scaffolds

Update on Pest Management and Crop Development

FRUIT JOURNAL

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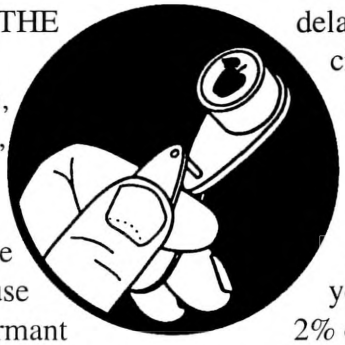
INSECTS

CLASSIC FILM

BOTTOM OF THE BARREL (Art Agnello, Entomology, Geneva)



❖❖ One of our most durable spring rituals continues to be the use of petroleum oil as a delayed dormant application for mite and insect control in fruit trees. Despite the fact that a number of newer and capable contact miticides are now available for early season use, oil retains a justifiably preferred position because of its effectiveness, affordability, and relative safety from a biological and resistance perspective. Getting the most out of an oil application does require taking advantage of the earliest acceptable spraying conditions for maximizing (tree and block) coverage, which can be a challenge in our area, but few spray efforts can deliver as much payback as this one when it's done right.

Pear Psylla

It always seems to happen over the weekend, when we're not at our peak work efficiency, but we're assuming that psylla adults have been actively flying since the warm temperatures started a few days ago, and have already begun to lay eggs on pear buds not yet covered by a protective oil spray.

Early oil applications can be very useful against pear psylla all throughout the swollen bud stage; although it's capable of killing adults and nymphs that are contacted directly, oil is used chiefly because the residue has a repellent effect on female psylla looking to deposit their eggs that lasts for an extended period after treatment. The strategy behind the use of oil is to delay the timing of any needed insecticide spray until as late as possible before (or after) bloom. Oil rates depend on when you start: If your buds are at the dormant stage, one spray of 3% oil, or two of 2% through green cluster are recommended; if you start at swollen bud, one spray at 2% or two at 1% up to white bud should be adequate for this purpose, especially if applied as soon as the psylla become active (50°F or above). This will also give some red mite control at the same time.

European Red Mite

A delayed-dormant spray of petroleum oil from green tip through tight cluster can be a favored approach for early season mite control, both to conserve the efficacy of and to help slow the development of resistance to our contact

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PEST FOCUS, PHENOLOGIES

UPCOMING PEST EVENTS

miticides. Our standard advice has been that it is possible to get good control of overwintered eggs using 2 gal/100 at the green tip through half-inch green stage, or 1 gal/100 at tight cluster; this assumes ideal spraying conditions and thorough coverage. Naturally, oil applications don't always live up to the best expectations, not only because of weather and coverage problems, but also because proper timing can be difficult, especially if there are a number of blocks to cover during this transient window. Certainly, it is possible for mites to start hatching when the trees are at solid tight cluster, so oil's smothering action is seriously compromised once the mites are able to walk around or wade through the surface deposits. Let practicality determine how best to use the following guidelines.

First, to be sure that mites are in the egg stage, start on your blocks as soon as the weather and ground conditions permit, even if this means using a higher rate. This March was more typically wet and snowy compared with last year, so the degree to which you'll be able to follow this advice will depend on how quickly the orchard floors dry up. The short-term weather is looking to be more rainy than not, so that could work against this strategy. Also, tend toward the high end of the dosage range, especially if there's been no frost during the 48-hour period before your intended spray, and no danger of one for 24–48 hours afterwards. For example, use 1.5 gal/100 if the buds linger somewhere between half-inch green and full tight cluster during your chosen spray period.

Good coverage of the trees naturally is critical if you're to take advantage of oil's potential efficiency; this in turn requires adequate spray volume delivered at an appropriate speed. Experience and research have shown that a 1X concentration (300 gal/A) in larger trees is clearly preferable; however, if all other conditions are optimal (weather, speed, calibration), then 3X, or 100 gal/A, is the highest concentration that should be expected to give acceptable control at any given time. Growers like to concentrate more than this to save time and the hauling of extra water, but the problems this can cause usually make this a false economy.

Don't limit this mite-control tactic just to apples and pears. Talks with stone fruit growers over the winter have reminded us that many cherry, peach and plum plantings can suffer equally seriously from European red mite infestations that weren't given the early season attention they might need. We don't have hard and fast threshold guidelines for these crops, but stone fruit plantings with a history of past ERM problems should be examined for presence of the red overwintered eggs, and if they're numerous enough to see without a hand lens, then a prebloom application of 2% oil would be a prudent measure to help stave off this damage.

