



PLANT SCIENCES

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Extension-based tree-fruit insect pest management strategies for apple and pear

John R. Leeper

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INTRODUCTION

In 1978, a System for the Computer Aided Management of Pests (SCAMP) was developed at the New York State Agricultural Experiment Station to provide county extension personnel with an information delivery system. In response to demands by agents for timely, in-depth strategies for tree fruit insect pests, a STRATEGY file was developed for the 1979 season for which it was this author's responsibility to provide the strategies.

The intent of STRATEGY was to anticipate insect pest problems with enough lead time to allow the direct users, tree fruit extension agents, to pass the information on to their growers and chemical distributor fieldmen who were considered the indirect or secondary users. An attempt was made to keep the format non-technical in order to make it understandable to an audience with a limited entomological background. No guidelines or restrictions were set as to how the agents were to use the strategies. STRATEGY was well accepted by the tree fruit agents, who used the information in presenting radio programs, code-a-phone tapes, and newsletters. Use ranged from abstracting information to verbatim dissemination of the strategy.

The strategies presented in this publication are based on those provided to New York State tree fruit agents in 1979. They have been rewritten and can be accessed through the computer program LIBRARY.

Users may LOGIN and be asked:

WHAT WOULD YOU LIKE TO DO NEXT?

They may answer:

=•LIBRARY

They will then be asked:

=•ENTER: COMMODITY NAME, INDEX, OR END

They may answer:

=•TREE FRUIT

They will be asked:

=•ENTER: FILE NAME, INDEX, OR END

They may answer:

=•APPLE MAGGOT

They will then be asked:

=•ENTER: WARNING, LIFE HISTORY, MONITORING, CONTROL OR ALL

They may then enter and receive whatever information they wish.

Users entering the STRATEGY file will also be prompted to refer to specific information provided in the LIBRARY file.

Orchard ecosystems, including the insects and mites within them, are dynamic systems and, therefore, the strategies for the management of pests must also be dynamic. A drawback to publishing strategies is that they become static and can not easily be changed. The strategies within the computer program LIBRARY can and

are expected to be continually updated to include changes in monitoring, action thresholds, materials recommended, and the addition of new pests.

The purpose of this publication is to demonstrate the service provided to New York tree fruit agents and their constituents through SCAMP. It may also provide a base from which other states may wish to construct similar STRATEGY and LIBRARY files. Portions or all of the LIBRARY files may be duplicated and disseminated if credit is given to the author and the Entomology Department, New York State Agricultural Experiment Station.

I wish to thank my colleagues within the department for advise in writing the strategies and especially James Tette, IPM Coordinator, and Douglas Bruno and David Way, Tree Fruit Pest Management Farm Advisors, for their help in developing the monitoring and action thresholds.

I also wish to thank Linda Smith, Tammy Caplan, and Janet Walton for entering and editing the strategies in the computer.

APPLE GRAIN APHID (AGA)

Rhopalosiphum fitchii (Sanderson)

Life History

The AGA spends most of the growing season on grains and grasses, and although high populations can be found on apple in the early spring, it is not considered a serious pest of apple. The AGA overwinters as a black egg on the bark of the previous year's growth and can not be differentiated from rosy apple aphid and green apple aphid eggs. The AGA is the first of the three species to hatch in the spring as the trees begin to break dormancy; by bloom, heavy infestations may occur on the new growth and become a concern to growers. By petal fall, the AGA has begun to migrate to its alternate hosts and shortly thereafter they cannot be found on the trees.

Monitoring

Since the AGA is not an economic pest and leaves the trees shortly after petal fall, no specific monitoring is required.

Control

Since the AGA is not an economic pest and leaves the trees shortly after petal fall, insecticides directed specifically against this pest are not recommended. The pink and petal fall sprays applied to control the rosy apple aphid will also control the AGA.

APPLE MAGGOT (AM)

Rhagoletis pomonella (Walsh)

Warning

AM emergence is predicted to occur at about 1137 degree-day units, with a base of 43 F. This normally occurs in mid-June in downstate New York and late June or early July in upstate New York. AM sticky boards should be ordered from the pest management program. See "Monitoring" for trap use.

Life History

The AM is a native American species that has become a pest of the introduced apple. Typically, there is a single generation a year with adult flies emerging from about mid-June through apple harvest.

Normally, AM is not resident within commercial apple orchards, but annually migrates in from unsprayed sites and must be killed before oviposition occurs. Although migration can occur whenever flies are out, it is normally not a serious problem until late July or August. Growers should, therefore, become more concerned and tighten up their AM control programs as the season progresses.

AM emergence is related to heat units, soil type, host, and rainfall.

1. Heat units, more specifically, degree-days, must be above 1137 with a base of 43 F for AM to emerge. After the appropriate degree-days have been accumulated from March 1, other factors become important.
2. Soil type. AM tend to emerge earlier in sandy soil than in heavy clay soil.
3. Host. AM tend to emerge earlier when they have been reared on early maturing varieties rather than late maturing varieties. AM females also prefer to oviposit on fruit as it begins to ripen and, therefore, are often found first around these trees. Early oviposition stings on late maturing varieties frequently do not result in wormy fruit. The eggs or newly hatched larvae are believed to be crushed by the rapidly growing fruit.
4. Rainfall. There is a sharp increase in AM emergence following a soaking rainfall. It is believed that rain loosens the soil, especially the heavier soil, and makes it easier for the adult to push its way to the surface.

Once the AM has emerged, a maturation or pre-oviposition period of 7 to 10 days is required before a female begins laying eggs. Growers have timed their first AM spray at least 7 to 10 days after first emergence in order to take advantage of this fact.

Monitoring

The method of determining when to spray for AM is important and is based on whether monitoring of adult emergence and migration into an orchard is being conducted.

The most commonly used monitoring tool for AM emergence and migration is the yellow sticky board. A few growers may be using red sticky spheres which are used the same way as the boards.

First emergence can best be determined for an area by placing sticky boards in an unsprayed site where early apple varieties are grown on sandy soil and AM is known to exist. Besides checking the traps on a regular schedule of no longer than 3 days, traps should be checked after the first warm day following a rain.

Once emergence has been determined for an area, the boards should be placed along the edge of the block closest to where the greatest AM migration is believed to come. The traps should be inspected for AM adults at least

every 3 days, and an insecticide should be applied as soon as possible after the first catch. The boards should continue to be monitored for AM, but another insecticide application should not be made until the first fly is caught after residues from the last spray are no longer present in amounts large enough to protect the crop. The length of this period will vary with conditions; for most materials, residues remain at effective levels for about 10 to 14 days. Rainfall is probably the most common factor that can reduce field residues.

Growers wishing to monitor orchards to determine spray timing should follow the directions provided in "Using Sticky Traps To Monitor Fruit Flies In Apple And Cherry Orchards." Copies of this publication are available through the pest management program or your county agent.

If boards are not being used to monitor migration into an orchard, the orchard should have its first AM spray applied 7 to 10 days after AM emergence in the area. Additional sprays should be applied on a 10 to 14 day schedule.

