weight in 2011 of Gala trees on several rootstocks in the Massachusetts planting of the 2002 NC-140 Apple Rootstock Trial.[z]

	Yield per tree (kg)		Yield efficiency (kg/cm^2 TCA)		Fruit weight (g)	
Rootstock	2011	Cumulative (2004-11)	2011	Cumulative (2004-11)	2011	Average (2004-11)
B.9 (Europe)	7.3 c	90 d	0.27 d	3.0 a	207 ab	161 b
B.9 (North America)	10.4 bc	114 cd	0.29 cd	3.2 a	196 ab	169 ab
M.26 EMLA	48.3 a	199 ab	0.63 ab	2.6 ab	195 ab	178 ab
M.26 NAKB	52.8 a	242 a	0.54 abcd	2.6 ab	194 ab	177 ab
M.9 Burgmer 756	40.0 abc	207 ab	0.56 abc	2.8 a	211 ab	180 ab
M.9 Nic 29	45.5 ab	184 abc	0.70 a	3.0 a	217 a	185 a
M.9 NAKBT337	34.6 abc	183 abc	0.55 abcd	2.9 a	206 ab	185 a
P.14	44.6 ab	216 ab	0.35 bcd	1.8 c	208 ab	182 ab
PiAu51-11	31.5 abc	162 bcd	0.33 bcd	1.6 c	195 ab	176 ab
PiAu51-4	65.3 a	245 a	0.37 bcd	1.4 c	188 b	173 ab
Supporter 4	38.6 abc	182 abc	0.42 abcd	2.0 bc	202 ab	179 ab

[z] Means within column not followed by a common letter are significantly different at odds of 19 to 1 (Tukey=s HSD, P = 0.05).

Table 3. Trunk cross-sectional area, tree height, canopy spread and root suckering in 2011 of Gala trees on several rootstocks in the New Jersey planting of the 2002 NC-140 Apple Rootstock Trial.[z]

Rootstock	Trunk cross-sectional area (cm^2)	Tree height (m)	Canopy spread (m)	Root suckers (no./tree, 2002-11)
B.9 (Europe)	18.1 f	2.9 d	1.7 e	30.0 a
B.9 (North America)	29.0 ef	3.5 cd	2.1 de	5.2 b
M.26 EMLA	67.9 cd	4.3 bc	2.6 cd	0.4 c
M.26 NAKB	71.3 cd	4.4 b	2.7 bc	2.3 b
M.9 Burgmer 756	71.1 cd	4.7 b	2.8 bc	5.7 b
M.9 Nic 29	53.3 de	4.5 b	2.7 bc	23.8 ab
M.9 NAKBT337	61.0 d	4.4 b	2.8 bc	8.4 ab
P.14	104.9 ab	5.6 a	3.4 a	1.7 bc
PiAu51-11	95.3 bc	4.7 b	2.9 abc	2.6 b
PiAu51-4	131.8 a	5.6 a	3.2 ab	7.2 ab
Supporter 4	70.1 cd	4.3 bc	2.7 bc	6.2 b

[z] Means within column not followed by a common letter are significantly different at odds of 19 to 1 (Tukey=s HSD, *P* = 0.05).

on Supporter 4 were similar in size to those on the two strains of M.26, which were similar to each other. Trees on M.9 Burgmer 756 were similar to those on M.26 EMLA. The other two strains of M.9 produced a slightly smaller tree, and trees on the two strains of B.9 were the smallest in the trial.

Root suckering was pronounced at both sites from trees on M.9 Nic 29 and B.9 Europe (Tables 1 and 3). In Massachusetts, trees on PiAu 51-4 and those on M.9 NAKBT337 suckered profusely.

