Maine Apple Newsletter  
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Apple maggot

A final insecticide application in mid-August is usually late enough to protect against apple maggot through September harvest. Traps can be taken down by August 30.

1) Assail insecticide calls for combination with a surfactant. Growers are often including calcium in late season tankmixes, which raises the question of whether there is risk of leaf burn by including Assail + surfactant + calcium in the same tankmix. As far I can determine, the risk is less with the liquid calcium formulations versus dry calcium chloride. While there has been at least one observation leaf burn related to calcium application shortly after a Silwet application (not even same tankmix), there are apparently many cases of combining the two in the same tankmix without any problem.

Different adjuvants have different levels of surfactant (spreading) activity. Silwet is more active as a spreader than Li-700. In return for less spreading activity, Li-700 provides some pH buffering and penetrant activity. I am not sure how the two products perform relative to each other as drift retardants. My guess is that would be related to the surfactant activity.

While the risk may not be that great from combining a spreader with calcium, it may also be true that including the surfactant with Assail is less important when the target pest is apple maggot. You would definitely want to include the surfactant if the target pest is wooly apple aphid or apply mealybug, which are difficult to control because of their waxy coating. Scale insects are in that hard to control group too. But for control of surface feeding apple maggot adult flies that move around a lot, superb coverage may be less important.

While definite answers are not available, after talking with three field advisors and manufacturer reps, it seems that a multipurpose adjuvant like LI-700 would be a better choice for this combination than a spreader-only material; the risk may not be that great even if using a full strength surfactant; and alternatively, that assuming the target pest is apple maggot, adequate control may be achieved by using Assail without spreader.
2) Asana was found to be ineffective as a final August apple maggot spray last year. While this was a special case of a block that seems to have had exceptionally high pressure (but no trap data to document such), it also fits with the observation that pyrethroids, at least or especially the early generation pyrethroids like Asana, do not perform well when temperatures exceed 80F. The exact temperatures threshold may be even lower. Newer pyrethroid products like Baythroid, Danitol, and Warrior may be less susceptible to this temperature effect. However, it is also true that the negative effect of pyrethroids on beneficial species is most harmful with late season applications, so the non-pyrethroid options are preferable anyway.

**Mites**

If living, hatched European red mites or Twospotted spider mites are present on more than 86% of middle-aged leaves, or if there is an average of 7.5 mites per leaf, then a rescue miticide treatment is recommended to prevent impact on preharvest drop and fruit size. Nexter, Portal, Kanemite, and Acramite are all good options for rapid knockdown of adult mites.

**Wooly apple aphid, Apple mealybug, Leafhoppers & Leafminers**

Wooly apple aphid (WAA) create white cottony clusters in branch angles and pruning cuts. Inside these clusters you will find a colony of purplish WAA. Their primary impact is caused by excretion of sugary honeydew which falls onto fruit and supports the growth of sooty mold fungi. If abundant, WAA can interfere with harvest operations. WAA are also known to create galls on roots of apple trees. There is little known about the relationship between the number of above-ground colonies and the below-ground root feeding population of WAA. Without a validated treatment threshold, growers must determine their own tolerance, which will reflect orchard specific marketing requirements. The old rule of thumb was to treat WAA if there were colonies on more than 50% of pruning cuts and branch junctions. I think most growers would find it worth treating WAA long before they reached that level. Even though the honeydew staining is removable, the other old rule of thumb to treat for aphids if 10% or more of the fruit are affected also seems far too high.

Because of the waxy coating, WAA are difficult to control. The only insecticide rated “Good” for control of WAA with an acceptable preharvest interval is Movento. Unfortunately, Movento will not help with protection against apple maggot or codling moth. Diazinon has a 21-day PHI.

Of the products listed as “Fair” against WAA, only Assail and Calypso will also protect against apple maggot or codling moth. The preharvest interval (PHI) for Assail is 7 days. It is too late to use Calypso in most blocks because of its 30-day PHI.