Control

The AM adult is an active insect, and excellent control can be achieved with insecticide coverage that would not be acceptable for controlling many other insect pests. The fly will sooner or later come in contact with enough material to kill it. Growers using alternate middle row spraying as well as those applying the insecticide high concentrate obtain AM control.

Azinphos Methyl, Guthion, Imidan, Penncap-M, and Zolone are five of the more commonly used AM insecticides. If Vydate is used for spotted tentiform leafminer control, do not expect AM control. Add a full rate of another insecticide that will control AM.

APPLE RUST MITE (ARM)

Aculus schlechtendali (Nalepa)

Life History

The ARM is a cone-shaped, straw-colored mite that cannot be easily seen with the naked eye. It is most commonly found on the leaf undersurface, especially along the leaf midrib.

The ARM overwinters as an adult female under the bud scales of apple trees. As the trees break dormancy, the mites become active and remain so until late July or early August when the overwintering females are produced and the mites become difficult to find.

The ARM feeds on the undersurface of apple leaves. Feeding injury from high populations can cause the leaves to take on a rusty appearance. The injured leaves may also roll longitudinally and give the appearance that the tree is under drought stress. Apple trees can normally withstand ARM populations up to 200 or more per leaf before injury becomes noticeable. Occasionally, the ARM will move to and can be found at the calyx and stem ends of the fruit. Even more infrequently, they will russet the fruit.

There are beneficial aspects to maintaining a moderate ARM population within an orchard. They are a good host for

mite predators and help to build up and maintain predator populations before European red mite populations increase. Their feeding may also condition the foliage and make it less susceptible to attack by the European red mite.

Monitoring

A good hand lens is required to monitor ARM populations. Pick 10 leaves from 10 different trees in an orchard, for a total of 100 leaves. Because low populations of the ARM tend to congregate along the basal third of the leaf midrib, this is a good place to look for the mite on a leaf. Without counting the exact number of mites, control is recommended if there is an average of 200 or more ARM per leaf. Control is also recommended at the first sign of leaf injury.

Control

Most insecticides and acaricides will suppress ARM populations with a single application. Suppression of the population is normally sufficient. For more complete ARM control, two applications of an acaricide (Plictran, 4-6 oz./100gal.; Omite 1-1 1/2 lb./100 gal.; Carzol, 1/8-1/2 lb./100 gal.) with a 7-10 day interval between sprays is recommended.

BEES

See "Honey Bee" in LIBRARY.

BLOOM

Orchards are in bloom at this time. Although insecticides cannot be applied now, preparations should be made for the petal fall spray. During bloom, orchards should be inspected to determine what insect and mite pests will need to be controlled, and a decision should be made as to what materials to apply at petal fall. For further information on what insects may require control and the recommended materials, see "Petal Fall" in LIBRARY.

CODLING MOTH (CM) *Cydia*

(*Laspeyresia pomonella* (L.))

Warning

In New York, we follow the Michigan model which predicts CM first emergence to occur at 248 degree-days from March 1, with a base temperature of 50 F. The first CM traps should be hung when the degree-day accumulation reaches 200 or at full bloom, whichever occurs first. CM pheromone traps should be ordered from the pest management program.

Life History

The CM has two generations and, in some years in the Hudson Valley, a partial third generation. The CM overwinters within cocoons as full-grown larvae. They may be found under loose bark on trees or in debris on the orchard floor. The overwintering larvae pupate in the spring, beginning about mid-April. The length of the pupal

period is dependent on spring temperatures and can range from a month or longer to as short as 10 days. First emergence occurs at about 248 degree-days from March 1, with a base temperature of 50 F or about the time apples are in full bloom. Peak flight occurs about mid-June, and flight can continue into July. CM flight and egg laying occur in the early evening, normally when evening temperatures at 8 PM are 60 F or above.

A female can lay approximately 100 eggs. The eggs are laid singly, directly on the fruit or upper leaf surface. They are flat, slightly oval discs. Immediately after being laid, the eggs are translucent. They later take on a red ring and, 1 -2 days before hatching, the dark head capsule can be seen.

After hatching, the larvae seek out and enter the fruit where they feed and pass through five instars. The larvae are cream to pink colored and have dark speckling on their thoracic shield. The absence of an anal comb is a key characteristic in differentiating the CM from larvae of the other internal fruit feeding Lepidoptera. To determine if the anal comb is present or absent, squeeze the internal body fluid from the head end of a larvae toward the anal end. This will extend the anal end, and if present, the anal comb will be easily visible with the aid of a good hand lens.

The larvae of the CM and the other internal fruit feeding Lepidoptera tunnel to the core of the fruit and enlarge an exit hole that they plug with frass. The majority of first generation CM larvae are mature and leave the fruit by mid to late July. About 40 per cent of the larvae pupate and emerge as adults. Peak flight occurs about the first week in August. The remaining larvae overwinter and pupate and emerge as adults the following spring.

The second generation follows a life history similar to the first. The larvae are active during the latter half of August and September. When mature, the larvae exit the fruit and construct cocoons in which they overwinter.

Monitoring

CM first emergence and flight are monitored with pheromone traps which should be placed in both commercial and abandoned orchards. In commercial orchards, a trap station should be placed for every 50 acres of orchard, and traps should be checked at least once a week. Traps and caps should be replaced during the last week in July in preparation for monitoring the second CM flight. It should also be pointed out that the flights overlap.

Although the CM has been a serious pest in the past and retains that potential, insecticides are no longer applied regularly to specifically control it. The insecticides applied to control the plum curculio at petal fall and the apple maggot later in the summer also control the CM in most instances. Therefore, the action threshold based on trap catches in New York is higher than in areas where these other insects are not present. Sprays directed specifically at the CM are not recommended unless pheromone trap catches within commercial orchards exceed the trap catch in a nearby abandoned block, or a total of 14 or more moths are trapped in a commercial orchard in a week.

Control

Guthion, Azinphos Methyl, Imidan, and Zolone are four of the more commonly used insecticides that will control the CM as well as the plum curculio and apple maggot. Penncap-M and Sevin will also give good control of all three insects. Sevin is also used as a fruit thinner and will control the white apple leafhopper, but may precipitate woolly apple aphid problems. Penncap-M, if used, will provide woolly apple aphid control if the aphids are present on the wood or terminals. Both Penncap-M and Sevin are highly toxic to honey bees. For precautions to take to help reduce bee poisoning, see "Honey Bee" in LIBRARY.

EARLY LEPIDOPTERA (EL)

The term EL is used to collectively refer to the Lepidoptera that are out feeding as larvae by petal fall. It is frequently difficult to identify the species present, and it is difficult to differentiate the fruit injury at harvest. See "Green Fruitworm", "Obliquebanded Leafroller", and "Petal Fall" in LIBRARY.

EUROPEAN RED MITE (ERM)

Panonychus ulmi (Koch)

Life History

The ERM is a perennial apple pest with up to eight generations per year. It overwinters in red egg masses on the tree, frequently on or around the base of fruit spurs. The overwintering eggs begin hatching between tight cluster and pink; normally all have hatched by petal fall.

