scaffolds
Update on Pest Management and Crop Development

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DISEASES

FINISH LINE

USING APOGEE TO MANAGE FIRE BLIGHT AND IMPROVE FRUIT FINISH

(Dave Rosenberger, Plant Pathology, Highland; dar22@cornell.edu)

❖❖ Apogee (prohexadione-calcium) has been recommended for many years to both reduce terminal shoot growth on vigorous trees and to slow the spread of the shoot blight phase of fire blight. The mechanism by which Apogee makes shoots more resistant to fire blight is still not fully understood, but a recent publication by McGrath et al. (2009) provides evidence that Apogee treatment causes thickening of the cell walls in the cortical parenchyma tissue in the mid-veins of newly unfolded leaves. Cell walls in the youngest treated leaves were nearly double the thickness of the cell walls in control plants. The fire blight bacterium, *Erwinia amylovora*, may be unable to cause infections in shoots of Apogee-treated plants due to the thickened cell walls.

In unrelated work in North Carolina, Steve McArtney et al. (2006, 2007) found that a single application of Apogee (12 oz/A) applied at petal fall reduced the severity of both fruit russet on Golden Delicious and scarf skin on Rome Beauty and Gala apples. Apogee used alone was sometimes less effective than treatments where Apogee was followed by a series of ProVide sprays, but Apogee used alone provided a consistent reduction in the severity of both of these fruit finish disorders.

Implications of these research papers are discussed below. However, anyone who chooses to apply Apogee should carefully review the product label where they will find the following warnings and suggestions: First, do NOT apply Apogee to Empire or Stayman cultivars because Apogee can cause fruit cracking on these cultivars. Second, it may be more difficult to adjust crop loads on Apogee-treated trees because fruit thinners will be less effective, and this can be especially problematic on Golden Delicious, a cultivar that is sometimes difficult to thin adequately, even under normal conditions. Do not tank-mix Apogee with calcium or boron because these foliar nutrient sprays can inactivate Apogee. Finally, note the label suggestions for including a water conditioner and a nonionic surfactant in the tank when Apogee is being applied.

Scarf skin and fruit russetting are two problems that have been difficult to predict and con-

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IN THIS ISSUE...

trol. Scarf skin is the term used to describe the milky or opaque appearance of red-skinned fruit that occurs when air spaces in cells several layers below the epidermis change the way light is reflected from the

Fig. 1. Scarf skin on Cameo

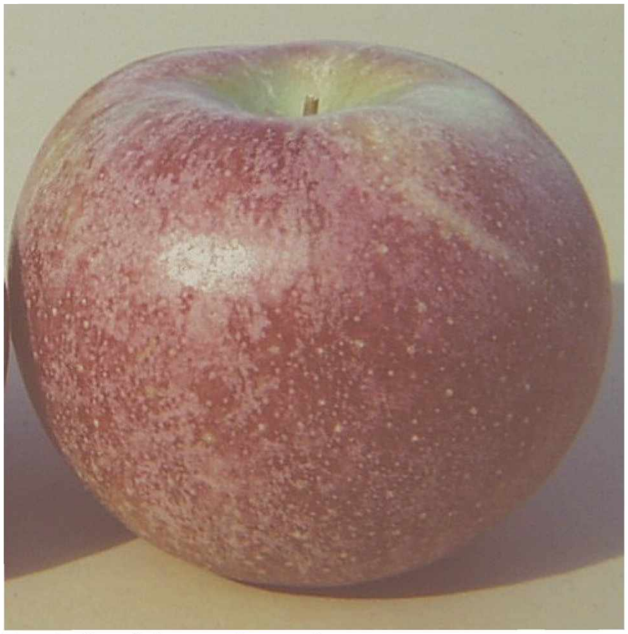

Fig. 2. Scarf skin on Rome Beauty

fruit surface (see figures 1 and 2). Fruit russet can be caused by many different factors, including injury from frost, powdery mildew, or pesticides such as copper. In 1997, a group working in Tom Burr's Lab at the Geneva Experiment Station showed that the yeast-like fungus *Aureobasidium pullulans* could cause fruit russetting (Matteson Heidenreich et al., 1997). Fruit russet is a perennial problem on Golden Delicious, but it can affect other cultivars as well (see figures 3 and 4).