Apple mealybug is another insect that creates white cottony masses. This pest has been noticeable in at least three Maine orchards in 2011. We do not have specific insecticide ratings versus apple mealybug, but assuming the ratings against Comstock mealybug apply, effective options with a PHI of <= 14 days are Assail, Provado, Movento (all with 7 day PHI), and Portal and Centaur (14 day PHI).
**White apple leafhopper**, and possibly rose leafhopper, can become so numerous in September as to create a substantial nuisance for pickers (and PYO customers). They also cause small tar-like spots of excrement on apples. Their feeding reduces leaf photosynthesis. The recommended treatment threshold is if there is more than an average of 2.0 WAL nymphs or adults per leaf. Many insecticides, including the standard recommendation of reduced-rate Sevin (carbaryl) or Provado are effective options.

**Leafminers** did not show up at all on early season trunk traps, and were above 0.25 per leaf in only 6 out of 119 blocks monitored this summer. But one block that had 0.2 mines per leaf in June exploded to 4.5 mines per leaf in late July and August. The grower applied Assail in early August. This should prevent much additional leaf stress from third generation mines. Those mines would start appearing in late August to mid-September if not prevented. While 4.5 mines per leaf looks terrible, research studies have found that even higher infestation of 10+ mines per leaf is required to show an effect on preharvest drop. I cannot find anything in the spray history or site conditions of the orchard to explain a 20X increase between generations. Leafminers are present in just about every orchard every year, but are normally kept at low levels by natural enemies and unsuitable weather.

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**Stink bugs**

Maine has native **brown stink bug**, **dusky brown stink bug**, and **green stink bugs** that occasionally cause some late-season fruit damage. The damage appears as small discolored spots appearing on apples in late July and August. There are various other causes beside stink bugs for such spots. Probably the most common is bitter pit caused by calcium deficiency that causes decay spots on the calyx end of the apple, though in more severe cases spots may be found on the upper half of the apple. Some cultivars, including Golden and Red Delicious are susceptible to Cork Spot, the cause of which is less clear, but which is also probably related to calcium, drought, and/or crop load.

Characteristics that help distinguish stink bug from similar damage symptoms are:
- distinct versus gradual border around the damaged tissue,
- each spot has a small puncture wound, though it might not be visible without high magnification,
- less likely to be clustered around the calyx end, and can be more prevalent where a leaf laid next to fruit or in a line where a stink bug made successive probes,
- browning of flesh only just under the surface, browning does not go deeper,
- less variation between cultivars than with bitter pit or cork spot.

For the native stink bug species found in Maine, beside pyrethroids, products with a “Good” efficacy rating are Clutch (7 day PHI), Lannate (14), Beleaf (21) and Thionex (21). Materials with a “Fair” rating include Assail (7), Provado (7) and Avaunt (14).

The **brown marmorated stink bug** (BMSB) which caused so much tree fruit damage in the MidAtlantic states in 2010 has not become established in Maine as of August 2011. There have been a few cases of BMSB found on materials brought into Maine from Pennsylvania, but these introductions have not resulted in established overwintering populations.
While BMSB have been found in NY, CT, MA, and NH, BMSB trapping programs in CT and NY have not found much activity so far this year. BMSB activity was first noted on peach and vegetable crops in the Hudson Valley in early August.

The USDA Ag Research Service lab in WV released a 2-page MidAtlantic BMSB status report on August 9. ([http://www.caf.wvu.edu/kearneyville/BMSB/BMSB-Tree-Fruit-Update-8-8-11.pdf](http://www.caf.wvu.edu/kearneyville/BMSB/BMSB-Tree-Fruit-Update-8-8-11.pdf)) They report that BMSB successfully overwintered, and that BMSB have been widespread this summer on corn, soybeans, various trees and other woody plant hosts. Overwintered adults laid eggs that hatched into summer feeding nymphs, which matured and began laying another generation of eggs, which has resulted in considerable overlap between adults and nymphs of both the summer and second generation.