Upon hatching, the mite passes through three stages before becoming an adult. The first or larval stage is six legged. The protonymph and deutonymph are progressively larger and are eight legged. The time period from hatching to becoming an adult ranges from about 6-15 days. Normally, the ERM does not become a problem until mid-July or later. Overwintering eggs begin to be produced in mid-August.

Excessive ERM feeding on leaves can cause bronzing. If bronzing is excessive and occurs early, it can affect fruit maturation and yield. Under high populations, the mites will also move to and lay eggs at the calyx end of the fruit. This is particularly undesirable on the lighter colored varieties destined for the fresh fruit market.

There are a number of predators that feed on the ERM. In the Hudson and Champlain Valleys, the mite, *Amblyseius fallacis*, is the most common predator and can be very effective in keeping ERM populations in check. In western New York, the mite, *Typhlodromas pyri*, is the most common predator. However, at best, it is inconsistent in controlling ERM populations. Both *A. fallacis* and *T. pyri* are small, fast moving, pear-shaped mites that may be tan to straw-colored or may take on a red tinge from their food source, the ERM.

Monitoring

If, in inspecting 10 leaves per tree from 10 trees in an

orchard, an average of 6 or more ERM per leaf are found and the average number of predator mites is below 1 per leaf, an acaricide is recommended.

Control

Dormant - Oil may be applied in the early spring to kill overwintering eggs. The oil application will also control San Jose Scale. Complete coverage is essential.

Pink - Plictran (4-6 oz./100 gal.) must be applied before newly hatched mites become adults.

Post Bloom - A reduced rate Vendex spray program (3 oz./100 gal.) at petal fall and first and second cover may be substituted for the oil spray. If used, all three Vendex sprays must be applied at 7-10 day intervals. The program has given seasonal control of ERM. Vendex is not recommended for the summer control of the ERM.

Summer - Plictran (4-6 oz./100 gal.) and Omite (1-11/2 lb./100 gal.) are two of the more commonly used summer acaricides. With either material, two applications 7-10 days apart are recommended. The split applications help kill the mites as they hatch from their eggs.

GREEN APPLE APHID (GAA)

Aphis pomi De Geer

Also see "Petal Fall" in LIBRARY.

Life History

Although the GAA remains on apple trees throughout the year, it does not reach serious population levels, if at all, until summer.

The GAA overwinters as a small black egg on the bark of trees. It is difficult, if not impossible, to differentiate between GAA eggs and those of the apple grain aphid and the rosy apple aphid. Early New York literature states that the GAA eggs tend to be laid in groups while the eggs of the two other species are more uniformly distributed throughout the orchard. The eggs hatch as the apple trees break dormancy and after about 2 weeks, the nymphs mature to adults and begin producing living young.

The GAA have up to 17 generations per year. A portion of each generation develops into winged adults that fly off to start new colonies. The GAA favors new growth on which to develop and are most common on suckers and water sprouts late in the season.

The sexual forms are produced only in the fall. After they become adults and mate, the females lay their eggs on the bark of the trees.

The GAA is an indirect pest in that it does not feed on the fruit itself. Fruit injury occurs when the honey dew produced by the aphid colony drops onto fruit.

There are a large number of beneficial insects (parasites and predators) and a disease that play an important role in controlling the GAA. Due to the relative lack of seriousness of a low GAA population and in order to promote the beneficial insects, growers need not spray until about 50 per cent or more of the terminals with tender growth are infested.

Monitoring

In checking 10 terminals with tender growth on each of 10 trees in a block, treatment is recommended if 50 per cent of the terminals are infested with healthy GAA colonies.

If parasites, predators, or the disease appear to be influencing the GAA populations, postpone spraying a week and resample to determine whether chemical control is required.

Control

Systox and Phosphamidon are two of the more commonly used materials for controlling the GAA during the summer. The GAA has developed resistance to many of the organophosphates in many apple growing areas of the state, and the materials will no longer even suppress the insect. If Vydate is used for controlling the second generation of the spotted tentiform leafminer, it will also control GAA and another material to control the aphid need not be added.

GREEN FRUITWORM (GFW)

GFW is a collective common name used in New York to refer to a number of Lepidoptera. The life history presented here is that of one of the more common members of that group, *Orthosia hibisci* (Guenee). Also see "Petal Fall" in LIBRARY.

Life History

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 pink for McIntosh apples. The adults are about 2/3 of an inch long. They are grayish-pink in color and have 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.

Monitoring

At pink and at weekly intervals through first cover, check 20 fruit clusters per tree on 5 trees per block. On each tree, look for larvae or evidence of fresh feeding on 6 clusters on the outside of the tree, 6 clusters in the center of the tree, and 8 clusters in the top of the tree. Treatment is recommended if there is an average of two or more larvae or fresh feeding sites per tree. Monitoring for the GFW is the same as monitoring for the obliquebanded leafroller and both species may be considered together in making a control decision.

Control

In the past, sprays were applied at pink and petal fall to

control the GFW. Recent research has indicated that a single spray at petal fall provides comparable control to the 2-spray program.

Guthion, Azinphos Methyl, and Imidan are three of the standard insecticides used to control GFW; however, they are not providing adequate control in a few areas of New York. In those areas, Thiodan still offers control. If Thiodan is used, a full rate of one of the above materials should also be included to control the plum curculio.

If GFW populations are mixed with populations of obliquebanded leafroller, Lannate, Nudrin, or PennCap-M should be used. Lannate and Nudrin are the preferred materials where they can be used. If Lannate or Nudrin is used at petal fall, a 1/4 to 1/2 rate of one of the first three insecticides should be included to pick up where Lannate and Nudrin fall down on plum curculio control. Lannate and Nudrin are labeled for peaches and apples, but should not be used on Early McIntosh, Wealthy, and Dutchess varieties. They are not labeled for use on pears or cherries. Where PennCap-M must be used, care should be taken to reduce the threat of bee poisoning. Also see "Honey Bee" in LIBRARY.

HONEY BEE (HB)

Apis mellifera (L)

HB play an important role in pollinating crops and are, therefore, beneficial insects to the fruit grower. It is important to protect HB from poisoning due to their exposure to insecticides applied to control insect pests.

The following precautions should be taken to help-reduce the possibility of HB kills when insecticides are applied:

1. Cover or remove hives from the orchard before spraying at petal fall.
2. Have 90 per cent of the petals off before spraying an insecticide.
3. If there are five or more flowers in bloom per square yard of ground cover, mow before spraying. This is important throughout the growing season.
4. Whenever possible, spray insecticides in the evening after the HB have stopped foraging and the flowers have closed.
5. Whenever possible, choose the insecticide with the lowest HB toxicity to get the job done.

For further information on HB poisoning, pesticide toxicity to HB, HB as pollinators, HB behavior, etc., see the current edition of "The Cornell Recommendations for Commercial Tree Fruit Production."

MITES

For Mite strategies see "Apple Rust Mite," European Red Mite," "Pear Rust Mite," and "Two Spotted Spider Mite" in LIBRARY.

OBLIQUEBANDED LEAFROLLER (OBLR)

Choristoneura rosaceana (Harris)

Also see "Petal Fall" in LIBRARY.

