scaffolds

Update on Pest Management and Crop Development

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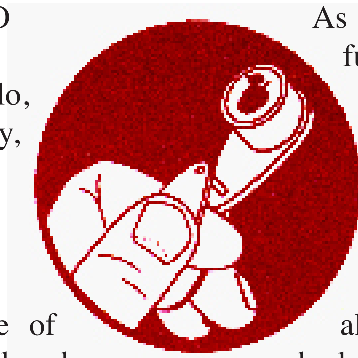
GENERAL INFO

SPRINGING UP ALL OVER

EARLY TO RISE

(Art Agnello, Entomology, Geneva)



❖❖ Whenever we get one of "these springs", somebody, usually a local news writer, always asks me whether the mild winter/early season will result in there being more insects this year, or infestations that are harder to control, since they obviously didn't have as difficult a time making it through the winter as they normally do. When I was less experienced (and therefore knew a lot more), I always replied that, yes – certainly, the bugs would be pretty bad this season, so we'd better watch out. Turns out that it's not that simple.

Certainly, pests having growth forms that overwinter outside — usually eggs or "hibernating" adults – all suffer some degree of die-off (winter mortality) that varies each year, depending on temperature, amount of snow cover, number and extent of warm-up/cool-down periods, etc. A warmer winter like we're currently coming out of would naturally reduce the percentage of the population that suffers this overwintering mortality. However, we often see that spring and early summer weather conditions tend to have a greater influence on the size and activity levels of insect populations than does winter severity. How wet or dry the season starts out, how warm it gets, or how long it takes to get warmer, what kind of temperature swings we see — all of these sort of "re-interpret" the insect population potential coming out of the winter months.

As it happens, we actually aren't much further ahead of our "normal" progression as you might think. Although we didn't have a lot of cold temperatures during January and February, we also didn't get much in the way of the warm weather that we often see, usually for several days in a row, during this period. A look at our degree day records shows that we are about a week, at most, ahead of the 15 year average for this time of year. We are, however, well ahead of last year. (See UPCOMING PEST EVENTS)

Still, it would be a lot easier having to shift yourself into action in March if it meant we'd be finished with harvest by August and could spend the rest of the fall visiting wineries and watching the leaves turn, but naturally it doesn't work that way. These days, when asked about the bugs and the early spring, I almost think it

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IN THIS ISSUE…

would be just as reasonable to say that our turning the clocks ahead will probably trick them into thinking that it's still February, so they'll prefer to stay in bed for another month.

Turning the Crank

Scaffolds will continue to be offered only via email and the web this year, in deference to considerations of access, budget limitations, and that whole paperless process thing. We encourage subscribers to inform us of any address changes, so that there are no interruptions in delivery of this newsletter; if we don't hear from you (or else get obtuse bounce-back messages), we won't know where you are.

We will again be sending Scaffolds out as a pdf file via email each Monday afternoon. For those desiring a more screen-friendly format than the double column we currently use, I can send an unformatted plain text version to anyone who requests it, in addition to (or in place of) the pdf. There is also a web version available, which should be up and ready for viewing at the same time as the emailed pdf is sent. Scaffolds can be found online at: http://www.scaffolds.entomology.cornell.edu/index.html . Please make a note of this address in any bookmarks you may maintain that point to Scaffolds.

Also, we will continue to post a version of Scaffolds online that is formatted to be more easily read on smartphones and other mobile devices. Look for "ScaffoldsMD for Mobile Devices" under the current link to the PDF version.

As always, we are happy to consider contributions (particularly from N.Y. sources) in the form of articles on topics in any of the fruit crop protection or crop production areas, as well as N.Y. field observations, trap data, etc. Our preferred deadline for such dispatches is 3 p.m. on Monday.
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DISEASES

OUT FROM UNDER

MANAGING APPLE SCAB IN HIGH-INOCULUM ORCHARDS
(Dave Rosenberger & Kerik Cox, Plant Pathology, Highland and Geneva)

❖❖ 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 with 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.

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scaffolds
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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 Mills 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).

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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 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

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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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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% to 0.52%	1.1% to 3.5%	4% to 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.

[2] Assuming 1% of released spores could cause infections but 99.9% of those would be prevented by fungicides applied before the infection period.