Piercing-Sucking

Despite our inclination to write off the San Jose scale as a vestige of orchard programs gone by, the vagaries of current regulatory decisions have had a hand in keeping them on our screen. The recent disappearance (or restriction) of products like Penncap-M and Lorsban from our choice of spray materials has been at least partly responsible for the fact that SJS still presents a challenge in a number of orchards. It's therefore

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worth pointing out that a 2% oil treatment at half-inch green will control the nymphs, and this is a preferred treatment if no other problem insects need to be controlled. Combining the oil with an insecticide has not been shown to be more effective than using the oil (or insecticide) alone. If you choose not to use oil against the scale nymphs, or if you have Rosy Apple Aphid or other early season insects to be controlled, an insecticide would be more appropriate. For both of these pests, Lorsban 4EC or Supracide have proven very effective during the green tip to tight cluster stage. Check the opening buds for infestations of Rosy Apple Aphid; treatment would be advisable upon finding one colony per 100 clusters.❖❖

WEATHER MATTERS

KNOWING WHICH WAY THE WIND IS BLOWING
(Art Agnello, Entomology, Geneva)

❖❖ (The following article, reprinted from our 1999 Apple In-Depth School proceedings, reviews a number of principles behind weather and pest management interactions.)

Weather Effects on Pest Activity and Control Measures

Of all the factors that can possibly have an effect on the development of a given pest population, the weather must certainly be one of the most critical. Nearly every discussion of how moderate or how severe an insect or mite problem is, was, or might be in a given season, starts with a general estimation of the temperature, wind, humidity and rainfall conditions to which that pest is subjected. We all have plentiful anecdotal evidence of how the spring rains of one year prevented one insect from taking off, or how the summer heat encouraged another. The point here is not to document specific effects, which are complex and abundant, but rather to indicate the need to take weather patterns into account when planning pest management programs, both before (prevention) and after (rescue) the fact.

Developmental Rates and Thresholds

Mammals are warm-blooded, developing at a constant rate regardless of the environmental temperature because they are able to maintain an internal temperature that allows their biochemical reactions to progress normally. Insects, which are exothermic, remain at the same temperature as their environment. They do not generate body heat and therefore depend on favorable external temperature. At a certain temperature, which varies among species, an insect's biochemical reactions cannot proceed and development stops. This temperature is known as the insect's developmental threshold or developmental base. Charting the ambient temperature makes it possible to track insect development, which is directly proportional to the amount of time accumulated above the developmental threshold (up to some maximum not often reached during the season). We divide this time arbitrarily into heat units or degree-days (DD).

Degree-Day Calculation Methods

There are different ways to determine the quantity of heat units accumulated, which is equivalent to the area under a temperature-vs-time graph on a given day. The methods are listed below in order of their precision in measuring small changes during the day or departures from idealized heating and cooling trends.

Average or Max/Min Method—This method is the simplest and least precise. It assumes that the daily temperature graph is linear and that the area beneath it is triangular.

DD = [Daily max temp + Daily min temp*]/2 – Devel. Threshold

(* If Daily min temp < Devel. Threshold, substitute Devel. Threshold)

Sine Wave (Baskerville-Emin) Method—This method is more precise and assumes that the daily temperature cycle takes the form of a sine wave. The area beneath this curve is determined by integration, which requires calculus. This method makes the same use of daily maximum and minimum temperatures and developmental threshold as does the Aver-

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age Method. Using the Sine Wave Method tends to accumulate more DD's than the Average Method, particularly during the early part of the season.

Continuous Integration Method—This method is the most precise and requires multiple temperature readings hourly or more frequently throughout the day to obtain a temperature versus time graph that is truly representative of a field situation. The area beneath the curve is still calculated using integration. The data collection is most efficient if handled by a computer.

Relating Degree-Days to Life Cycle and Development

These methods are attempts to correlate a pest event or activity with another event that can be measured more precisely. Events in an insect's life cycle often occur after the same heat units have accumulated each year, but many years' observations must be collected to measure this precisely. Degree-days can be used to predict events wherever weather data are available.

Temperature—By monitoring temperature and pest activity simultaneously for many years, it is possible to build up a data base of events and the range of accumulated DD's that correspond with them (refer to Table 14 in the 2001 Tree-Fruit Recommends, or see NY Food & Life Sci Bull. No. 142, "Fruit pest events and phenological development according to accumulated heat units").

Phenology—Some events occur reliably at the same time as other, easily observed biological events in the field; for example, mites hatch from late tight cluster to pink; European apple sawflies lay eggs from late bloom to petal fall. These rules of thumb often draw on the evolved relationships between pests and their hosts.

