2023 Cornell Pest Management Guidelines for Commercial Tree Fruit Production

Cornell Cooperative Extension

Additional information available at the Cornell fruit homepage: www.fruit.cornell.edu

These guidelines are not a substitute for pesticide labeling. Always read and understand the product label before using any pesticide.

2023 Cornell Pest Management Guidelines for Commercial Tree Fruit Production

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Every effort has been made to provide correct, complete, and up-to-date pest management information for New York State at the time this publication was released for printing (December 2022). Changes in pesticide registrations, regulations, and guidelines occurring after publication are available in county Cornell Cooperative Extension offices or from the Cornell Cooperative Extension Pesticide Safety Education Program (CCE-PSEP) (psep.cce.cornell.edu).

Trade names used in this publication are for convenience only. No endorsement of products is intended, nor is criticism of unnamed products implied.

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The guidelines in this bulletin reflect the current (and past) authors' best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this bulletin does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of particular discharge levels from agricultural land.

Cover photo: Researching biological disease control methods. (*Photo: Līga Astra Kalniņa, Cornell AgriTech.*)

1 Integrated Crop and Pest Management

1.1 Background

Cornell University and Cornell Cooperative Extension actively promote the use of Integrated Crop and Pest Management (IPM) by New York growers in order to address agricultural concerns. In many areas of New York State, there are horticultural, economic, social, and political pressures to reduce the environmental impact and use of pesticides in crop production. Public concerns with nutrient and sediment movement into ground and surface water and pressure against pesticide applications is growing. In other regions, agricultural producers are being asked to submit nutrient and soil management plans to address the offsite impacts of their practices. In addition, the development of pesticide resistance in key pests; registration of fewer and more expensive new chemicals for pest control; loss of existing products; and increased competition from other regions continue to push New York agriculture to look for nonchemical alternatives.

IPM requires a combination of long and short term production strategies to maximize net profit while minimizing risks of undesirable environmental impacts of practices. Some of these practices include site selection, crop-specific production strategies, nutrient management, and cover cropping. IPM is a pest control strategy that promotes the use of a variety of tactics including pest-resistant cultivars and biological, cultural, and physical controls. Pesticides are a control tactic employed in IPM, but they are used preferably only when needed. Pesticide use is thus minimized without jeopardizing crop quality or yield. Applying multiple control tactics minimizes the chance that pests will adapt to any one tactic and allows growers to choose the most environmentally sound, efficacious, and economically efficient pest management program for their situation.

This manual provides information and references that will allow New York fruit growers to practice IPM for many of their crops. While information for the proper use of pesticides is a main component of this manual, other information is contained that can help growers reduce their reliance on pesticides and take advantage of alternatives to pesticides that may be less expensive, less environmentally harmful, and more acceptable to the non-agricultural community.

1.2 Practicing IPM

In an IPM program, it is important to accurately identify the pests (vertebrates, diseases, insects, and weeds) and assess pest abundance. See the listing (at the end of this publication) of laboratories at Cornell that do pest and disease diagnosis and soil and tissue analysis for assistance in maintaining crop health and nutrition. It is important to have knowledge of the biology and ecology of the pest(s) attacking the crop and the factors that can influence pest infestations. An understanding of the influence of factors such as weather and natural enemies on pest abundance will aid the choice of management tactics. IPM programs stress suppression of insect and disease populations to levels that do not cause economic damage, rather than total eradication of a pest. In the case of insect pests, it may be important to have at least some pests present to ensure that natural enemies will remain in the crop to suppress subsequent infestations.

1.3 IPM Components

1.3.1 Monitoring (Scouting)

Scouting includes detecting, identifying, and determining the level of pest populations on a timely basis. Insect traps can often be used to detect pests and identify times when scouting should be intensified or control measures should be taken. Monitoring individual orchard blocks throughout the season is the most effective way of assessing the insect, disease, and weed situation and, therefore, the need for chemical treatment in that block. Scientifically based, accurate, and efficient monitoring methods are available for many pests on fruit crops in New York. Brief descriptions of the recommended techniques are given in this manual.

1.3.2 Forecasting

Weather data and other information helps predict when specific pests will most likely occur. Weather-based pest forecast models for diseases and insects of many crops have been developed in New York. This information will be referred to for the pests that have such models available. Weather forecasts are available through the NYS IPM Program's Network for Environment and Weather Awareness (NEWA) on a daily basis.

Access to a computer network to obtain weather, regional insect, and disease forecasts is useful but not essential. NEWA provides automated local weather information and the results of pest forecasts on a daily basis. Access NEWA online at www.newa.cornell.edu. Simple weather recording equipment such as thermometers, hygrometers, and rain gauges placed in orchards will assist the prediction of pest outbreaks. Information on the potential for pest outbreaks generally can also be obtained from local Cooperative Extension offices, newsletters, and regional crop advisors.

1.3.3 Thresholds

Use thresholds to determine when pest populations have reached a level that could cause economic damage. Thresholds have been scientifically determined by Cornell researchers. Following the thresholds indicated in this manual has reduced pesticide use by as much as 50%, saving significant money for growers. The term ***suggested action threshold*** is used in this publication to denote

2 Organic Tree Fruit Production in New York State

2.1 Introduction

A large number of both native and introduced pest species attack apples and other tree fruits grown in commercial orchards. Control of this pest complex is particularly challenging in N.Y., because unlike more arid production regions in the country, fruit orchards in N.Y. are commonly in close proximity to semi-wooded areas with an abundance of naturalized and wild host species that can harbor populations of certain tree fruit pests. Traditionally, conventional fruit orchards in N.Y. have been treated heavily with pesticides to control this extensive pest complex.

In the past, very few growers in the northeast have attempted to produce apples and other tree fruits organically because of the practical difficulties involved in controlling pests in this region without using conventional, broad-spectrum pesticides. However, during the last 10-15 years, studies have been conducted to develop management programs that may be able to replace current strategies that rely primarily on these pesticide applications. For example, recent studies have shown that the predaceous mite, *Typhlodromus pyri*, which is native to apple production regions in western N.Y., can successfully control populations of the key mite pest, European red mite, in commercial apple orchards so that no applications of miticides are required for seasonal control. Recent research in N.Y. and elsewhere has also shown that pheromones can be deployed in orchards to disrupt mating of key lepidopteran species such as oriental fruit moth, and borer species, and substantially reduce fruit damage from this complex of pests. In addition to some of these newer types of organically compatible pest control technologies, traditional control methods such as selective fruit thinning, pruning, sanitation (frequent removal of dropped fruit and/or vegetative tissue infested or infected with pests), removal of wild hosts near commercial plantings, and exclusion of pests with biological or physical barriers near or around trees, have also been shown to reduce populations of many types of pests in fruit plantings in this region.

Ideally, organic fruit production is the synthesis of an entire suite of practices intended to take advantage of natural ecosystem interactions and minimize synthetic inputs. Such a system might start with the selection of disease-resistant cultivars, to circumvent the need for the majority of normal disease sprays. This one tactic could eliminate or substantially reduce the need to manage apple scab, powdery mildew, cedar apple rust, and fire blight (Ellis et al., 1998). In lieu of resistance, a combined strategy of orchard sanitation and frequent applications of elemental sulfur and copper throughout most of the season would be the next practical alternative.

2.2 Fungicide Options in Organic Tree Fruit Production

Organic approved fungicides and bactericides are often not as effective and the conventional fungicides and antibiotics in temperate apple production regions such as NY and New England. In recent years, organic copper and sulfur products, and biopesticide products have greatly improved in terms of formulation and efficacy. In drier seasons and against lower disease pressure situations (e.g. low level of inoculum & among less susceptible cultivars), organic-approved products can provide a level of control comparable to conventional products. That being said, organic-approved products may need to be applied at higher rates and frequencies to match the activity of convention products. In field trials conducted at Cornell and other regional institutions, applied plant pathologists are achieving greater success in managing fire blight and summer diseases with biopesticides based on *Bacillus subtilis*, *B. amyloliquefaciens*, *B. mycoides*, and *Reynoutria sachalinensis*, and new low MCE copper products formulated to reduce risk of phytoxicity. In many instances, biopesticides and organic copper and sulfur products are being used in conventional production as means of resistance management or to avoid exceeding seasonal tolerances for key conventional fungicides. Biopesticides based on natural oils, such as white mineral oil or oil of thyme have similar potential for controlling fungal and bacterial diseases, but the use of oils complicates the use of other agrichemicals as oils act as intensifiers and could lead to problems with phytoxicity in tank mixes. Biopesticides based on potassium bicarbonate and peroxides have utility against fungal diseases, particularly, powdery mildew and sooty blotch fly speck. However, these would be need to be applied every 3-5 days or at each wetting event for maximum efficacy. Phosphorous acid fungicides are biopesticides and can be fairly effective against fire blight, powdery mildew, and flyspeck sooty blotch when applied at model recommendations and short intervals (e.g. 3-7 days). However, these products are not approved for organic agriculture. Additional biopesticides and organically approved copper and sulfur products are being developed and improved every year. While some of these products have been evaluated, many are either not commercially available or have yet to be thoroughly evaluated by multiple experts in the region. Products designated with the section symbol "§" indicate that they are suitable for organic production. A provisional program for managing the major diseases of apples covering might resemble:

- **Apple scab** [silver tip through harvest] – copper [silver tip & green tip]; sulfur, *Bacillus sp,* potassium bicarbonate, and peroxides [tight cluster to midsummer]

3 Pesticide Information

3.1 Pesticide Classification and Certification

Pesticides can be classified as general-use or restricted-use. **General-use pesticides** may be purchased and used by anyone. **Restricted-use pesticides** can only be purchased and used by a certified applicator or used by someone under a certified applicator's supervision. In some cases, the pesticide label may limit use of a restricted-use pesticide to only a certified applicator.

Private applicators use or supervise the use of pesticides to produce agricultural commodities or forest crops on land owned or rented by the private applicator or their employer. If a private applicator wants to use or supervise the use of restricted-use pesticides, they need to be a **certified private applicator**. Certified private applicators are also allowed to purchase restricted-use pesticides. Certification is not needed if a private applicator uses general-use pesticides.

In New York State, a **certified commercial applicator**, **certified commercial technician**, or **commercial apprentice** working under the supervision of a certified commercial applicator is allowed to apply any type of pesticide on property that is not a private application (described above) or is a residential application. (A residential application is the use of general-use pesticides on property owned or rented by the applicator, excluding establishments selling or processing food and residential structures other than where the applicator lives.) Certified commercial applicators are allowed to purchase restricted-use pesticides.

Information on pesticide certification and classification is available from your Cornell Cooperative Extension office (cce.cornell.edu/localoffices), regional NYSDEC pesticide specialist (www.dec.ny.gov/about/558.html), the Pesticide Applicator Training Manuals (www.cornellstore.com/books/cornell-cooperative-ext-pmep-manuals), or the Cornell Cooperative Extension Pesticide Safety Education Program (psep.cce.cornell.edu).

3.2 Use Pesticides Properly

Using pesticides requires the user to protect their health, the health of others, and the environment. Keep in mind "pesticide use" is more than just the application. It includes mixing, loading, transporting, storing, or handling pesticides after the manufacturer's seal is broken; cleaning pesticide application equipment; and preparing a container for disposal. These activities require thoughtful planning and preparation. They also require you to comply with state and federal laws and regulations intended to protect human health and the environment from the adverse effects pesticides may cause.

3.2.1 Plan Ahead

Many safety precautions should be taken *before* you begin using pesticides. Most pesticide accidents can be prevented with informed and careful practices. **Always read the label on the pesticide container before using the pesticide.** Make sure you understand and can follow all label directions and precautions. Be prepared to handle an emergency exposure or spill. Know the first aid procedures for the pesticides you use.

3.2.2 Move Pesticides Safely

Transporting pesticides carelessly can result in broken containers, spills, and contamination of people and the environment. Accidents can occur even when transporting pesticides a short distance. You are responsible for a pesticide accident so take every effort to transport pesticides safely. Be prepared for an emergency.

3.2.3 Personal Protective Equipment and Engineering Controls

Personal protective equipment (PPE) needs depend on the pesticide being handled. **Required PPE are listed on pesticide labels.** Any required PPE is based on the pesticide's toxicity, route(s) of exposure, and formulation. Label-listed PPE are the minimum that must be worn when using a pesticide. You can always use more than what's listed!