BMSB started damaging stone fruit in late May and early June. BMSB feeding on apple began at fruit set (ca. mid-May), but the early season feeding causes only a small puncture wound that is not considered economic damage. Stink bug feeding on apple from mid- to -late June onward has resulted in visible damage.

Growers have been able to reduce stink bug damage by frequent application of broad spectrum insecticides. Fruit damage along the edge of monitored sprayed apple blocks averages 13%. Damage in the periphery of monitored sprayed peach blocks averages 20%, with 14% damage on interior trees. These damage counts are in blocks with varying degrees of insecticidal control. In addition to the fruit damage, there is economic damage caused by the costs of making additional spray applications. Damage is expected to increase from mid-August through harvest.

**Apple Scab**

Pennsylvania is reporting serious problems with poor scab control this year. Resistance to sterol inhibitor/DMI and strobilurin (QoI) fungicides combined with an unusually wet spring is suspected as key factors. In a 2009 resistance survey, 75% of samples were resistant to at least one of the three DMI fungicides tested, and 14% of the samples were resistant to all three. Age of trees, orchard size, number of DMI sprays in 2009, and lack of dormant copper sprays were positively correlated with the incidence of fungicide resistance.

The status of strobilurin resistance in PA is not yet known. But given the DMI resistance status, many growers relied heavily on strobilurins this spring. Now it suspected that strobilurin resistance has also developed.

Maine orchards are vulnerable to the same selection for fungicide resistant scab strains. Thanks to Dr. Kerik Cox at Cornell University, we have been able to have 11 orchards tested for scab resistance to:

– dodin (Syllit),

– DMI Sterol inhibitors (Rally, Vintage, Procure, Indar*, Inspire Super*, Tebuzole*).

* The more recent DMI fungicides may retain rate-dependent efficacy against DMI resistant scab for an unknown number of additional applications, &

– QoI Strobilurins (Flint, Sovran, Pristine, Cabrio).
The scorecard so far is shown below. Seven more Maine samples were collected this summer and sent for testing. Results will not be available until January at the earliest (and sometimes tests on a sample fail).

The keys to preventing fungicide resistance in apple scab are
- minimize the use of materials that are susceptible to resistance, and when they are used:
  - combine them with a protectant fungicide (captan or mancozeb) not prone to resistance,
  - apply them at full rate and with excellent coverage.
- minimizing the amount of scab pressure through sanitation and effective protectant programs
- minimize reliance on long-range post-infection control

Combining DMI fungicides with at least a half rate of a protectant fungicide has been the standard recommendation for many years, but even now it is deemed sufficient to a strobilurin fungicide by itself. I have never understood this. The August 2011 update of the Fungicide Resistance Action Committee (FRAC) guidelines list strobilurins as being at High Risk of resistance, and the DMIs as Medium risk. It was established years ago that the “magic number” of total applications that could be used before resistance developed is lower for the strobilurins than for the DMIs. I think the magic number concept has been discarded because it implies that all applications create an equal contribution toward resistance selection. This is not the case. Applications made at full dose in combination with a protectant fungicide, with excellent coverage, before or right after an infection period, and in low inoculum orchards may be repeatable forever. Whereas, low-dose and alternate row applications made alone or with inadequate amount of protectant fungicide partner, applied with poor coverage with long delay of 100 hours after the start of infection periods in high inoculum orchards, or worse yet, in orchards with sporulating secondary scab lesions, will rapidly select for fungicide resistant scab strains.