Life History

The OBLR has one or two generations a year; there are two generations in New York. The OBLR overwinters as a third instar larva on the tree and becomes active at about pink. It begins feeding on the tender new foliage, flower buds, and after petal fall, on the fruit.

The OBLR larvae have pale green bodies. Their head capsules may vary in color from black to light brown, and their thoracic shields vary from black to pale tan. The larvae are very active when disturbed and will drop from the tree on a silk thread. By petal fall, the first of the larvae are full-grown and shortly thereafter they pupate, frequently within a rolled leaf.

The first OBLR flight begins about 3 weeks after petal fall and continues for about a month. Females begin egg laying about 24 hours after emergence. The eggs appear as greenish-yellow masses of up to 200 or more eggs. As the females continue laying eggs, the masses become progressively smaller.

The eggs hatch in 10-12 days, and the larvae begin feeding on new foliage, frequently on water sprouts or in the tops of the trees. The larvae often move to and feed on the fruit as they become larger. They complete their development in late July or early August and begin to pupate.

The second adult OBLR flight occurs from early August through early September. The young produced by these adults develop into the third instar overwintering larvae.

Monitoring

Pheromone traps may be used to determine OBLR flight. The OBLR has a wide host range; high trap catches need not indicate previous in-orchard problems, but may be from outside OBLR populations that may be a source of future in-orchard problems. The pheromone trap catches can, therefore, indicate when the OBLR adults begin flying, their relative abundance in the area, and when peak flight occurs. The need to treat should not be based on pheromone trap catches, but should be determined by inspecting individual blocks for larvae or their feeding.

At late bloom or early petal fall, check 20 clusters per tree on 5 trees per block. On each tree look for larvae or evidence of fresh feeding on 6 clusters on the outside of the tree, 6 clusters in the center of the tree, and 8 clusters in the top of the tree. Treatment is recommended if there is an average of two or more larvae or fresh feeding sites per tree. Monitoring for the OBLR at this time is the same as monitoring for the green fruitworm, and both species may be considered together in making a control decision.

From about June 25 through August, monitoring of the summer brood should be conducted weekly by checking 10 fruit clusters and 10 terminals in the outside, center, and top of 5 trees per block. Treatment is recommended if there is an average of three or more OBLR larvae per tree.

Control

In the past, sprays were applied at pink and petal fall to control the OBLR. Recent research has indicated that a single spray at petal fall provides comparable control to the 2-spray program.

Guthion and Azinphos Methyl have not given adequate control of larger OBLR larvae. Where larger larvae (third instar or larger) are present at petal fall or in the summer, Lannate, Nudrin, or Penncap-M should be used.

Lannate and Nudrin are not registered for use on pears. Penncap-M is the only material available that will give acceptable control at petal fall. If Penncap-M must be used at this time, take every possible precaution to avoid bee kills. Also see "Honey Bee" in LIBRARY.

OYSTERSHELL SCALE (OSS)

Lepidosaphes ulmi (L.)

Life History

Normally the OSS is not a problem in commercial orchards. It is believed that insecticides applied to control other pests are responsible for maintaining OSS at low population levels.

The OSS overwinters in the egg stage protected by the scale of its dead mother. The small, white eggs hatch in mid to late May. The minute, pale yellow to white nymphs or crawlers crawl out from the scale and after finding a suitable site, settle down and begin feeding; soon after, they begin secreting a waxy covering. The scales become adults about mid-July when the winged, minute, non-feeding males emerge and mate with the female OSS that remain under this 1/8 inch brown, oyster-shaped scale covering. Each female lays between 30 and 150 eggs and then dies.

There are one or two generations of OSS per year.

Monitoring

The easiest time to find OSS infestations is in the winter while pruning. During the growing season, look for crawlers on the present year's growth in late May through early July. After that period, look for the developing scales in areas of the trees where poor coverage is likely.

Control

Most insecticides applied against other orchard pests will also control OSS crawlers. This is probably why the scale normally does not become a problem in commercial orchards.

OSS infestations found while pruning should be pruned and destroyed.

PEAR PSYLLA (PP)

Psylla pyricola Foerster

Life History

The PP is the most important pest of pears in New York and the nation. It overwinters as an adult that measures about .08 inch long and resembles a miniature cicada. During the first warm days of spring, the overwintered adults

mate and lay their eggs on spurs, twigs, and around bud scales. As the foliage appears, the eggs are laid on the tender new growth, particularly on the undersurface of leaves along the midrib. The first eggs hatch at about the time foliage begins to appear and the nymphs pass through five instars and produce a honeydew that collects in droplets. The honeydew can burn the leaves under hot, dry conditions, or drop onto the fruit. It is an excellent media for sooty molds and trees that have had serious PP problems in the past are characterized by black bark. There are about four PP generations a year.

Monitoring

Pre-bloom

A beating tray is used in the pest management program to sample adults. A less precise but acceptable method is to make a quick count of adults on several terminals.

In the early spring, terminals and spurs should be checked for the first signs of egg laying. It is particularly important to do this after temperatures have been above 50 F.

Once foliage is present, eggs and nymphs may be monitored by looking on the tender new growth and, later in the season, on water sprouts.

Post bloom

On each of 5 trees within an orchard, sample terminal growth rather than hardened-off leaves. The PP is a flush feeder and prefers to lay eggs and feed on new growth. In checking the leaves, look along the midrib, especially on the leaf undersurface. Only consider eggs and small nymphs in making the spray decision. If only eggs are present, hold off control until hatch begins. Treatment is recommended if three or more of the sample sites have 10 per cent or more of their terminals infested. Spot treatment within a block is recommended if an average of 5-10 small nymphs per terminal are found in a portion of an orchard. If hot, dry conditions prevail, tend to act on counts at the lower end of the range. If it is rainy, tend to act on the higher end of the range. The rain will wash the honeydew from the leaves and fruit and a higher PP population can be tolerated.

Control

The PP has developed resistance to all of the materials currently registered for its control except oil. We have, therefore, had to obtain "Emergency Use Permits" (Section 18) for the use of non-registered materials to control the PP.

Pre-bloom

Oils have been used in the dormant stage to inhibit egg laying. The oil must be applied as the first eggs are laid. Although it is effective, with the Section 18 for the pre-bloom use of Pydrin, the oil spray is no longer necessary. Pydrin should be applied to pear orchards between green cluster and white bud. It will kill adult PP and the nymphs. It is a long lasting insecticide and should kill additional nymphs as they hatch. Pydrin may precipitate mite problems later in the season, and particular attention should be given to monitoring pear rust mite following bloom.

Post bloom

Baam is the recommended material for summer PP control. Quite frequently, growers who have applied Pydrin will not have to apply another PP spray until mid to late July and in many cases, a single Baam application is all that is required during the summer. Baam is also an excellent acaricide for controlling the European red mite and the pear rust mite, and when used in PP control, should aid in the control of these pests. If the two-spotted spider mite becomes a problem, another acaricide is recommended because Baam is inconsistent in its control.