Numerous scientists have noted that fruit russetting on Golden Delicious is exacerbated by extended periods of wetting during the 30 to 45 days after full bloom. That fact fits nicely with the observation that *A. pullulans* contributes to russetting because moisture is required for growth and development *A. pullulans* on leaf and fruitlet surfaces. However, I have occasionally noted very smooth (i.e., non-russetted) Golden Delicious in years with persistent rains during the 30 days after petal fall. I suspect that russetting may fail to develop in some wet years because regular rainfall can wash away both the developing populations of *A. pullulans* and also the soluble carbohydrates on leaf surfaces that serve as a food source for this organism.

In the eastern United States, *A. pullulans* acts like a nutrient scavenger that shows up wherever there is a "free lunch." It is a common component in the mildew that shows up on exterior walls of buildings, especially where nutrients are deposited on the paint from overhanging or nearby trees. *A. pullulans* is a

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Fig. 3. Fruit russet on Ginger Gold


Fig. 4. Fruit russet on McIntosh

common epiphyte on plant surfaces, where it apparently survives on nutrients that leach out of the plant tissues. Researchers in Wisconsin documented that it is by far the most common epiphyte on apple trees in late summer when leaves become "leaky" and soluble carbohydrates therefore accumulate on leaf surfaces.

None of our fungicides will completely control *A. pullulans*, but contact fungicides such as Captan, Polyram, mancozeb, and Ziram can suppress it. As a result, plant pathologists have noted for many years that russetting of Golden Delicious is often worse in unsprayed control plots than in plots where trees have been sprayed with contact fungicides.

Why is russetting a consistent and significant problem on Golden Delicious, whereas it occurs much less frequently on other cultivars? I don't think that anyone has a definitive answer to this question. However, I suspect that young Golden Delicious leaves and fruitlets may be more "leaky" than those of other cultivars, and those leaked nutrients may allow for higher populations of *A. pullulans*, which then contribute to more russetting. Why would Apogee reduce russetting? Again, there are no definite answers, but it seems possible, based on the work with fire blight in Michigan, that Apogee may thicken cell walls in fruitlets, thereby making them less leaky and therefore less able to support the populations of *A. pullulans* that ultimately cause russetting. More research will be required to prove or disprove these hypotheses, but there is enough evidence concerning the beneficial effects of Apogee on fruit finish to warrant grower-initiated field trials.

Apogee may provide the greatest benefits for both blight control and improvements in fruit finish if applications are initiated at the very earliest growth stage allowed by the product label. The Apogee label indicates that the first application should be made when new shoots are 1 to 3 inches long, but that has frequently been converted to a recommendation that the first application of Apogee should be made at petal fall. In fact, trees may have some shoots with one inch of growth at about the same time that the king flowers are approaching petal fall and while lateral flow-

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ers are still in full bloom. Phil Schwallier and other researchers in Michigan have been using petal fall of the king bloom as their indicator for the first application of Apogee, and they feel that this timing provides improved control of fire blight compared with making the first application when petal fall insecticides would be applied.

Remember that Apogee is NOT a substitute for traditional streptomycin sprays during bloom because Apogee will not control blossom blight. However, it may be feasible to tank-mix Apogee and streptomycin (or Apogee plus oxytetracyline where strep-resistant blight is present) if the blossom blight models call for an antibiotic application around the same time that king flowers are beginning petal fall.

Although McArtney and co-workers tested only a petal fall application of Apogee in their work with scarf skin and fruit russet, applying Apogee during bloom as suggested above for optimal suppression of fire blight might result in even better control of fruit finish problems, and following up with a second Apogee application two or three weeks after the first application may also benefit fruit finish. We know that effects of Apogee on tree physiology and fire blight only become evident 7 to 14 days after Apogee has been applied and that the effects of Apogee disappear after a few weeks. Applying Apogee before petal fall may ensure that effects are functional by the time fruit become susceptible to russetting, presumably during the interval shortly after petal fall. A second application of Apogee may be needed to extend the benefits through the entire period when fruit develop russetting. On the other hand, if the developing fruitlets must be directly contacted by the Apogee spray, then the true petal fall application that was evaluated in North Carolina may prove more effective than earlier applications because the open petals on lateral flowers may prevent spray droplets from contacting tissue at the base of each flower that will ultimately become the apple fruit.

