2025
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.

2025 Cornell Pest Management Guidelines for Commercial Tree Fruit Production

Authors

Anna Wallis (Cornell Integrated Pest Management Program, Highland, NY; *Editor, integrated pest management*)

Bryan Brown (Cornell Integrated Pest Management Program, Geneva, NY; *weed management)*

Lailiang Cheng (Section of Horticulture, Ithaca, NY; *nutrient management*)

Kerik Cox (Section of Plant Pathology and Plant-Microbe Biology, Geneva, NY; *disease management, characteristics of crop protectants, general pest management*)

Paul Curtis (Department of Natural Resources, Ithaca, NY; *wildlife damage control*)

Amara Dunn (Cornell Integrated Pest Management Program, Geneva, NY; *biological control*)

Michael Helms, (Cornell Integrated Pest Management Program Pesticide Safety Education, Ithaca, NY; *pesticide information*)

Monique Rivera (Department of Entomology, Geneva, NY; *Insect and mite management, characteristics of crop protectants, general pest management*)

Terence Robinson (Section of Horticulture, Geneva, NY; *growth regulators, nutrient management*)

Lynn Sosnoskie (Section of Horticulture, Geneva, NY; *weed management*)

Special Appreciation

Special appreciation is extended to Arthur Agnello, Julie Carroll, Robin Bellinder, Deborah Breth, David Kain, and Andrew Landers for their contributions to this publication. Additionally, the authors acknowledge the helpful assistance of the research staff of Cornell University at Geneva and Ithaca, as well as county fruit extension specialists and educators in preparing these guidelines.

Cover photo: *Anna Wallis, Cornell Integrated Pest Management Program.*

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 Cornell Integrated Pest Management 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***

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 (dec.ny.gov/about/contact-us/statewide-office-information), the Pesticide Applicator Training Manuals (www.cornellstore.com/books/cornell-cooperative-ext-pmep-manuals), or the Cornell 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 are less prone to drift, reducing environmental and operator contamination.

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.
2. 300 (gal) divided by 4(X) = 75 gallons of 4X concentrate per acre required.
3. Table 4.5.1 indicates 6.6 minutes required to spray 1 acre of 30-foot rows at a speed of 2.5 mph.
4. Total sprayer output for 2-sided operation = 75 (gal/acre) divided by 6.6 (min/acre) = 11.36 gallons per minute.
5. Output required per side = 11.36 divided by 2 = 5.68 gallons per minute per side.
6. Rate of output = 5.68 gal/min/side.

4.6 Tree Row Volume

4.6.1 Dilute Applications

A standard dilute application uses 400 gallons to account for the trees' actual stature and density per acre on a planting basis of standard size trees. Modern orchards contain smaller trees and therefore require less volume of water for adequate coverage. Tree row volume, a measurement of tree canopy size designed to account for the planting system, is defined as canopy width times the tree height, times row length per acre. Row length per acre is 43,560 square feet per acre divided by the distance between rows, in feet.

Tree row volume = canopy width x tree height x row length per acre

$$\text{Tree row volume (cu ft/acre)} = \text{tree canopy diameter (feet)} \times \text{Tree height (feet)} \times \frac{43{,}560 \text{ sq ft/acre}}{\text{distance between rows (feet)}}$$

An example:
Trees 10 feet wide and 8 feet tall in rows 18 feet apart

$$= 10 \text{ ft} \times 8 \text{ ft} \times \frac{43{,}560 \text{ sq ft/acre}}{18}$$

$$= 80 \times 2420 = 193{,}000 \text{ cu. ft.}$$

Note:
It takes 0.7-1.0 gallons to treat 1,000 cubic feet of tree canopy volume. Therefore, the minimum of 0.7 gallons/ 1,000 cu ft should be used in well pruned trees. The maximum of 1.0 gallon/1,000 cu ft should be used in an unpruned orchard with a thick canopy.