PEAR RUST MITE (PRM)

Epitrimerus pyri (Naplepa)

Life History

The PRM is a very small, cone-shaped mite and, unlike the apple rust mite, it can cause damage at a very low population level. The most serious damage occurs when they feed on and russet the fruit. The extent of russetting will vary with the number of mites feeding and the length of time they feed.

The PRM overwinters as an adult female under the bud scales and becomes active in the spring as the trees break dormancy. The number of generations of PRM a year in New York is not known, but they are present on the tree throughout the growing season.

In the early spring and on into the summer, PRM may be found on the leaves. They are most frequently found along the basal portion of the midrib on the undersurface of the leaf. PRM injury to leaves causes a gray to brown russetting which typically runs in a narrow band along either side of the midrib. A serious PRM level may be present before leaf russetting occurs. On the fruit, the PRM normally congregate at the calyx end, but with high populations will also move to the stem end of the fruit.

Monitoring

To sample PRM, you need a good hand lens (10X or better) and good lighting. In sampling 25 fruit clusters throughout an orchard, treatment is recommended if 5 or more are found to have PRM.

Control

All the acaricides plus Sevin, Thiodan, and Zolone have been recommended in the past to control PRM. In a single test in 1979, Dr. Lienk obtained poor PRM control with Sevin and Thiodan. Coverage is essential and spraying dilute is recommended. Two sprays with a 7-10 day interval are advised. Baam, when used to control the pear psylla, will also provide PRM control, and may be substituted for 1 of the 2 sprays.

PETAL FALL

Introduction

While apple trees are in bloom, insecticides cannot be applied. During bloom, orchards should be inspected to determine what insect and mite pests will need to be controlled, and the decision should be made as to what

materials to apply at petal fall.

It is interesting and important to note that the petal fall spray is the only regularly scheduled insecticide application made in the pest management program, and, through intensive monitoring for insect pests, the Farm Advisors can delay this spray up to 10 days past actual petal fall. Orchards not under an intensive monitoring schedule should not have their sprays delayed, but should be sprayed at petal fall.

Pests

The following is a list of the principal arthropod pests that may be present at petal fall:

1. Codling Moth (CM)
2. European Red Mite (ERM)
3. Green Apple Aphid (GAA)
4. Green Fruitworm (GFW)
5. Obliquebanded Leafroller (OBLR)
6. Plum Curculio (PC)
7. Rosy Apple Aphid (RAA)
8. San Jose Scale (SJS)
9. Spotted Tentiform Leafminer (STLM)
10. Tarnished Plant Bug (TPB)
11. White Apple Leafhopper (WALH)
12. Woolly Apple Aphid (WAA)

Insecticide

With few exceptions, three insecticides (Lannate, Guthion, PennCap-M) fit into practical petal fall spray strategies.

A. Lannate

Wherever Lannate is used throughout this text, Nudrin may be substituted.

The first thing to remember in the use of Lannate is to not even consider it for spraying early McIntosh, Wealthy, and Dutchess varieties. Lannate has caused fruit and leaf injury and premature fruit drop on these varieties. These problems have not occurred with McIntosh, Red Delicious, Golden Delicious, Cortland, Rome, and Rhode Island Greening varieties.

Lannate is the petal fall insecticide to use if first generation STLM need to be controlled. With the varieties on which Lannate cannot be used, anticipation of a STLM problem should have led to a Vydate spray at pink where needed. Vydate should not be applied for 30 days after petal fall or thinning may result; we do not fully understand its thinning capabilities, and its label specifically does not allow for its use at this time. Lannate will not only knock down the adult STLM, but will also kill the sap feeding larvae. To adequately control the larvae, Lannate must be applied prior to the onset of the tissue feeding stage.

Lannate is a carbamate insecticide and will give good control of organophosphate-resistant WALH. Therefore, if Lannate is used at petal fall, Sevin need not be used as a thinner to give added WALH control.

Lannate can be expected to give good control of the majority of the other insect pests present at petal fall. It will fit in well in controlling the early Lepidoptera (OBLR, GFW)

where Guthion has begun to fall down.

Lannate will only give fair control of PC. To aid Lannate in controlling PC, add 1/4 to 1/2 rate of Guthion to the tank. Do not cut back on the Lannate if you have a STLM problem.

Lannate will not control ERM, but will kill the predator mites. Therefore, if ERM is a problem, an acaricide could be added now or in the summer.

A final note on Lannate: although it will control the aphids (except RAA), growers using Lannate are more likely to experience WAA outbreaks later in the season. This is believed to be because it eliminates the WAA parasites. A similar problem may be precipitated with the use of Sevin. Therefore, be prepared for potential secondary pest problems if carbamates are used at petal fall or later in the season.

B. Guthion

Although Guthion is specifically mentioned throughout this text, Azinphos Methyl, Imidan, and Zolone have similar properties and can be substituted wherever Guthion appears.

Guthion has been an old standby at petal fall and throughout the summer for a number of years. Although it is still good at controlling PC, it has begun to fall down in the control of OBLR and GFW in some areas. Guthion is still a good petal fall insecticide to use where the STLM is not a problem. Guthion can also be used where it still works on the early Lepidoptera, or they are not a problem. The STLM has developed resistance to Guthion. Therefore, where the STLM is present and needs to be controlled, refer to the Lannate section. Where the STLM does not need to be controlled and Guthion is no longer adequately controlling the early Lepidoptera, refer to the PennCap-M section.

When used in a regular seasonal spray program, Guthion will suppress but not control the GAA. It should not be counted on to even suppress RAA or WAA. If Systox did not control the RAA at pink, it may be added again, at full rate, at petal fall, but expect to see some RAA injury. Systox may be used now or later in the summer to control WAA. Where STLM needs to be controlled in the second generation with Vydate, a special Systox spray to control WAA normally will not be needed.

With the exception of ERM and WALH, Guthion will control most of the other insect pests present at petal fall. If WALH is a problem, consider thinning with Sevin to get the added benefit of WALH control. If ERM is a problem, add an acaricide now or in the summer.

C. PennCap-M

Where STLM does not need to be controlled and Guthion is not adequately controlling the OBLR and GFW, PennCap-M fits into the petal fall spray program. A few extra precautions should be taken to avoid bee kills. Also see "Honey Bee" in LIBRARY.

With the exception of STLM, WALH, and ERM, PennCap-M will control most of the insect pests present at petal fall. If first generation STLM needs to be controlled, refer to the

Lannate section. If WALH is a problem, consider thinning with Sevin to get the added benefit of WALH control. If ERM is a problem, consider adding an acaricide now or in the summer.

An Added Caution

If the SJS has been a problem in the past, Lannate, Guthion, or PennCap-M at petal fall should not be expected to alleviate the problem. The presence of SJS in an orchard is an indication of inadequate spray coverage. It may take 2 or more years to control this pest and require pruning, dormant oil applications, and seasonal spray programs with insecticides to kill emerging males and crawlers.

Mites

Although the ERM was listed among the potential pests present at petal fall, none of the insecticides discussed will control this pest. One or two oil sprays before pink will act as an ovicide on overwintering ERM eggs. Coverage is the key to control. If coverage was insufficient for adequate control or oil was not applied, there are two post-bloom strategies to cleaning up the problem.