On average at both sites, yield per tree was higher from the largest trees than from the smallest (Tables 2 and 4); however, yield efficiency gives a

Table 4. Yield per tree, yield efficiency, and fruit weight in 2011 of Gala trees on several rootstocks in the New Jersey planting of the 2002 NC-140 Apple Rootstock Trial.[z]

	Yield per tree (kg)		Yield efficiency (kg/cm^2 TCA)		Fruit weight (g)	
Rootstock	2011	Cumulative (2004-11)	2011	Cumulative (2004-11)	2011	Average (2004-11)
B.9 (Europe)	10.3 c	78 d	0.60 a	4.3 a	176 a	175 b
B.9 (North America)	13.7 bc	117 c	0.45 ab	4.0 ab	175 a	187 b
M.26 EMLA	16.3 bc	178 b	0.26 b	2.6 cde	166 a	186 b
M.26 NAKB	21.3 bc	200 ab	0.31 ab	2.9 cde	199 a	196 ab
M.9 Burgmer 756	21.6 bc	188 ab	0.33 ab	2.8 cde	179 a	197 ab
M.9 Nic 29	31.5 b	167 bc	0.58 a	3.1 bcd	187 a	202 ab
M.9 NAKBT337	19.3 bc	191 ab	0.32 ab	3.2 bc	173 a	188 b
P.14	32.8 b	239 a	0.32 ab	2.3 def	192 a	205 ab
PiAu51-11	28.1 bc	182 ab	0.33 ab	2.1 ef	193 a	210 ab
PiAu51-4	51.6 a	220 ab	0.40 ab	1.7 f	192 a	223 a
Supporter 4	23.8 bc	197 ab	0.35 ab	2.8 cde	190 a	202 ab

[z] Means within column not followed by a common letter are significantly different at odds of 19 to 1 (Tukey=s HSD, $P = 0.05$).

better indication of productivity, since it relates yield to tree size. It is predicted that a tree with higher yield efficiency, planted at an appropriate density, will outyield a less yield efficient tree, planted at an appropriate density. Trees on B.9 and those on M.9 were the most yield efficient trees in this trial (Tables 2 and 4). Trees on Supporter 4 were similarly efficient to those on M.26, and trees on P.14, PiAu 51-11, PiAu 51-4 were the least efficient.

Fruit size varied quite a bit among trees on the various rootstocks (Tables 2 and 4). Few important results were observed, except that fruit from trees on B.9 Europe tended to be the smallest in the trial.

Conclusions

B.9 Strains. The two strains of B.9 were statistically similar for all but one measure (excessive root suckering in New Jersey). Data from all NC-140 cooperators suggest that the North American strain is more vigorous than the European strain and develops fewer root suckers.

M.26 Strains. In Massachusetts and New Jersey, M.26 EMLA and M.26 NAKB performed similarly.

M.9 Strains. In this trial, no differences among these strains were statistically significant, except M.9 Nic 29's enhanced ability to produce root suckers. That said, there is a trend toward greater vigor of trees on M.9 Burgmer 756 than the other two strains.

P.14. Trees on P.14 were reasonably productive for what likely is semidwarf in size, but there was nothing observed that makes it a particularly desirable rootstock.

PiAu 51-11 and 51-4. The two un-named selections from the Pillnitz breeding program produced semidwarf trees, with the lowest yield efficiency in the trial. There are no characteristics which suggest that these rootstocks should be considered for commercial planting.

Supporter 4. Trees on Supporter 4 were in all ways similar to those on M.26. They performed reasonably well and likely could be used to produce a large dwarf or small semidwarf tree.

Effects of Sysstem-CAL on Jersey Peaches in Massachusetts and New Jersey

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It is well known that introducing nutrients into peach trees through foliar applications is difficult, so growers have been unable to take advantage of calcium applications to potentially improve fruit quality and storability. Sysstem™-CAL is a commercial formulation of calcium (4%) and copper (0.25%) intended for foliar applications. It is postulated that Sysstem-CAL may encourage uptake differently than other nutrient sources, and may be a way to apply foliar calcium and ultimately increase fruit calcium. To study this potential with peaches, we conducted experiments in 2010 and 2011 to determine if Sysstem-CAL could increase peach fruit calcium concentration.