In conclusion, the studies published to date suggest that an Apogee application during bloom can provide multiple benefits. In addition to reducing vegetative growth and thereby reducing pruning costs, Apogee can significantly reduce the incidence of the shoot blight phase of fire blight and it may provide some benefits for fruit finish. More work is required to determine the rates and spray timings that will maximize all of these benefits while minimizing interference with fruit thinning. Anyone using Apogee on Golden Delicious should leave at least a few control trees so as to determine if their treatment really does reduce fruit russet under our conditions in northeastern United States and to ascertain how much the Apogee treatment affected fruit thinning. ❖❖

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GENERAL INFO

THE WILD ONES

WILD POLLINATORS GUIDE AVAILABLE

(Art Agnello, Entomology, Geneva; ama4@cornell.edu)

There is a new publication available on the Cornell Fruit website. "Wild Pollinators of Eastern Apple Orchards and How to Conserve Them" is a 20-page booklet written by Mia Park, an Entomology graduate student, in collaboration with various other people at Cornell, Penn State, and The Xerces Society, and supported by a CALS Land Grant Graduate Fellowship. It's written for use by both commercial and hobbyist orchardists, and is available at no cost. In this booklet you will find:

- A photo guide to bees most important for apple production in the East;
- Steps to conserving, even optimizing, wild bee pollination in and around your orchard;
- Recommendations for plantings to enhance food for pollinators;
- Summary of bee toxicities for commonly used orchard pesticides;
- Links to other key resources for more information.

A PDF of the booklet can be found online at: http://www.fruit.cornell.edu/tree_fruit/resources/wild_pollinators.pdf

PEST FOCUS

Geneva: **Green fruitworm** 1st catch.

Highland:
1st **lesser appleworm** trap catch.

INSECTS

VELVET HAMMER

MITE MANAGEMENT USING REDUCED-RISK PEST MANAGEMENT PROGRAMS AND BIOLOGICAL CONTROL

(Peter Jentsch, Entomology, Highland; pjj5@cornell.edu)

❖❖ We surveyed three Hudson Valley orchards this spring for European red mite (ERM) eggs. Despite the heavy rains late in the 2011 season, we found ERM adults had produced high numbers of eggs, with the emerging nymphs testifying to a successful overwintering in what was a very mild winter. In one of the monitored blocks in which a pre-bloom oil application had been made, we observed an exponential reduction in egg viability. Nymph emergence from untreated eggs ranged from 60–80% survival to <10% nymph emergence in the oil treated block. Unless we have a dramatic frost event or continued cold days, it is likely we will see mites hatching this week. In most years we see >50% ERM egg hatch through pink and 100% emergence by the end of bloom. In blocks where mites were a problem last year and you were unable to make an effective oil application, it may be wise to dust off the hand lens and scout for eggs and nymphs this week to determine the need for early management. The suggested action threshold for egg is 10% of spurs containing viable eggs.

Remember that mite management is a numbers game. You can tolerate high numbers late in the season. However, early season populations above the economic thresholds will reduce photosynthesis, impact bud development and thus return bloom, reduce fruit size, quality, color, and increase stress to contribute to premature drop of fruit and leaves. At pink, the suggested action threshold is 1 mite/leaf or 30% of the leaves with one or more motile mites. This will increase to 2.5 nymphs/leaf in June.

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Chart 1. Environmental Effects of Temperature on European Mite Populations.

Average Daily Temp (°F)	Egg Stage (days)	Hatch to Adult (days)	Total Time (days)	# Generations per Season June 1- Sept 20 (122 days)
55.4	19	19	40	3.1
59.9	16	14	30	4.1
64.4	11	10	21	5.8
69.8	8	7	15	8.1
75.2	6	4	10	12.2
80.6	4	3	7	17.4

In dry years where spring temperatures exceed 80°F, the European red mite (ERM) population can build very quickly. These early populations can irreversibly damage cluster leaves and newly developed terminal leaves. Under this scenario, the time it takes for a mite egg to hatch and mature to the adult stage can occur rapidly, in about one week's time (see Chart 1). These shortened intervals of development, relative to higher average temperature, typically lead to more mite generations and higher mite populations that can require season-long aggressive management. With a greater number of generations during a season comes the likelihood of increased resistance potential to the miticide management programs you use.