The type of PPE used depends on the type and duration of the activity, where pesticides are being used, and the user's exposure. For example, mixing/loading procedures often require more PPE than when applying a pesticide. Studies show you are at a greater risk of accidental poisoning when handling pesticide concentrates. Pouring pesticide concentrates is the most hazardous activity.

Engineering controls are devices that help reduce a pesticide user's exposure. An example is a closed transfer system that reduces the exposure risk when dispensing pesticide concentrates. Consult the product label for more information on using engineering controls in place of PPE.

3.2.4 Avoid Drift, Runoff, and Spills

Pesticides that move out of the target area can injure people, damage non-target areas, and harm the environment. Choose weather conditions, pesticides, application equipment, pressure, droplet size, formulations, and adjuvants to minimize drift and runoff potential. Product labels may have specific application and/or equipment requirements to reduce issues with drift and runoff.

4 Sprayer Information

4.1 Solutions For Safer Spraying

4.1.1 Reducing Risk of Pesticide Exposure Through Use Of Engineering Controls

Because handling and applying pesticides is risky business, keeping pesticide exposure to a minimum should be a chief concern of any pesticide applicator. To reduce the risks associated with handling and applying pesticides, devices known as engineering controls can be used that help to reduce or practically eliminate exposure to toxic chemicals.

4.1.2 Areas of Potential Contamination

1. Loading the Sprayer

Closed Transfer Systems – Closed transfer systems allow concentrated pesticide to be moved from the original shipping container to the sprayer mix tank with minimal or no applicator contact. Many systems provide a method to measure the concentrated pesticide. Some systems also include a container rinsing system. Currently available closed transfer systems use a probe inserted into the pesticide container, a connector on the container that mates to a similar connector on the application equipment, or a vacuum-type (venturi) system that uses flowing water to transfer the chemical from the container.

Induction Bowls – Induction bowls are metal, plastic or fiberglass hoppers attached to the side of the sprayer or nurse tank that allow pesticides to be added to the mix tank without the applicator climbing onto the spray rig. Pesticides are poured into the bowl and water is added to flush out the bowl and carry the pesticide to the spray tank. Often a rinse nozzle is mounted inside the bowl for rinsing out empty pesticide containers. Typically induction bowls are raised out of the way during spraying and lowered to about 3 feet above ground when loading the sprayer.

Direct Pesticide Injection System – Direct pesticide injection systems allow pesticides to be mixed directly with water in the sprayer plumbing system rather than in the main spray tank. The pesticide is pumped from its container and mixed with the water either in a manifold or at the main water pump. Only clean water is held in the main tank of the sprayer. An electronic controller and up to four pumps adjust the amount of concentrated pesticide that is injected into the water stream, allowing for variable application rates.

Container Rinse System – Container rinse systems consist of a rinse nozzle and a catch bowl that traps the container washings (rinsate). The empty container is placed over the rinse nozzle and a jet of water cleans the inside of the container. The rinsate caught in the bowl is pumped into the spray tank to be used along with the spray mixture. Often rinse nozzles are installed in chemical induction bowls. Most closed transfer systems also provide a way of rinsing containers and piping the rinse water into the spray tank.

2. Reducing Contamination at the Boom

Boom Folding/Extending – Manually folding booms can be a source of operator contamination because the boom can be covered with pesticide from drift or dripping nozzles. Consider the use of hydraulic or mechanical folding methods.

Diaphragm Check Valves – Typically, when a sprayer is shut off and as the system pressure drops, any liquid remaining in the boom piping drips from the nozzles, possibly dripping onto the boom or even the operator. Diaphragm check valves installed at each nozzle prevent this by using a spring-loaded rubber diaphragm to close off the flow of liquid once the system pressure drops below about 10 pounds per square inch. When the sprayer is switched on and system pressure builds up, the valve opens and allows the liquid to flow through the nozzles.

Multiple Nozzle Bodies – Contamination can occur when operators change or unclog nozzles during an application. Multiple nozzle bodies (or turret nozzles) allow operators to switch between nozzles with a turn of the nozzle body rather than having to unscrew or undo a threaded or a bayonet fitting.

Hand Wash Water Supply – Providing adequate wash water is essential (and often required). A simple container with a hand-operated valve can be mounted on the side of the sprayer to provide clean water for hand washing and personal hygiene.

3. Protecting from Drift and Contaminated Clothing in Cabs

Cab Filtration Using Carbon Filters – Carbon filtration systems are used to remove pesticide odor and pesticide-laden mist from fresh air used in a tractor or self-propelled sprayer cab. Carbon filtration systems are often a standard feature on self-propelled sprayers. Now many factory installed tractor cabs offer optional filtration systems.

Protective Clothing Lockers – To prevent contamination of the tractor or sprayer cab interior, protective clothing should be removed before entering the cab. A few sprayer companies offer a simple compartment (or locker) mounted to the side or front of the sprayer where protective clothing can be stored. Alternatively a locker can be fitted to the nurse tank.

4. Controlling Drift

Low-Drift Nozzles – Low-drift nozzles create larger-size droplets than conventional nozzles. The larger droplet sizes

Table 4.4.1. Gallonage of dilute spray per acre required to provide equivalent coverage for mature trees of different sizes and spacings.

Distance Between Rows (feet)	Tree Width (feet)	Tree Heigh (feet)	Dilute spray Per acre[1] (gal/acre)
40	28	20	427
40	28	16	342
30	20	15	305
25	16	14	273
22	14	13	252
20	12	12	220
18	10	12	203
16	8	10	152
14	6	10	131
12	5	10	127
11	4	10	111
10	3	9	82

[1]Minimum dilute gallons per acre=tree width x tree height x linear feet of row per acre (43,560 divided by distance between rows) x approximately 0.7 gallon per 1,000 cu ft of tree volume.

4.4.8 Travel Speed Calibration

Travel speed is a critical factor in maintaining accurate application rates and will influence spray deposition depending on location within the canopy. The slower a sprayer travels, the greater the uniformity in spray deposition. Although there is inconsistency in research results that try to determine the effect of travel speed on average spray deposition, all studies to date have been in agreement that the higher the travel speed, the greater the variability in spray deposit. Variation in spray deposit is an important factor where uniformity of spray coverage throughout the canopy is required. Conclusions from research were drawn using travel speeds of 1-4 mph.

Factors that will affect travel speed include:

- weight of sprayer to be pulled
- slope of terrain
- ground conditions traveled over (wheel slippage!)

The best way to measure travel speed is to pull a sprayer with tank half filled with water on the same type of terrain that the sprayer will be operated on.

Set up test course at least 100 feet long, measure the course with a tape measure. Do not pace the distance. The longer the course the smaller the margin of error. Run the course in both directions.

Use an accurate stop watch to check the time required to travel the course in each direction. Average the two runs and use the following formula to calculate the speed in MPH.

Formula: $\text{MPH} = \dfrac{\text{ft traveled}}{\text{sec traveled}} \times \dfrac{60}{88}$

Your figures:

Tractor gear _________ Engine revs.___________

$\text{MPH} = \underline{\qquad} \; \dfrac{\text{ft traveled}}{\text{sec traveled}} \times \dfrac{60}{88} = \underline{\quad}$

A modern alternative to using the above method is to purchase a hand-held GPS receiver. A number of systems are available, costing $80-150 and are available from electronics stores, hunting equipment suppliers, and online. The small device is portable so can be used in all tractors to determine forward speed in specific tractor gears at known engine RPM. They may also be used to measure row length and determine block size.

4.5 Rate of Output (GPM)

The gallons of spray desired per acre and the time required to spray an acre determine the rate of output for which the sprayer must be nozzled. Since volume of spray needed per acre varies with tree size, the most common row-spacing for the tree size to be sprayed should be used in calibrating the sprayer. The gallons of dilute spray required for various row-spacing and tree-size combinations are indicated in Table 4.4.1. Gallons of concentrate spray required is determined by dividing dilute gallonage by the concentration desired. The rate of output by the sprayer is calculated by dividing the gallons of concentrate spray by the time required to spray 1 acre, Table 4.5.1.

Table 4.5.1. Approximate time required to spray 1 acre of orchard (two-sided sprayer operation, spraying both sides of trees).

Distance between Rows (feet)	Linear feet of Row/ acre[1]	Travel speed (mph)				
		1	1.5	2	2.5	3
		minutes per acre[2]				
40	1089	12.4	8.2	6.2	5.0	4.1
30	1452	16.5	11.0	8.2	6.6	5.5
25	1742	19.8	12.4	9.9	7.9	6.6
22	1980	22.5	15.0	11.2	9.0	7.5
20	2178	24.8	16.5	12.4	9.9	8.3
18	2420	27.5	18.3	13.8	11.0	9.2
16	2723	30.9	20.6	15.5	12.4	10.3
14	3112	35.4	23.6	17.7	14.1	11.8

[1]Linear feet of row per acre = 43,560 divided by distance between rows.
[2]Minutes per acre = linear feet of row per acre divided by speed in feet per minute. Speed in feet per minute = mph x 88.

4.5.1 Example for Calibrating Rate of Output:

Rows 30 feet apart, trees 20 feet wide x 15 feet high. A 4X concentrate application is to be made at a speed of 2.5 miles per hour.

1. Table 4.4.1 indicates 300 gallons of dilute spray required per acre.

5 Characteristics of Crop Protectants Used on Tree Fruits

5.1 Cross Reference of Chemical vs. Trade Names of Pesticides

Key to pesticide type: (**A**) = Acaricide; (**B**) = Bactericide; (**F**) = Fungicide; (**I**)= Insecticide.

NOTE: See Chapter 8 for a discussion of herbicides used in tree fruit.

5.1.1 By Common Name

abamectin/avermectin – (*†Agri-Flex, *Agri-Mek) Syngenta; (*Abba) Makhteshim; (*Gladiator) FMC (**A,I**)
acequinocyl – (Kanemite) Arysta LifeScience **(A)**
acetamiprid – (*Assail) UPL NA (**I**)
afidopyropen – (*†Versys Inscalis) BASF **(I)**
azadirachtin – (Aza-Direct) Gowan; (§Neemix 4.5) Certis **(I)**

Bacillus subtilis – (Serenade ASO) Bayer **(B, F)**
Bacillus amyloliquefaciens – (§DoubleNickel prodcucts) Certis **(B, F)**
Bacillus mycoides isolate J– (§LifeGuard) Certis **(B, F)**
benzovindiflupyr (*Aprovia) Syngenta (F)
bifenazate – (Acramite) Chemtura (**A**); (Banter) UPL NA **(A)**
bifenthrin – (*Brigade) FMC (**I, A**)
boscalid + pyraclostrobin – (Pristine) BASF (**F**)
Bacillus thuringiensis (B.t.) – (§Agree) Certis; (§Dipel) Valent BioSciences; (Deliver) Certis; (Javelin) Certis **(I)**
buprofezin – (*†Centaur) Nichino **(I)**
Burkholderia spp. Strain A396 – (§Venerate XC) Marrone Bio Innovations **(I)**

captan – (Captan) Micro Flo, Drexel, Makhteshim Agan **(F)**
carbaryl – (Carbaryl) Drexel; (Sevin) TKI (**I**)
chlorantraniliprole – (*†Altacor) DuPont; (*†Voliam Flexi, *†Beseige) Syngenta **(I)**
chlorothalonil – (Bravo) Syngenta; (Echo) Sipcam Agro; (Equus) Makhteshim Agan **(F)**
Chromobacterium subtsugae – (Grandevo WDG) Marrone Bio Innovations **(I)**
clofentezine – (Apollo) Makhteshim Agan **(A)**
copper hydroxide – (Kocide, Champ) DuPont, Nufarm Americas **(B, F)**
copper oxychloride/copper sulfate – (C-O-C-S) Loveland **(B, F)**
copper oxychloride/ copper hydroxide – (Badge SC, §Badge X2) Gowan **(B, F)**
copper octanoate – (Cueva) Certis **(B, F)**
copper sulfate – (Cuprofix Ultra 40 Disperss) UPL NA **(B, F)**
cyantraniliprole – (*†Exirel) FMC **(I)**
cyantraniliprole/abamectin – (*†Minecto Pro) Syngenta **(I)**
cyclaniliprole – (*†Verdepryn) Summit Agro; (*†Cyclaniliprole) ISK Biosciences **(I)**
cyflumetofen – (Nealta) BASF **(A)**
cyfluthrin – (*Baythroid, *Leverage) Bayer **(I)**
cyprodinil – (Vangard) Syngenta **(F)**

