Managing Post-Harvest Disease of Apples: August 5, 2014
Mary Concklin, Visiting Associate Extension Educator - Fruit Production & IPM

The following is from Dave Rosenberger, Cornell:

Managing post-harvest diseases requires action in at least three areas: pre-harvest disease control in the field, sanitation of bins and storages, and application of post-harvest treatments. This discussion will focus on managing diseases in the field during late summer with particular emphasis on the last spray that is applied before fruit are harvested.

Post-harvest diseases that must be controlled via field sprays include apple scab (which can appear as pinpoint scab after harvest), sooty blotch and flyspeck (SBFS), and fruit rots caused by Botryosphaeria species (black rot, white rot) and Colletotrichum species (bitter rot). Pinpoint scab can develop during storage if the orchard has a high incidence of leaf scab, fungicide residues are depleted before harvest, and fruit remain wet for more than 24 hours after the fungicide residues are depleted. Although 24-hr pre-harvest wetting periods can result in a low incidence of pinpoint scab, severe outbreaks are usually limited to fruit exposed to a 48-hr wetting period before harvest and after fungicide residues were depleted. Fungicide residues are generally depleted after fruit have been exposed to 2 inches of accumulated rainfall following the application. Fruit infections that occur shortly before harvest will not yet be evident when fruit are harvested, but they will develop into pinpoint scab while fruit are held in cold storage.

Late-season infections by the fungi causing SBFS may also be invisible at harvest and develop during storage if fruit are cooled slowly. Unlike the apple scab fungus which can grow slowly at temperatures below 35 F, the fungi causing SBFS will not grow after fruit are cooled to below 40 or 45 F. However, if rooms with limited refrigeration capacity are filled quickly, then it may take 10 days or more for fruit in the center of stacks to cool to below 40 F. If fruit in a partially filled room cool down at night and then the temperature rises again the next day as additional fruit are added to the room, the colder fruit may “sweat”, thereby providing ideal growing conditions for incubating SBFS infections that needed just a few more hours of wetting to develop visible symptoms.

Effective fungicide coverage during July and August is essential for preventing development of summer fruit rots. If bitter rot becomes established in some fruit, then spores from the infected fruit may spread to other fruit and cause incipient infections that will not be visible at harvest. Those incipient infections can develop into fruit decays during storage. Like the fungi causing SBFS, most of the summer rot fungi stop growing when fruit are cooled to below 40 F, but the rots can develop rapidly if stored fruit are cooled slowly.

To the best of my knowledge, none of the diseases mentioned above can be reliably eradicated by fungicides applied after harvest. Thus, if fruit are left unprotected during critical infection periods in late summer and become infected with SBFS, scab, or summer rot fungi, those errors
of omission during summer cannot be corrected by applying a post-harvest fungicide. Research at the Hudson Valley Lab over the past 10 years clearly demonstrated that Pristine provided the longest residual control of SBFS, and a combination of Pristine plus Captan has therefore been recommended for the last spray of the season for apple cultivars that will be harvested in October. Because that combination was also very effective for controlling bitter rot, it was also recommended for high-value cultivars, such as Honeycrisp and SweeTango, that can sometimes develop summer fruit rots. However, Pristine may be in short supply this year. Fortunately, results from a trial that we conducted at the HVL in 2013 indicate that Merivon should perform just as well as Pristine for controlling SBFS and summer rots (Rosenberger et al, 2014). When fruit from the 2013 trial were held in storage after harvest, the incidence of decay that developed in stored fruit was also similar for the Pristine and Merivon plots (data not yet published), thereby providing evidence that Pristine’s ability to suppress storage decays will be matched by the activity of Merivon. Luna Sensation may also perform well in late summer sprays, but it was not included in our 2013 trials, and it has a 14-day pre-harvest interval whereas Pristine and Merivon both have 0-day PHI.

Merivon probably should NOT be substituted for Pristine in situations where a fungicide is being applied shortly before or after applications of Harvista (the sprayable form of 1-MCP). Harvista applications require the use of spray oil, and the Merivon label specifically notes that Merivon should NOT be used with oil or other products formulated as emulsifiable concentrates. We don’t yet know what degree of separation may be required between applications of Merivon and Harvista, but caution is advised.

