scaffolds Update on Pest Management and Crop Development
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PETAL FALL

PETAL FALL INSECT CONTROL STRATEGIES
(Art Agnello)

❖❖ A few points to keep in mind for your petal fall insecticide sprays:

1) To minimize the hazard to honey bees, apply pesticides only after ALL petals have fallen in the block and when no bees are actively foraging on blooming weeds (evening is better than early morning).

2) Do not use Lannate on early McIntosh, Wealthy, or Dutchess because of possible injury to fruit and foliage.

3) Postbloom use of any synthetic pyrethroid insecticide has on occasion encouraged the build-up of mites and woolly apple aphid. If a pyrethroid (Asana, Ambush, Pounce) was used in any of the prebloom sprays, do not apply another pyrethroid at petal fall. Try to limit use of these materials to one application per season to delay resistance development and extend their useful field life.

4) When choosing an insecticide for this application, keep in mind its range of activity, both adverse and beneficial. For example, if Sevin is applied for thinning, it will also help to control plum curculio and white apple leafhopper (even at the 1 lb rate). Carzol acts not only against European red mite, but will also control white apple leafhopper; however, it is not kind to predatory mites.

5) Be aware of the destructive effects of any spray materials on beneficial mites and insects (refer to Tables 8 and 12 on pp. 39 and 44–46 in the 1994 Recommends).

6) Do not use Vydate or Sevin during the first 30 days after bloom without taking into account their thinning effects.

MITES

European red mite hatch will soon be starting in apple blocks around the state. Some bona fide treatable populations may have already been noted. Now is the time to keep one eye on the thermometer and the other on mite numbers, because a little warm weather can quickly boost numbers into the problem category. Until June 30, we recommend a threshold of 2.5 motile stages (anything except eggs) per leaf. You can determine the mite densities on the foliage by actually counting them if you want to, but this is more effort than required. Your time is probably better spent using the presence/absence technique:

Examine intermediate-aged leaves (from the middle of the fruit cluster) for motile stages. Check at least 50 leaves (5 per tree), for the presence of any number of mites; no treatment is recommended if <62% of the leaves examined are infested. A sequential sampling table (p. 87) and chart (p.95) are provided in the Recommends.

WHITE APPLE LEAFHOPPER

WALH nymphs can be numerous in some blocks, especially in the eastern part of the state; growers using Sevin in their thinning sprays will get some control at the 1 lb rate. Alternative choices for control include Thiodan and Lannate; Carzol used for mites now will also do the job, but will be harmful to your predator mites; this first generation is generally not worth the trade-off.

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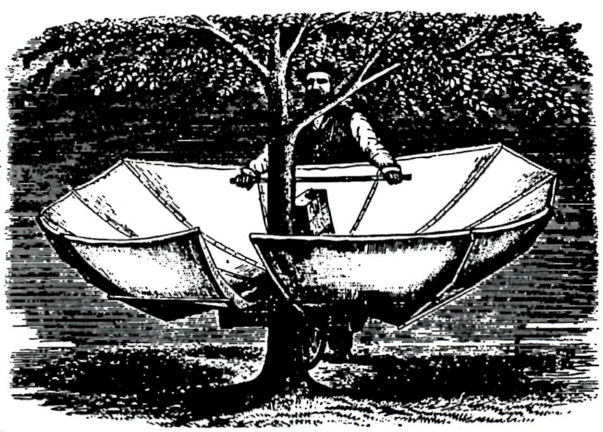
PLUM CURCULIO
(Art Agnello & Harvey Reissig)

Plum curculio adults move into orchards from overwintering sites in hedgerows or the edges of woods and are present in the trees from late pink to early bloom before the fruit is susceptible to damage. Adults are active in the spring when temperatures exceed 60°F. Adult females oviposit in fruit during both day and night but feed mostly at night. Depending on temperature, overwintering adults remain active for two to six weeks after petal fall. Although adults may feed on blossoms, apples are not susceptible to damage until petal fall, at which time adults damage fruit by both feeding and ovipositing. Unlike fruit injured by other pests, many apples damaged by plum curculio will remain on the tree until harvest. Because adults are not highly mobile, orchards near overwintering sites, woodlands, and hedgerows are most susceptible to attack. Fruit damage is usually most common in border rows next to sites where adults overwinter.