Example: A well pruned orchard using minimum spray volume

$$\text{Minimum spray volume (gal/acre)} = \text{your tree row volume (cu ft/acre)} \times \frac{0.7 \text{ gal}}{1{,}000 \text{ cu ft}}$$

$$\text{Minimum spray volume (gal/acre)} = 193{,}600 \text{ cu ft} \times \frac{0.7 \text{ gal}}{1{,}000 \text{ cu ft}} = 136 \text{ gal/acre}$$

Example: A traditional, un-pruned, dense orchard using maximum spray volume

$$\text{Maximum spray volume (gal/acre)} = \text{your tree row volume (cu ft/acre)} \times \frac{1.0 \text{ gal}}{1{,}000 \text{ cu ft}}$$

$$\text{Maximum spray volume (gal/acre)} = 193{,}600 \text{ cu ft} \times \frac{1.0 \text{ gal}}{1{,}000 \text{ cu ft}} = 194 \text{ gal/acre}$$

4.6.2 Concentrate Applications (Low Volume Application)

Concentrate spraying is reducing the gallons of water per acre to reduce or eliminate leaf run-off, often referred to as low volume application. The acceptable concentrate level depends on several factors, including the pest being controlled, density of foliage, weather conditions and the material being applied.

$$\text{Concentration} = \frac{\text{dilute volume of water per acre}}{\text{concentrate volume of water per acre}}$$

If we are using a pesticide that is recommended at 2 lbs/100 gallons on a dilute basis, then in the traditional orchard above we would use 4 lbs in 200 gallons of water (approx.).

If our sprayer is applying at 60 gallons/acre, then our concentration is:

$$\frac{200 \text{ gal water/acre}}{60 \text{ gal water/acre}} = 3$$ Therefore, a 3X application

or

If our sprayer is applying at 50 gallons/acre, then our concentration is:

$$\frac{200 \text{ gal water/acre}}{50 \text{ gal water/acre}} = 4$$ Therefore, a 4X application

Remember the debate that exists between all concerned:

1. It is the amount of water per acre that changes, not the amount of pesticide per acre.
2. The amount of pesticide reduces in proportion to the water, to maintain a constant concentration.

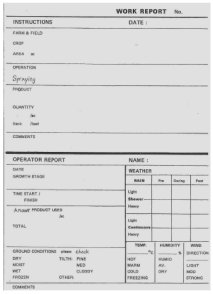
4.12 Going Spraying!

Mixing Procedures

Safety and the Law

- Always remain alert, pesticides are potentially dangerous to the operator and the environment.
- Tractors and sprayers are dangerous machines and careshould be taken when operating them.
- Always follow federal and state laws concerning applicator certification and handling, application and disposal of pesticides.

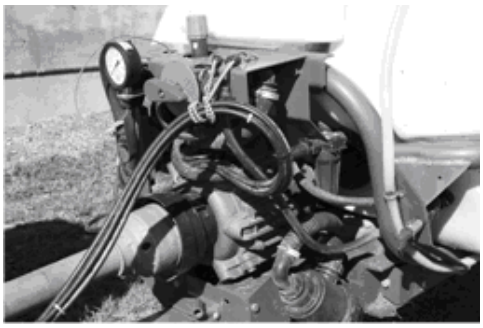
Always read the label for detailed application information and keep a record.



The six Ps of machinery management.

Proper prior planning prevents poor performance.

- Fill the tank on level ground per label instructions. If none are given, fill the tank half full with clean water.



- Prime the pump with water, if needed.

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)**
Aureobasidium pullulans strains DSM 14940 & 14941 (Blossom Protect) San Agrow **(B)**
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)**
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) UPL **(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**)
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)**
ipflufenoquin – (Axios) UPL (**F**)
inpyrfluxam– (Excalia) Valent BioSciences (**F**)
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)**

Sulfur. The most commonly used and acceptable form of sulfur is the wettable form. Wettable sulfurs are finely divided elemental sulfur particles with a wetting agent added so that the sulfur can be mixed with water and remain in suspension while being applied. The wettable sulfurs are most readily available as dry, wettable powder containing 90% sulfur, and as fused bentonite sulfur containing 30% or 81% sulfur, depending on the brand used. Against apple scab, the sulfur products are effective in a protective schedule only.

Dry wettable sulfur is used at a rate of 5 lb AI/100 gal in early-season sprays in a protective program. It can be used through bloom without substantially reducing set. Fruit russeting and reduction in yield may result if it is used under high-temperature conditions such as those that occur during postbloom sprays. Use caution when applying sulfur following an oil application. Consider waiting 14 days, unless the label states otherwise, after an oil application before using sulfur. There have been documented occurrences of injury to apples when sulfur was applied with 14 days after an oil application.

