scaffolds
Update on Pest Management and Crop Development
FRUIT JOURNAL
August 25, 2008 VOLUME 17, No. 23 Geneva, NY

INSECTS

MEDDLE COUNT

ORCHARD RADAR DIGEST

<u>Geneva Predictions</u>:

Codling Moth

Codling moth development as of August 25: 2nd generation adult emergence at 93% and 2nd generation egg hatch at 71%.

❖❖

A MITE LATE

SUMMER REFRAIN
(Art Agnello, Entomology, Geneva)

❖❖ This season has been more cool and wet than normal, which has discouraged outbreaks of some arthropod pests, but encouraged others. However, most of this year's problems have been met appropriately by NY growers, so surprises and crisis infestations have been relatively few. With harvest approaching, there are just a couple remaining pest management duties.

Of greatest potential concern are the internal leps, which have been plentiful enough in the normal trouble spots, and there are still oriental fruit moths and even a few codling moths flying in some blocks. Therefore, to be cautious, we're not ruling out the possibility that blocks with a history of internal worm problems might need a last-minute application of a short-PHI material to help stave off the final feeding injury caused by young larvae. Before the harvest period begins in earnest, a fruit examination could help determine whether the last brood of any of the likely species needs a final deterrent before the sprayer is put away. Potential choices include a B.t., a pyrethroid, Calypso, Assail, Delegate, or a sprayable pheromone, as appropriate (pay attention to PHIs).

Another season-end problem that may deserve consideration now is pearleaf blister mite, a sporadic pest of pears that shows up in a limited number of commercial pear orchards and is a fairly common problem in home plantings. The adults are very small and cannot be seen without a hand lens; the body is white and elon-

continued...

IN THIS ISSUE...

gate oval in shape, like a tiny sausage. The mite causes three distinct types of damage. During winter, the feeding of the mites under the bud scales is believed to cause the bud to dry and fail to develop. This type of damage is similar to and may be confused with bud injury from insufficient winter chilling. Fruit damage is the most serious aspect of blister mite attack. It occurs as a result of mites feeding on the developing pears, from the green-tip stage through bloom, causing russet spots. These spots, which are often oval in shape, are usually depressed with a surrounding halo of clear tissue. They are 1/4–1/2 inch in diameter and frequently run together. A third type of injury is the blistering of leaves; blisters are 1/8–1/4 inch across and, if numerous, can blacken most of the leaf surface. Although defoliation does not occur, leaf function can be seriously impaired by a heavy infestation.

The mite begins overwintering as an adult beneath bud scales of fruit and leaf buds, with fruit buds preferred. When buds start to grow in the spring, the mites attack developing fruit and emerging leaves. This produces red blisters in which female blister mites then lay eggs. These resulting new colonies of mites feed on the tissue within the protection of the blister, but they can move in and out through a small hole in its center. The mites pass through several generations on the leaves but their activity slows during the warm summer months. The red color of the blisters fades and eventually blackens. Before leaf fall, the mites leave the blisters and migrate to the buds for the winter.

For those plantings that might be suffering from this errant pest, a fall spray is recommended sometime in early October, when there is no danger of frost for at least 24–48 hr after the spray. Use Sevin XLR Plus (1.5 qt/A) or 80S (1 7/8 lb/A), or 1–1.5% oil plus either Diazinon 50WP (1 lb/100 gal) or Thionex (50WP, 1/2–1 lb/100 gal; 3EC, 1/3–2/3 qt/100 gal). A second spray of oil plus Thionex, in the spring, just before the green tissue begins to show, will improve the control. ❖❖

D I S E A S E S

HOLD MOLD

POSTHARVEST FUNGICIDES FOR APPLES IN 2008

(Dave Rosenberger, Plant Pathology, Highland)

❖❖ Apple storage decays can cause significant losses of apples held in long-term controlled atmosphere storages, especially when apples are stored for more than six or seven months. With some cultivars (e.g., Honeycrisp), storage decays can develop more quickly after harvest and can become significant even when fruit are held in regular air storage. The most common storage decays are blue mold, caused by *Penicillium expansum*, and gray mold, caused by *Botrytis cinerea*. In northeastern United States, neither blue mold nor gray mold is commonly found on apple fruit in the field. Blue mold develops almost exclusively as a result of spores that enter wounds or fruit stems during harvest and postharvest handling.