Monitoring for plum curculio is not currently recommended in New York because of the amount of time and labor involved and because plum curculio is generally assumed to be present in every orchard. Various techniques have been used in other areas to monitor plum curculio damage and the presence of adults:

- Clubs or shakers can be used to jar adults from limbs into catching frames or cloths for counting.
- Polyethylene funnels hung under branches can be used to capture adult plum curculio.
- Immature "scout apples" hung in trees near the edges of orchards serve to measure oviposition scars before petal fall so potential damage can be estimated before control sprays are applied.
- Oviposition scars on immature fruit can be counted in orchards starting at petal fall to estimate damage from plum curculio. Because substantial oviposition and damage can occur even after a single warm day and night, frequent scouting for damaged fruit is necessary after petal fall. The economic threshold for plum curculio damage after petal fall in Massachusetts has been set at 1 feeding or oviposition scar among 60 apples, 6 from each of 10 trees per block.

Several species of wasps parasitize eggs and larvae of plum curculio. Ants, lacewings, and ground beetles prey on larvae in the soil, and some fungi kill larvae. These organisms are not usually sufficient to regulate populations of plum curculio in commercial orchards. Plum curculio is difficult to control completely with insecticides. Relatively high rates and persistent applications are important because adults may be active for two to six weeks after petal fall depending on temperatures. In normal orchards that are not near woodlots or hedgerows and have not suffered previous damage, a single application at petal fall will provide seasonal

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control. In problem orchards, a petal fall application followed by a second spray 10 to 14 days later will provide adequate control. In orchards with chronic problems, or in seasons when adult activity is prolonged by unusually cool and wet weather, two cover sprays applied 10 to 14 days apart after petal fall may be necessary to prevent late damage. Guthion, Imidan, Lorsban, and all pyrethroid insecticides are effective at controlling plum curculio. These materials will also control codling moth later on.

The current control strategy is treatment with an organophosphate insecticide at petal fall and the first cover spray in western N.Y., and at petal fall plus the first and second cover sprays in eastern N.Y. Harvey Reissig and Jan Nyrop continued their field tests on oviposition last year, to find out whether the egg-laying period can be defined in terms of the always variable postbloom weather patterns, especially regarding degree-day accumulations. Their results again reinforced a few points we generally try to make each season:

1) Although plum curculio adults may be in the trees during bloom, they generally do not begin to do any bud-cutting or egg-laying until some time (i.e., 80 degree days, base 50°F, or at least a few days) after petal fall.

2) Unless weather conditions cause an inordinately extended progression from bloom to petal fall to fruit set, perfectly adequate control can be achieved with a timely spray at petal fall and another at first cover (population pressure in the research check plots gave 10% fruit damage).

3) Application of a pyrethroid at pink does not reduce fruit damage compared with the above postbloom schedule.

GREEN FRUITWORM (GFW)

This is a collective common name used in New York to refer to a number of Lepidoptera, but one of the more common members of this group is the speckled green fruitworm, *Orthosia hibisci*. Traditionally, orchards in eastern N.Y., particularly the Hudson Valley, have had greater problems with GFW than those in the western part of the state. The GFW has a single generation per year and overwinters in the pupal stage in the soil. Adult emergence begins at about green tip and is complete by the pink stage of McIntosh apples. The adults are about 2/3 of an inch long, and are grayish-pink in color with two purplish-gray spots on the forewings. Egg laying begins at about half-inch green. Eggs are laid singly or in pairs. They are white to grayish in color and have ridges radiating from the center. GFW larvae begin hatching between tight cluster and pink. The larvae feed on new leaves, flowers, and developing fruit. Fruit feeding is normally restricted to larger larvae. The larvae mature between late May and late June, at which time they drop to the ground and pupate in the soil at a depth of 2 to 4 inches. In the past, sprays were applied at pink and petal fall to control the GFW. However, research has indicated that a single spray at petal fall provides comparable control to the two-spray program. Monitoring for the GFW is the same as monitoring for the obliquebanded leafroller, which should take place during the late bloom stage, and both species may be considered together in making a control decision. Pesticides recommended for control of this caterpillar include: Lorsban, Thiodan, Lannate, and the pyrethroids Asana, Ambush, or Pounce.