If mites are present in number at petal fall, three Vendex sprays at 3 oz./100 gal. beginning at petal fall and again 10 and 20 days later will give seasonal control. In order to be successful, once started, the Vendex program must be adhered to. This is the only time and method that we recommend the use of Vendex.

The second mite control program is the old standby utilizing two Plictran sprays at 4 to 6 oz./100 gal. at 7 to 10 days apart when the mites become a problem.

PLUM CURCULIO (PC)

Conotrachelus nenuphar (Herbst)

Also see "Petal Fall" in LIBRARY.

Life History

The PC has a single generation per year and overwinters as an adult in debris on the ground in woodlots and in hedgerows. The adults are about 1/5 inch long, have four pairs of humps on their wing covers, and are a mottled black, gray, and brown color. The adults become active in the spring when temperatures rise above 60 F. After mating in the spring, the females lay their eggs under a crescent-shaped slit which they cut with their mouthparts. Each female may lay several hundred eggs.

The eggs hatch in about a week, and the larvae begin tunneling to the center of the fruit. The larval period lasts about 16 days, and the majority of infected fruit fall to the ground with the June drop.

Upon reaching maturity, the larvae leave the fruit and enter the soil where they pupate. About a month later, the adults emerge from the soil and will feed on the fruit until they are forced into hibernation as temperatures drop below 60 F.

Monitoring

The monitoring for PC activity is done by observing the fruit for feeding and egg laying cuts. The seriousness of the

PC as an orchard pest requires the use of an insecticide at petal fall.

In the summer, emerging adult PC are controlled by insecticides applied against other orchard pests and, therefore, a monitoring program for these insects is not required.

Control

Guthion, Azinphos Methyl, Imidan, and Zolone are four insecticides applied at petal fall to provide PC control. PennCap-M will also provide control, but care should be taken to prevent bee kills. Also see "Honey Bee" in LIBRARY. Lannate or Nudrin will provide fair PC control when applied at petal fall to control early Lepidoptera or the spotted tentiform leafminer. Growers may wish to add a half rate of another material to get additional PC control when using Lannate or Nudrin at petal fall. Sevin will provide good PC control and, if used in thinning, will help control any stragglers that migrate into the orchard.

ROSY APPLE APHID (RAA)

Dysaphis plantaginea (Passerini)

Also see "Petal Fall" in LIBRARY.

Life History

The RAA overwinters as a small, black egg on the bark of apple trees. The eggs of the RAA cannot be differentiated from the apple grain aphid or the green apple aphid. Overwintering RAA eggs usually hatch by half-inch green or tight cluster. The hatching nymphs are all females and move to fruit buds where they begin feeding. These nymphs mature into stem mothers during bloom and begin giving birth to living young which mature in 2-3 weeks and continue the cycle. If the RAA is present at petal fall or persists into June or early July, fruit injury proportionate to the population and duration of the infestation will result.

A few winged adults are produced in the second generation and proportionately more are produced in the third and fourth generations. These winged adults, produced between May and mid-July, leave the apple trees and move to weed host plants to spend the summer. Narrow-leaved plantain and dock are two of the more important summer hosts for the RAA.

In the late summer or early fall, winged adults are again produced and the RAA migrate back onto the apple trees. These adults produce offspring that in turn produce male and female offspring. This is the only time that male RAA are produced. When these males and females become adults, they mate and the females lay eggs to carry the species through the winter.

Monitoring

Monitoring of the rosy apple aphid should be conducted from tight cluster through petal fall. Check 100 fruit clusters in the middle of the most susceptible varieties in a block. Cortland, Rhode Island Greening, Monroe, Twenty Ounce, and Golden Delicious tend to be very susceptible, and the Red Delicious varieties are intermediate. McIntosh tend to

be the least susceptible to RAA injury. Treatment is recommended if an average of one colony or more per tree of the susceptible varieties is found.

Treatment with a systemic aphicide at pink has been a standard practice. If for some reason RAA are not controlled at pink, a systemic insecticide with activity against the RAA should be applied at petal fall.

Control

Coverage is essential in the control of the RAA. Control is best achieved when the insecticide is applied dilute or at least no greater than 6X. Growers with sprayers that cannot go below 20X are often the first to find that they have a RAA problem.

Systox has been the standard insecticide applied at pink and, when need be, at petal fall for the control of RAA. Systox has been inconsistent in controlling RAA where growers have been spraying high concentrate. If a grower cannot spray at 6X or below, Vydate should be used at pink. Vydate has better systemic properties than Systox and will, therefore, redistribute itself better within the plant. Vydate applied at pink will also aid in the control of the spotted ten-tiform leafminer if it is a potential problem. Vydate should not be used at petal fall.

Several instances of Systox not working when applied at 6X or below were reported in 1979. Laboratory tests indicated the development of resistance to Systox in several RAA colonies tested. If poor RAA control has been experienced with Systox applied at low concentrations, it is suggested that Zolone, Thiodan, or Phosphamidon be used at pink. These materials remained effective in controlling Systox-resistant colonies in the laboratory.

SAN JOSE SCALE (SJS)

***Quadraspidiotus perniciosus* (Comstock)**

Also see "Petal Fall" in LIBRARY.

Life History

The SJS attacks apple, pear, quince, peach, nectarine, plum, apricot, and sweet cherry trees. It frequently becomes a problem in larger, poorly pruned trees that prevent adequate spray coverage. The fruit and bark around the scales are frequently reddened. On heavily infested trees, the scales are crowded together and give the bark a gray, roughened appearance. If not controlled, a heavy infestation can kill a tree.

The SJS overwinters as a yellow second instar nymph under a gray, waxy scale covering. With the return of sap flow in the spring, the nymphs begin to feed and develop. By bloom, they are fully developed and the sexes can be easily differentiated. The male scales are oval with a raised dot near the larger end and are about 1/25 inch long and half as wide. The females are circular with a diameter of about 1/12 inch and have a raised nipple in the center.

The males emerge from their scales as minute, yellow, two-winged insects at about bloom. The females remain immobile and sac-like in appearance under their protective

scales. Mating occurs soon after the males emerge and the females can produce an average of 200 young in the 6-week period that they remain productive.

First instar nymphs, called crawlers, are yellow, six-legged, and resemble a mite. They crawl about until they find a place to settle and feed. Shortly after settling down to feed, they moult, lose their legs, and become yellow sacs attached to the plant by their mouthparts. A waxy, flaky, secretion is produced that in 2 or 3 days is matted down to form the protective scale under which the nymph develops.

There are at least three broods of SJS each season in New York. By fall, all stages of the insect can be found, but only the second instar nymphs overwinter. Those scale in the other stages of development die during the winter.

The SJS are carried from orchard to orchard in the crawler stage by birds and larger insects. They are also carried through the air by the wind.

Monitoring

Because of its small size and its color blending into that of the bark, it is difficult to detect the SJS before it has become a problem. The presence of the SJS on fruit at harvest indicates the need for special control measures the following season.