diazinon – (*Diazinon) Makhteshim **(I)**
difenoconazole + cyprodinil– (Inspire Super) Syngenta **(F)**
difenoconazole + fludioxonil– (Academy) Syngenta **(F)**
dimethoate – (*Dimethoate) Loveland (*Dimethoate) Drexel **(I)**
dodine – (Syllit FL) Arysta **(F)**

emamectin benzoate – (*Proclaim) Syngenta **(I)**
esfenvalerate – (*Asana) Valent **(I)**
etoxazole – (Zeal) Valent **(A)**

fenazaquin – (Magister) Gowan **(A)**
fenbuconazole – (Indar) Corteva Agriscience **(F)**
fenbutatin-oxide – (*Vendex) UPL NA **(A)**
fenhexamid – (Elevate) Arysta **(F)**
fenpropathrin – (*Danitol) Valent BioSciences **(I)**
fenpyroximate – (Portal) Nichino America **(A,I)**
flonicamid – (Beleaf) FMC **(I)**
flupyradifurone – (*†Sivanto Prime) Bayer **(I)**
flutriafol – (†Rhyme) FMC **(F)**
fluopyram + pyrimethanil (*†Luna Tranquility) Bayer (**F**)
fluopyram + trifloxystrobin (*†Luna Sensation) Bayer (**F**)
fluopyram + tebuconazole (*†Luna Experience) Bayer (**F**)
fluxapyroxad (*†Tesaris) BASF (**F**)
fluxapyroxad + pyraclostrobin) (*†Merivon) BASF (**F**)
ferbam – (Ferbam Granuflo) Taminco **(F)**
fludioxonil – (Scholar) Syngenta **(F)**
fosetyl-Al – (Aliette) Bayer **(F)**

GS-omega/kappa-Hxtx-Hv1a – (Spear-Lep) Vestaron **(I)**

hexakis – (*Vendex) UPL NA **(I)**
hexythiazox – (Savey, Onager) Gowan **(A)**

imidacloprid – (*Admire Pro, *Leverage) Bayer **(I)**
indoxacarb – (Avaunt) DuPont **(I)**
insecticidal virus – (§Cyd-X, §Madex) Certis;(§Virosoft CP4) BioTEPP **(I)**
iprodione – (Rovral) Bayer; (Iprodione) MicroFlo **(F)**
isofetamid – (Kenja 400SC) Summit Agro USA, LLC **(F)**

kaolin – (§Surround) TKI (**A,F,I**)
kasugamycin – (Kasumin 2L) Arysta LifeScience **(B)**
kresoxim-methyl – (*†Sovran) FMC **(F)**

lambda-cyhalothrin – (*Lambda-CY EC) UPL NA; (*Warrior; *†Endigo) Syngenta **(I)**

malathion – (Clean Crop Malathion) Loveland; (Malathion) Drexel; (*Prentox Malathion) Prentiss **(I)**
mancozeb – (Dithane) Corteva Agriscience; (Manzate) DuPont; (Penncozeb) UPL NA **(F)**
maneb – (Manex) Griffin **(F)**
mefanoxam – (Ridomil Gold) Syngenta **(F)**
mefentrifluconazole – (*†Cevya) BASF (**F**)

young developing leaves if the spray is preceded by extended periods of cloudy wet weather.

Captan is also registered for use as a postharvest dip or drench of apples, pears, cherries, and peaches for the control of postharvest rots. If fruit is likely to be exported, review the acceptability and tolerance limits of captan for countries of export destination before postharvest treatments. Check maximum residues allowed online at mrldatabase.com.

Chlorothalonil (Bravo, Echo, Applause, Equus) is available in a number of different formulations. Chlorothalonil shows good activity against cherry leaf spot, peach leaf curl, brown rot blossom blight, and black knot. However, some of the generic products are not labeled for all of these diseases. Users should pay strict attention to the timing of applications because improper use of this material (after shuck split on some crops) may result in phytotoxicity and unacceptable residue levels. Chlorothalonil is a broad-spectrum fungicide that is not at risk for development of fungicide-resistance in pathogens that it controls.

Cyprodinil (Vangard) is an anilinopyrimidine or AP fungicide registered for the control of apple scab and blossom blight on stone fruits (except for sweet cherries). Because it works best at lower temperatures and does not control fruit scab, Vangard is not recommended for use beyond tight cluster. Vangard can provide 48 to 72 hr of postinfection activity against apple scab on leaves. In efficacy trials conducted in Cornell orchards, Vangard was rarely more effective against scab than mancozeb fungicides except in situations where post-infection activity played a role. However, activity may be reduced in orchards with apple scab that is resistant to the SI fungicide group.

Difenoconazole + Cyprodinil (Inspire Super) is labeled for use on for diseases of apples and pear, and has provided outstanding control of apple scab, powdery mildew, and flyspeck and sooty blotch in research trials. Given the efficacy considerations mentioned above for Cyprodinil, it is important to note that a considerable portion of this fungicide premix's efficacy likely results from the difenoconazole component. No more than 60 fl oz./A of Inspire Super can be applied to pome fruit in a single season and no more than two consecutive applications can be made before rotating to a non-frac group 3 or 9 chemistry. There is a 14 day PHI for pome fruit and a 2 day PHI for stone fruit.

Note: Inspire Super is able to control SI resistant apple scab in varieties that have reduced susceptibility to apple scab (e.g. develop less scab than 'McIntosh') in seasons with low disease pressure. However, this material should not be used specifically to manage SI resistant apple scab.

Difenoconazole +Fludioxonil (Academy) is a non-systemic fungicide registered for postharvest uses on pome fruits. Academy is one of two prodcuts containing fungicides in the phenylypyrrole class of chemistry and it therefore is effective against fungi that have developed resistance to benzimidazole and other fungicide groups. Academy applied after harvest is effective against, *Botrytis cinerea*, *Botryosphaeria dothidea* (White rot), *Rhizopus stolonifer*, *Bull's-eye rot (Neofabraea malacorticis; N. alba; N. perrenans; N. nova),* and *Penicillium expansum* (blue mold). Academy can be applied as a dip or drench, as line spray, or mixed in fruit waxes. For fruit destined for export, check with importers to be certain that the importing country has an established tolerance (MRL) for fludioxonil before treating fruit.

Dodine (Syllit) is formulated and sold as a flowable containing 3.4 lb dodine per gallon. In apples, dodine should be applied at no more than 1.5 pt/A and should be combined with either captan (1.5-2 lbs a.i./acre) or a mancozeb fungicide (2.25 lbs a.i./acre). Syllit can provide excellent pre-symptom and antisporulant activity against dodine-sensitive strains of apple scab. However, regular use of dodine for post-infection suppression of scab will generate selection pressure for dodine-resistant scab populations and therefore is not recommended. Dodine provides excellent control of cherry leaf spot on both sweet and sour cherry, although dodine-resistant cherry leaf spot has been reported in Michigan. Dodine is not effective against brown rot on cherries or against mildew and rust diseases on apples. Dodine should be applied no more than two times per season and prior to bloom.

Warning: Incompatibility problems have been reported for tank mixes consisting of Syllit and copper.

Fenbuconazole (Indar) is a sterol inhibitor fungicide labeled for use on stone fruits and apples. Indar has provided outstanding control of brown rot in university trials and commercial orchards, with good residual activity following the last application. Follow label directions for including a spray adjuvant when using Indar. Indar is also labeled for control of cherry leaf spot and peach scab, and provides moderate control of powdery mildew on sour cherries. For stone fruit, the PHI is up to the day of harvest and a 12-hour restricted-entry interval for worker protection. Indar has most recently been approved for use on apples. It has demonstrated outstanding control on apple scab, and is also labeled for control of powdery mildew, rusts, and flyspeck and sooty blotch. For apple, there is a 14 day PHI.

Warning: Indar may fail to control disease where the pathogen populations have become resistant to SI fungicides.

Fenhexamid (Elevate) is labeled for control of brown rot blossom blight and fruit rot on all stone fruits. University trials in other states have shown that Elevate provides good control of blossom blight but is less

6 Disease Management

6.1 Apple Scab Fungicides

Apple scab fungicides can control disease through four different types of activity: protection, post-infection activity, presymptom activity, and postsymptom activity. Understanding these activities and knowing which fungicides exhibit them can help a grower determine the materials that are likely to give the best results under a certain set of conditions.

Protection. Protection refers to the ability of fungicide residues to kill or inactivate scab spores (and thereby prevent infection) when the residue is already on or in the leaf or fruit before the infection takes place. A good protective fungicide must exhibit satisfactory retention, that is, the fungicide residue must stick to the leaf surface or be retained within to resist excessive washing away of the deposits by rain. On the other hand, a good protective fungicide should also have good redistribution properties, that is, fungicide residues should have a tendency to be washed by rain and redeposited on previously unprotected tissue. Ideally, a fungicide should stick well enough not to be washed off the tree, but should be redistributed well enough during rains to protect new growth.

Post-infection activity. Post-infection activity refers to the ability of a fungicide to kill or stop the growth of the fungus and thereby prevent the establishment of scab lesions, if applied within a given period after the start of a wetting period. It is expressed as the period of time from the beginning of a wetting period within which the fungicide must be applied to stop infection. The data given in Table 6.1.3 are accurate at average temperatures of 50-60°F. At lower temperatures, the periods of after-infection activity for contact fungicides are longer than those listed.

Presymptom activity. Presymptom activity can be thought of as an extension of post-infection activity. When applied following an infection period, but beyond the time limits of its post-infection activity listed in Table 6.1.3, a fungicide with significant presymptom activity will allow small chlorotic lesions to develop; however, it will inhibit or greatly reduce the production of secondary spores from those lesions. Thus, if applied too late to completely stop infection, it will still greatly reduce the amount of inoculum available for secondary spread.

Postsymptom activity. Postsymptom activity refers to the ability of a fungicide, when applied to an actively sporulating scab lesion, to prevent or greatly inhibit the further production of secondary scab spores from that lesion. Because such applications do not kill the fungus, but merely arrest its development, they must be repeated to maintain this suppression. As with presymptom activity, this has the obvious benefit of reducing the pressure for the spread of secondary scab.

Table 6.1.1. Activity spectrum of apple fungicides.

			Ratings for the Control of						
Active Ingredient (Trade Name)	**Fungicide Family**	**FRAC code‡**	*Scab*	*Powdery Mildew*	*Cedar Apple Rust*	*Black/ White Rot*	*Sooty Blotch/ Fly speck*	*Bitter Rot*	*Mite Suppres-sion(a)*
§*Bacillus amyloliquefaciens* strain D747 (§Double Nickel 55/LC)	Microbial	44	—	—	—	—	2	—	—
benzovindiflupyr (*Aprovia) [h]	SDHI	7	4[i]	2	2	3	4	2	—
captan[g]	Phthalimide	M4	4	0		2	3	2[e]	3[e]
cyprodinil (Vangard)	Anilinopyrimidine	9	2(f)[i]	1		0	0	0	0
dodine (Syllit)	Guanidine	M7	4[i]	0	1	1	1	0	0
difenoconazole + cyprodinil (Inspire Super MP)[f]	DMI (SI) and Anilinopyrimidine	3	4	3	4	2	4	2	
fenarimol (Rubigan)[f]	DMI (SI)	3	4[c]	4	4	0	0	0	
ferbam (Ferbam)	Dithiocarbamate	M3	2	0	2	1	2	1	0
fenbuconazole (Indar 2F)[f]	DMI (SI)	3	4[c]	3	4	2	2	2	
fluopyram + pyrimethanil (*†Luna Tranquility)	SDHI and Anilinopyrimidine	7 & 9	4[i]	3	1	3	3	3	—
fluopyram + trifloxystrobin (*†Luna Sensation)	SDHI and Strobilurin (QoI)	7 & 11	4[i]	4	1	3	3	3	—
flutriafol (†Rhyme)	DMI (SI)	3	4[c]	4	4	2	2	2	—
fluxapyroxad (*†Tesaris)	SDHI	7	4[i]	3	2	3	4	3	—
fluxapyroxad + pyraclostrobin (*†Merivon)	Strobilurin (QoI) and SDHI	11 & 7	4[i]	3	2	3	4	3	—

7 Insect and Mite Management

Table 7.1.1. Activity spectrum of pome fruit insecticides and acaricides.