IN THE PIPELINE

OPTIONS, BENEFITS, AND LIABILITIES FOR COPPER SPRAYS IN TREE FRUITS

(Dave Rosenberger, Plant Pathology, Highland)

❖❖ 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 1800s 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.

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 sul-

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fate 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).

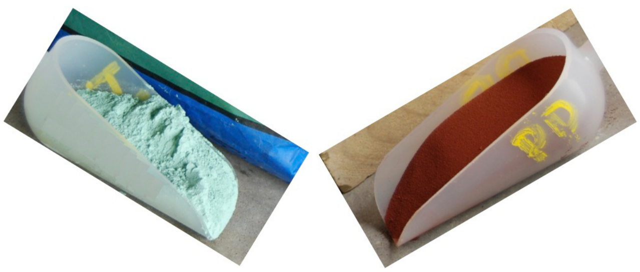

Figure 1: A typically pale-blue formulation of basic copper sulfate (left) contrasts with the red color of copper oxide (Nordox). Both products are effective for applications on tree fruits.

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 with 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

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adjust rates of elemental copper to compensate for the increased efficacy of finely-ground compared with 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 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) or 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 with 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

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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 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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Hardy, S., Fallow, K, and Barkley, P. 2007. Using copper sprays to control diseases in citrus. NSW DPI Primefacts #757, available at http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/138171/Using-copper-sprays-to-control-diseases-in-citrus.pdf

CHEM NEWS

WHAT SNOW?

PRODUCT REGISTRATION UPDATE

(Art Agnello, Entomology, Geneva)

Label Changes

• This is the final season for the use of Guthion/azinphosmethyl products, in accordance with the scheduled phase-out guidelines previously established by EPA. In both apples and pears, a total of 3 lb formulated product/A is allowed in 2012, the same as in 2011. In cherries, it's 1.5 lb/A for 2012. Recall that there is a 60–ft buffer required from permanent bodies of water and occupied buildings, and a PHI in Pick-Your-Own operations scaled from 33–44 days, according to use rate. Read your labels carefully. (These products had been previously excluded from use on peaches, nectarines, plums, prunes, and apricots.)

• Admire Pro Insecticide (EPA Reg. No. 264-827, Bayer CropScience) is now approved in NY for foliar use as well as soil applied uses. This step now completes Bayer CropScience's conversion of all Provado uses to Admire Pro. There is still some Provado in the channels of trade and that label is still legal. However, now Admire Pro with the foliar uses on the label can be shipped into NY and used accordingly. Please note that Admire Pro is a restricted use product in NY (as are all imidacloprid formulations).

New Labels

• Isomate DWB (EPA Reg. No. 53575-40, Pacific Biocontrol/CBC America) is now registered in NY for use in the mating disruption of dogwood borer in all tree fruit crops, including organic operations.

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Please note that the 2012 Cornell Pest Management Guidelines for Commercial Tree Fruit Production are now available as both a hard copy (https://psep.cce.cornell.edu/store/Guidelines/Item.aspx?Item=9) and online at: http://ipmguidelines.org/treefruits/.

PHENOLOGIES

Geneva:
All dormant

Highland:
Apple (McIntosh): dormant
Apple (Empire, Ginger Gold, Spur Red Delicious): silver tip

UPCOMING PEST EVENTS

	43°F	50°F
Current DD accumulations (Geneva 1/1–3/12/12):	50	16
(Geneva 1/1–3/12/2011):	22	3
(Geneva "Normal"):	37	11
(Highland 1/1–3/12/12):	39	8

Coming Events:	Ranges (Normal ±StDev):	
Green fruitworm 1st catch	60–132	17–59
Pear psylla adults active	31–99	8–34
Pear psylla 1st oviposition	40–126	11–53
Redbanded leafroller 1st catch	109–175	39–79
Spotted tentiform leafminer 1st catch	112–206	42–96
McIntosh silver tip	60–110	18–42

NOTE: Every effort has been made to provide correct, complete and up-to-date pesticide recommendations. Nevertheless, changes in pesticide regulations occur constantly, and human errors are possible. These recommendations are not a substitute for pesticide labelling. Please read the label before applying any pesticide.

This material is based upon work supported by Smith Lever funds from the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.