Control

Pruning is important in SJS control. It is important to cut out heavily infested branches in the winter to reduce the possibility of the infestation spreading the following summer. Pruning also opens the trees up and allows for better penetration and coverage of insecticides.

There are several beneficial insects that attack the SJS. They do not provide satisfactory control and are suppressed in commercial orchards by insecticides required to control the SJS and other insect pests.

Concentrate spraying is acceptable for general maintenance spraying, but complete coverage is important in controlling the SJS and dilute spraying is advised. An oil spray at half-inch green will provide excellent SJS control and kill overwintering European red mite eggs if coverage is complete.

From petal fall throughout the remainder of the season, SJS are suppressed by the insecticidal action of most broad spectrum insecticides on the adult males and the crawlers.

A serious SJS problem may take several years to clean up.

SPOTTED TENTIFORM LEAFMINER (STLM)

***Phyllonorycter blancardella* (F.) *Phyllonorycter crataegella* Clemens**

Also see "Petal Fall" in LIBRARY.

Life History

Both *P. blancardella* and *P. crataegella* occur in New York and are similar in appearance, biology, and injury caused. They also possess the same common name, the STLM. *P. blancardella* is the only species occurring in

western New York and the Champlain Valley and is the predominant species found on the western side of the Hudson River. *P. crataegella* occurs only in the Hudson Valley. It is the only species found on the eastern side of the Hudson River and is the lesser species on the western side of the river.

The STLM has three broods a year. They overwinter in the pupal stage within their mines in leaves on the ground. Adults begin emerging at half-inch green or tight cluster. The adults are small, weak fliers that are commonly found at rest in the ground cover or on the trees. The moths become active in the evening, when both mating and egg laying occurs.

The eggs are very small and difficult to see with the naked eye. They have the appearance of small elliptical blisters on the leaf undersurface and, depending on the temperature, hatch in 5 to 16 days.

The STLM has five larval instars. The first three instars are referred to as the sap feeding stage; they feed on the sap from the spongy mesophyll in the leaves. Injury from the sap feeding stage is only visible from the leaf undersurface and appears as an area where leaf tissues have separated. The fourth and fifth instars are collectively referred to as the tissue feeding stage. In this stage, the larvae begin feeding on the leaf tissues and the mines become visible on the upper leaf surface as an oblong green tent with whitish spots. Larval development takes about 24 days.

The STLM pupates within the mine and changes from yellow, when first formed, to a dark brown color. The STLM remains in the pupal stage for about 1-12 weeks for the first and second broods and overwinters in the pupal stage for the third brood. Prior to emerging as an adult, the pupa cuts a hole in the leaf undersurface and partially protrudes from the leaf. The pupal skins remain attached to the leaf after the adults emerge, until they are weathered off.

Monitoring

Monitoring for the STLM requires close observation of leaves at or shortly before petal fall and again as the second brood begins to hatch and mine the leaves. It is difficult, if not impossible, to equate STLM adult populations or egg counts with the need to control the pest. Control recommendations are based on the number of sap feeding mines present for any particular brood. An insecticide application is recommended prior to the larvae entering the tissue feeding stage if there is an average of one or more mines per leaf for the first brood, and two or more mines per leaf for the second brood. Insecticide applications are not recommended against the third brood, no matter how serious the problem. A serious third brood STLM problem is normally due to a high second brood population that was not properly controlled. The injury to the leaves by the second brood would have been substantial, and any further injury should not add to the seriousness of the problem. The third brood larvae are normally well parasitized, and spraying against the STLM will reduce parasitization. The parasite, if protected, can significantly reduce the

overwintering STLM population.

Control

First Brood

The first opportunity to control the STLM is as they emerge as adults in the spring. Thiodan is the material to use solely for the control of adults. This strategy, however, is not recommended as a standard practice for several reasons.

1. The preceding fall's STLM problem or population cannot be equated with an expected spring problem for the present season.
2. Pheromone trap catch numbers cannot be equated with the need to spray.
3. The adult stage is not the stage that treatment or control should be aimed at.

This spray is best suited for the conservative grower who had a serious problem with STLM the preceding season. More than one Thiodan application will be needed. One Thiodan spray should be applied at half-inch green and another at pink. A third Thiodan spray may be required between the two if it turns cool and the period lengthens out.

The second strategy is to control the first generation miners within the leaves. There are two different timings and materials available for action against the first generation larvae. The first material, Vydate, must be applied at pink and will enter the leaves and kill the larvae as they feed. Applying Vydate at pink is normally not recommended because we cannot equate any stage present at pink with the need to spray. At pink, adults and eggs will be present but normally not the larvae. If Vydate is the preferred material by the grower, it should be applied at pink. It should not be applied for 30 days after bloom because it can thin the apples, and at present, we do not know enough about its thinning capabilities.

The recommended material and time of application to control first generation STLM larvae is the use of Lannate or Nudrin at petal fall. The action threshold for spraying at petal fall is an average of one or more mines per leaf. Lannate or Nudrin should be applied before the larvae go from the sap to the tissue feeding stage. Therefore, the mines that must be counted will only be visible on the undersurface of the leaves and will appear as a separation of the undersurface of the leaf. Lannate or Nudrin applied at petal fall will also control white apple leafhopper as well as most of the other insects out at that time.

Second Brood

Whether it is determined to spray or not to spray for the first brood, you should be prepared to monitor the second generation larvae which begin to appear in July. If your counts indicate that an insecticide application is required, you may use Lannate, Nudrin, or Vydate. Vydate is preferred because it is better in its systemic action within the leaf.

Vydate applied against the second generation of STLM larvae will suppress the white apple leafhopper and some

of the other insects present at that time. Vydate will not control apple maggot.

Third Brood

The STLM has a third generation which first appears in August. No action is advised against the third generation.

Note

A few additional comments about Lannate, Nudrin, and Vydate should be made. They are carbamate insecticides and can precipitate mite outbreaks, are harmful against predator mites, and can also precipitate other insect outbreaks, such as woolly apple aphid. If these materials are used to control STLM, be prepared for secondary pest outbreaks. Do not let the secondary pests get out of hand.

TARNISHED PLANT BUG (TPB)

Lygus lineolaris (Palisot de Beauvois)

Also see "Petal Fall" in LIBRARY.

Life History

The TPB overwinters as an adult and with the onset of warm temperatures emerges to feed. Tree fruits are a very attractive early food source in the spring. Later in the spring, the TPB move to weeds and a wide range of other crops, including strawberries, of which it is a serious pest.

On tree fruits, the TPB prefers to feed on the developing flower buds beginning at about tight cluster and continuing on after the fruit have set. The feeding done prior to bloom causes the buds to abort and, therefore, the insect acts as a natural thinner. Feeding done after pollination does not drop the fruit, but causes the typical cone-shaped indentation or injury on apples and pears and cat-facing and scabbing on peaches.

Monitoring

From tight cluster through first cover, particularly during bloom and petal fall, attention should be paid to looking for the TPB. Because the TPB is a very active insect that can rapidly enter or leave an orchard depending on the availability of alternate food sources and climatic conditions, and frequently hides when approached, it is difficult to monitor. Therefore, no action thresholds have been developed.