Whereas the potential for damaging fruit via sequential applications of Merivon and Harvista is largely unknown, problems everyone should realize by now are that Captan and oil are not compatible, and they should not be applied within 10-14 days (or perhaps even longer) of one another. Normally, we would recommend that Captan should be included in all summer sprays on apples regardless of what other fungicides might be included in the tank mix. However, it appears that an exception may be required in blocks where Harvista will be applied in the next 10-14 days (again, we don’t know the exact limits). Where Harvista will be applied, the safest bet will be to apply either Pristine or Flint as the sole fungicide in applications prior to or shortly after Harvista has been applied. However, remember that Flint has a 14-day PHI, that Flint must be used at the rate of 3 oz/A for bitter rot suppression, and that the Flint label specified only four applications per year with a maximum of 11 oz/A/year. An alternative where Harvista will be used might be to apply a combination of Flint-plus-Ziram or Pristine-plus-Ziram, thus substituting Ziram for Captan. However, Ziram can leave a lot of visible residues, and it will match the activity of Captan only if it is applied at nearly full label rates.

In various trials conducted over the years, including the 2014 trial mentioned above, I have found that although pre-harvest applications of Pristine can help to suppress storage decays, the pre-harvest sprays never match the effectiveness of post-harvest drenching for controlling blue mold caused by Penicillium expansum. The level of storage rot control provided by Pristine when it is applied in pre-harvest sprays is presumably affected both by the quality of spray coverage and by the amount of rain that occurs between the last application and harvest. Thus, sprays applied one day before harvest should be more effective for suppressing storage decays.
caused by *P. expansum* than are sprays applied three weeks before harvest. However, even if sprays are applied one day before harvest, complete coverage of the fruit surface will be almost impossible on trees that carry a full crop. By comparison, post-harvest drenching ensures complete coverage, and post-harvest fungicides that are “fogged” into storage rooms may also provide more complete coverage than can be achieved with pre-harvest sprays.

Despite the fact that pre-harvest sprays cannot match the efficacy of some post-harvest treatments, the slight edge that is provided by pre-harvest sprays may be good enough for situations where there is little disease pressure for post-harvest decays. In general, the incidence of fruit decays is very low if fruit are not wetted after harvest, if fungicide protection was maintained throughout the growing season, and if harvest is well managed (ie, fruit are harvested at the proper maturity with a minimum of bruising). Using a pre-harvest spray within a week or two of the planned harvest date also increases the likelihood that harvested fruit will still have enough residue to prevent SBFS, bitter rot, and black rot from growing during the cool-down period after harvest. Furthermore, pre-harvest sprays may provide fungicide coverage that is equivalent to the bin-top treatments that have been used successfully to apply diphenylamine (DPA) after harvest. DPA applied via bin-top treatments protects all fruit surfaces from storage scald because of the volatility of DPA, but post-harvest fungicides are less volatile and therefore do not protect all fruit surfaces when applied as bin-top treatments (Rosenberger, 2011). Nevertheless, field experience has shown that, like pre-harvest sprays, bin-top treatments can provide control that is “good enough”, even if it is less than perfect.

**One final note:** When the QoI fungicides (FRAC group 11) were first labeled, all products in this group (including Flint, Sovran, Pristine) had a label restriction dictating a maximum of four sprays per season for any combination of products that contained a QoI active ingredient. That restriction remains on the current labels for Sovran and Flint. However, the labels for Pristine, Merivon and Luna Sensation have been changed. Those products still have label limitations indicating that no more than two sprays can be applied in succession with a maximum of four applications per year for each product, but they no longer limit users to a maximum of four applications per year for all QoI fungicides combined. Thus, for example, current labels would allow two applications of Merivon pre-bloom, two applications of Merivon post-bloom, and two applications of Pristine in pre-harvest sprays. However, any use of Flint or Sovran during the season would appear to limit apple growers to a maximum of four sprays per year for any and all products that include a QoI fungicide. Limiting total QoI usage to four sprays per year may help to delay resistance development, but options for using five or six sprays per year (e.g., three or four for early-season scab plus one or two pre-harvest) could be helpful in some situations and would be feasible if the Sovran and Flint labels were updated to include the same wording currently used for Pristine, Merivon, and Luna Sensation.
Disclaimer for Fact Sheets:

The information in this document is for educational purposes only. The recommendations contained are based on the best available knowledge at the time of publication. Any reference to commercial products, trade or brand names is for information only, and no endorsement or approval is intended. UConn Extension does not guarantee or warrant the standard of any product referenced or imply approval of the product to the exclusion of others which also may be available. The University of Connecticut, UConn Extension, College of Agriculture, Health and Natural Resources is an equal opportunity program provider and employer.