Biofix—This is a distinct, easily monitored event in the life history of an organism, used to fine-tune our predictions of its activity; for example, first flight, first egg laid, first mine observed.

Direct Influence of Weather on Pest Activity

First of all, in NY particularly, early spring is considered to be the die-is-cast period; the growth of most prebloom arthropod populations is pretty much determined for the first half of the season by what sort of spring weather occurs. European red mite, rosy apple aphid, spotted tentiform leafminer, tarnished plant bug, San Jose scale, and mullein bugs are only the most obvious of the species that suffer from a cold, wet, rainy and windy (in other words, typical) spring. They may be slowed considerably until the summer generations, or they might fail to show up at all in some cases. Conversely, a warm, dry, quick spring can result in nearly spontaneous generation of most of these pests. After the petal fall period, the rate of heat unit (Degree Days) accumulation is a primary factor in the duration of plum curculio oviposition (hotter = shorter period) and the speed of summer mite population growth. This latter case is especially crucial, as the first summer ERM eggs are generally hatching in June so the population is already primed to expand; additionally, the trees are particularly susceptible to foliar feeding stress, so a failure to act against a threshold-level infestation early will result in a long, hard battle for the rest of the summer.

Moving into midsummer, an abundance of rainfall will obviously stimulate foliar growth, which may have some advantages to the tree's development, but can also encourage undesirable infestations of pests such as green aphids, leafhoppers and even leafrollers. Hot and dry weather can be a mixed blessing, since it's associated on the one hand with localized outbreaks of twospotted spider mites, and on the other it tends to discourage emergence of apple maggot adults and woolly apple aphid aerial colonies if the ground is hard and dried out. The objective is to keep in mind which problems the prevailing conditions might require you to watch out for (and which to de-emphasize) as you go through the year. You can prevent a lot of needless effort in some cases, and effectively respond to otherwise serious infestations in other cases, simply by being aware of these basic trends.

Weather Effects on Pesticide Activity

The effect of rainfall and humidity on pesticide behavior is a topic that is much-debated, but about

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which few hard details exist. Certainly, everyone gets nervous by a long, hard rainfall immediately following a pesticide spray. How much rain does it take to wash off a residue? Does it need to be reapplied? If so, how soon? The truth is, the factors that determine the need for a respray are usually very specific to each case, and generalizations never give a specific enough answer. Research on this topic has shown that there are intrinsic differences between insecticides, and that advice on whether to respray if rain falls after an insecticide application is mostly dependent on the insecticide and its formulation, and not so much on the intensity of the rainfall. The guidelines we use are heuristic and anecdotal—in other words, fuzzy—but they may help you decide on the advisability of going back in with a respray. In general, we assume that a spray deposit is pretty much solidly in place on the plant surface if allowed to dry for 2 hr after being applied; anytime before this, and there may be cases where thorough drying has not taken place. After 2 hr, the potential loss in efficacy from a rain will generally vary with the duration and frequency of the rain, but not necessarily with how hard the rain falls.❖❖

FIELD NOTES

HUDSON VALLEY

HUDSON VALLEY APPLE SCAB

Apple Scab Ascospore Maturity Counts, Highland, NY:

Date	% ascospores that were Imm.	Mature	Empty	No. spores in tower shoot
April 5	85%	15%	0%	8

❖❖ Spore maturity in the Hudson Valley is unusually advanced compared to tree phenology. Trees still had no green tissue present at the time of this spore count. Significant spore discharges usually begin when we reach 15% mature spores in our counts. Although very few spores were discharged in the tower shoot test, that could change quickly with a few days of warmer weather. (Tower discharges usually exceed 400 spores at the peak of the season.)

The early spore maturation is hardly surprising given the constant snow cover during winter and the wet weather of the past two weeks. The early spore maturation in the Hudson Valley is similar to that of 1998 when many orchards developed severe scab as a result of a green-tip infection period followed by a wet spring and summer. Thus, Hudson Valley growers should be prepared to spray as soon as there is green tissue and a predicted infection period, even if they can only spray alternate rows. With high carry-over inoculum present in many orchards, this will not be the year to take chances on skipping early infection periods.❖❖

HUDSON VALLEY

ADJUSTING APPLE FUNGICIDE PROGRAMS TO COMPENSATE FOR SI RESISTANCE

(Dave Rosenberger, Plant Pathology, Highland)

DISEASES

❖❖ The last two issues of *Scaffolds Fruit Journal* contained articles discussing scab and mildew control strategies for orchards where SI fungicides (Rubigan, Nova, Procure) are still effective for controlling apple scab and powdery mildew. Strategies suggested in those articles must be modified for orchards where the SI fungicides no longer provide acceptable control of apple scab or mildew.