To maintain the usefulness of new reduced-risk materials, managing the build-up of resistance to insecticides and miticides in arthropod populations is essential. The pressure imposed on a population by a pesticide that selects for the survival of resistant individuals is cited as the primary cause of insecticide resistance. This is often the result of employing a single mode of action pesticide for multiple generations over many seasons. The generally accepted method of reducing selection pressure is to treat each generation of a pest with pesticides of different classes of chemistry. Additionally, the use of oil and non-chemical control strategies such as biological control will contribute to reducing the resistance potential in pest populations, as there is little or no selection pressure imposed by these strategies.

The recent legislative shift limiting the use of the organophosphate class of insecticides (OPs) in pome fruit production, GAP-certified market constraints, and public perception, have all prompted fruit producers to use reduced-risk pest management tools to control the arthropod pest complex. These include the neonicotinoids such as Actara, Assail, Calypso and Provado; the insect growth regulators (IGRs) Intrepid and Esteem; the oxadiazine Avaunt, diamides like Altacor and Belt, and the spinosyn Delegate. With the advent of reduced-risk (RR) pest management programs come insecticides having generally lower levels of toxicity to predacious insects and mites. However, we have observed mite response (flare-ups) through the use of some RR insecticides, especialy with the use of imidacloprid. Constraints on the use of the neonicotinoid class near bloom is also advised, given the poor press recently citing impacts on pollinators.

In previous studies by Jan Nyrop, NYSAES, it has been demonstrated that the phytoseiid mite, *Typhlodromus pyri*, can be introduced and conserved to achieve biological mite control. The use of RR programs provides a more favorable environment for using biological control organisms to obtain phytophagous mite management, while reducing the selection pressure placed on miticides alone. Many of the RR miticides are compatible with the preservation of biological control agents.

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From my perspective, the weak link in the biological control of mites is not solely the use of disruptive insecticides. The fungicide mancozeb, belonging to the EBDC group, is used to manage apple scab, *Venturia inaequalis*. Each application of Manzate made prior to bloom reduces *T. pyri* populations by roughly 30%, while post-bloom applications impose significantly greater reductions in numbers of phytoseiid predators. Given the importance of achieving apple scab control, resistance of scab to sterol inhibitors in the Northeast, the rising costs of new fungicides and lower efficacy levels of Captan use alone compared with mancozeb/Captan combinations, it is unlikely that most producers can avoid using mancozeb strictly to maintain biological control agents. Thus, the requirement of apple scab management in scab-susceptible apple varieties will limit optimum biological control measures in tree fruit if mancozeb is employed. However, in blocks of low apple scab-susceptible varieties or scab-resistant varieties, there would be a reduced need for mancozeb, reducing the negative impact on phytoseiid populations.

In reviewing the many options for mite management, one should be aware of the stage of development of mites present in the field. If eggs are high in number, the use of materials with ovicidal efficacy should be selected (Esteem, Zeal, Apollo, Savey/Onager and to some extent Acramite); applications against newly emerging mite larvae (Savey/Onager, Zeal) or against motile mites (Envidor, Nexter, and Agri-Mek) should be made at lower than economic threshold levels when recommended by the label. Considering the impact insecticides and miticides can have on the phytoseiid populations may promote increased levels of phytoseiid presence and enhanced biological mite control. In table 7.1.2 of the Tree Fruit Pest Management Guidelines (http://ipmguidelines.org/TreeFruits/Chapters/CH07/default-2.aspx) is a table of pest management tools showing their toxicity to beneficials, including the phytoseiids Amblyseius fallacies and Typhlodromus pyri.