Materials & Methods

In 2010, twenty 4-year-old PF14-Jersey/Lovell trees at the UMass Cold Spring Orchard (Belchertown, MA) and twenty-eight 3-year-old PF14-Jersey/Bailey trees at the Rutgers Snyder Farm (Pittstown, NJ) were selected for this trial. Four treatments were allocated randomly among the trees at each location, giving five trees in MA and seven trees in NJ receiving each treatment. Treatments began at bloom and were applied every two weeks until approximately 1 week before harvest: (1) control was not treated; (2) calcium chloride was applied at the equivalent of 2 pounds per acre per treatment; (3) Agro-K low was the equivalent of 2 quarts Sysstem-CAL per acre per treatment, but the last treatment was 2 quarts Vigor-CAL per acre; (4) Agro-K high was the equivalent of 2 quarts Sysstem-CAL plus 2 quarts Vigor-CAL per acre per treatment, but the last treatment was 2 quarts Vigor-CAL per acre only. All treatments included 0.1% Regulaid.

In 2011, thirty-six 4-year-old PF14-Jersey/Lovell trees at the Rutgers Snyder Farm (Pittstown, NJ) were selected for this trial. Three treatments were allocated randomly among the 36 trees, giving 12 trees per treatment. Treatments began at bloom and were applied every two weeks until approximately 1 week before harvest: (1) control was not treated; (2) calcium chloride was applied at the equivalent of 2 pounds per acre per treatment; (3) Agro-K high was the equivalent of 2 quarts Sysstem-CAL plus 2 quarts Vigor-CAL per acre per treatment, but the last treatment was 2 quarts Vigor-CAL per acre only. All treatments included 0.1% Regulaid.

In both years, 10-fruit samples were harvested from each tree. The weight and diameter were assessed. Fruit firmness was measured with a penetrometer (2 punctures per fruit after removing the peel). The juice released from the firmness assessment was combined for each 10-fruit sample and the soluble solids concentration was determined. A wedge of fruit in a longitudinal section (about 1/8 of a fruit) was taken from each fruit, and a bulked sample from the 10 fruit per tree was frozen for later calcium analysis. Samples were removed from the freezer, macerated in a blender, and freeze dried. Samples were then ground with a mortar and pestle, and ashed overnight at 500C. The ashed material was mixed with 1N HCl and diluted with water. Calcium concentration was then measured with an atomic absorption spectrophotometer.

Results

Table 1 shows the results from 2010 in Massachusetts and 2010 and 2011 in New Jersey. As expected,

Table 1. Effects of biweekly applications of calcium chloride, Sysstem-CAL, and Vigor-CAL from bloom to 1 week before harvest on Jersey peach fruit quality and calcium concentration in Massachusetts (2010) and New Jersey (2010 and 2011).

Treatment[z]	Average fruit weight (g)	Average fruit diameter (cm)	Flesh firmness (N)	Soluble solids concentration (%)	Fruit calcium conc. (ppm dry weight)
UMass Cold Spring Orchard 2010					
Control	222 a	7.41 a	48.1 a	11.5 a	193 ab
Calcium chloride	235 a	7.54 a	45.9 a	11.7 a	197 ab
Agro-K Low	219 a	7.37 a	49.1 a	11.1 a	213 a
Agro-K High	226 a	7.45 a	47.0 a	11.6 a	178 b
Rutgers Snyder Farm 2010					
Control	133 a	6.23 a	43.6 b	11.2 a	303 ab
Calcium chloride	133 a	6.27 a	45.3 b	11.1 a	279 b
Agro-K Low	113 b	5.90 b	49.7 a	10.9 a	332 a
Agro-K High	122 b	6.06 b	45.3 b	10.9 a	348 a
Rutgers Snyder Farm 2011					
Control	185 ab	6.9 a	40.8 ab	11.1 a	273 b
Calcium chloride	190 a	7.0 a	38.9 b	11.1 a	277 b
Agro-K High	175 b	6.7 a	42.6 a	10.6 b	308 a

[z]Treatments in 2010 began at bloom and were applied every two weeks until approximately 1 week before harvest: control was not treated; calcium chloride was applied at the equivalent of 2 lbs/acre; Agro-K low was the equivalent of 2 qts Sysstem-CAL per acre, but the last treatment was 2 qts Vigor-CAL per acre; Agro-K high was the equivalent of 2 qts Sysstem-CAL plus 2 qts Vigor-CAL per acre, but the last treatment was 2 qts Vigor-CAL per acre only. All treatments included 0.1% Regulaid. The 2011 treatments at Rutgers Snyder Farm were similar to those in 2010, except they included only the control, calcium chloride, and Agro-K High treatment and not the Agro-K Low.