Gray mold can also develop from wound infections. However, in New York gray mold

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usually originates from the calyx of intact apple fruit. In numerous other fruit crops, *Botrytis* is known to infect dying flower petals, grow from the petals into the sepals, and then remain quiescent until ripening of the fruit creates conditions favorable for the further growth that results in fruit decays. I suspect that most of the gray mold decay in New York apple storage results from that same infection process.

The fungi that cause "summer rots" in the field also can cause storage decays. The three common summer rots on apples are black rot, caused by *Botryosphaeria obtusa*, white rot, caused by *Botryosphaeria dothidea*, and bitter rot, caused by several species of *Colletotrichum*. These pathogens cause postharvest decays when harvested fruit have quiescent infections and/or are carrying high inoculum loads on their surfaces. They are best controlled with summer and preharvest applications of appropriate fungicides. None of these fungi grow at temperatures below 40° F, but they can invade and decay harvested fruit if cooling is delayed after harvest. When storage rooms are filled rapidly with warm fruit, cooling of the fruit in the center of large stacks of bins may take 7–14 days even though the thermometer inside the cooler door might indicate that the air temperature of the room is coming down relatively quickly.

The best low-cost option for minimizing blue mold decay in stored fruit involves using clean bins, avoiding recycling drenches after harvest, and storing apples in sanitized storage rooms. This combination of sanitation practices will minimize exposure of fruit to spores of *P. expansum*. However, postharvest treatments with diphenylamine (DPA) may be needed to control storage scald and/or carbon dioxide injury. Also, in the absence of a postharvest fungicide treatment, three to five percent of fruit left untreated may develop gray mold in some years and on some cultivars. A fungicide should ALWAYS be included in any recycling drench solutions used to apply DPA because the recycling drenches accumulate decay spores and act as inoculum baths in the absence of fungicides.

The four fungicides labeled for postharvest applications on apples include captan, thiabendazole (Mertect 340F), fludioxonil (Scholar) and pyrimethanil (Penbotec). However, Scholar and Penbotec may not yet be acceptable for some export destinations. The latest information on maximum residue tolerances for various countries can be accessed at http://www.mrldatabase.com/. Of course, some buyers may have additional restrictions.

Following is a summary of advantages, disadvantages, and considerations for each of the postharvest fungicides that can be used on apples:

• Mertect 340F: the label rate for drenches is 1 pt/100 gal. Mertect is the only remaining benzimidazole (BZ) fungicide registered for postharvest use since registrations for Benlate and Topsin M were discontinued. It is increasingly ineffective against blue mold due to BZ-resistant *Penicillium* that recycles on bins, and for this reason it probably should be used only in combinations with Captan. When combined with DPA, Mertect still controls gray mold (including the presumed latent infections on fruit calyces) because *Botrytis* has not yet developed resistance to the Mertect/DPA combination even though BZ-resistant *Botrytis* is quite common. As shown by Sharom and Edgington (1985), DPA has fungicidal activity against BZ-resistant strains of *Botrytis*.

• Captan: the label rates for drenches are 25 oz of 50W/100 gal for Captan 80WDG, and 1.25 qt/100 gal for Captec 4L. The pH of the drench water should be tested, and acidified if necessary to keep the pH below 7 because Captan will degrade under alkaline conditions. Captan is relatively ineffective for preventing infection of wounds if spores enter wounds just before or after Captan treatment. However, many storage operators have noted that they have less decay when they use Mertect-Captan combinations than when they use Mertect alone. This probably occurs because Captan slowly kills spores that collect in recycling drench solutions, thereby lowering inoculum levels. Where a Captan-Mertect combination is used, Captan will lower inoculum levels for both BZ-sensitive and

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BZ-resistant strains of *Penicillium*, but it is never 100% effective. Mertect will arrest growth of BZ-sensitive spores that get into wounds before Captan can kill them. Thus, where inoculum density and/or incidence of BZ-resistance are low, the combined action of Mertect plus Captan may be adequate to suppress postharvest blue mold.

• Penbotec: the label rate is 1 pt/100 gal. Penbotec is extremely effective against both BZ-sensitive and BZ-resistant strains of *Penicillium*. NY storage operators who previously had decay when they used Mertect or Mertect-Captan combinations report that those problems disappeared when they started using Penbotec. However, recent research in Washington State (Li and Xiao, 2008) suggests that Penbotec-resistant strains of *P. expansum* are likely to develop if this product is used continuously as the sole fungicide for controlling postharvest decays. Furthermore, Li and Xiao also reported that Penbotec-resistant strains of *P. expansum* might show reduced sensitivity to Scholar. Thus, continual use of Penbotec year after year may compromise the effectiveness of both Penbotec and Scholar fungicides, thereby leaving us once again with no effective controls for storage decays caused by *P. expansum*.