COMSTOCK MEALYBUG

From our past field trials, we can offer the following guidelines for control of this insect in pears (and apples):

- The preferred timing for control of the 1st brood of crawlers is at petal fall; for the 2nd, during the first week in August in western N.Y., and 10–14 days EARLIER in eastern N.Y. (as determined by monitoring migration with tape traps, which we'll do again this year).
- The best materials we have tested are Penncap-M, Lannate, and Diazinon; their ranking varied from one location to the next, and according to use pattern and population pressure. Penncap-M is probably the most economical. Lorsban is the best of all for apple infestations, but is not registered for postbloom use in pears.

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• Generally speaking, back-to-back sprays against the 2nd brood result in lower fruit infestations than 2 sprays against the 1st, or a single spray against each brood.

• In orchards with serious population pressure, more than 2 mealybug treatments may be required to ensure a reduction of infestations to commercially acceptable levels, and the first year of such treatments in a heavily infested block may still not do a tremendous job. This is a pest that requires yearly attention before you start getting good results.

The DEC has granted us a 2(ee) permit to apply Lannate for mealybug, at 1 lb/100 gallons. Diazinon 50WP is labeled at 1 lb/100 gal in up to 3 cover sprays, and Penncap-M is labeled at 2 pt/100 gal, which is also a 2(ee) use. These materials have had varying acceptability to processors for their fruit products from one year to the next. Be sure to check with your intended buyer's guidelines before making a spray decision. For situations where methyl parathion and diazinon are both unacceptable, a control option is to apply Lannate when it will do the most good. We would advise during peak 2nd brood crawler activity in August, and will let you know when that occurs.❖❖

DISEASES

RESISTANCE ???

RESISTANCE RISKS /MANAGEMENT STRATEGIES FOR SI FUNGICIDES

(W. Wilcox and W. Köller)

❖❖ As we head into the heart of scab control programs, it's an appropriate time to review a few basics concerning the possible risks of resistance to SI fungicides and how best to minimize them.

Fungicide resistance patterns differ. Remember that there are different patterns of resistance for different types of fungicides. The pattern most familiar to apple growers is that shown by the benzimidazole group (Benlate and Topsin-M), which is of the "all-or-nothing" type. With this pattern, scab isolates that have never been exposed to the fungicide fall into at least two distinct subgroups: (1) the vast majority, which are highly sensitive to field rates of the material; and (2) a relative few, which are essentially immune to even 500 or 1,000 times the normal usage rate. Therefore, no matter what rate is used, these isolates will survive every spray and rapidly become the dominant members of the scab population as applications of the fungicide continue. Unless they are kept from multiplying to damaging numbers (e.g., by tank-mix applications of an unrelated fungicide), control failures can occur suddenly.

In contrast, the resistance pattern for SI fungicides is of the very different "shades-of-gray" type. With this pattern, scab isolates in a previously unexposed population show a continuous range of sensitivities, along a so-called normal or bell-shaped distribution curve. That is, most individuals have an "average" level of sensitivity; a smaller proportion are moderately more or moderately less sensitive than average; and a very few individuals are much more or much less sensitive than average. This means that the percentage of individual scab spores that are controlled by each spray is determined entirely by the rate of the fungicide that they encounter.