Below is a list of miticides with a brief description of their use, relative to their class or mode of action. At the bottom of Table 7.1.1 in the Guidelines (http://ipmguidelines.org/TreeFruits/Chapters/CH07/default-1.aspx) is an efficacy chart based on mite species. Keep in mind when choosing a miticide that many of the newer materials are contact materials requiring complete coverage to be effective. A number of agrichemical companies have added to their miticide label a minimum use rate of 100 gallons per acre to aid in improving coverage. For legal (and efficacious) applications to be made, this requirement must be met.

Classes of Reduced Risk Miticides

Class 6: Proclaim (emamectin benzoate) is similar to Agri-Mek (abamectin), with activity against the Lepidopteran complex, primarily the obliquebanded leafroller leafminer and mites. Residual activity is shorter than Agri-Mek, with motile mites being the primary target stage. The use of a penetrant is required for mite management and complete coverage is required for mite control, with higher spray volume recommended. Do not use sticker/binder-type adjuvants, as they may reduce translaminar movement of the active ingredient into the plant.

Class 10: Apollo, Savey/Onager Zeal (extoxazole) – derived from diphenyloxazoline, this miticide acts as an ovicide and has molt-inhibiting activity against immature mites. Zeal is a contact miticide with translaminar movement, and performs much like Acramite against twospotted spider mites, but is more effective on European red mite. It acts slowly with mortality taking several days to occur. Labeling requires a minimum gallonage of 100 GPA. Zeal is considered by the EPA to be a reduced-risk miticide.

Class 20: Kanemite (acequinocyl) in the quinoline class of insecticides, acts as a mitochondrial electron transport inhibitor (METI), blocking cellular respiration. It should also be limited to one application/year. Kanemite provides quick knockdown and long residual control. Labeling requires

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a minimum gallonage of 100 GPA. Kanemite is considered by the EPA to be a reduced-risk miticide.

Portal (fenpyroximate) a phenoxypyrazole class of insecticide, also acts as a mitochondrial electron transport inhibitor (METI), blocking cellular respiration. It should also be limited to one application/year. Portal acts as a contact miticide, requiring complete coverage. Label states that the miticide rapidly stops feeding and egg laying, with 3–7-day mortality observed in the field. Portal is considered by the EPA to be a reduced-risk miticide.

Class 21: Nexter (formerly known as Pyramite) (pyridaben) belongs to the pyridazinone class of miticides. Nexter's mode of action as a mitochondrial electron transport inhibitor (METI) blocks cellular respiration. Conservative resistance management would recommend the use of METI miticides (Nexter, Portal or Kanemite) to be limited to one application/year. Nexter is an effective miticide against European red mites, with less activity against the two-spotted spider mite. Nexter is also effective against the apple rust mites. Boron prevents water-soluble bags (WSB) from dissolving. Care must be taken not to add soluble bag packets of Nexter to tank mixes with boron, and also to rinse tanks thoroughly after boron applications prior to using WSB. Labeling requires a minimum gallonage of 100 GPA.

Class 25: Acramite (bifenazate) is a hydrazine compound derived from carboxylic acid ester. Its mode of action is a GABA (gamma-aminobutryric acid) agonist in insects. Acramite has quick knockdown, is primarily used against the motile stages mites, and has some ovicidal activity. Acramite is a specific, selective miticide, with good activity against spider mites but little to no rust mite activity. Labeling requires a minimum gallonage of 50 GPA. Acramite is considered by the EPA to be a reduced-risk miticides.❖❖

Relative Efficacy Table for Insecticides / Miticides on Mites.

Insecticide /Miticides	Class	European red mite	Two spotted spider mite	Pear / apple rust mite
Oil	-	High	Low	Moderate
Carzol	1A	Moderate	Moderate	Moderate
AgriMek	6	High	Moderate	High
Mesa*	6	Moderate	Moderate	High
Proclaim	6	Moderate	Moderate	No Data
Apollo	10A	High	Low	Low
Savey/Onager	10A	High	Low	No Data
Zeal	10B	High	High	None
Vendex	12B	Low-Moderate	Moderate-High	Moderate
Portal	20B	Moderate	Moderate	No Data
Kanemite	20B	High	High	No Data
Nexter	21	High	Moderate	Moderate-High
Envidor *	23	Moderate	Moderate	None
Acramite	25	Moderate	High	Low