Given the loss of strobilurin efficacy for use against apple scab in Michigan only 12 years after being introduced to the market, my vote is that strobilurins, like DMIs, should only be used in combination with at least a half rate of captan, mancozeb, or another scab resistant fungicide.
The boscalid component of Pristine is of the SDHI class of fungicides that FRAC rates as having its own Medium to High risk of resistance. So while Pristine is already a combination product, by this line of reasoning a third fungicide should be included with a Pristine application, at least if there is active scab in the orchard. And the safe assumption is that there is always some scab around. This same logic applies to Inspire Super, which is a combination of the DMI difenoconazole and the anilinopyrimidine cyprodinil (sold alone as Vangard). Vangard has its own Medium risk of resistance.

As stated by FRAC: “... no mixture is likely to completely prevent the eventual development of resistance to a mixture component. Used wisely, however, mixtures can significantly delay the process and lead to a longer fungicide life.”

Once established, resistance to strobilurin or DMI fungicides is relatively permanent, but research conducted by K. Cox, S. Villani, G. Jacon has found that the prevalence of scab strains resistant to dodine declines after an extended number of years without additional exposures to the extent that dodine is once again as or more effective than other fungicides. It is not known how quickly dodine resistant strains may rebuild in these orchards with renewed exposures. But it is a safe bet that combination with captan or mancozeb would slow the resumption of dodine resistance in such orchards.

Flyspeck and Sooty blotch

The rains on August 15–16 and 21–22 have degraded fungicide coverage applied before August 22. This is especially true where the final fungicide application was made before August 15. Also, note that 6–10 day and 8–14 day forecasts call for above average amount of rain. Here are updated estimates for when flyspeck could begin appearing on fruit based on the date and type of fungicide used for the final application.

<table>
<thead>
<tr>
<th>Final application date</th>
<th>MONMOUTH Latest “safe” harvest date with low risk of flyspeck (assuming continuous protection prior to final spray)</th>
<th>Captan or Ziram</th>
<th>Captan + Tospin, Captan + phosphite, Flint, Sovran</th>
<th>Pristine, Cabrio</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 1</td>
<td>Aug. 29</td>
<td>Aug. 31</td>
<td>Sept. 7</td>
<td></td>
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<tr>
<td>August 10</td>
<td>Sept. 10</td>
<td>Sept. 10</td>
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<td>Sept. 10</td>
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<td>Sept. 22</td>
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<tr>
<td>August 20</td>
<td>Sept. 27</td>
<td>Oct. 8</td>
<td>Oct. 17</td>
<td></td>
</tr>
</tbody>
</table>
**SANFORD Latest “safe” harvest date with low risk of flyspeck**
(assuming continuous protection prior to final spray)

<table>
<thead>
<tr>
<th>Final application date</th>
<th>Captan or Ziram</th>
<th>Captan + Topsy, Captan + phosphite, Flint, Sovran</th>
<th>Pristine, Cabrio</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 1</td>
<td>Sept. 6</td>
<td>Sept. 6</td>
<td>Sept. 6</td>
</tr>
<tr>
<td>August 10</td>
<td>Sept. 6</td>
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<tr>
<td>August 20</td>
<td>Sept. 23</td>
<td>Oct. 1</td>
<td>Oct. 1</td>
</tr>
</tbody>
</table>

* Estimates for Monmouth and Sanford are updated twice daily at [http://pronewengland.org/AllModels/DecisionModels.htm](http://pronewengland.org/AllModels/DecisionModels.htm).

Testing done by Dr. Dave Rosenberger indicates that captan + a phosphite fungicide (Phostrol, ProPhyt, Fosphe, Agri-Fos, Fungi-Phite, Topaz) is as effective as captan + Topsy M for preventing flyspeck. However, the phosphite partner does not provide as much protection against fruit rots as Topsy M. So when combining captan with a phosphite, use a full dose of captan to improve fruit rot control. This is especially true for use on cultivars like Cortland and Honeycrisp that retain mummy fruit that harbor black rot spores.

Ziram + sulfur is better than ziram alone. Use of a spreader reduces noticeable Ziram residue.