Based on what we know about resistance management for fungicides, two strategies are suggested for managing resistance to Penbotec. Firstly, it is absolutely essential that storage operators alternate fungicides by using Penbotec one year and Scholar the next year, since these products have equivalent efficacy but different modes of action. Secondly, using a combination of Penbotec plus captan might also slow selection for resistance because the captan would reduce inoculum levels (as described above), thereby ensuring that Penbotec selection pressure would always be applied to a smaller number of spores within drench solutions. Using Penbotec-captan combinations will be less effective for resistance management than yearly alternation between Penbotec and Scholar, so using a tank mix combination cannot be substituted for alternating products from year to year. The very best strategy may be yearly alternations between Penbotec-Captan and Scholar-Captan combinations. However, the use of Captan may not be essential if the other two products are alternated yearly.

• Scholar: the label rate for Scholar SC is 16–32 fl oz/100 gal and the rate for Scholar 50W is 8–16 oz/100 gal. However, Syngenta recently released 2(ee) recommendations for Scholar on blue mold and gray mold that provide for use of Scholar SC at 10 fl oz/100 gal and Scholar 50W at 6 oz/100 gal. At these reduced rates, Scholar becomes more affordable and is still very effective against blue mold and gray mold. However, I suggest that storage operators get a price quote on Scholar when they place their order so as to minimize risks of heart failure when the bill arrives. Those who decide that Scholar is not cost effective should probably forego use of Penbotec as well since alternation of these fungicides is essential for resistance management (as described above).

In summary, Penbotec and Scholar provide apple storage operators with powerful new tools for managing storage decays, but these new fungicides will remain effective only if users manage them carefully to avoid selection for fungicide resistance. No postharvest fungicides may be needed if apples are moved directly to storage without DPA drenches. In other cases, a Mertect-captan combination may continue to provide adequate control of postharvest decays if sanitation measures are employed to keep inoculum levels low. ❖❖

Literature cited:

Li, H. X., and Xiao, C. L. 2008. Characterization of fludioxonil-resistant and pyrimethanil-resistant phenotypes of *Penicillium expansum* from apple. Phytopathology 98:427-435.

Sharom, M. S. and Edgington, L. V. 1985. Temperature dependent negatively correlated cross-resistance between benomyl and diphenylamine for *Botrytis cinerea*, *Gerlachia nivalis*, and *Monilinia fructicola*." Can. J. Plant Pathology 7:389-394.

CLEAN SWEEP

USING SANITIZERS AND BIOCIDES IN APPLE STORAGE AND PACKING OPERATIONS
(Dave Rosenberger, Plant Pathology, Highland)

❖❖ For more than 10 years, I have been emphasizing the need for, and benefits of, sanitation measures that can be applied to apple storage and packing operations. This article provides a brief summary of factors to consider when implementing sanitation in apple storages and packing facilities in eastern United States. This article does not cover all available options, some of which were previously described in the postharvest newsletters for 2003, 2004, and 2005 that are available on-line at http://www.fruit.cornell.edu/cfhsnews.html.

First, we should clarify some terminology. Biocides and sanitizers both kill microorganisms, and most sanitizers could also be called biocides. However, the term "sanitizer" is commonly used for a product that is applied to hard surfaces AFTER the surface has been cleaned. Sanitizers are applied specifically to reduce microbial contamination. However, sanitizers will not kill microbes that are contained within decaying organic matter (e.g. a rotten apple) or within dirty films that accumulate on hard surfaces. Thus, sanitizers are effective only when applied to surfaces that have already been cleaned by removing visible organic matter and/or scrubbing with a detergent to remove dirty films. In general, quaternary ammonium products (quats) are the preferred sanitizers for hard surfaces in apple packinghouses and storages because quats are less affected by the combination of short exposure times and presence of underlying organic matter (e.g., wood in wooden bins) that often limits the effectiveness of hypochlorite solutions.

I prefer to use the term "biocide" for products that are introduced into water flumes to control microorganisms that would otherwise accumulate in water. The most commonly used biocide is sodium hypochlorite, the active ingredient in chlorinated water.

Activity of all sanitizers and biocides is affected by interactions among the following four factors:
1. Product concentration.
2. Exposure time.
3. Temperature.
4. Introduction of contaminating organic matter.