* Not registered in NYS

Non-Toxic	Slightly Toxic	Moderately Toxic	Highly Toxic
Dipel (other Bts)	Diazinon	Lorsban	Asana
Cyd-X	Guthion	Supracide	Baythroid
Virosoft	Imidan	Actara	Danitol
	Assail	Calypso	Decis
Late Season ERM Rescue Materials	Centaur	Clutch	Permethrin
	Confirm	Provado	Proaxis
	Esteem	Avaunt	Warrior
	Intrepid	Surround	Carzol
	Neem	Agri-Mek	Lannate
	Rimon	Envidor	Sevin
	Spintor/Entrust	FujiMite	Vydate
	Endosulfan	Zeal	Kelthane
	Acramite		Nexter
	Apollo		
	Kanemite		
	Savey		
	Vendex		
	Portal		

HIVE GOT A TIP FOR YOU

GETTING THE MOST OUT OF YOUR INVESTMENT IN POLLINATION

(Nick Calderone, Entomology, Ithaca; nwc4@cornell.edu)

❖❖ Tree fruits, small fruits, and many vegetable crops, especially many of the vine crops, all require pollinating insects for a successful harvest. Remember! Not only is pollination important for a high yield, it is just as important for fruit size, shape and sweetness. A number of insects pollinate crops; but, for several reasons, the honey bee is the most versatile pollinator. Honey bees are available in large numbers throughout the growing season, they pollinate over 90 commercial crops, they are easily transported by truck, and they can be easily distributed throughout large plantings. In addition, they restrict their foraging activities to a single species on any given trip to the field. Compared with other pollinators, honey bees are very cost effective. A single strong, two-story colony provides 15–25 thousand foragers.

How many colonies

New York growers have traditionally used about one colony of bees per three acres for apple pollination. This number may have been adequate in small orchards visited by feral honey bees and by solitary bees and bumble bees from adjacent hedgerows and woods. However, wild honey bee populations have been greatly reduced by parasitic bee mites, and modern agricultural practices have eliminated many natural nesting sites for solitary bees and bumble bees. In addition, the flight range of solitary bees is not generally sufficient to ensure coverage of the interior portions of large plantings. Growers with large blocks of apples and other tree fruits may wish to increase the number of hives to one per acre. Modern cultivars with high blossom densities, such as trellised apples, also require more pollinators. If your fruit set has been lower than expected in the past, or your fruits are lopsided or misshapen, you probably need to use more bees. Remember, if your fruit set is too high, you can always thin, but if it is too low, you are just out of luck. Move bees into apples, regardless of variety, right before the king blossoms begin to open.

Special requirements

Most other crops are adequately served by a single strong colony per acre; however, some crops have special requirements. Red Delicious apples have a flower structure that is different from that of most other common varieties such as McIntosh. The anthers on Red Delicious flowers are widespread, and bees learn to insert their mouthparts between them to obtain nectar. Consequently, the bees do not contact the flower's sexual parts and pollination does not take place. Since it takes time for bees to learn to obtain nectar in this way, you can counteract this problem by using more colonies per acre to increase the number of inexperienced bees in the orchard. Up to two colonies per acre may be needed in large stands of Red Delicious apples.

Pollination of pears will probably always be a problem because pear nectar contains only about 15% sugar versus 40% for apples, dandelions, and yellow rocket. The answer is to move the bees into the center of the pear block when the pears are at 50% bloom. It will take some time for the bees to discover better sources farther away, and in that time, the pears may be adequately pollinated. An alternative is to use more colonies per acre, which will increase the number of bees foraging within the orchard. Sweet cherries should be pollinated soon after they open. Therefore, bees should be moved in the day before bloom. Since sweet cherries require a high fruit set for a commercially viable crop, and since they bloom early in the season when the weather is often unfavorable for foraging, two colonies per acre may be required. Research at the Geneva Experiment Station has shown that strawberries benefit substantially from having hives of bees in the field during bloom.

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Hive Placement

To obtain maximum benefit for your pollination dollar, always select good locations for the bees you rent. A good location slopes slightly to the south, is protected from the prevailing winds, is dry, and has as much exposure to sunlight as possible. It is important that colonies of honey bees be kept in full sunlight in order to warm the hives rapidly in the morning and entice the workers out of the hives on chilly spring mornings. Entrances should face south to southeast whenever possible.