At insufficient exposure rates (low use rates and/or poor coverage), a few of the least sensitive isolates can slip through. If they are not controlled by subsequent sprays that provide better rates or coverage, they will multiply and become an increasingly larger percentage of the population over time. Control problems caused by population shifts of this type first show up as a need for higher fungicide rates and shorter spray intervals compared to when the material was first introduced, followed by increasingly poor performance as time goes on.

Monitoring and determining resistance levels. General theories are important for understand-

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ing the principles of resistance development, but how can we apply them to specific practices? What is an "average" level of sensitivity in a scab population? What is the difference in sensitivity between average isolates and those that are more tolerant? How much does the scab population have to change before control becomes difficult with common use rates? How fast do populations change under different use regimes?

To provide some answers to these questions, we first performed lab tests on over 500 individual scab strains obtained from orchards in Western NY where SI's had never been used. This allowed us to determine the "starting point" range of sensitivities to various SI fungicides in an unexposed (or wild type) population of the fungus. These results were then compared against similar tests performed on populations obtained from commercial orchards throughout the state, in which SI's have been used for a limited number of years. We've also compared them against populations from two orchards at the Experiment Station in Geneva, where SI's have been tested for 12 and 22 years, respectively, and from a similar orchard at the Agriculture Canada Research Station in Kentville, Nova Scotia. Complete control failure due to resistance was reported after 12 years of SI testing in the Nova Scotia orchard (population data from Nova Scotia were determined and supplied by Dr. P. Gordon Braun, Ag. Canada).

In the wild type population, the various SI's had inherently different levels of activity. For instance, when compared with the strongest fungicide, about 9 times as much active ingredient of the weakest material was required to produce the same effect. Also, isolates highly sensitive to one SI were highly sensitive to the others, and isolates resistant to one material were cross-resistant to the others. Neither of these findings is surprising, but they are important to remember.

We also found that 10–15% of the wild type isolates fell into a "reduced-sensitive" category, where about three times as much fungicide was required to produce the same level of inhibition as was required for the average strains. Resistant isolates (i.e., those that now make up 30–40% of the population in the Nova Scotia orchard and seem to be the main cause of control failures) required approximately 10 times the rate that the average strains did. It appears that these isolates represent somewhere around 0.2% of the wild type population, since we've found one out of 500 wild isolates tested.

History of resistance development. So, what does the history of the Nova Scotia site tell us about why the most resistant portion of the scab population increased from 0.2% of the total up to 30–40% of the total in a matter of a dozen years? At a first casual glance, the history is discouraging: Baycor (an older SI used in Europe since the late 70's, similar in scab activity to Rubigan and Nova) provided very good control during the first 4 years that SI's were tested. However, by the 8th year it was shakey and by the 11th year, Baycor test plots had 63% fruit scab vs. 10% in the standard protectant plots. But let's take a closer look at the details of what did and didn't work (all usage rates are given in terms of active ingredient per acre):

(1) in the early years when Baycor was most effective, the rate tested was 7.0–10.5 oz

(2) in the later years when it failed, the tested rate was 3.5 oz, although the recommended rate in other regions was 4.2–5.6 oz

(3) in the 11th year, when the low rate of Baycor allowed 63% fruit scab, Nustar (another SI) allowed 65% scab at 0.2 oz but only 12% scab at 0.5 oz (equivalent control to the standard protectant program). As a point of reference, the recommended rate of Nustar was 0.6–0.8 oz in the Experimental Use Permit trials in New York orchards a few years ago.

In other words, a significant number of fungus strains that were resistant to 3.5 oz of Baycor were also resistant to 0.2 oz of Nustar, but they were susceptible to 0.5 oz of Nustar. This vividly illustrates that <u>when we talk about "SI resistance", we need to specify material and rate.</u> Any scab strain

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is "resistant" to a low enough rate and, at the same time, "susceptible" to a high enough rate. What we're really interested in is their reaction to labeled rates.