		Ratings for the Control of														
Trade Name (Active Ingredient)	**IRAC‡**	**AM**	**Aph**	**EAS**	**Int**	**GFW**	**LH**	**OBLR**	**PC**	**PPs**	**RAA**	**RBLR**	**SJS**	**STLM**	**TPB**	**WAA**
*†Actara (thiamethoxam)	4A	1	3	3	1	—	3	0	3	3	3	0	0	2	2	—
*Admire Pro (imidacloprid)	4A	—	3	—	—	—	3	—	—	2	3	—	2	3	—	2
*†Agri-Flex (abamectin/ thiamethoxam	6/4A	1	3	3	1	—	3	0	3	3	3	0	0	3	1	—
*Agri-Mek (abamectin)	6	—	—	—	—	—	3	—	—	3	—	—	—	3	—	—
*†Altacor (chlorantraniliprole)	28	2	1	3	3	3	—	3	2	—	—	3	2	—	1	—
*Pounce (permethrin)	3A	3	2	2	—	3	3	2-3	2	2	2	3	1	3	3	—
*Asana XL (esfenvalerate)	3A	3	2	2	2-3	3	3	2-3	2	2	2	3	1	3	3	—
*Assail (acetamiprid)	4A	3	3	2	3	—	3	0	2	2	3	0	2	3	2	2
Avaunt (indoxacarb)	22	2	1	2	2	—	3	0	3	—	0	—	0	2	2	—
Aza-Direct, Neemix	18B	—	2	1	2	—	2	—	0	—	2	—	—	3	—	—
§B.t, (§Agree, §Biobit, Deliver, §Dipel, §Javelin)	11A	0	0	—	2	3	0	3	0	0	0	3	—	0	0	—
*Baythroid (cyfluthrin)	3A	3	2	2	2-3	3	3	2-3	2	—	—	3	—	3	3	—
Beleaf (flonicamid)	9C	—	3	—	—	—	—	—	—	—	—	—	—	—	3	2
*†Besiege (chlorantraniliprole/lambda-cyhalothrin)	3A/28	3	2	3	3	3	3	3	3	2	2	3	2	3	3	—
*†Centaur (buprofezin)	16	—	—	—	—	—	2	—	—	3	—	—	3	—	—	—
*Danitol (fenpropathrin)	3A	3	2	2	2-3	3	3	2-3	2	2	2	3	1	3	3	—
Delegate (spinetoram)	5	2	0	—	3	3	—	3	2	3	—	3	—	3	—	—
*diazinon	1B	3	1	—	2	2	1	0	2	0	3	0	2	1	1	3
*†Endigo (thiamethoxam/ lambda-cyhalothrin)	3A/4A	3	2	2	2-3	3	3	2-3	2	2	2	3	2	3	3	—
§Entrust (spinosad)	5	2	0	—	2	3	0	3	0	–	0	3	—	2	0	—
Esteem (pyriproxyfen)	7C	0	0	—	2	0	0	0	0	3	3	0	3	2	0	—
*†Exirel (cyantraniliprole)	28	2	1	3	3	3	3	3	3	3	3	3	0	3	0	0
Grandevo WDG (*Chromobacterium subtsugae*)	—	—	—	—	2	—	—	2	—	—	—	—	—	—	—	—
*Imidan (phosmet)	1B	3	1	3	3	1	1	1	3	0	1	3	2	1	1	—
*†Intrepid (methoxyfen-ozide)	18A	0	0	—	2	—	0	3	0	—	0	3	0	2	0	—
*Lannate (methomyl)	1A	2	2	1	3	3	3	2-3	2	0	1	3	2	3	1	—
*Leverage (cyfluthrin/ imidacloprid)	3A/4A	3	3	2	3	3	3	2-3	3	2	3	3	2	3	3	—
M-Pede, Des-X (insecticidal soap)	—	0	2-3	0	0	0	1	0	0	2	1	0	1	0	0	—
Magister (fenazaquin)	21	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—
Malathion	1B	2	2	2	2	1	1	1	2	0	1	2	—	1	1	—
*†Minecto Pro (cyantraniliprole/abamectin)	28/6	2	0	0	3	3	3	3	3	3	3	3	0	3	0	0
Movento (spirotetramat)	23	—	3	—	—	—	—	—	—	3	—	—	3	—	—	3
*Mustang Maxx (zeta-cypermethrin	3A	3	2	2	2-3	3	3	2-3	2	2	2	3	—	3	3	—

Table continued on next page.

Table 7.1.4. Degree-day accumulations (from Jan. 1) corresponding to selected fruit phenology and arthropod pest events.

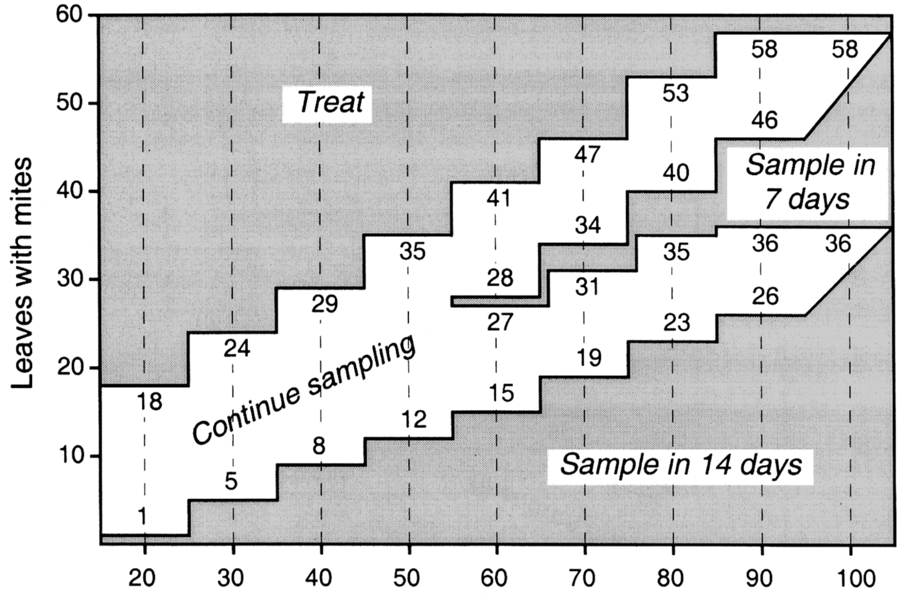
Pest/Phenology Event	DD Base 43˚F mean	DD Base 43˚F std dev	DD Base 50˚F mean	DD Base 50˚F std dev	Approx. Date mean	Approx. Date std dev
San Jose scale – 1st crawlers observed	1124	91	688	69	19-Jun	8 days
Dogwood borer – 1st adult catch	964	230	571	151	12-Jun	9 days
American plum borer – 1st flight ending	1344	144	856	111	29-Jun	7 days
Apple Maggot Traps Set Out (in orchard)			1-Jul			
ERM Sample – 5.0 mites/leaf			1-Jul			
Comstock mealybug tape traps set out			1 Jul (ENY), 15 (WNY)			
OFM – 2nd flight starting	1180*	136*	856	106	29-Jun	5 days
OBLR Summer Gen. 1st Sample					10-Jul	5 days
STLM Summer Gen. 1st Sample					9-Jul	7 days
RBLR – 2nd flight starting	1367	105	866	135	29-Jun	6 days
AM – 1st catch	1509	285	973	206	4-Jul	12 days
Lesser peachtree borer – peak catch	1234	470	785	338	25-Jun	19 days
STLM – 2nd flight peak	1563	207	1011	163	6-Jul	8 days
Codling moth – 1st flight ending	1557	262	1011	187	6-Jul	12 days
Peachtree borer – peak catch	1579	465	1036	353	7-Jul	19 days
Lesser appleworm – 2nd flight starting	1768	339	1165	240	14-Jul	12 days
OFM – 2nd flight peak	1450*	147*	1115	190	11-Jul	9 days
American plum borer – 2nd flight starting	1850	290	1231	203	16-Jul	11 days
RBLR – 2nd flight peak	1721	232	1129	176	13-Jul	7 days
San Jose scale – 2nd flight starting	1804	170	1199	136	15-Jul	8 days
Codling moth – 2nd flight starting	1887	313	1251	223	20-Jul	13 days
Dogwood borer – peak catch	1611	226	1040	172	8-Jul	10 days
STLM – 2nd flight ending	2167	177	1466	151	28 Jul	8 days
American plum borer – 2nd flight peak	2290	285	1564	213	1-Aug	8 days
OFM – 2nd flight ending	2044*	233*	1545	195	31-Jul	7 days
ERM Sample – 7.5 mites/leaf			1-Aug			
Cherry fruit fly traps in			1-Aug			
San Jose scale – 2nd flight peak	2312	174	1591	147	3-Aug	9 days
Apple maggot – peak flight	2394	247	1634	191	6-Aug	10 days
Codling moth – 2nd flight peak	2327	349	1585	265	6-Aug	13 days
RBLR – 2nd flight ending	2419	273	1651	206	7-Aug	10 days
STLM – 3rd flight starting	2420	196	1653	162	6-Aug	7 days
Comstock mealybug – 2nd gen. crawlers emerging	2429	195	1643	138	8-Aug	12 days
OBLR –2nd flight starting	2413	201	1646	160	7-Aug	9 days
OFM – 3rd flight starting	2275*	290*	1720	208	9-Aug	9 days
Lesser appleworm – 2nd flight peak	2607	463	1781	348	15-Aug	23 days
RBLR – 3rd flight starting	2715	214	1868	163	19-Aug	10 days
STLM – 3rd flight peak	2755	222	1899	174	19-Aug	9 days
OFM – 3rd flight peak	2625*	137*	2019	197	27-Aug	12 days
All Traps In			30-Aug			

*** = DD Base 45˚F**

Abbreviations: ENY = Eastern New York; ERM = European red mite; OBLR = Obliquebanded leafroller; OFM = Oriental fruit moth; RBLR = Redbanded leafroller; STLM = Spotted tentiform leafminer; WNY = Western New York

Note: Information in above table is based on field observations. Values and dates are given +/- one standard deviation; i.e., events should occur within the stated range approximately 7 years out of 10. This information is provided as a scouting and sampling guide.