Keep colonies on pallets or cinder blocks to keep the bottom boards 6–8 inches above the ground. Hives with wet bottom boards will be cooler and have less foraging activity than dry colonies. A hive stand will also keep colonies above tall grass, which may shade or block the entrance. Place colonies in groups of 4–6 to take advantage of good locations. In large orchards and fields, groups of 10–20 hives can be used to take advantage of prime locations. It is best to locate hives near pollinizer rows where that consideration applies, such as with apples and sweet cherries.

Pesticides

The situation with pesticides is less clear today than at any time in the recent past. Serious poisoning incidents still occur. The uncertainty arises from the growing use of nenicotinoids; this group of pesticides remains suspect in the large colony losses of honey bees that have occurred since 2006. One recent study showed that exposure to neonicotinoids resulted in greater susceptibility to the parasitic fungi *Nosema ceranae* that infects a bee's digestive tract. The exact impact of this parasite is unclear, although it seems to be responsible for large losses in Europe the past few years. A second study showed that exposure to neonicotinoids interferes with a forager's ability to navigate back to the hive.

Clearly, exposure of bees to any pesticide while on site for pollination is a serious problem; but exposure can also result from bees feeding on stored pollen collected earlier in the season at other locations. Of course, if growers other than fruit growers use neonicotinoids during fruit bloom, that could also pose a problem. Remember, the bees you rent don't know where your orchard ends and another grower's field begins. They may forage 2–3 miles from the target site. So, some routes of exposure are outside of the fruit grower's control. Nonetheless, always use the most pollinator-friendly management practices that you can. Do not use a neonicotinoid or any other pesticide on a blooming crop or on blooming weeds if honey bees are present; avoid their use pre-bloom as much as possible. If you do need to use a pesticide pre-bloom (e.g. pink in apples), use a material that has a lower toxicity to bees. For the neonicotinoids, the compounds with lower toxicity for honey bees include acetamiprid and thiacloprid. However, the synergists piperonyl butoxide and propiconazole greatly increase the toxicity of these pesticides. Until the situation with neonicotinoids is better understood, seek alternatives where possible. You can eliminate most pesticide damage to bees by following a few simple rules:

1 - Never apply pesticides to flowers in bloom, as this will contaminate the pollen and nectar collected by the bees.

2 - Unfortunately, pesticides often drift onto non-target crops and weeds, and honey bees are poisoned when they ingest the contaminated pollen and nectar. You can minimize the dangers from drift by limiting spraying to periods when the winds are less than 5 mph. If possible, begin to spray in the evening, about an hour before sunset, because there is generally little wind at that time.

3 - Use the largest droplet size possible when spraying, and check out the use of spray stickers to help minimize drift.

4 - Bees can be poisoned when they collect water from sources that have been contaminated by drifting pesticides. Standing water in wheel ruts or old tires near your fields are prime sources of contaminated water. Provide a source of clean water near the hives. A wash tub filled with fresh water and straw works well.

5 - Always apply pesticides in the evening when

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the bees are home; this gives the pesticide time to breakdown before the bees come out again in the morning.

6 - Dispose of empty pesticide containers in an appropriate manner.

7 - Keep flowering ground-cover plants mowed if you are going to spray in an orchard during the summer. Clover and dandelions are a common problem for bees on orchard floors. If mowing is not possible, use an herbicide for control.

8 - Do not apply any pesticide post-bloom (e.g. petal fall) until after the colonies have been removed from the orchard.

9 - Read the pesticide label and avoid using materials that are especially toxic to bees when there is a safer alternative available. Sevin (carbaryl) and Guthion (azinphosmethyl) are especially toxic to bees.

10 - Remember! If too many bees are killed, your crops will not be adequately pollinated, and it may be necessary to rent more bees.

General Recommendations

Bees should be moved at night, and once the hives have been placed on location, they should be left there until the job is done. Moving a colony in the daytime or moving it short distances at any time (less than 3 miles as the crow flies) will result in a serious loss of foragers and will seriously reduce its ability to pollinate your crops. Always contact the beekeepers if the need arises to move the bees. If you live in an area with known bear problems, use an electric fence to protect the bees.