Status of fungicide resistance in apple orchards: Apple scab has developed resistance to dodine (Syllit), the benzimidazoles (Benlate, Topsin M), and the SI fungicides. Apple scab has never developed resistance to any of the "contact" fungicides, a broad grouping that includes the EBDC fungicides (mancozeb, Polyram), captan, the other carbamates (ferbam, thiram, ziram), or sulfur. The contact fungicides

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are multi-site inhibitors. That means that they disrupt several different metabolic pathways in fungi, thereby making it difficult for the fungus to circumvent the action of the fungicide. By comparison, the fungicides to which apple scab has developed resistance are single-site inhibitors. They arrest fungal development by interfering with a single critical metabolic pathway in the fungus. Resistant strains of apple scab survive the fungicide either by using an alternative metabolic pathway or by limiting access of the fungicide to the critical pathways within the cells.

Fungicide resistance comes in two flavors. With benzimidazole fungicides, resistance is an "all or nothing" proposition. That means that strains of the apple scab fungus that are resistant to the benzimidazoles cannot be controlled by using higher rates of Benlate or Topsin M. Resistant strains will grow through any rate of fungicide that could be applied in the field.

Resistance to dodine and the SI fungicides develops in a gradual "step-wise" process. Wild populations of apple scab contain strains with varying levels of sensitivity to dodine and SI fungicides. Repeated use of these fungicides gradually eliminates the most susceptible strains from the population, leaving only the less sensitive strains. These less sensitive strains can still be controlled with higher rates of the fungicides, but they survive in the field when fungicide rates are low, when intervals between sprays are too long, or when spray coverage is incomplete. This gradual selection for resistance ultimately produces stable scab populations that cannot be controlled by applying fungicides at labeled rates and intervals.

Resistance to dodine and benzimidazole fungicides is so widespread in New York State that these fungicides are no longer recommended for control of apple scab. They are still effective in some orchards, but their performance is unpredictable because of the unpredictable distribution of fungicide resistance. Furthermore, Drs. Wolfram Koeller and Wayne Wilcox at the Geneva Experiment Station have shown that a few orchards also contain scab populations with levels of SI resistance sufficient to account for failure of the SI fungicides under field conditions. Growers and fieldmen have also reported that SI fungicides are no longer controlling powdery mildew as effectively as when these fungicides were first introduced. However, levels of SI resistance in powdery mildew have not been documented by researchers.

The extent of SI resistance in apple orchards is difficult to determine because testing for resistance is a tedious and expensive process. As a result, most assessments of SI resistance in commercial orchards must be based on grower experience: If the SI fungicides fail to provide good control of scab or mildew when they are applied in a conservative 10-day program (as always, in combinations with contact fungicides), then quite possibly the scab and/or mildew population in that orchard has shifted toward SI resistance.

<u>Adjusting programs to compensate for SI resistance</u>: Apple growers with SI-resistant apple scab and/or powdery mildew are at a significant disadvantage compared with growers where SI fungicides are still effective. The new strobilurin fungicides (Sovran, Flint) can control scab and mildew as well as SI fungicides, but the strobilurins represent the last available chemistry with post-infection activity against apple scab and good protectant activity against mildew. Where SI fungicides are no longer effective, growers should take extra precautions (= extra expense!) to protect strobilurins against resistance development. We do not know how quickly scab and mildew may develop resistance to Sovran and Flint, but we know that resistant strains will eventually appear if these products are used inappropriately.

Following are my suggestions for using Sovran and Flint in orchards where growers suspect that apple scab or mildew has become resistant to the SI fungicides:

1. Use a very conservative program of contact fungicides from green tip to tight cluster or pink. Resistance to Sovran and Flint can be expected in orchards where these strobilurin fungicides are

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routinely used as "clean-up" materials to compensate for missed infection periods earlier in the season.

2. Where SI-resistant scab is present, Sovran and Flint should be used in combinations with a contact fungicide (either mancozeb, Polyram, or Captan). Although Sovran and Flint have been tested as "stand-alone" fungicides, tank mixes are essential for orchards where alternating with SI fungicides is no longer an effective resistance management option. As indicated in last week's article, rates of Sovran and Flint should never be reduced below the standard dilute rates (equivalent to 0.67 oz of Flint or 1.33 oz of Sovran per 100 gallons), and this applies even when the products are used in combinations. Tree-row volume adjustments are acceptable down to the dilute equivalent of 100 gal/A. Thus, even on very small trees, the minimum rate per acre should never be less than 0.67 oz of Flint or 1.33 oz of Sovran.