Sulfur is effective against powdery mildew of apple when used at 2 to 3 lb AI/100 gal from half-inch green to 2nd cover or when temperatures exceed 85F. It is also somewhat effective against cherry mildew. Sulfur is used on stone fruits to control brown rot, but is not as effective as captan or the newer brown rot fungicides. It is moderately effective against cherry leaf spot, but not effective against Rhizopus rot.

Flowable sulfur products are also available. They have the advantage over wettable sulfur in that they are effective at lower rates and have better retention capabilities.

Thiabendazole (Mertect 340-F, Shield-Brite TBZ) is registered as a flowable formulation for control of storage rots of apples and pears. Thiabendazole (TBZ) is active against *Penicillium* and *Botrytis* (blue mold and gray mold), but will not control rots caused by Alternaria and Rhizopus. Dip, drench, or spray the harvested fruit with a suspension of 16 fl oz of the flowable formulation in 100 gal of water. TBZ is compatible with DPA, but not with ethoxyquin. Strains of fungi resistant to TBZ are present in most apple storages and may compromise the performance of this fungicide. Combinations with captan can improve activity against TBZ-resistant strains of *Penicillium*.

Thiophanate-methyl (Topsin M, T-methyl) is formulated as a 70% or 85% wettable and a 4.5-lb/gal flowable and is registered for control of diseases of stone fruits, apples, and pears. Topsin M is a benzimidazole fungicide in the same chemical group as benomyl and thiabendazole. Many fruit pathogens have developed resistance to benzimidazole fungicides, but Topsin M is still effective for controlling fly speck, sooty blotch, black rot, and white rot on apples in most NY orchards. Do not tank mix thiophanate-methyl with copper-containing materials or with highly alkaline pesticides such as Bordeaux mixture or lime sulfur. The maximum annual use-rates listed on the labels limit the number of applications can be used to control summer diseases on apples.

Trifloxystrobin (Flint, Gem, Flint Extra) is a strobilurin fungicide. Like *†Sovran, Flint is an excellent protectant and should be used in this manner. Flint provides good control of apple scab and powdery mildew but is only moderately effective against cedar apple rust and is weak against quince rust. Flint also provides excellent control of sooty blotch and fly speck and good control of black rot bitter rot. Gem is the formulation registered for control of stone fruit diseases such as cherry leaf spot, scab, and mildew on stone fruits.

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

Triflumizole (*Procure) is a sterol inhibitor fungicide with activities, strengths, and weaknesses similar to those of Rally. *Procure provides very good to excellent control of apple scab, powdery mildew and cedar apple rust. It is labeled for control of scab and mildew on pears and for brown rot, mildew, and leaf spot control on sweet and tart cherries.

Warning: *Procure is no longer effective against apple scab in many NY orchards because the pathogen has developed resistance to the SI fungicide group. *Procure may fail to control other disease where the pathogen populations have become resistant to SI fungicides.

Ziram (Ziram) is a contact carbamate fungicide in the same chemical family as ferbam and thiram, but it is not an EBDC fungicide. It is used most effectively as a summer cover spray for apples, where it provides good control of sooty blotch and fly speck, but only marginal control of rots (black, white, and bitter). It is not as effective against scab as either captan or the EBDC fungicides, but will provide acceptable control of secondary scab under low to moderate pressure. It is compatible with oil. Ziram is also labeled for control of scab and Fabraea leaf spot on pears. It has a 14-day PHI on both crops, and a 48-hour restricted-entry interval.

5.3 Bactericides (Antibiotics)

Kasugamycin (Kasumin 2L) is a bactericide used for fire blight of apples and pears. It is formulated as kasugamycin hydrochloride in a 2.3% liquid solution. Kasugamycin is applied at bloom at the rate of 64 fl oz/100 gal for fire blight control, and it can be used in combination with wetting agents to enhance efficacy. It should be applied only in conjuction with disease forecasting models. It can be applied until 90 days prior to harvest, but Kasumin may not be applied after petal fall. Kasugamycin should not be applied in orchards that

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	1	2	—	—
Bacillus subtilis strain AFS032321 (Theia)	Microbial	BM02	4[i]	2	—	2	—	2	—
Bacillus subtilis strain QST 713 (Cease)	Microbial		—	—	0	0	—	—	—
benzovindiflupyr (*Aprovia) [h]	SDHI	7	4[i]	2	2	3	4	2	—
captan[g]	Phthalimide	M4	4	0	1	2	3	2[e]	3[e]
cyprodinil (Vangard)	Anilinopyrimidine	9	2(f)[i]	1	0	2	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	
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	—

maturity will be outside of the confidence limits due to unusually advanced or retarded spore maturity.