What is a full rate? Understand that label rates are determined by individual companies on a trial-and-error basis, and for various reasons are sometimes set just above the point at which control begins to slip. Also remember the wide range of SI sensitivities among scab isolates in any given orchard population. This means that virtually all label rates are high enough to control the highly sensitive isolates, the average isolates, and even the 10–15% of reduced-sensitive isolates present in a typical scab population (otherwise, performance would be unacceptable from the start). However, depending on how close to the breaking point these rates have been set, they may or may not be sufficient to control the least sensitive individuals in the population. In other words, different materials have different margins of safety when it comes to control of these more resistant strains at recommended rates. Our data, and field experience from Nova Scotia and Europe, suggest that the SI's currently registered for scab control in the U.S. have little such safety margin, especially at their minimum labeled rates. Therefore, using them below recommended rates is a good way to start building up tolerant or resistant isolates in the orchard.

Current status of resistance in NY. It is interesting to contrast the Nova Scotia orchard, where resistant scab strains built up to hard-to-control levels within 11 years of SI use, to one of the orchards at the Geneva station in which SI's have been tested for the same length of time. Our lab assays showed that the scab population in this Geneva orchard is still very similar to a wild type population in terms of SI sensitivity. The reason for the difference between these two orchards is not certain, but we think it is probably due to two major factors in the Nova Scotia block: (1) extremely large scab populations (about 25% of trees were left unsprayed); and (2) perennially cool and wet summers, perfect for repeated generation cycles of any scab strains that could survive exposure to low fungicide rates. So what happened in Nova Scotia can also happen here, it probably just happened faster there because of larger populations and more generations per year.

This supposition is supported by our data from another Geneva Experiment Station orchard, where SI's have been tested for 22 years. In this orchard, the scab population has begun to shift towards resistance (the reduced-sensitive strains have become more common and resistant strains now make up about 5% of the population), but we can still get acceptable control with full labeled rates. However, when we go below labeled rates (e.g., 1.5 fl oz of Rubigan 1E/100 gal dilute, equivalent to 0.75 oz of Nova 40W/100 gal dilute), control falls apart. Furthermore, when we've tested the sensitiviy of the scab lesions on trees sprayed with these rates, a very high percentage of them fall into the reduced-sensitive and resistant categories. So, using such rates not only provided poor scab control, it also provided selection pressure favoring the buildup of the more resistant members of the scab population.

Finally, what is the current status of scab sensitivity in commercial orchards where the SI's have been used for the last few years? Quite simply, we have found no evidence of a shift towards resistance in any Western NY orchards, and only a very slight shift in two Hudson Valley orchards.

Anti-resistance strategies. With the preceeding in mind, we believe that growers can successfully use SI fungicides to control apple scab for many years if they follow a few simple anti-resistance strategies:

(1) Reduce selection pressure by keeping the scab population low. This allows you to keep the actual number of problem isolates to an absolute minimum, since they represent a very low percentage of the population to begin with. In other words, good annual scab control is also an important anti-resistance strategy! Get thorough spray coverage, use adequate rates and intervals to maintain control,

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tank mix with a protectant.

(2) Reduce the percentage of resistant (thus, selectable) isolates in a population. Because "resistance" and "susceptibility" of any individual scab spore is determined entirely by rate, you determine the proportion of "resistant" isolates in the orchard each time you fill up the tank—don't cheat! Also, remember that the fungus doesn't react to the rate in the tank, only to the rate on the tree—thorough coverage is critical!

(3) Reduce the selection time by limiting the use of SI's to the primary scab season. Current practices of limiting SI use to a maximum of 4–5 sprays per season should help maintain their viability for a long time to come.❖❖

FIELD NOTES

HUDSON VALLEY

HUDSON VALLEY DISEASE UPDATE
(Dave Rosenberger)

Apple scab ascospore maturity counts, Highland, NY, May 11

Immature	Mature	Discharged	Tower shoot
37%	41%	31%	395

APPLE SCAB

❖❖ Scattered showers Thursday May 12 provided a light Mills' infection period at the Hudson Valley Lab. Some locations in the Hudson Valley received considerable hail, but it appears that damage to tree fruits was minimal.