In addition, activity of sodium hypochlorite is strongly affected by the pH of the treatment solutions. The pH of chlorinated flume water should always be maintained between 6.0 and 7.0.

Product concentrations that can be used in sanitation procedures are regulated by label restrictions. With quaternary ammonium sanitizers, the labels may allow a higher concentration if hard surfaces receive a clean water rinse following application of the sanitizer. Only lower concentrations are allowed for surfaces that will not be rinsed. For most applications in the apple industry, the lower concentration without a water rinse will be both adequate and easier to use.

When sodium hypochlorite is added to water flumes, the optimal concentration depends on a variety of factors. Although concentrations of up to 200 ppm of free chlorine are allowed on some product labels, concentrations above 100 ppm increase chances of injuring fruit. The standard recommendation has been to maintain the concentration of free chlorine between 50 and 100 ppm in water flumes where chlorine is added manually, so as to ensure that an effective concentration will be maintained even if there is a sudden influx of organic debris that neutralizes some of the hypochlorite. Where automated systems are used to meter in chlorine and buffer solutions on an as-needed basis, free chlorine concentrations as low as 15 to 25 ppm will prove effective. When chlorinated water is used in large presort operations, using lower concentrations of hypochlorite will minimize salt accumulations in water flumes where it is not feasible to change out the entire volume of water on a regular basis. High levels of salts that sometimes accumulate in the water flumes of presort lines can result in fruit injury.

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Exposure time can be a limiting factor for effectiveness of both quaternary ammonium sanitizers and hypochlorite solutions, especially in situations where solution temperatures drop below 70° F. For example, we conducted two bin sanitation trials with the quaternary ammonium sanitizer Deccosan 315 and found that spraying or drenching wooden and plastic bins with this sanitizer reduced the number of *P. expansum* spores on the bins by roughly 99.9%. However, in a third trial with the same product, we achieved only a 70–80% reduction in spore load despite using similar methods. In attempting to determine why sanitation was less effective in the third trial, I realized that our sanitizer solution in the first two trials had been held long enough to reach ambient summer temperatures. However, the third trial involved solutions made with well water (presumably about 55° F.) and immediately applied to bins under conditions where the bins dried rather quickly after they were drenched with the sanitizer. In that latter case, the combination of lower temperature and limited exposure time reduced effectiveness of the sanitizer treatment.

The same temperature/exposure-time limitations allow bins coming out of chlorinated water dumps on packing lines to retain large numbers of viable *P. expansum* spores. The temperature of flume water on packing lines is usually between 43 and 50° F. because the water is constantly cooled by the introduction of the cold apples coming out of storage. At these temperatures, and assuming that the chlorinated water in the dump tank is adjusted to 100 ppm of free chorine, an exposure time of at least 15 minutes might be required for an effective kill of P. expansum spores on bin surfaces. Activity of the chlorinated water on wooden bin surfaces may be further reduced by interaction of the hypochlorite with wood fibers or with other adhering organic matter.

So if using chlorinated water in flumes and bin dumps does not fully sanitize bins, why is it recommended? The reason for chlorinating water flumes is to prevent cross-contamination of large volumes of fruit by microorganisms that are introduced with the fruit from each bin that is emptied. Despite the fact that bins may not be fully sanitized in cold flume waters, spores of *P. expansum* that are released into the water will be exposed for much longer periods and will ultimately be killed by the hypochlorite. More importantly, bacteria are far more sensitive to hypochlorite than are spores of *P. expansum*, so bacteria introduced into the water flumes will be killed rapidly despite the low water temperatures. Using chlorinating flume water on packing lines should be a standard practice for food-safety reasons.

What about ozone generators? Ozone generators have been used for many years on the west coast to introduce ozone gas into water flumes on packing lines. Ozonated water is an effective alternative to chlorinated water, but it is usually used only where packinghouses have problems with disposal of chlorinated water.

In recent years, apple storage operators have frequently asked about the value of placing ozone generators in apple storage rooms to sanitize the rooms and break down ethylene. So far as I know, no one has ever shown any benefit from using ozone generators in apple storage rooms. Although ozone does break down ethylene in air, it cannot stop the natural generation of ethylene inside apple fruit and it therefore is not a substitute for treatment with 1-MCP. Ozone in the storage air will NOT stop the advance of decay organisms that are already present in fruit wounds, and I doubt that the low levels of ozone that can be tolerated in storage air are adequate to kill dry spores of *Penicillium* that may be adhering to storage walls or bin surfaces.