For state-wide, season-specific information on ascospore maturity and apple scab infection periods, consult the NEWA (newa.cornell.edu) Apple Diseases forecasting webpage. This ascospore maturity model incorporates rain into the estimate of maturity, because research has shown that maturity fails to advance during prolonged periods without rain.

Table 6.2.2. Cumulative percentage of ascospores matured at various degree-day (base 32°F) accumulations.

Degree-days [1]	Cumulative ascospores matured (%)	90% Confidence interval for estimate [2]
35	1	0-7
110	3	0-14
145	5	1-19
215	10	2-32
325	25	7-55
450	50	21-80
575	75	46-94
685	90	69-98
740	95	79-99
790	97	86-100
865	99	93-100

[1] Degree-days should be recorded from the date when 50% of McIntosh fruit buds are between silver tip and green tip. The base temperature for degree-day accumulation is 32°F. Data of Gadoury & MacHardy, 1982.
[2] The width of the 90% confidence interval is a statistical measure of the precision of estimated maturity. It is the range within which the estimate should fall 90% of the time.

6.3 Cedar Apple Rust Management

6.3.1 Determining Cedar Apple Rust Infection Periods

Cedar apple rust infection of susceptible cultivars is highly dependent on leaf wetness when inoculum is present. Table 6.3.1 shows the minimum duration of wetting required for infection and the predicted severity of disease at various temperatures. At temperatures above 46˚ F, wetting periods that differ only by 1-2 hours can make the difference between a light and severe infection. If inoculum (in the form of swollen galls with telial horns) is not present, infection is not likely to take place at temperatures below 46˚ F. If temperatures are above, 50˚ F, and galls are not present, 4 additional hours of leaf wetness can be sustained before infection would occur.

Table 6.3.1. Approximate number of hours of leaf wetness required for cedar apple rust infections to occur on leaves of susceptible cultivars.

Average Temp (˚F)	Hours of Leaf Wetness: Degree of Infection [1] — *Light*	*Severe*
36	24	—
40	12	24
43	8	10
46	6	7
50	5	6
54	4	5
58	3	5
61	3	4
64	3	4
68-76	2	4
79+	–	–

[1] Based on the data of Aldwinckle, Pearson, & Seem, Cornell University assumes that cedar apple rust inoculum (orange, swollen galls) is available at the start of the rain. If inoculum is not already present (dry period prior to the rain), add 4 hr at temps above 50˚ F and 6 hr at temps of 46-50˚ F. Infection is unlikely at temps below 46˚ F if inoculum is not already present.

6.4 Stone Fruit Fungicides

6.4.1 Characteristics of Stone Fruit Fungicides

Stone fruit fungicides can manage several diseases and range from site-specific fungicides with protective and post-infection activity to multi-site fungicides with protection activity. Protective activity refers to the ability of fungicide residues to kill or inactivate pathogen inoculum (usually spores) when the residue is already on or in the leaf or fruit before the infection takes place. 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 infections when applied within a certain 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 considerations listed for protectant and post-infection activity for apple scab in 6.1 also apply to stone fruit fungicides. Table 6.4.1 lists common stone fruit fungicides with FRAC codes, the crops on which they are registered, and the relative efficacy against diseases of stone fruit.

Table 6.4.1. Activity spectrum of stone fruit fungicides.