Control

The standard recommendation in the past has been to apply up to two pre-bloom sprays (tight cluster and pink) and a petal fall spray. Even with these sprays, injury to the fruit can occur. This is because the TPB is a very mobile insect and, once the plants are free of effective insecticide residues, new individuals can move into the orchard and begin feeding. The feeding by insects that move into the orchard during bloom causes the injury seen at harvest. During years of prolonged bloom, it is nearly impossible to prevent this injury. Therefore, we no longer recommend pre-bloom TPB sprays as a common practice. Pre-bloom sprays may be used if a grower feels that he has an unusually high TPB population pre-bloom and is concerned

about having an adequate fruit set. The pre-bloom sprays may kill the TPB that are present and reduce their fruit thinning effect.

Bloom is the best time to spray for the TPB. That, however, cannot be done. Insecticides cannot be applied during bloom.

Normally, a petal fall spray will not eliminate TPB injury, but it will keep it at a minimum. If a grower feels that he has a TPB problem during bloom, the petal fall spray should come as soon as possible after petal fall (be sure the bees are out) instead of trying to stretch the interval until the plum curculio are present.

Most of the commonly used insecticides will control the TPB.

TWO SPOTTED SPIDER MITE (TSM)

Tetranychus urticae Koch

Life History

Although a few immature TSM overwinter, the majority of the overwintering populations are gravid adult females. They overwinter under loose bark or protected under leaf litter on the ground. With the onset of warm weather in the spring, they begin feeding and egg laying.

The TSM is commonly found on weeds in the orchard ground cover and normally does not move into the trees until hot, dry conditions occur in the summer. When moving into the trees, the TSM either climb the trunk and first infest the lower shoots and water sprouts, or use weeds touching lower limbs as bridges to climb up to and infest the trees.

Feeding injury to pear leaves can develop rapidly under hot, dry conditions and causes the leaves to blacken and appear scorched. One or two TSM per leaf can cause this injury on pears. By the time the injury becomes apparent, the mites are frequently no longer present. On apples, TSM injury resembles European red mite injury.

The oval eggs of the TSM are white in color and are usually laid on the undersurface of leaves. The immature and adult mites can be white to dark green in color, depending on their food source; they have a dark spot on either side of their body. The mites produce a webbing which covers the leaves they infest.

Monitoring

Monitoring for the TSM in trees should begin in early summer and continue until harvest. From 10 trees in an orchard, pick a total of 100 leaves (10 per tree) from the lower shoots and water sprouts along the trunk. If the ground cover is high and touches the lower limbs, pick an additional 100 leaves from the lower limbs touched by the weeds.

On apples, control is recommended if there is an average of six or more TSM per leaf and the average number of predator mites is below one per leaf.

On pears, control is recommended if there is an average of one or more TSM per leaf.

Control

Keeping the ground cover mowed and climbing weeds

out of the trees will help prevent TSM from climbing into the trees.

Plictran (4-6 oz./100 gal.) and Omite (1-1 1/2 lb./100 gal.) are two of the more commonly used summer acaricides. With either material, two applications 7-10 days apart are recommended. The split applications help kill the mites as they hatch from their eggs.

WHITE APPLE LEAFHOPPER (WALH)

Typhlocyba pomaria (McAtee)

Also see "Petal Fall" in LIBRARY.

Life History

The WALH has two generations per year. It overwinters as eggs deposited under the bark of 1-5 year old twigs. The eggs appear as very small, elongated blisters on the bark. Egg hatch normally begins during pink and is complete shortly after petal fall. The young nymphs are white with red eyes and as they feed and develop, they become creamy-white to a pale yellow-green color and lose the red color in their eyes. By early June, the wedge-shaped adults of the first generation (measuring about 1/8 inch) begin to appear and lay their eggs in the leaf tissue. The second generation eggs begin hatching in late July and have developed into adults by late August or early September. These adults are present until early October and can be a nuisance to pickers.

The WALH is an active insect when disturbed. The nymphs will run to the opposite side of a leaf while the adults will either run or fly off. The WALH can be differentiated from the potato leafhopper, which can also be a periodic pest of apple, by the way they run when disturbed. The WALH will normally run straight ahead or backward, while the potato leafhopper normally runs sideways or crab-like.

The WALH normally remains on the undersurface of the same leaf or cluster of leaves as it develops. Its cast skins also remain on the leaf undersurface until they weather off. WALH feeding removes the chlorophyll from the leaf. Light feeding injury appears as white spots on the upper leaf surface and as feeding increases, the loss of chlorophyll and evidence of leaf injury increases. The WALH also produces a honeydew which can drop onto the fruit and appear as tan to brown spots or streaks. The honeydew is an excellent media for the growth of sooty molds and both the honeydew and molds can russet the fruit. Fruit injury from honeydew deposits is more common from second generation infestations.

The following facts should be kept in mind while developing a control program for the WALH:

1. The first generation will be less strung out than the second generation and is, therefore, easier to control. (The second generation may require two sprays to

control.)

2. The small nymphs are easier to kill than the large nymphs and adults.
3. WALH egg hatch normally peaks during bloom and the majority of nymphs have hatched by petal fall.
4. The WALH has developed a high level of resistance to the organophosphate insecticides.

Monitoring

From bloom through petal fall, check 50 leaves per tree from 10 trees per block for the first generation WALH nymphs. Particularly check the leaves of clusters in the inside of the trees. Treatment is recommended if there is an average of 1/2 nymph or greater per leaf.

For the second generation WALH, check 50 leaves per tree from 10 trees per block for nymphs from late July through August. Treatment is recommended if there is an average of one or more nymphs per leaf. Due to the protracted egg hatch of the second generation, two treatments may be necessary to control this generation.

Control

The WALH is easiest to control in the small nymphal instars. The WALH in New York is resistant to many of the insecticides used in tree fruit production. The carbamate insecticides Sevin, Lannate, Nudrin, and Vydate remain effective materials.

If the spotted tentiform leafminer, obliquebanded leafroller, or green fruitworm are not a problem and you plan on thinning the orchard, then Sevin would be the material to control the first generation WALH. For the second generation, Sevin would have an added benefit over Lannate, Nudrin, and Vydate in that you could also expect to get apple maggot control out of the two sprays that may be needed to control the WALH.

When Lannate or Nudrin is applied at petal fall to control the spotted tentiform leafminer, obliquebanded leafroller, or green fruitworm, it should provide the needed control of the first generation WALH. When used to control the second generation spotted tentiform leafminer, Lannate or Nudrin should also provide control for the early hatch of the second generation WALH. A second spray of Lannate, Nudrin, or Sevin may be required to control the late hatching second generation.

When applied at pink to control the spotted tentiform leafminer, Vydate should also control the WALH nymphs that are out at that time. Unfortunately, we cannot rely on residual activity to carry through bloom. Therefore, Vydate may hold down the first generation WALH, but cannot be counted on to control it. When applied against the second generation spotted tentiform leafminer sometime in July, Vydate may control an early portion of the second generation WALH, but should not be expected to provide adequate control. A second spray, of Sevin, will normally be required.