Figure 7.1.4. Mite Sampling Chart – Threshold = 2.5 mites/leaf (June 1-30)



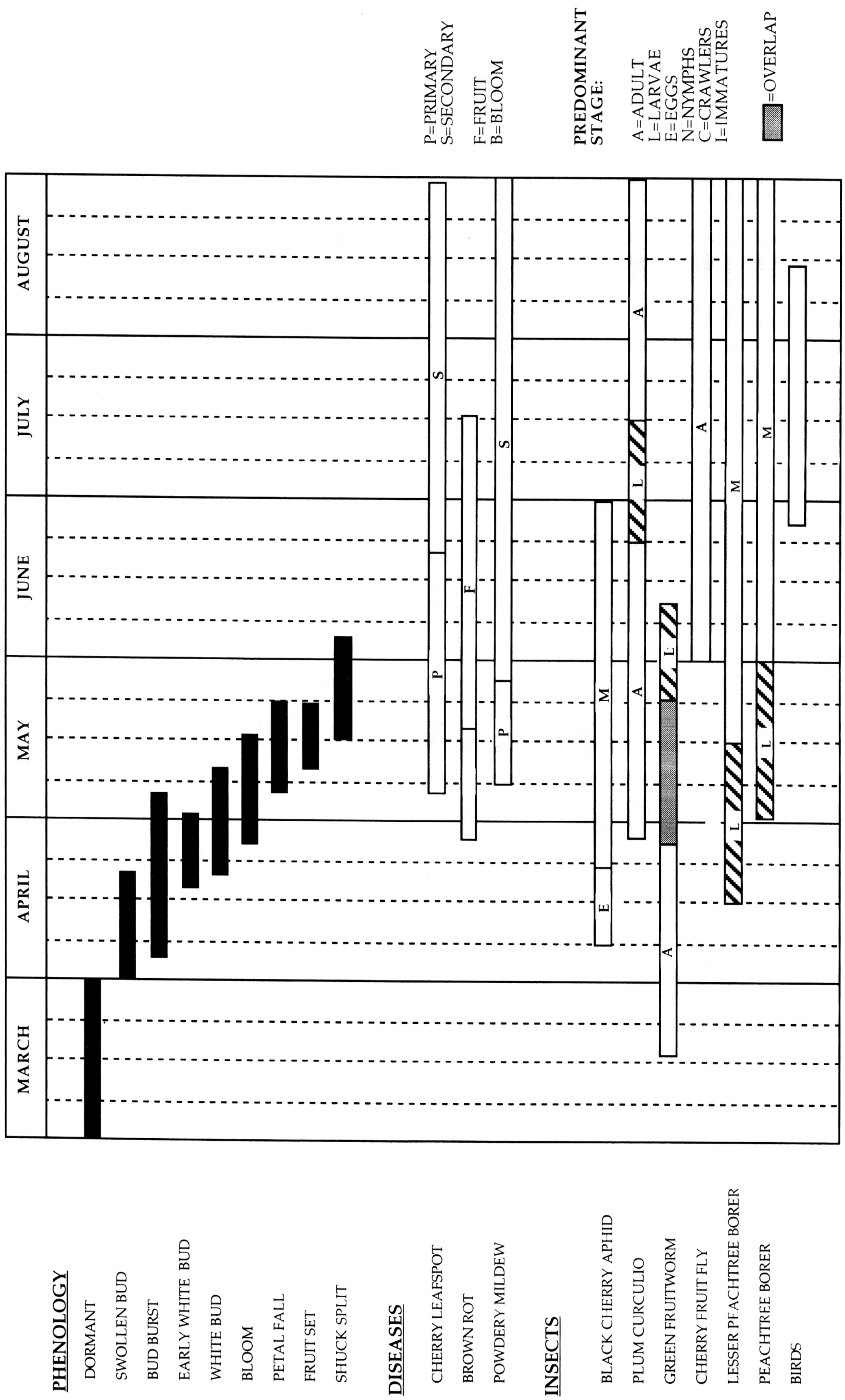
- This procedure involves examining middle aged leaves for motile mites (any stage except eggs). Use this chart, which corresponds to a mite density of 2.5 mites per leaf, from June 1 until June 30. You will not be counting mites, but will only determine whether they are present or absent on each leaf sampled.

- Starting with a random tree and sampling every other tree, collect 4 leaves in a plastic bag from each of 5 trees, choosing from each quadrant of the canopy. To make sure the leaves are of an intermediate age, pick them from the middle of the fruit cluster.

- Using a magnifier, examine the top and bottom surface of each leaf for motile mites, and keep track of the number of leaves containing motile mites. When all 20 leaves have been examined, compare this number with the numbers on the above decision guide. If the number of leaves with mites is equal to the values on the stairstep lines, the decision is the one shown in the area immediately below the value (example: For "29" after sampling 40 leaves, the decision is "Continue sampling"; for "8" the decision is to "Sample in 14 days").

- When the counts fall into any of the shaded regions, sampling is stopped and a decision is made to either treat, or else re-sample in 7 or 14 days. If the counts fall in the "Continue sampling" zone, take and examine more leaf samples in batches of 10 (5 per tree) until the counts fall into one of the shaded regions. If you reach one of the resample zones, the population is below threshold, and should remain so for at least the number of days stated. Return at the designated time and conduct another sample. If the -7 day" resample date falls during the 5.0 mites/leaf Threshold period, you can wait for a total of 14 days before resampling.

Figure 7.1.11. Cherry Events Calendar for the Lake Plains Area of New York



8 Weed Management

8.1 Calibration to Ensure Correct Herbicide Rate

Herbicide labels indicate rate of application as amount of product per acre; that is, per acre actually treated. Only if you broadcast herbicide over the entire orchard floor will the treated acreage equal the orchard acreage. Follow the instructions below to assure application of the correct herbicide rate.

8.1.1 Calculating Nozzle Flow Rate

Travel Speed:
For most situations, 2-2.5 mph is best (176-220 ft. /min.).

Pressure:
Refer to labels and nozzle manufacturer guidelines regarding optimal targets for each herbicide-nozzle combination. Using low pressure (20-35 psi) can minimize the formation of small droplets, because small droplets can drift off target.

Spray Volume per Treated Acre:
Rates will be dependent on the herbicide being applied. For example, some products may have lower recommended spray volume rates in order to concentrate the product in droplets on treated tissue while others will recommend higher volumes to improve overall spray coverage. See label regarding use recommendations.

Shields:
By adding a shield over the spray boom, thin, young bark of fruit trees may be protected when using glyphosate or other herbicides that can injure sensitive tissue. If weeds are tall when treated, and spring back into the tree banches after application under a shield, herbicides can still come into contact with leaves, stems, branches, flowers, and fruit. Post-emergence products should be applied when weeds are sufficiently small so that good coverage can be achieved with minimized potential for injury.

Nozzles:
Unless specified on the label, avoid nozzles that produce fine mist. Generally, hollow cone nozzles produce the finest droplets, flat sprays are second, and full cone nozzles produce the coarsest spray.

A single boomless off-center flat spray nozzle, or a flooding nozzle, may be suitable for some orchards, but one or more regular flat spray nozzles on a boom may be better where branches are close to the ground.

Use the following formula to determine nozzle flow rate in gal./min., then consult a nozzle manufacturer's chart to select the proper nozzle.

8.1.2 Definition of Terms

1. **Gallons per Treated Acre (G/TA)** = Amount of herbicide spray you want to apply per treated acre.
2. **Swath (S)** = Width of the sprayed area in feet.
3. **Travel Speed (TS)** = Feet traveled per minute.
4. **Nozzle flow rate** (gallons per minute) = (Gallons per Acre x Swath x Travel Speed) divided by 43,560

Nozzle Flow Rate = **(G/TA x S x TS) / 43,560**

Example:
What nozzle flow rate do you need to apply 25 gallons of herbicide spray mix per treated acre, using a 3-foot-wide swath and a travel speed of 220 feet per minute (=2.5 miles per hour)?

Nozzle flow rate
= (25 x 3 x 220) divided by 43,560
= (16,500) divided by 43,560
= 0.38 gallons per minute.

If using 2 nozzles, select 2 that will give 0.19 gallon per minute each at the selected pressure.

8.1.3 Checking Herbicide Sprayer Output

Spray Pattern:
Check uniformity of spray pattern, using corrugated fiberglass roofing panels as a spraying surface. Spray from the same height as will be used in the orchard. Compare liquid volume collected in each trough. Although relatively more expensive, water-sensitive paper can be purchased to evaluate spray patterns.

Actual Spray Volume:
With proper nozzles installed, travel a measured distance at the selected speed and pump pressure. Use this formula to determine the actual spray volume in gallons per treated acre.

Gallons per Treated Acre:
= (Gallons sprayed during trial run x 43,560) divided by (feet traveled during trial run x swath width in feet).

Example:
You emptied a tank containing exactly 3 gallons in a distance of 1,200 feet. The treated swath was 3 feet wide. How many gallons of spray are you applying per treated acre?

Gallons per Treated Acre
= (3 x 43,560) divided by (1,200 x 3)
= (130,680) / (3,600)
= 36.3 gallons

translocated to the leaves where it interferes with photosynthesis. It must be applied and moved into the soil before weeds germinate to be most effective; therefore, late fall or very early spring applications are labeled in STONE FRUIT. Note that APPLES and PEARS have a 150 day PHI. Activity is reduced in soils of low pH. Rates of simazine application and crop tolerance depend on soil texture and organic-matter content as well as crop and tree age. Registered for use in APPLE, PEAR, TART CHERRY, SWEET CHERRY, PEACH, and PLUM established 1 year. The product is prone to leaching.

Terbacil is formulated as an 80% water dispersable granule under the name *Sinbar. It is effective in controlling most annual grasses and broadleaf weeds and in providing partial control or suppression of such perennials as quackgrass, horsenettle, and nutsedge. Terbacil is absorbed by plant roots and is translocated to the leaves where it interferes with photosynthesis. Residual activity of terbacil in the soil is relatively long-lived. This material is frequently used in tank-mix combinations with diuron or simazine. Application rates and crop tolerance depend on soil texture and organic-matter content as well as crop and tree age. Use is limited to APPLES and PEACHES established 3 years. Terbacil is also registered for newly-planted fruit trees after the soil has settled and young and non-bearing apple, peach, plum, apricot and cherry trees at very low rates.

Table 8.4.1. Minimum time between planting and herbicide use.

None = no time limit noted on label NB = Nonbearing trees only — = not labeled for use on crop.

Sample Trade Names (*active ingredient*)	**Apple**	**Pear**	**Apricot**	**Tart Cherry**	**Sweet Cherry**	**Nectarine**	**Peach**	**Plum**	**Prune**
Aim EC (*carfentrazone-ethyl*)	None[4]	None[4]	None[4]	None[4]	None[4]	None[4]	None[4]	None[4]	None[4]
*†Alion (*indaziflam*)	3 yrs	3 yrs	3 yrs	3 yrs	3 yrs	3 yrs	3 yrs	3 yrs	3 yrs
Casoron 4G (*dichlobonil*)	4 wk	4 wk	—	4 wk	4wk	—	—	—	—
Casoron CS (*dichlobonil*)	1 year	1 year	—	1 year	1 year	—	—	—	—
Chateau SW (*flumioxazin*)	1 yr[3]	1 yr[3]	1 yr[3]	1 yr[3]	1 yr[3]	1 yr[3]	1 yr[3]	1 yr[3]	1 yr[3]
†Fusilade DX (*fluazifop*)	NB	NB	None	None	None	None	None	None	None
Goal 2XL, Galigan 2E, Goaltender (*oxyfluorfen*)	None	None	None	None	None	None	None	None	None
*Gramoxone (*paraquat*)	None	None	None	None	None	None	None	None	None
Karmex 80DF, Diuron 4L (*diuron*)	1 yr	1 yr	—	—	—	—	3 yr	—	—
*Kerb 50-W, Kerb SC[1] (*pronamide*)	1/2-1 yr	1/2-1 yr	1/2-1 yr	1/2-1 yr	1/2-1 yr	1/2-1 yr	1/2-1 yr	1/2-1 yr	1/2-1 yr
Matrix 25 DF (*rimsulfuron*)	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr
Poast (*sethoxydim*)	None	None	None	None	None	None	None	NB	NB
*†Princep 4L, *Simazine 4L, *Simazine 90DF, *†Caliber 90 (*simazine*)	1 yr	1 yr	—	1 yr	1 yr	—	1 yr	1 yr	—
Prowl 3.3EC (*pendimethalin*)	NB	NB	NB	NB	NB	NB	NB	NB	NB
Prowl H_2O (*pendimethalin*)	None	None	None	None	None	None	None	None	None
†Rely280, †Cheetah (*glufosinate-ammonium*)	None[4]	None[4]	None[4]	None[4]	None[4]	None[4]	None[4]	None[4]	None[4]
Roundup (*glyphosate*)	None	None	None	None	None	None	None	None	None
Sandea (*halosulforon-methyl)*	1 yr	1 yr	—	—	—	—	—	—	—
*Sinbar 80WP[2] (*terbacil*)	3 yr/NB		NB	NB	NB	NB	3yr/NB	NB	NB
*†Solicam DF (*norflurazon*)	None	1 yr	1 yr	18 mo	18 mo	6 mo	6 mo	1 yr	1 yr
*†Stinger (*clopyralid*)	1 yr	—	None	None	None	None	None	None	None
Surflan AS (*oryzalin*)	None	None	None	None	None	None	None	None	None
*†TreeVix (*saflufenacil*)	1 yr	1 yr	—	—	—	—	—	—	—
*Unison (*2,4-D*)	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr
Venue	None[4]	None[4]	None[4]	None[4]	None[4]	None[4]	None[4]	None[4]	None[4]

Table 8.4.3. Weed control guidelines for tree fruit.

Refer to back of book for key to abbreviations and footnotes.