			Registered for use on:				*For Control of*						
							Brown Rot		Cherry			Peach	
Fungicide	Fungicide Family	FRAC code‡	Apricot	Cherry	Peach	Plum	*Blossom Blight*	*Fruit Rot*	Leaf Spot	Powdery Mildew	Black Knot	Leaf Curl	Peach Scab
*†Aprovia	SDHI	7	+	+	+	+	4	4	4	4	—	—	4
Applause 720 [d]	Chloronitrile	M5	+	+	+	+	—	—	4[e]	0	4[e]	4[e]	4[e]
Bravo [d]	Chloronitrile	M5	+	+	+	+	3	—	4[e]	0	4[e]	4[e]	4[e]

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)	29	—	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 7.1.2. Relative toxicity of pome fruit insecticides and acaricides to beneficials. *(continued)*

Active Ingredient (Trade Name)	Beneficial Species				
	Bees[1]	*Amblyseius fallacis*[2]	*Typhlodromus pyri*[3]	*Stethorus punctum*[4]	*Aphidoletes aphidimyza*[5]
Acaricides					
*Agri-Mek (abamectin)	L	M	M	M	L
Apollo (clofentezine)	L	L	L	L	L
*†Envidor (spirodiclofen)	L	L	M	M	—
Kanemite (acequinocyl)	L	L	L	L	—
Magister (fenazaquin)	H	—	—	—	—
*†Minecto Pro (cyantraniliprole/abamectin)	H	M	M	M	L
†Nexter (pyridaben)	H	M-H[d]	M-H[d]	M	M
§oil (Sunspray, PureSpray, Damoil, Stylet, Omni)	L	L-M[a]	L-M[b]	L	L
Portal (fenpyroximate)	L	L	L	—	—
*Proclaim (emamectin benzoate)	H	—	—	—	—
Savey, Onager (hexythiazox)	L	L	L	—	—
*Vendex (hexakis)	L	L	L	L	L
Zeal (etoxazole)	L	M	M	—	L

[1]Bees = honeybees
[2] A predatory mite found throughout New York State
[3]A predatory mite found mostly in Western New York
[4]A ladybird beetle predator of mites
[5]A cecidomyiid predator of aphids

* Restricted-use pesticide.
† Not for use in Nassau and Suffolk Counties.
§ = Potentially acceptable in certified organic programs

Key to toxicity ratings:

Bees:

L = Low; not hazardous to honey bees at any time. 1 hr to 1 day residual toxity
M = Moderate; not hazardous if applied either in evening or early morning when honey bees are not foraging, except during periods of high temperature. 3 hr to 1 day residual toxicity
H = High; hazardous to honey bees at any time. 1 day to 2 week residual toxicity
— = no data.

All other Beneficials:

L = low impact on population (less than 30% mortality).
M = moderate impact on poppulati (between 30% and 70% mortality).
H = high impact on opulation (more than 70%mortality).

Notes:

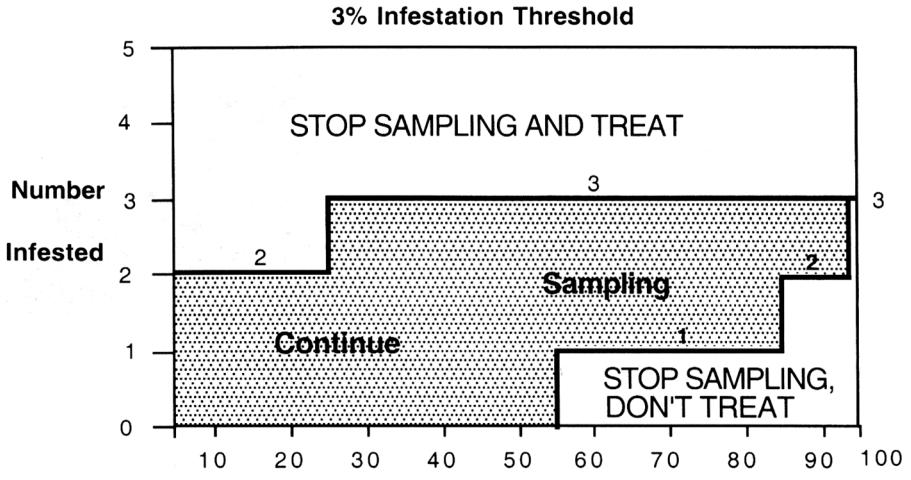
[a] = low impact on immatures, moderate impact on eggs.
[b] = low impact on adults, moderate impact on eggs and immatures. However,general population recovery occurs within 7 days.
[c] = This information derived from application field tests conducted at the NYS Agricultural Experiment Station.
[d] = Dependent on rate.