In the past, I have recommended that you keep nearby flowering plants mowed to reduce competition for the bees' attention. However, there is growing evidence that native pollinators can provide a significant amount of pollination, especially in smaller orchards (< 5 acres), and many native pollinators require stands of wildflowers growing in areas adjacent to your orchard to supplement their diet. The major factors to consider when planning for native pollinators include an adequate supply of food, adequate nesting sites, and protection from pesticides. The optimal location for these 'bee gardens' has not yet been determined. These areas need to be far enough from the orchard so as not to be sprayed during the season (unlike the honey bee that is removed after bloom, native pollinators are permanent residents), yet close enough so that the native bees will fly to your trees. You can learn more about native pollinators and their use as pollinators at the Xerces Society web at http://www.xerces.org.

The Beekeeper

The past three years have seen an increase in the stocks of bees from a low of 2.3 million colonies in 2008 to 2.69 million in 2011. Fruit growers in the northeast are competing with almond and fruit growers in the west; so, I cannot tell you exactly what impact that will have on prices. I have also heard from many commercial beekeepers that the primary pesticide they rely on for mite control is no longer available in the US. The impact of that on the number of colonies has yet to ripple through the industry. I recommend establishing good working relations with several beekeepers to ensure that you have a ready supply of bees for pollination. Any individual beekeeper's situation may change over time, but if you work with several beekeepers, you should always have access to an adequate supply of colonies.

Expectations

Remember! Bees are an essential part of your crop production system, but they are only one part. In many ways, they are like the fertilizers and chemicals that you buy. Each is essential, but none of them, by themselves, can guarantee a crop. Many things influence the quantity and quality of your crop. One is the weather. Bees will visit flowers and pollinate only if they can fly. Cool, rainy, and windy weather will delay, slow, or stop flight, and the beekeeper cannot do anything about the weather. Excessive heat during the summer can cause problems with fruit set in certain crops, like pumpkins. Again, this is beyond the beekeeper's control. Be clear up front about your expectations concerning the strength of the colonies you rent, and satisfy yourself that you have received what you expected. This will eliminate misunderstandings down the road. ❖❖

PHENOLOGIES

	4/9 Predicted:
Geneva:	
Apple (McIntosh, Red Delicious): tight cluster	pink—bloom
Apple (Empire): early pink	pink—bloom
Pear (Bartlett): white bud	bloom
Peach: bloom	bloom
Sweet cherry: white bud — bloom	petal fall
Plum: bloom	bloom

Highland:
Apple(Empire, Red Delicious): late pink
Apple(McIntosh, Golden Delicious): pink
Apple(Ginger Gold): king bloom
Pear (Bartlett, Bosc): 1st bloom
Apricot (early): petal fall
Sweet cherry: bloom
Peach (early, late): petal fall, shucks on
Plum (Stanley): bloom

UPCOMING PEST EVENTS

	43°F	50°F
Current DD accumulations (Geneva 1/1–4/9/12):	282	145
(Geneva 1/1–4/9/2011):	63	15
(Geneva "Normal"):	110	44
(Geneva 1/1–4/16 predicted):	320	160
(Highland 1/1–4/9/12):	343	167
(Highland 1/1–4/9/11):	81	23

Coming Events:	Ranges (Normal ±StDev):	
Green fruitworm flight subsides	247–451	111–239
Spotted tentiform leafminer 1st oviposition	143–273	58–130
European red mite egg hatch	231–337	100–168
Obliquebanded leafroller larvae active	158–314	64–160
Oriental fruit moth 1st catch	224–328	95–165
Pear psylla 1st egg hatch	174–328	60–166
Comstock mealybug crawlers in pear buds	215–441	80–254
Redbanded leafroller 1st flight peak	231–363	105–185
Rose leafhopper nymphs on multiflora rose	239–397	96–198
Spotted tentiform leafminer 1st flight peak	266–402	123–207
Lesser appleworm 1st catch	263–567	120–306
McIntosh pink	274–316	125–159

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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