Crop: Apples	Crop: Pears	Crop: Cherries	Crop: Peaches	Crop: Apricots	Crop: Plum/Prune	Tree Age: Planting Year	Tree Age: 1 year plus	Tree Age: 2 years plus	Tree Age: 3 years plus	**PRODUCT NAME** (*active ingredient, weight of active per unit of herbicide*) *Notes:*
										MATRIX 25DF *(continued)* *Comments:* Can be applied once a year as a single application or two times if a banded application of 50% is used (do not exceed 4 oz/A/year). Rainfall or irrigation is necessary for activation. Best results observed is soil is moist at application. Has post-emergence activity on small weeds (< 1" tall). Avoid direct ontact with sensitive tissues. Spray solution pH should be between 4-8.
X	X	X	X	X	X	X	X	X		**POAST** (*sethoxydim,1.5 lb/gal*) *Weeds Controlled:* annual grasses *Rate (per acre):* 1.0-2.5 pt *AI per acre (lbs/acre):* 0.28-0.47 *Days to harvest:* Apples and pears: 14; apricots, cherries, and peaches: 25; plums/prune: 1 year (non-bearing application) *REI (hours):* 12 *Comments:* Apply to actively growing grass before tillering or seedhead formation. Do not apply to stressed plants. See label about use of crop oil concentrates. See additional notes on label about applications in peaches, plums and nectarines.
X	X	X	X		X		X	X	X	*†**PRINCEP 4L** (*simazine, 4 lb/gal*) and other generics *Weeds Controlled:* annual grasses and broadleaves *Rate (per acre):* 1-2 qt *AI per acre (lbs/acre):* 1.0-2.0 *Days to harvest:* Apples: 150; pears, tart cherries: not listed; peaches, plums, sweet cherries: applied late fall to early spring *REI (hours):* 12 *Comments:* Apply early spring before weeds emerge. See soil-texture rate limitations on label. Trees must be established at least 1 year. Avoid contact with sensitive crop tissues.
X	X	X	X	X	X	X	X	X		**PROWL 3.3 EC** (*pendimethalin, 3.3 lb/gal*) *Weeds Controlled:* annual grasses and broadleaf weeds *Rates (per acre):* 2.4-4.8 qts. *AI per acre (lbs/acre):* 2-4 *Days to harvest:* Non-bearing use only. *REI (hours):* 24 *Comments:* Prowl 3.3 EC use limited to NONBEARING TREES ONLY. Do not apply until soil settles around newly transplanted trees. . Do not apply if buds have started to swell.
X	X	X	X	X	X	X	X	X		**PROWL H2O** (*pendimethalin, 3.8 lb/gal*) *Weeds Controlled:* annual grasses and broadleaf weeds *Rate (per acre):* 2-4 qts. *AI per acre (lbs/acre):* 1.9-3.8 *Days to harvest:* 60 (for all tree fruit) *REI (hours):* 24 *Comments:* Prowl H2O can be used in non-bearing and bearing trees. No more than 4.2 qts/acre/year of Prowl H2O may be applied. Rate is dependent of soil and weed species present. Do not allow contact with roots or other sensitive tissue.

9 Wildlife Damage Management

9.1 Deer and Rabbits

Several commercial repellents are available to reduce deer or rabbit browsing to orchards (Table 9.1.1). The effectiveness of repellents is extremely variable and is affected by factors such as deer or rabbit numbers, feeding habits, and environmental conditions, such as snow depth and duration. Repellents may be cost-effective for controlling wildlife damage when:
(1) light to moderate damage is evident,
(2) small acreages are damaged, and
(3) few applications will be needed for adequate control.

If these three conditions are not satisfied, it is best to look at the cost-benefit ratios for fencing and/or state permits for removing deer. The NYS Department of Environmental Conservation has a Deer Management Assistance Program (DMAP) to help growers reduce deer numbers and damage on their farms.

With the use of repellents some damage must be tolerated, even if browsing pressure is low. None of the existing repellents provides reliable protection for more than 5 weeks when deer or rabbit densities are high. If browsing pressure is severe, a long-term damage management program should be implemented, including potential habitat modifications, reductions in animal numbers, and an evaluation of fencing alternatives.

A landowner can use a variety of non-chemical alternatives to reduce wildlife damage to fruit trees. These techniques fall into three primary categories: exclusion, habitat modification, and wildlife population reductions. Fencing is the most common exclusion technique used to prevent damage to crops. Helpful information concerning wildlife management can be found online at wildlifecontrol.info.

Habitat modifications can reduce damage levels by making areas less suitable for problem wildlife species. Damage prevention with cultural manipulations should begin with site selection and plant establishment. Removal of brush, stone piles, and non-mowable wet areas in and near orchards, will reduce the attractiveness of sites to rodents and rabbits. Mowing in established plantings can reduce preferred foods of wildlife, remove protective cover, enhance predation, and expose animals to severe weather conditions. Sites adjacent to croplands should also be managed to reduce pest numbers, as nuisance wildlife may reinvade orchards from these habitats.

Wildlife population reductions may be necessary to reduce damage to tolerable levels. When trapping, care and experience are necessary to reduce captures of non-target species. Live-traps should be substituted for body-gripping or other kill traps in areas where pets or endangered wildlife may inadvertently be captured. In rural locations, shooting can be used to effectively remove problem animals. When practical, reductions in populations of game species (i.e., deer, rabbits, squirrels, etc.) should occur during open hunting seasons. The New York State Department of Environmental Conservation (DEC) offers permits through the Deer Management Assistance Program (DMAP) to help reduce deer abundance and impacts on agricultural and forested lands.

A license or special permit may be required from the New York State Department of Environmental Conservation (DEC) for lethal control or transport of wildlife species. Contact the nearest regional DEC office for more information concerning specific situations. If migratory birds are involved, federal permits may also be necessary from the USDA, Animal & Plant Health Inspection Service (APHIS), Wildlife Services Office in Albany (contact the State Director, at 518-477-4837).

Wildlife population reduction by lethal methods often fails to provide long-term relief from damage. Where habitat conditions are suitable, and exclusion is not attempted, most pests will repopulate the site soon after lethal control efforts have ceased. Habitat modification and exclusion methods usually require more initial effort and expense, but these techniques may provide longer-term damage prevention, especially when a few pest individuals can inflict substantial losses.

9.2 Meadow and Pine Voles

Two species of voles cause damage in New York orchards. Meadow voles are found throughout the state and probably inhabit every sod orchard. Pine voles are a problem in several orchards in the Hudson River Valley, especially in a 5-county area (Dutchess, Orange, Putnam, Ulster, and Westchester). Several orchards in these counties have both species present, and may experience considerable damage to trees during severe weather, or when other food sources become unavailable.

The contrasting living habits of meadow and pine voles have important implications for their detection and control. Meadow voles live primarily above the ground surface in dense sod or vegetation. Pine voles live primarily below ground and damage the root systems of trees. When feasible, hand placement of baits in tunnels or under roofing shingles, slabs of wood, or similar protected bait stations, is the preferred method for baiting pine voles. The optimum times to apply baits are in the early spring after snow melt, and after the fall harvest.

For orchards with persistent meadow vole problems, an annual post-harvest baiting program using a zinc phosphide-treated bait is strongly recommended. Both grain-based and pelletized baits are available from commercial sources (Table 9.1.1). Do not apply baits (particularly grain-based products) to areas with bare

10 Nutrient Management of Apple Orchards

10.1 Introduction

When developing mineral nutrient management programs for tree fruits, it is important to consider the nutrient demand-supply relationship throughout the season.

10.2 Nitrogen

Early season canopy development and fruit growth require large amounts of nitrogen (N), while fruit quality development and the acquisition of adequate cold hardiness by the tree later in the season require only a minimum supply of N. Thus, an ideal seasonal pattern of tree nitrogen status should be to start the season with relatively high nitrogen status to promote rapid leaf development and early fruit growth. As the season progresses, nitrogen status should decline gradually to guarantee fruit quality development and wood maturity before the onset of winter. There are three sources of nitrogen supply tree fruits can use. First is reserve nitrogen that has accumulated in the tree from the previous growing season. This source of nitrogen is readily available for initial growth during the spring. In fact, spur leaf development and early fruit growth are mainly supported by the reserve N. The second source is the natural N supply from the soil mineralization process. This process provides substantial amounts of nitrogen for trees growing on soils with high organic matter. The third is nitrogen fertilizers applied to the soil or to the foliage. To determine the amount of fertilizer nitrogen needed, we need to know the total tree demand and the amounts the other two nitrogen sources can provide. However, there is not enough information currently available on this demand-supply relationship to make this approach practical. Instead, soil and leaf analyses have been developed over the years to help growers diagnose tree nutrient status and soil nutrient availability and make adjustments on their fertilization programs accordingly.

10.3 Soil Analysis

Soil analysis is very useful for determining lime requirement and mineral availability in the soil before orchard establishment. For existing orchards, it provides information necessary for interpreting leaf analysis results and modifying fertilization programs.

A soil nutrient analysis should be performed before planting a new orchard and every 2 to 3 years after orchard establishment. The soil sample taken should be representative of the soil type and conditions within the orchard. Generally, the area included in any one-sample collection should not exceed 10 acres. Scrape away the surface 1-inch of soil, then collect samples from the 1 to 8 inch depth, and separate samples from 8 to 16 inches. In a 10 acre orchard, a minimum of 10 to 20 subsamples is suggested. Thoroughly mix the 1-8 inch subsamples together to provide a representative sample for the topsoil, and treat the 8 to 16 inch subsamples similarly to get a representative sample for subsoil. Soil samples can be sent to Agro-One, 730 Warren Road, Ithaca, NY 14850.

10.4 Preplant Soil Preparation

New York soils are classified into 5 management groups on the basis of texture and parental materials (Table 10.4.1). Percentage of clay, buffering capacity, and potassium supply power decrease from group I to V.

10.4.1. Liming

The pH values of orchard soils should be maintained in the range of 6.0 to 6.5 throughout the soil profile to optimize plant growth and nutrient availability. For preplant soil preparation, we recommend the pH of topsoil (0-8 inch depth) be adjusted to 7.0 and that of subsoil to 6.5. Most soils in New York have pH values lower than optimum and need liming to raise the pH prior to planting a new orchard. This also ensures adequate calcium and magnesium supplies in the soil.

The amount of lime required to adjust topsoil pH to 7.0 and subsoil pH to 6.5 is determined by the current pH values of the topsoil and subsoil (determined from a soil analysis) and the buffering capacity of the soil, i.e. exchange acidity or cation exchange capacity, (CEC), of topsoil and subsoil (also determined from a soil analysis). Using these values, the lime requirement can be determined from Table 10.4.2 for topsoil and from Table 10.4.3 for subsoil. The amount of lime to be added is the sum of topsoil plus subsoil requirement. When complete soil tests are not available, Table 10.4.4 may be used to estimate lime requirement.

Table 10.4.1. Soil management groups

Soil group	Texture	Examples
I	Clayey soils, fine-textured soils.	Vergennes, Kingsbury, Hudson, Rhinebeck, Schoharie, Odessa.
II	Silty loam soils with medium to moderately fine texture.	Cazenovia, Hilton, Honeoye, Lima, Ontario, Lansing, Mohawk, Chagrin, Teel.
III	Silty loam soils with moderately coarse texture.	Barbour, Chenango, Palmyra, Tioga, Mardin, Langfor, Tunkhannock.
IV	Loamy soils, coarse- to medium-textured soils.	Bombay, Broadalbin, Copake, Empeyville, Madrid, Sodus, Worth.
V	Sandy soils, very coarse-textured soils.	Alton, Colton, Windsor, Colonie, Elmwood, Junius, Suncook

FIGURE 11.1.1
GROWTH STAGES IN APPLE

11 Apples

11.1 Insecticides and Fungicides for Apples

See Sections 11.2, 11.3, 11.4, and 11.5 for comments related to this table.

Table 11.1.1 Pesticide Spray Table – Apples.

(Refer to back of book for key to abbreviations and footnotes.)