Flint appears to have been ineffective against sooty blotch in a Hudson Valley in 2010 test, with additional anecdotal observations of less than stellar performance in commercial orchards. Dr. Rosenberger recommends that neither Flint nor Sovran be used as the final spray on yellow-skinned cultivars because of unreliable performance against a member of the sooty blotch species complex that gives fruit a cloudy gray cast. Sooty blotch and flyspeck are more serious diseases in the Hudson Valley than in Maine, so I do not know if this concern is relevant to Maine.

### Other troubles

**Shiro plums** at Highmoor Farm have cracking damage. This is a varietal tendency and not due to a disease or insect. Some peaches have been lost to late season brown rot. Stone fruits are susceptible to brown rot during rainy weather during bloom, and again as harvest nears and fruit water content increases in the three weeks before harvest. Captan, Elevate, and DMI fungicides (Indar, Quash, Rally, Tebuzol, Tilt) are effective against brown rot and have a zero-day preharvest interval.

Weak trees in one orchard visited recently had me wondering if herbicide exposure could be a contributing cause. Weed control in tree rows with glyphosate herbicide can harm apple trees and affect fruit quality even without noticeable foliar effects from uncontrolled drift. Dr. Dave Rosenberger et al. published a comprehensive article on this topic in the August 2, 2010 issue of the Scaffolds Newsletter, online at [http://www.scaffolds.entomology.cornell.edu/2010/100802.pdf](http://www.scaffolds.entomology.cornell.edu/2010/100802.pdf)
Stop Drops for Apples

Many varieties are prone to preharvest drop especially McIntosh. A “stop drop” can be used to prevent fruit loss before adequate color has developed or to delay harvest one to two weeks. A delay in harvest can also increase fruit size, but long-term storage is always compromised in late-harvested apples. Two chemicals are available that can slow fruit drop, NAA and ReTain. In some cases, fruit color development will be delayed since ReTain also slows the ripening process. Gala and Honeycrisp are more sensitive to ReTain than McIntosh and can have a delay in ripening and fruit drop with two-thirds the full rate.

NAA can slow fruit drop without delaying fruit ripening. When applied more than once, it will actually hasten ripening and fruit softening. It is typically applied at the first drop of sound fruit. The two NAA products, Fruit Fix and Fruitone, each contain a different amount of ingredient.

ReTain™ applied 3-4 weeks before first pick will slow fruit maturation and allow for a later harvest. This is useful for orchards where a later harvest is desired or necessary as in the case of a labor shortage. ReTain does not improve the storage life of apples when harvest is delayed.

ReTain applied 2 to 3 weeks before first pick will not slow ripening of the first harvest, but will extend fruit drop control of the second harvest. This is useful for extending the harvest over a period of time without delaying the first harvest.

A combination of ReTain and NAA applied 2 to 3 weeks before first pick can improve drop control compared to using either chemical alone. The NAA can also be applied separately after ReTain. The optimum timing of these chemicals when used together is still a matter of ongoing research.

Do not apply NAA closer than five days before harvest or ReTain within seven days of actual harvest. Apply ReTain or NAA in at least 100 gallons of water per acre to get maximum effectiveness.

Alternatives to postharvest fungicide drench

Implications made by the Environmental Working Group (EWG) “Dirty Dozen” list about the safety of consuming fresh produce based on using their non-standard qualitative ranking system on the most recent pesticide residue data released by USDA are erroneous and unjustifiable. We are working on an independent analysis of the USDA data, focusing on apples and using scientifically valid criteria. We reach much different conclusions. That report is not done yet, but you can see a review of the EWG methodology as it was applied to a variety of crops based on an earlier set of USDA pesticide residue test data at [http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3135239/](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3135239/) (Dietary Exposure to Pesticide Residues from Commodities Alleged to Contain the Highest Contamination Levels, by Carl K. Winter and Josh M. Katz).
The amounts found in the most recent USDA pesticide residue test results (based on samples taken in 2009) on apples are far below regulatory thresholds for even the most frequently detected compounds. It is worth noting that those thresholds are set with safety divisors of at least 100X below levels found not to cause adverse effects in laboratory tests. This is done to account uncertainty introduced by extrapolation from test animals to humans, and for potential variable sensitivity in human subpopulations. Additional safety divisors can be added for other uncertainty factors.