(Information compiled from 48-hr residue tests conducted at the NYS Agr. Exp.Sta. except where noted. Pesticides with long residual periods (pyrethroids) will have a greater impact than those with a shorter residual (like some organophosphates)).

Table 7.1.3. Activity spectrum of stone fruit insecticides.

Insecticide	IRAC‡	APB	Aphids	CFF	JB	OFM	PC	PTB/LPTB	SWD	TPB	WFT
*†Actara (thiamethoxam)	4A	—	3	2	—	—	3	—	—	3	2
*Admire Pro (imidacloprid)	4A	0	3	2	2	0	1	0	—	2	—
*†Altacor (chlorantraniliprole)	28	—	—	2	—	3	—	—	—	—	—
*Pounce (permethrin)	3A	—	—	3	—	2-3	3	2	—	3	2
*Asana (esfenvalerate)	3A	2	3	3	—	2-3	3	3	3	3	2
*Assail (acetamiprid)	4A	—	3	3	3	3	2	—	—	2	—
Avaunt (indoxacarb)	22A	—	—	—	—	2	3	—	—	—	—
Aza-Direct, Neemix (azadirachtin)	18B	—	2	—	0	2	0	2	—	—	—
*Baythroid (cyfluthrin)	3A	2	3	3	—	2-3	3	3	3	3	—

Figure 7.1.2. Obliquebanded Leafroller Sampling Form



- Examine 10 bud clusters (overwintering generation) or expanding terminals (1st summer generation) per tree for live OBLR larvae. For the 1st summer generation, sample at ~600 degree-days (43°F base) after the 1st moth flight in your area; if you do not have access to this information, use July 5 as an estimated best sample date in WNY (5-7 days earlier in ENY and Long Island).

- Sample every other tree starting with a random tree and continuing down the row. Remember that you are NOT counting OBLR larvae, but sites infested with LIVE OBLR. If trees are >10ft tall, try to include some samples from the upper canopy, or from watersprouts.

- If the total number of infested samples falls in the "Continue Sampling" zone, sample another tree. If the total falls in the "Stop Sampling, Don't Treat" zone, sampling is stopped and no treatment is recommended. If the total falls in the "Stop Sampling and Treat" zone, sampling is stopped and treatment is recommended. Refer to the Apple Pesticide Spray Table for a choice of pesticide materials.