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Silver Tip							
Apple scab	9 + 7	*†Luna Tranquility	11.2-16 fl oz/acre	72	12	High	
	M01	Badge SC	3.5-7.0 pts/acre	0	48		[8.4]
	M01	Badge X2	3.5-7.0 lb/acre	0	48		[8.4]
Blister Spot	33	Phostrol	2.5-5.0 pts/acre	0	4	High	[5.1]
Crown rot	4	Ridomil Gold SL	2 qt/acre 0.5 pt/100 gal water		48		[7.2]
	33	Aliette WDG	2.5-5 lb/acre 0.5-1 pt/100 gal water	14	24		
	33	Phostrol	2.5-5.0 pts/acre	0	4	High	
	33	Prophyt	2-4 pt/acre	0	4	High	[7.3]
European Fruit Lecanium		oil	2-3 gal/100 gal water			High	[20.2]
European Red Mite		oil	2-3 gal/100 gal water			High	[20.2]
Fire Blight		*Agri-mycin 50	8-16 oz/acre	50	12		[8.5]
		Kocide 3000 O	3.5-7.0 lb/acre 1.11-2.3 lb/100 gal water	HIG	48		
	M01	Previsto	2-4 qt/acre	See label	48		
	M01	Badge SC	3.5-7.0 pts/acre	0	48		[8.4]
	M01	Badge X2	3.5-7.0 lb/acre	0	48		[8.4]
Phytophthora Rots	33	Phostrol	2.5-5.0 pts/acre	0	4	High	[7.3]
	33	Prophyt	2-4 pt/acre	0	4	High	[7.3]
Green Tip							
Apple scab	3	*†Cevya	3.0-5.0 fl oz/acre	0	12	High	
	7	*Aprovia	5.5-7.0 fl oz/acre	30	12	High	
	7	Kenja 400SC	12.5 fl oz/acre	20	12	High	
	7	*†Tesaris	4.5 fl oz/acre	0	12	High	
	M1	Badge SC	3.5-7.0 pts/acre	0	48		[8.4]
	M1	Badge X2	3.5-7.0 lb/acre	0	48		[8.4]
	M3	Manzate ProStik	3.0-6.0 lb/acre 1.0-2.0 lb/100 gal water	BL, 77(A)	24		[1.3,2.2]
	M3	Penncozeb 75DF	3.0-6.0 lb/acre 1.0-2.0 lb/100 gal water	BL, 77(A)	24		[1.3,2.2,2.8]
	M3	Polyram 80DF	3.0-4.5 lb/acre	BL, 77(A)	24		[1.3,2.2]
	M4	Captan 50WP	8.0 lb/acre 1.0-2.0 lb/100 gal water	0	24		[2.1,2.2]
	U12	Syllit FL	1.5 pts/acre	7	48		[2.15]
	9	Scala	7.0-10.0 fl oz/acre	72	12		
	9	Vangard WG	3.0-5.0 oz/acre	0	12		
	9 + 7	*†Luna Tranquility	11.2-16 fl oz/acre	72	12	High	
	11 + 7	*†Luna Sensation	4.0 to 5.8 fl oz/acre	14	12	High	
	11 + 7	*†Merivon	4-5.5 fl oz/acre	0	12	High	

11.3.16 Japanese Beetle

• Biology & Cultural

Adults emerge from the soil between early July and mid-August to feed on numerous trees and shrubs. In apple trees, beetles devour the tissue between the veins, leaving a lace-like skeleton. Severely injured leaves turn brown and often drop. Adults are most active during the warmest parts of the day and prefer to feed on plants that are fully exposed to the sun.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[22.2] Although pheromone traps are available and can be hung in the orchard in early July to detect the beetles' presence, they are generally NOT effective at trapping out the beetles. Fruit and foliage may be protected from damage by applying protective sprays; repeated applications may be required.

11.3.17 Lesser Appleworm

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[14.1a] Control of 1st generation oriental fruit moth larvae generally coincides with the petal fall application window. Sprays against the summer generations of oriental fruit moth should be timed to start approximately at the 10% hatch point, 175-200 DD (base 45°F) after the respective first sustained adult catches of the 2nd and 3rd broods, with follow-up applications on a 10–14-day interval. Sprays against oriental fruit moth should generally also provide control of lesser appleworm. Sprays of §Madex should target the 5% hatch point of each generation, and can be applied on a 7-14-day interval.

[14.2] Better control of target species is obtained when pheromone disruption begins with the first generation of the season; regardless, products for disruption should be applied before first flight of the generation being targeted. Products directed against oriental fruit moth (§Checkmate, §Isomate, §Cidetrak products) are incidentally active against lesser appleworm. CM-OFM combination products are active against the above species as well as codling moth. The need for re-application depends on residual field life; for §Checkmate OFM-F and CM 2.0, 14-21 days, §Cidetrak products, 120 days. Insecticide sprays or double the rate of pheromones may be needed in border rows of orchards adjacent to sources of adult immigration or in other high pressure situations.

[14.3a] *†Altacor, Avaunt, *Assail, *†Cyclaniliprole and *†Verdepryn applied at petal fall will also control European apple sawfly. Avaunt and *†Verdepryn will control plum curculio. *†Verdepryn will also control codling moth and obliquebanded leafroller.

[14.3b] *†Altacor and *†Intrepid provide only suppression of codling moth; not registered for use in Nassau or Suffolk Counties.

[14.3c] Use of a non-ionic surfactant is recommended with *Assail.

[14.3i] *Rimon is limited to 1 application per season.

[14.3j] Use Sevin for codling moth and lesser appleworm; do not use within 30 days of full bloom unless fruit thinning is desired.

[14.3k] Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season.

11.3.18 Mullein Plant Bug

• Biology & Cultural

Although predaceous on aphids and mites, nymphs occasionally damage fruit by feeding on flowers or young fruitlets. Damage appears as raised corky lesions and, in severe cases, fruit deformities. Most problematic in Red and Golden Delicious, Northern Spy, Empire and Spartan varieties.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

• Monitoring & Forecasting

During bloom, tap 2 yr-old flower-bearing shoots over a black beating tray, especially in problem spots and those in proximity to areas containing mullein and evening primrose. Suggested action threshold: 10 nymphs per 40 limbs (4 on each of 10 trees). High populations can also be predicted from pheromone trap catches the preceding fall (more than 6/trap/day any time after Sept. 1).

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[23.3] Susceptible to most insecticides applied at petal fall, but much damage has usually occurred by then. *Asana applied at pink against other pests will provide incidental control.

[23.3a] *†Actara will also control spotted tentiform leafminer, rosy apple aphid and tarnished plant bug when applied at this time; *†Actara not registered for use in Nassau or Suffolk Counties. Multiple applications of *†Actara in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. of thiamethoxam containing products per acre per growing season.

[23.3c] *Assail will also control codling moth, European apple sawfly, rosy apple aphid, leafminers, and leafhoppers. Do not spray when bees are actively visiting the area.

reductions each year through chemical thinning. The use of growth regulating chemicals to thin apple trees is not an exact science and each grower must weigh and evaluate the many factors that affect chemical thinning response in deciding on a thinning program. Although the recommendations in this section are based on research and experience, growers are cautioned that their success with chemical thinning depends on many factors and they should use these recommendations only as a guide.

11.6.2 Weather Factors That Affect Thinning Response

Frost. Frost before application of thinners can greatly increase the amount of thinning obtained from chemical thinners. Frost at bloom can damage fruitlets and reduce seed set, which can result in increased natural drop and greater chemical thinning response. Frost can also damage spur leaves, resulting in greater chemical uptake and thus greater thinning response. Wherever flowers and leaves have been damaged by frost, extreme caution should be used with chemical thinners. Typically, lower rates would be used in such cases. Surfactants and oil additives should be avoided following a frost and may cause overthinning.

Sunlight Levels before Application*.* The amount of sunlight for the 3-5 days preceding application of chemical thinners has an important effect on chemical uptake and response. Intense cloudy weather before application of thinners can result in increased chemical uptake and greater thinning response, due to greater succulence of the leaves and a thin wax cuticle. In addition, intense cloudy weather results in reduced carbohydrate supply for fruit growth and reduced fruit growth rate. This results in increased natural drop.

Temperature at Time of Application. The uptake of chemical thinners is greater at higher temperatures than at lower temperatures. The optimum is between 70-80°F. Above 80°F, uptake is substantially greater than below 80°F. The time of day applications are made appears to be unimportant. Applications made in the morning or evening when it is cool have a longer drying time on the leaf, resulting in a slow but sustained uptake of chemical, while at higher temperatures during mid-day, drying times are shorter, resulting in a short but rapid uptake of chemical. Thus, the total amount of chemical taken into the plant appears to be very similar regardless of the time of day. Recent research results also indicate that similar thinning is achieved regardless of the time of day applications are made.

Weather After Application. Temperature and sunlight levels for the 5-day period after application of thinners are the predominant weather factors affecting chemical thinning response. The interaction of temperature and sunlight affect the production and demand for carbohydrates within the tree. Warmer temperatures increase carbohydrate production (photosynthesis) up to about 85F but higher temperatures reduce photosynthesis. The demand for carbohydrate to support fruit growth and shoot growth increases linearly with increasing temperature. Increasing sunlight level increases photosynthesis. The combined effects of sunlight and temperature on chemical thinning are complex but a simplification is presented in Fig. 11.6.1. A more sophisticated estimate of the effects of light intensity and temperature on thinning is given by the Cornell Carbohdyrate thinning model available on the web at www.newa.cornell.edu.

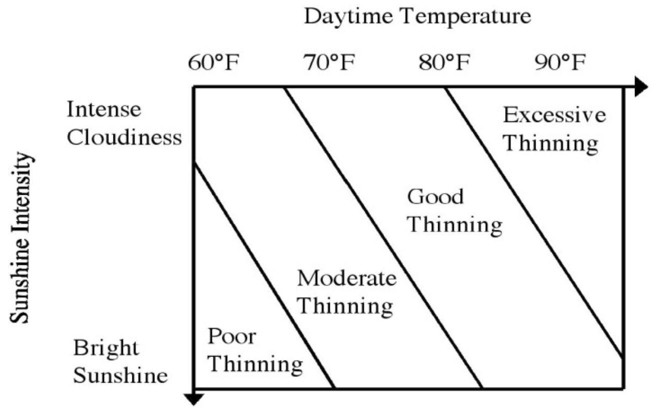


Figure 11.6.1. The interaction of temperature and sunlight intensity on thinner action.

Night temperatures are also an important factor to consider. Warm night temperatures greater than 60°F give greater thinning response. With high night temperatures, fruits use up the carbohydrates that were produced during the day at a fast rate, resulting in a deficit of resources for fruit growth and causing the weakest fruits to drop. The greatest thinning can result if warm night temperatures are combined with intense cloudy/warm daytime weather. Under these conditions, the tree produces little reserves during the day and at night the fruits use up all of the reserves produced during the day, making the fruits very susceptible to the stress caused by chemical thinners. Under these conditions, excessive fruit drop can result. The least effective thinning is achieved when bright, warm daytime weather is accompanied by low night temperatures. Under these conditions, the tree produces large amounts of carbohydrates during the day and the fruits use them up at a slow rate during the night. With a large surplus of carbohydrates there is little stress created by chemical thinners and the thinning response is poor. At the time of application of thinnes, growers should critically examine the weather forecast for the upcoming 5-day period and adjust rates up or down 50% based on forecasted temperatures and sunlight levels. The Cornell Apple Carbohydrate Thinning Model available on the web at www.newa.cornell.edu is an easy to use tool that calculates the combined effects of forecasted temperature and sunlight for the upcoming 5 day period on tree carbohydrate balance and recommends an adjustement in thinning rates based on the carbohydrate balance.

Table 11.6.2. Recommendations for thinning specific apple varieties in New York.

The chemicals and rates suggested in this table are the "best suggestion" of the authors for mature trees with a heavy fruit set and "normal" fruit thinning weather. Our rates should be adjusted up or down by 50% depending on weather conditions, pollination, fruit set and tree sensitivity. Other chemicals, rates, timings and combinations may also work.