Apart from any dietary significance, or the lack thereof, reducing the number of pesticide residue detections at even the most minute levels is advantageous. It is interesting to note that the three most commonly detected materials in the USDA apple tests (thiabendazole, diphenylamine (DPA), and pyrimethanil) are from postharvest applications made to prevent scald and fruit rot in storage. This is not surprising. It makes perfect sense that materials applied after harvest are the ones most likely to be found in later testing.

This context makes recent work by Dr. Dave Rosenberger exploring ways to reduce or eliminate some of those applications even more interesting and useful.

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1) Excerpts from an article by Dr. Dave Rosenberger in the August 8, 2011 edition of the Cornell Scaffolds newsletter.
http://www.scaffolds.entomology.cornell.edu/2011/SCAFFOLDS%208-8-11.pdf

“Many NY growers are opting to apply DPA via methods that no longer involve the high-volume recycling drenches that redistributed mold spores and exacerbated postharvest decay problems. Alternative methods for DPA applications include both the bin-top sprays mentioned above as well as thermofogging or aerosol injections of DPA into storage rooms after they are filled. Eliminating the recycling drenches also reduces the exposure of fruit to spores of *Penicillium expansum*, the cause of blue mold. Many storage operators are finding that they can safely eliminate postharvest fungicide treatments on apples if they do not wet the fruit via recycling drenches. However, *Penicillium* spores left in storage rooms from last year's crop can be blown onto fruit, enter wounds, and cause decays if no fungicides are applied. This risk can be minimized by sanitizing storage floors with a quaternary ammonium sanitizer during summer.”

“Quaternary ammonium sanitizers can be introduced either as sprays to the floors and walls of storages or via fogging of empty rooms. Peroxyacetic acid sanitizers can also be introduced by fogging, but surface sprays of the peroxyacetic acids may be less effective because these sanitizers require a longer contact time prior to drying than quaternary ammonium sanitizers. Chlorinated water sanitizers generally are not recommended for sanitizing hard porous surfaces.

Sanitizing storage rooms during summer is always a good practice, but is especially important if the fruit to be stored will not receive any postharvest fungicide treatment.”
“Postharvest fungicide options for apples can be summarized as follows:

1. Omit fungicide treatments completely where no DPA treatment is needed. This option has been adopted for most fruit that will be stored less than 90 days. A postharvest fungicide treatment might still be warranted for high-value, decay-prone cultivars such as Honeycrisp that will be stored for more than a few weeks.

2. Where DPA is applied via a traditional high-volume recycling drench, a fungicide should always be included in the drench solution. Options include thiabendazole (Mertect 340F or Deccosalt 19), Penbotec, or Scholar. Captan can also be included with any of the previous three, but I would not suggest using Captan alone in a recycling drench. Captan is not very effective for preventing decays after spores enter wounds, but it may reduce viability of the spores that collect in the recycling drench water. Including Captan with one of the other fungicides may help to reduce the inoculum load in the drencher solution and thereby reduce selection pressure for development of pathogens that are resistant to thiabendazole, Penbotec, or Scholar.

3. Where DPA is applied via thermofogging or aerosol injection, many storage operators have omitted fungicide treatments without encountering major decay problems, especially for fruit that will be packed by the end of March. Where no postharvest fungicide will be applied, decay risks from blue mold can be reduced by sanitizing storage rooms as outlined in last week's article in Scaffolds.