FIRE BLIGHT

Weather remained cool and the epiphytic infection potential (EIP) for blossom blight infection (according to the MaryBlyt model) remained below threshold. Despite numerous short wetting periods during bloom, we suspect fire blight incidence this year will be very low because of the cool temperatures during bloom.❖❖

GENEVA

APPLE SCAB
(Wayne Wilcox)

ASCOSPORE MATURITY (5/13)

	Maturity category (%)**					Discharge test
DD 32*	1	2	3	4	5	(Spores/LP field)
498	7	19	11	38	25	81

*Accumulated degree days (base 32°F) between first date of green tip and date of assessment. Ability to discharge ascospores usually begins to increase rapidly at approx. 175–225 DD after green tip.
**Categories: 1–3 = immature; 4 = morphologically (apparently) mature; 5 = discharged. Growth stage on 5/13: McIntosh = Full pink

PHENOLOGIES

Geneva:
Apple(McIntosh) - **Bloom** ; Pear - **Bloom**; Tart cherry(Montmorency) - **50% Petal fall**; Sweet cherry(Windsor) - **100% petal fall** Peach - **Fruit set** ; Plum(Darrow) - **Petal fall**

Highland:
Apple (McIntosh): **Petal fall** ; Apple (Rome): **75% petal fall** ; Apple (Jerseymac): **10mm fruit** Pear (Bartlett): **Petal fall**

PEST FOCUS

Geneva:
Oriental fruit moth and Lesser appleworm adults flying
Predator mites (*Typhlodromus pyri*) active, feeding on ERM
White apple leafhopper nymphs persent

Highland:
1st **codling moth** trap catch
Obliquebanded leafroller active

INSECT TRAP CATCHES (Number/Trap/Day)

Geneva NY

	5/9	5/12	5/16
Green fruitworm	0.1	0	0
Redbanded Leafroller	0**	0**	0**
Spotted Tentiform Leafminer	386	540	688
San Jose scale	0	0	0
Lesser appleworm	0.4*	0.3	12.1
Orientall fruit moth(apple)	0	0.5*	10.6
Oriental fruit moth(peach)	0	0	0.4*

** We are not catching any RBLR in designated traps, but have seen them in other traps at the Station, and in Wayne County.

* = 1st catch

HVL, Highland NY

	5/9	5/16
Green fruitworm	0	0
Redbanded Leafroller	0.9	0.6
Spotted Tentiform Leafminer	12.9	3.5
Oriental Fruit Moth	16.1	6.8
Fruitree Leafroller	0.1	<0.1
Lesser appleworm	0.1*	0.9
Codling moth	0	1.4*
American plum borer	0	0
Sparganothis fruitworm	0	0

(Dick Straub, Peter Jentsch)

UPCOMING PEST EVENTS

		43°F	50°F
Current DD accumulations			
	(Geneva 1/1 – 5/16):	372	181
	(Highland 1/1 – 5/16):	539	272

Coming Events:	**Ranges:**	
Comstock mealybug 1st crawlers	220–425	82–242
Lesser peachtree borer 1st catch	224–946	110–553
Oriental fruit moth 1st flight peak	323–606	138–298
Redbanded leafroller 1st flight peak	180–455	65–221
Spotted tentiform leafminer 1st flight peak	180–375	65–192
STLM sap feeders present	295–628	146–325
Tarnished plant bug adults active	71–536	34–299
Lesser appleworm 1st flight peak	455–851	255–471
Codling moth 1st catch	273–805	141–491
European red mite egg hatch complete	361–484	183–298
Pear psylla hardshell present	463–651	259–377
McIntosh at petal fall	418–561	210–317
Pear at petal fall	343–505	144–275
Peach at shuck split	362–518	174–287
Plum at petal fall	277–448	113–251
Sweet cherry at fruit set	409–518	209–287
Tart cherry at petal fall	394–518	201–287

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