calcium chloride had no measurable impact on fruit quality or fruit calcium concentration at either location or in either year. Sysstem-CAL (Agro-K Low) alone or with Vigor-CAL (Agro-K High) did not impact fruit quality in Massachusetts in 2010, but the Agro-K Low treatment resulted in a somewhat higher fruit calcium concentration than did the Agro-K High treatment. In New Jersey in 2010, both Agro-K treatments reduced fruit size and increased fruit calcium. The experiment in New Jersey in 2011 included only the Agro-K High treatment, and the results appeared similar to those for 2010, with fruit size reduced and calcium increased. Additionally, fruit firmness was higher for the Agro-K High treatment, and soluble solids concentration was slightly lower than the control.

Conclusions

Foliar calcium products have never proved efficacious in increasing fruit calcium. Agro-K's Sysstem-Cal and Vigor-CAL combination treatment is a foliar calcium system that can add calcium to peach fruit and increase fruit firmness. Additional work should be done to increase the amount of calcium taken up by peach fruit. If we can get some calcium in with foliarly applied Sysstem-CAL plus Vigor-CAL, there is the potential for adjusting the timing and rates to get more calcium uptake.

Managing Apple Scab in High Inoculum Orchards

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In apple orchards where scab was poorly controlled last fall, growers will need to compensate this spring for what we might call the five curses of high-inoculum, as outlined below:

1. Expect more ascospores: Using data from a study by Gadoury and MacHardy (1986), New Hampshire orchards that had less than 1% leaf scab in autumn produced an estimated 888,000 ascospores/A as compared to 6.1 billion spores/A for an orchard with 20% leaf scab (Table 1). These data suggest that orchards with 20% leaf scab may produce nearly 7,000 times more ascospores than orchards that had less than 1% leaf scab. Thus, orchards with a lot of scabby leaves in fall are indeed "high-inoculum" orchards.

2. Expect more ascospores at green-tip: This is a logical corollary to the previous item. However, it is noted separately because the spores that are discharged early in the season pose the greatest risk for generating economic losses in commercial orchards. If ascospores initiate infections at green tip, then the first generation of conidia will become available about the time that trees are in bloom, and that is a period when fruit and leaves are at maximum susceptibility. Also, fungicide protection sometimes lapses toward the end of bloom if a fungicide spray is delayed with the objective of combining the fungicide with petal fall insecticides. Thus, having more ascospores at green tip escalates the risk of getting green-tip infections that will produce conidia before petal fall, which in turn ratchets up the risk of fruit scab.

3. Conidia may overwinter in buds: Work by Holb et al. (2005) in the Netherlands showed that when scab incidence in autumn exceeded 40% of terminal leaves, then small numbers of viable conidia would often survive through winter inside bud scales. Although the numbers of conidia surviving in buds under the worst-case scenarios reported by Holb are dwarfed by the numbers of ascospores that would be produced in those orchards, the conidia in buds are perfectly positioned to cause infections as buds begin to grow in spring. Thus, conidia in buds can be expected to have much greater infection efficiency than ascospores since the majority of ascospores released at green tip will never find tissue where they can cause infections. Incidentally, viable spores have been found inside buds on at least several occasions in New York, so it seems probable that the results reported by Holb from studies in the Netherlands are also applicable to high-inoculum orchards in northeastern United States.

4. Expect more infections from marginal infection periods: In low-inoculum orchards, relatively small numbers of ascospores are released during any given wetting period, and only a few of those released will be deposited on host tissue and complete the infection process in the minimum time listed for infections in the revised Mill's table. As the duration of wetting increases, more and more spores can be deposited on host tissues, so the severity of infection periods increases with time at any given temperature. In high-inoculum orchards, the total spore contingent is much higher (perhaps 7000 times higher as pointed out in #1 above), so many more spores will succeed in completing the infection process during short or "marginal" infections periods.