	APPLICATION TIMING			
	30-80% Full Bloom	**Petal Fall 5-6mm (1 week after bloom)**	**10-14 mm fruit size (2-3 weeks after bloom)**	**Return Bloom Enhancer (4-7 weeks after bloom)**
VARIETY	*Rates are per 100 gallons based on a full dilute TRV application**			
Rome Beauty (Spur)		2 oz NAA plus 1 pt Carbaryl	3 oz NAA plus 1 pt Carbaryl **OR** 64 oz 6-BA plus 1 pt Carbaryl	
Spartan and Acey Mac		3 oz NAA plus 1 pt Carbaryl	64 oz 6-BA plus 1 pt Carbaryl **OR** 3 oz NAA plus 1 pt Carbaryl	
Stayman		1 pt Carbaryl	2 oz NAA plus 1 pt Carbaryl	
MN1914 (Sweetango) (with ProVide)		1 pt Carbaryl	2 oz NAA plus 1 pt Carbaryl	
Tydeman		1 pt Carbaryl	2 oz NAA plus 1 pt Carbaryl	
Vista Bella		1 pt Carbaryl	2 oz NAA plus 1 pt Carbaryl	
Wealthy		1 pt Carbaryl	3 oz NAA plus 1 pt Carbaryl	
Yellow Newtown		1 pt Carbaryl	3 oz NAA plus 1 pt Carbaryl	
Yellow Transparent		5.5 oz AmideThin plus 1 pt Carbaryl		

* All rates are amounts per 100 gal assuming a full dilute tree row volume (TRV) spray. Rate per acre = amount/hundred gallons X hundreds of gallons per acre TRV dilute. Tree Row Volume dilute gallonage (TRV)= (Tree Height X Tree Width X 43560 X 0.7) / (Between Row Spacing X1000). The rate per acre may safely be concentrated 3X.

** NAA is sold either as the traditional powder (Fruitone-N), the liquid (Fruitone-L) or the new Pomaxa. The recommended rates are the same in either fluid ounces or lb ounces.

***6-BA is sold in 3 formulations. Maxcel and Riteway have similar percentage AI concentration but Exilis 9.5SC is 5 times as concentrated. The recommended ounces in the table above are for Maxcel or Riteway. If using Exilis 9.5 divide the recommended ounces by 5 to get the correct ounces of Exilis 9.5SC

Table 11.6.3. Conversion of ppm Maxcel or RiteWay BA thinners to fluid ounces for various TRV gallonages.

Dilute Gallonage per Acre	**PPM Maxcel**					
	25	**50**	**75**	**100**	**125**	**150**
	Fluid ounces per acre*					
50	8	16	24	32	40	48
100	16	32	48	64	80	96
150	24	48	72	96	120	144
200	32	64	96	128	160	192
250	40	80	120	160	200	240
300	48	96	144	192	240	288
350	56	112	168	224	280	
400	64	128	192	256		

*To convert fluid ounces to milliliters, multiply fluid ounces by 29.57.

15.3.14 Western Flower Thrips

• Biology & Cultural

Drought conditions and high temperatures may encourage damaging populations in nectarines, particularly in the Hudson Valley region. Adults move from alternate weed or crop hosts to fruit just prior to and during harvest, feed on the fruit surface in protected sites, such as in the stem end, the suture, under leaves and branches, and between fruit. Feeding results in silver stipling or patches; injury is particularly obvious on highly colored varieties.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for those situations when the pest complex to be treated is appropriately matched to the combination of active ingredients and modes of action contained in the product.

[8.2a] *†Altacor/chlorantraniliprole not registered for use in Nassau or Suffolk Counties.

[8.2b] Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season.

[10.1a] Not registered for use in Nassau or Suffolk Counties.

[15.1] In orchards with severe infestations, a petal fall application may be warranted against thrips feeding in fruit clusters. Control may be improved by addition of an adjuvant.

[15.2] An application immediately after harvest may prevent subsequent losses; however, an additional application may be needed if pressure is severe.

[15.2a] Control with §Entrust or Delegate may be improved by addition of an adjuvant. Note 14-day pre-harvest interval.

15.3.15 White "Peach" (Prunicola) Scale

• Biology & Cultural

Infestations are characterized by numerous white scales that cluster on the trunk and scaffolds, giving them a whitewashed appearance. Feeding reduces tree vigor, and foliage of affected trees may become sparse and yellow; heavy infestations can cause death of twigs, branches and entire trees if left unattended. This species overwinters as an adult female and deposits eggs in the spring.

• Pesticide Application Notes

[17.1] Horticultural oil is recommended as a delayed dormant spray in April.

[17.1a] Apply Esteem at delayed dormant or against crawlers in mid-June through early July (about 700–1150 DD base 50°F from March 1).This is a 2(ee) recommendation; user must have a copy of the recommendation in their possession at the time of use.

[17.1b] Apply *†Centaur against crawlers in mid-June through early July (about 700–1150 DD base 50°F from March 1).

[17.1c] Apply Senstar against crawlers in mid-June through early July (about 700-1150 DD base 50F from March 1).

15.4 Storage Rot Notes

• Pesticide Application Notes

[16.1] A postharvest treatment with Scholar SC via dipping, flooders, T-jet, or similar system for control of storage rots is recommended for fruit coming from orchards where sporulating brown rot was observed, or when one hopes to keep fruit in cold storage for a few days prior to sale. Holding tanks in postharvest treatment equipment must have excellent agitation to keep fungicides in suspension. Solutions must be replenished regularly as directed on the product label. Never expose treated fruit to direct sunlight. This will cause the fungicide to break down.

15.5 Growth Regulation of Apricots

Table 15.5.1. Plant Growth Regulator Use in Apricots.

Refer to back of book for key to abbreviations and footnotes.

Timing	Product	Concentration	Rate of Formulated Product	Comments
Chemical Thinning				
30-90% Bloom	ATS (foliar nutrient)	4-6 gal/100 gal	Apply 100 gal/acre	Apply 2 sprays for best results. The first spray at 30% bloom and the second spray at 90% bloom.
Preharvest Fruit Drop Control				
1-2 weeks before anticipated harvest	ReTain	132 ppm	333 g/acre (1 pouch)	Apply in sufficient water to ensure thorough but not excessive coverage. An organosilicone surfactant (12 oz/100 gal) should be used with ReTain.

17 Appendices

17.1 Pesticide Data

Table 17.1.1 Common names, product names, formulations, and days-to-harvest for insecticides, acaricides, fungicides, and bactericides used on tree fruits.

Common Names/ Products Formulations	DAYS TO HARVEST (A)					
	Apples	*Apricots*	*Cherries*	*Peaches*	*Pears*	*Plums*
Insecticides and Acaricides						
abamectin/avermectin						
*Agri-Mek 8SC	28	21	21	21	28	21
*Abba 0.15EC	28	21	21	21	28	21
*†Agri-Flex SC	35	—	—	—	35	—
*Gladiator EC	28	21	21	21	28	21
acequinocyl						
Kanemite 15SC	14	—	—	—	14	—
acetamiprid						
Assail 30SG	7	7	7	7	7	7
afidopyropen						
*†Versys Inscalis 0.83DC	7	7	7	7	7	7
azadirachtin						
Neemix 4.5L, Aza-Direct 1.2L, §Azatin XL 0.27EC	0	0	0	0	0	0
bifenazate						
Acramite 50WS	7	3	3	3	7	3
Banter SC, WDG	7	3	3	3	7	3
bifenthrin						
*Brigade 10WS, 2 EC *Fanfare 2EC	—	—	—	—	14	—
Bt (*Bacillus thuringiensis*)						
Deliver 18WG	0	0	0	0	0	0
§Dipel 10.3 DF	0	0	0	0	0	0
§Biobit 2.IFC	0	0	0	0	0	0
Javelin 7.5WDG	0	0	0	0	0	0
§Agree 3.8 WS	UDH	—	UDH	UDH	UDH	UDH
buprofezin						
*†Centaur 0.7WDG	14	14	14	14	14	14
Burkholderia spp. strain A396						
Venerate XC	0	0	0	0	0	0
carbaryl						
Sevin 4EC	3	3	3	3	3	3
chlorantraniliprole						
*†Altacor 35WDG	5	10	10	10	5	10
*†Voliam Flexi WDG	35	14	14	14	35	14
*†Besiege CS-SC	21	14	14	14	21	14
Chromobacterium subtsugae						
Grandevo WDG	0	0	0	0	0	0
clofentezine						
Apollo 4SC	45	21	21	21	21	—
cyantraniliprole/cyazypyr						
*†Exirel	3	3	3	3	3	3
cyantraniliprole/abamectin						
*†Minecto Pro	28	21	21	21	28	21
cyclaniliprole						
*†Verdepryn 100SL	7	7	7	7	7	7
*†Cyclaniliprole 50SL	7	7	7	7	7	7
cyflumetofen						
Nealta	7	7	7	7	7	7
cyfluthrin						
*Baythroid XL 1E, 2EC, *Leverage 360	7	7	7	7	7	7

Table 17.2.1 Insecticides and acaricides

NOTE: *Always read product label to confirm required PPE.*

Product	EPA Reg. No.	Common Name	REI (hrs)	Applicator PPE	Early Entry PPE
*†Envidor 2SC	264-831 (NY SLN 140006)	spirodiclofen	12	abc	abc
Esteem 35WP	59639-115	pyriproxyfen	12	ac	bce
*†Exirel	279-9615	cyantraniliprole	12	acf	cfk
*Gladiator EC	279-3441	zeta-cypermethrin, avermectin B1	12	acf	cfk
*Imidan 70W	10163-169	phosmet	3-7 days(E)	acfjl	cfjk
Grandevo WDG	84059-27	*Chromobacterium subtsugae*	4	abchl	bchk
*†Intrepid 2F	62719-442	methoxyfenozide	4	acf	cfk
§Isomate CM/OFM Mist Plus	53575-50	pheromone			
§Isomate-CM/OFM TT	53575-30	pheromone	0	b	—
§Isomate-PTB Dual	53575-34	pheromone	0	b	—
§Isomate OFM TT	53575-29	pheromone	0	b	—
§Isomate DWB	53575-40	pheromone	0	b	—
Javelin 7.5WDG	70051-66	Bt	4	abcl	bck
§JMS Stylet-Oil	65564-1	parrafinic oil	4	acf	cfk
Kanemite 15SC	66330-38	acequinocyl	12	acf	cfk
*Lambda-CY EC	70506-121	lambda-cyhalothrin	24	acfh	acf
*Lannate SP	352-342	methomyl	48-96 (E)	acfhl	cfhk
*Lannate LV	352-384	methomyl	48-96 (E)	acfk	cfhk
*Leverage 360	264-1104	imidacloprid/beta-cyfluthrin	12	acf	cfk
§Madex HP	69553-1	insecticidal virus	4	abc	bck
Magister SC	10163-322	fenazaquin	12	acf	cfk
Malathion 57EC	34704-108	malathion	12	acfh	cfhk
*†Minecto Pro SC	100-1592	cyantraniliprole/ abamectin	12	acf	cfk
Movento	264-1050	spirotetramat	24	acf	cfk
*Mustang MAXX	279-3426	zeta-cypermethrin	12	acfh	cfhk
M-Pede	10163-324	insecticidal soap	12	ac *or* dfghij	cfk
Nealta	7969-336	cyflumetofen	12	acf	cfk
Neemix	70051-9	azadirachtin	4	acfh	cfhk
†Nexter 75WS	81880-4-10163	pyridaben	12	abchjl	bchjkl
Onager 1EC	10163-277	hexythiazox	12	acf	cfk
Portal	71711-19	fenpyroximate	12	acfh	cfhk
*Pounce 25 WP	279-3051	permethrin	12	abc	cfk
*Proclaim 5SG	100-904	emamectin benzoate	12/48(E)	acef	cfhk
§PyGanic 1.4EC	1021-1771	pyrethrins	12	acf	cfk
*Rimon 0.83EC	66222-35-400 (NY SLN 100001)	novaluron	12	acfh	cefh
Savey 50DF	10163-250	hexythiazox	12	abc	abc
§Seduce Insect Bait	67702-25-70051	spinosad	4	ac	bck
Senstar	59639-243	pyriproxifen/ spirotetramat	24	acf	cef
Sevin XLR Plus	61842-37	carbaryl	12	acfj	cfjk
*†Sivanto Prime 1.67SL	264-1141	flupyradifurone	4	acf	fgk
Spear-Lep	88847-6	biological peptide	4	abch	bchk
SPLAT OFM 30M-1	80286-1	pheromone	4	acfh	afhk
§Surround 95WP	61842-18	kaolin	4	acl	acl
*Vendex 50WP	70506-211	hexakis	48	dfghijl	cfhk

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