3. Shift the use Sovran + contact fungicide or Flint + contact fungicide forward in the growing season compared to what might otherwise be considered optimum timing. Thus, where SI resistance is already present, the strobilurin + contact combinations should probably be applied at pink and petal fall (or at pink, petal fall, and first cover) rather than just at petal fall and first cover. In very wet years with high carry-over inoculum, the first strobilurin spray might be justified at tight cluster. The objective here is to eliminate any potential for letting scab or mildew infections become established before the strobilurin fungicides are applied. The peak period of risk for primary scab infections usually occurs near pink, so it makes sense to target the strongest fungicides toward this time period. (As mentioned last week, a mancozeb or captan spray may be needed during bloom to bridge the gap from pink to petal fall.) This forward shifting of the strobilurin sprays is especially critical for orchards where growers believe that SI fungicides are no longer controlling mildew because mildew is usually well established by petal fall and the strobilurins act more slowly than the SI fungicides for arresting a running population of mildew.

4. The strobilurin + contact fungicide combination can be used only three times in direct succession. Where mildew is a significant problem, additional sprays will be needed after petal fall or first cover. The best option here (or where scab is still a threat after first cover) is to follow up with an SI + contact spray. If activity of SI's against mildew has been declining, then higher rates and tighter spray intervals may be needed. In some young orchards, Benlate or Topsin M may provide effective control of mildew in cover sprays, but benzimidazole resistant isolates are present on many older orchards. The only other alternative for mildew is to include sulfur in the early cover sprays.

These guidelines using Sovran and Flint in orchards with SI resistance are based on our current understanding of fungicide activity and resistance management. The suggested guidelines may change as we gain a better understanding of resistance development in strobilurin fungicides and/or the extent of SI resistance in apple orchards.❖❖

ADVICE AT HAND

RECOMMENDS EMERGE
(Art Agnello, Entomology, Geneva)

❖❖ Must have been a temperature-response thing, but the 2001 edition of the Pest Management Guidelines for Commercial Tree-Fruit Production are finally available, only a little behind the crocuses, so copies should be showing up at your local CCE office before long if they haven't already appeared. This year's version includes a completely new chapter on Nutrient Management for Apples written by Dr. Lailiang Cheng (Dept. of Horticulture), as well as a revised and improved section on sprayer preparation and calibration, courtesy of Dr. Andrew Landers (Dept. of Agricultural and Biological Engineering). Before we start getting calls, I would point

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GENERAL INFO

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out that we know the footer of *every page* is labeled "Tree Fruit 2000", and also that there are some misalignment problems with the page-edge tab markings keyed to the back cover. Not to mention the slightly mysterious situation with Figs. 15, 16, and 16A. No excuses are offered, but anyone who's worked with publications of this type knows that printing is not an exact science.

In addition, we can now announce that this publication finally has an online version, as a series of PDF files, at:

http://www.nysaes.cornell.edu/ent/treefruit/

We're still working to make a few of the links a little easier to use, but for the most part it's all there; thanks go to John Zakour (Communications Services) for all his efforts.

HOUSEKEEPING NOTE: For those who receive the mailed version of Scaffolds, but who have not returned a re-subscription card, this will be the final issue you receive unless we are notified that you wish to remain on the mailing list. Please let us know by next week so we can bring our mailing list up to date.❖❖

PHENOLOGIES

Geneva: All dormant
Highland: Apple (McIntosh): green tip

UPCOMING PEST EVENTS

	43°F	50°F
Current DD accumulations (Geneva 1/1–4/9):	35	14
(Geneva 1/1-4/9/2000):	181	68
(Geneva 1/1–4/9 "Normal"):	108	47
(Highland 1/1–4/9):	49	6.4
Coming Events:	**Ranges:**	
Green fruitworm flight peak	64–255	19–108
Pear psylla adults active	2–121	0–49
Pear psylla 1st oviposition	25–147	1–72
McIntosh at silver tip	56–137	17–58

PEST FOCUS

Geneva:
First **green fruitworm** trap catch. Degree day accumulation is well below "Normal". At this point it's probably not all that meaningful and can "catch up" with just a few relatively warm days, but it certainly looks to be a more "Normal" season than last year.

Highland:
Pear psylla laying eggs. First **green fruitworm** trap catch.
McIntosh at green tip.

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

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