5. Fungicides will seem less effective: If one assumes that 2% of the total season's ascospores could be released at green tip, that only 1% of those released will succeed in causing infections in unsprayed orchards, and that a green-tip fungicide spray will be 99.9% effective (which may be optimistic), then one might expect only 0.18 scab infections/A for orchards that had less than 1% leaf scab last year whereas orchards with 20% leaf scab last year might see 1,218 infections per acre (Table 1). The only options for changing the odds are to either improve fungicide efficacy via higher rates, shorter intervals, and better spray coverage, or to implement inoculum reduction practices in the high-inoculum orchards.

Considering all of the above, the three early-season strategies outlined below are logical options for managing scab in high-inoculum orchards:

First, apply one or more inoculum-reduction strategies to reduce the potential ascospore load. Four

proven options for reducing ascosporic inoculum include (A) treating orchards in either late fall or early spring by applying 40 lb/A of urea dissolved in water and sprayed over the orchard floor (Sutton et al., 2000); (B) flail chopping leaf litter to speed leaf degradation (Sutton et al., 2000); (C) applying dolomitic lime to the orchard floor at the rate of 2.25 tons/A (Spotts et al., 1997); or (D) raking or vacuuming the leaf litter and removing it from the orchard. More details on methods for urea treatment or flail mowing can be found in a Scaffolds article published in 2009 (Rosenberger, 2009).

The use of dolomitic lime has only been tested for lime applied in late fall or winter, so its effectiveness following springtime applications is uncertain. Removing leaf litter from the orchard is practical only for small homeowner orchards unless one invests in specialized raking/vacuuming equipment that that can cover large acreages efficiently.

We have received several questions recently about the efficacy of lime-sulfur for suppressing ascospore production. Lime sulfur sprays were evaluated early in the 20th century, and three applications in spring partially suppressed ascospore production. However, later researchers abandoned lime-sulfur in favor of urea, which generally proved more effective.

Second, begin fungicide applications at silver tip or green tip. Having a fungicide in place before the first infection period after bud break is absolutely essential, especially in orchards where the DMI fungicides are no longer effective. As noted above, failure to control early infections vastly increases the risks of economic losses.

Third, use higher rates of fungicides or fungicide combinations: In low-inoculum orchards, the scab risk at green tip can be adequately addressed with a copper spray (as applied to suppress fire blight) or by using mancozeb at 3 lb/A. Either of these options will provide about seven days of protection against apple scab. Even in low inoculum orchards, however, we know that higher rates of fungicide are needed as we approach tight cluster because 3 lb/A of mancozeb used alone is not adequate to control scab during the period of peak ascospore discharge between tight cluster and petal fall. In high-inoculum orchards, high numbers of ascospores may be released at green tip. Therefore, we suggest that high inoculum orchards should be treated with a combination of either mancozeb at 3 lb/A plus copper, or mancozeb at 3 lb/A plus Syllit at 1.5 pt/A. (Note that Syllit and copper are NOT compatible!) Syllit is the liquid formulation of dodine. The new label no longer contains the restriction against using apple pomace from Syllit-treated trees for cattle feed.

For many years, dodine provided excellent scab control when applied in early-season sprays because of its excellent retention and redistribution characteristics, and also because it provides 48 hr of post-infection activity. Thus, it is an ideal mixing partner for mancozeb in green tip and half-inch green sprays except where dodine-resistant populations of apple scab are known to predominate. Recent testing in the Cox lab at Geneva suggests that dodine-resistant scab is less prevalent in NY than was previously suspected, so Syllit may again prove useful for one or two early-season sprays in many orchards. However, because no one can be absolutely certain that an orchard is entirely free of dodine-resistant scab, Syllit should never be used alone. By using it in combination with mancozeb, we anticipate

Table 1: Effect of inoculum levels on ascospore production based on predicted ascospore doses calculated for New Hampshire orchards by Gadoury and MacHardy (1986).