The suggestion that ozone generators might be useful in apple storages probably derives from the fact that they have proven useful for reducing decays in lemon storages in California. Constant exposure to low levels of ozone reduces sporulation of the *Penicillium* species that cause posthar-

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vest decays of lemons. This is important because lemons are stored at 55° F, a temperature that allows for multiple infection cycles by *Penicillium* species during the lemon storage period. Also, the blue-green spores produced by *Penicillium* on decaying lemons can stain adjacent healthy lemons and make them unacceptable for marketing, thereby multiplying the losses incurred from a single decayed fruit. With apples, the low oxygen atmosphere used for CA storage suppresses sporulation of *P. expansum* just like ozone does for lemons, and there is no secondary infection cycle of apples during storage due to the colder storage temperatures. Therefore, ozone generators in apple storages will not generate the decay-control benefits that have been observed in lemon storages. ❖❖

GOLD LEAF

EARLY LEAF DROP ON GOLDEN DELICIOUS
(Dave Rosenberger, Plant Pathology, Highland)

❖❖ In the Hudson Valley, many growers are noting leaf yellowing and early leaf drop on Golden Delicious. The disease causing this early defoliation is necrotic leaf blotch. It was previously described in a 2004 Scaffolds article that can be accessed at http://www.nysaes.cornell.edu/ent/scaffolds/2004/040823.html#d1.

The bottom line is that no one knows what causes this disease, and no one can predict when and where it will occur. It shows up sporadically, but when it does occur, it seems to affect Golden Delicious across an entire region. It is unique to Golden Delicious and does not spread to other cultivars. There are no practical methods for controlling this disease. In some cases, Golden Delicious trees may lose nearly half of their leaves. Fruit are not directly affected, but one might assume that the early leaf loss could have negative effects on fruit size, maturation, and/or sugar accumulation.❖❖

LAST CALL

FINAL REMINDER – TREE FRUIT PEST CONTROL FIELD DAY

❖❖ Please remember to make plans to attend this year's N.Y. Fruit Pest Control Field Day, which will take place during Labor Day week on Sept. 3 and 4. The Geneva installment will take place first (Wednesday Sept. 3), with the Hudson Valley segment on the second day (Thursday Sept. 4). Activities will commence in Geneva on the 3rd, with registration, coffee, etc., in the lobby of Barton Lab at 8:30 am.

The tour will proceed to the orchards to view plots and preliminary data from field trials involving new fungicides, bactericides, miticides, and insecticides on tree fruits and grapes. It is anticipated that the tour of field plots will be completed by noon. On the 4th, participants will register at the Hudson Valley Laboratory starting at 8:30, after which we will view and discuss results from field trials on apples/pears. ❖❖

INSECT TRAP CATCHES (Geneva, NY) (Number/Trap/Day)

	8/18	8/21	8/25
Redbanded leafroller	0.1	0.3	0.5
Spotted tentiform leafminer	18.9*	9.2	8.5
Oriental fruit moth	0.5	0.2	1.8*
American plum borer	0.1	0.0	0.3
Lesser peachtree borer	0.0	0.2	0.0
Lesser appleworm	0.1	0.8	0.1
San Jose scale	244	200	225
Codling moth	0.5	0.0	0.0
Obliquebanded leafroller	0.3	0.0	0.0
Peachtree borer	0.0	0.0	0.1
Apple maggot	0.4	0.2	0.0

* first catch

UPCOMING PEST EVENTS

	43°F	50°F
Current DD accumulations (Geneva 1/1–8/18/08):	2886	1966
(Geneva 1/1–8/18/2007):	2913	2014
(Geneva "Normal"):	2939	1991
(Geneva 1/1–8/25 Predicted):	3022	2060
(Highland 3/1–8/25/08):	3080	2134

Coming Events	Ranges (Normal ±StDev):	
Oriental fruit moth 3rd flight peak	2650–3242	1828–2252
Oriental fruit moth 3rd flight subsides	2962–3381	2000–2288
Apple maggot flight subsides	2772–3374	1908–2368
Spotted tentiform leafminer 3rd flight peak	2607–3043	1782–2118
Lesser appleworm 2nd flight subsides	2883–3467	1973–2387
Redbanded leafroller 3rd flight begins	2657–2969	1827–2085
Redbanded leafroller 3rd flight peak	2767–3237	1903–2325
Obliquebanded leafroller 2nd flight subsides	2965–3489	2036–2458
Peachtree borer flight subsides	2525–3145	1710–2194
San Jose scale 2nd flight subsides	2639–3349	1785–2371

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