4. Both blue mold and gray mold sometimes reach unacceptable levels in CA rooms that are not opened until after March or April. In long-term CA rooms where DPA is applied via fogging or aerosol injection, storage sanitation (i.e., treating storage room floors with a sanitizer during summer) is absolutely essential. Risks can be further reduced by treating filled rooms with ecoFOG-160 (the thermofog version of Penbotec) or Deccozole A (the aerosol formulation of thiabendazole). The Deccozole treatment will not control benzimidazole-resistant strains of Penicillium that are abundant in some storages. There is no published research on the effectiveness of ecoFOG-160 or Deccozole A, and these treatments are relatively expensive. However, these products may provide a cost-effective way of minimizing decay risks in long-term storage rooms where DPA will be applied via fogging or aerosol injection.

5. Where DPA will be applied via a non-recycling bin-top spray, we are still uncertain whether or not a fungicide needs to be included with the DPA solution. (For details of the bin-top spray method for applying postharvest treatments, see either the recent article in New York Fruit Quarterly [2011, Vol. 19, issue] or the preliminary article published in Scaffolds last year and available at http://www.scaffolds.entomology.cornell.edu/2010/100809.pdf.) Some packinghouse operators using the bin-top spray method have omitted fungicides without noting any significant increase in decay, but I believe that these storage operators are carefully sanitizing their storage rooms during summer.
The argument for including a fungicide in the bin-top DPA applications is that the DPA solution that is applied to the top of the bin could still redistribute spores into wounds on the 40–60% of fruit surfaces that are actually contacted by the bin-top spray solution. Including a fungicide with the DPA would also provide protection against quiescent gray mold for at least those fruit that are contacted by the solution. (DPA will be effective throughout the bins because of its vapor action, but fungicides lack similar vapor action and will be effective only on the fruit surfaces that are contacted, which our research indicated will be only about 40% of the total fruit surface.)

Finally, including a fungicide in bin-top spray applications will provide excellent protection from blue mold spores that are deposited on the upper layers of fruit in each bin as bins are being positioned in CA rooms. Although sanitizing CA rooms prior to refilling will eliminate most of the spore load in CA rooms, some spores will be dislodged from the sides of bins as they are stacked into rooms. Including a fungicide with the DPA solution used for bin-top sprays will minimize risks from the airborne blue-mold spores that are brought into the room on bin surfaces. Ultimately, each storage operator will need to assess the risks, costs, and benefits of including a fungicide with DPA in bin-top spray applications.

Fungicide resistance management strategies should be employed regardless of which fungicide application method is used. The best strategy is to rotate fungicides annually, using Penbotec (or ecoFog-160) one year and then rotating to Scholar the next year. Where thiabendazole is still working, Mertect or Deccozele A could be included in a three-year rotation, or one of the thiabendazole products could be rotated with one of the other products in a two-year rotation.

The objective of the rotation is to avoid exposing the bins themselves to the same treatment two years in a row because the bins carry most of the *Penicillium* spores. Thus, using the same fungicide for the entire season increases the probability that bins will be exposed to different fungicides each season as compared with what would occur if fungicides were rotated within a single harvest season. As noted above, including Captan with Mertect, Penbotec, or Scholar may also help to reduce selection pressure for resistant strains of *Penicillium*.

Resistance to pyrimethanil (Penbotec) has already been detected in Washington State where Penbotec has been used continuously for four years or more. These valuable postharvest fungicides must be managed carefully via annual fungicide rotation if we hope to maintain their usefulness for more than just a few years.”

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Closing Words

“The world is not respectable; it is mortal, tormented, confused, deluded forever; but it is shot through with beauty, with love, with glints of courage and laughter; and in these, the spirit blooms timidly, and struggles to the light amid the thorns.”

- George Santayana
Where brand names are used it is for the reader’s information. No endorsement is implied nor is any discrimination intended against products with similar ingredients. Always consult product label for rates, application instructions, and safety precautions. Users of these products assume all associated risks.

Orchard Radar weather and pest tracking models at http://pronewengland.org/AllModels/DecisionModels.htm

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