Scab incidence on leaves in autumn	0.03-0.52%	1.1-3.5%	4-10%	20%
Number of orchards used for the estimate	10	5	3	1
Total ascospores produced/A (X 1000)	888	9,262	242,559	6,090,000
Ascospores/A released at green tip (X 1000)[1]	18	185	4,851	121,812
Potential scab lesions/A from a green-tip infection period[2]	0.18	1.85	48.5	1,218

[1] Assuming that 2% of ascospores are released at green tip. The actual percentage of total ascospore load released at green tip may be much less than 2%, especially under cold conditions.
[2] Assuming 1% of released spores could cause infections but 99.9% of those would be prevented by fungicides applied before the infection period. The actual infection efficiency and fungicide effectiveness are unknown and will vary widely depending on infection conditions and spraying conditions.

better scab control than where mancozeb is used alone (again, with the exception of orchards with very high levels of dodine resistance). Where mancozeb-copper combinations are used in the first spray of the season, the mancozeb-Syllit combination could be used in the second spray to enhance early-season disease control. Where dodine-resistance is known to be present, mancozeb-captan mixtures should be used instead of mancozeb-Syllit mixtures.

Combinations of mancozeb plus Scala or mancozeb plus Vangard might also be considered at green-tip and half-inch green. However, so far as we can tell, Scala and Vangard do not redistribute very well and we therefore believe that mancozeb-copper, mancozeb-Syllit, or mancozeb-captan combinations are preferable to combinations with Scala or Vangard. The exception would be dodine-resistant orchards where an infection period occurred before any fungicide was applied. In that scenario, combinations of mancozeb with either Scala or Vangard could provide 48-72 hr of post-infection activity (counting from the start of the wetting period) whereas mancozeb-copper and mancozeb-captan combinations will only reach back 12-18 hr from the start of a wetting period.

In summary, high-inoculum orchards pose special challenges and must be treated with extra caution from the very beginning of the growing season. This is especially true for orchards where the DMI fungicides are no longer effective. Until the emergence of full-blown DMI resistance, DMIs provided an effective backstop for scab control programs because, when applied at bloom or petal fall, the DMIs could arrest any scab that had escaped early-season sprays. Where DMI fungicides are no longer effective, failure to control scab at green tip in high-inoculum orchards can potentially lead to significant economic losses and a summer full of headaches because once established in trees, scab will likely remain active throughout the entire growing season.

In a future article, we will discuss additional fungicides, including new products that are becoming available, that may help to control scab during the period from tight cluster to first cover.

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Mount Inducted into International Fruit Tree Association Hall of Fame at 55th Annual Conference in Chile

Gary Mount, co-owner of Terhune Orchards in Lawrence Township, New Jersey, received the International Fruit Tree Association's Hall of Fame Award at the international organization's annual conference and tour recently in Santiago, Chile.

The International Fruit Tree Association has nearly 1,000 members, principally fruit growers, in 26 countries and six continents. The Association has been instrumental in revolutionizing fruit growing around the world, primarily through the introduction and development of dwarfing fruit tree rootstocks. A hallmark of the organization is the free exchange of information by growers and researchers around the world. Mount has been active with the association for three decades.

Gary and Pam Mount at the 55th International Fruit Tree Association Conference in Santiago, Chile, where Gary was inducted into the Hall of Fame. Pam and Gary are owners of Terhune Orchards, Princeton, NJ.

Mount and his wife Pam Mount were in Chile for the association's 55th annual conference January 8-11, 2012, but did not know about the award until his name was announced at the organization's awards banquet. The conference was followed by a 4-day bus tour of Chilean orchards.

"It is really great to be honored by an organization I've been involved with for 36 years, and to be recognized by my peers all over the world," Mount said. "To realize that the award has only been given four times in 55 years is humbling."

Mount is known for his "let's try it" attitude, which has been key in an ever-changing industry where innovation has been crucial. He was previously named "Apple Grower of the Year" for 2005 by American Fruit Grower magazine.


Gary Mount and Win Cowgill, Area Fruit Agent, IFTA Orchard Tour in Chile.

He served on the association's board of directors for 11 years and currently serves on the IFTA research committee as he has for 20 years, being chairman for 18. He recently helped found the IFTA Research Foundation, a charitable foundation that will provide the fruit tree industry with more research fund donations and grant funding for fruit tree research. He is a founding trustee and secretary of the Foundation. Mount is a tenth-generation farmer who has been involved New Jersey agriculture since purchasing Terhune Orchards in 1975.

Fruit Notes

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