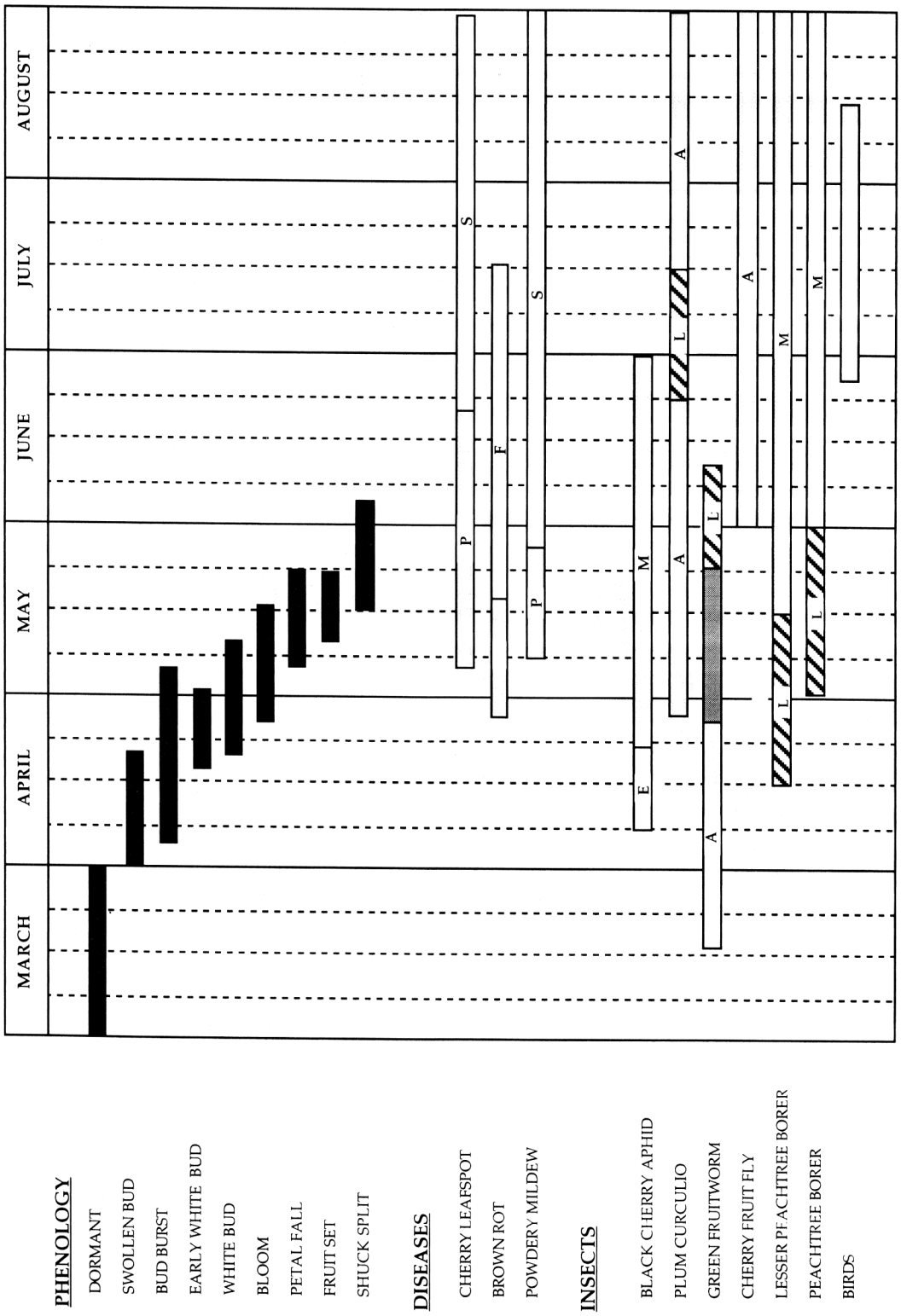
- Continue sampling until you REACH one of the boldface staircase lines in the chart above, or until you have examined a maximum of 100 clusters. If you reach the intersection of the two lines by the 100th sample, withhold treatment.

- If a no-treat decision is made for 1st summer generation larvae, resample again in 3-5 days (after approximately 100 DD more have accumulated). A second no-treat decision indicates that no treatment is recommended against this brood of OBLR.

Use this table to keep track of your samples

Total Number Examined	# Infested	Total Number Examined	# Infested
10	_____	60	_____
20	_____	70	_____
30	_____	80	_____
40	_____	90	_____
50	_____	100	_____

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

See label about tree age requirements, maximum use rates, and in-season timing restrictions. Do not use on or near non-dormant pears.

Glufosinate-ammonium is currently registered as †Rely 280 and other formulated products as a liquid with 2.34 lbs. AI per gallon. †Rely 280 is a non-selective herbicide for application as a directed spray labeled for control of a broad spectrum of annual and perennial grass and broadleaf weeds, and some woody species in pome fruit and stone fruit. glufosinate has no residual activity. Make directed sprays to actively growing weeds. Avoid all contact with foliage and green (e.g. uncallused) bark tissue since injury to the trees can result, especially in young trees. Not labeled for use in Nassau and Suffolk Counties.

Glyphosate is distributed as an aqueous solution under various generic formulations and under the name Roundup. Glyphosate is a nonselective broad-spectrum herbicide for controlling established annual and perennial grasses and weeds plus woody brush, vines, and trees. No residual soil activity is to be expected from this material. The best timing of applications varies with weed type but is usually after weeds have developed full foliage and/or have begun to flower. Greatest effectiveness against nutsedge is obtained after tuber formation begins. Inclusion of 2,4-D and/or a nonionic surfactant is suggested to increase effectiveness on perennial broadleaf weeds. Glyphosate is absorbed through foliage and bark and translocated throughout the plant. Glyphosate may be applied as a directed spray or by wiper; see labels about safe in-crop use in different tree species. PEACHES, PLUMS/PRUNES, APRICOTS, and NECTARINES are considered to be very sensitive. Do not allow contact with foliage or bark on trunks of young fruit trees. Root-suckers or low branches that might be contacted by glyphosate should be removed at least 10 days before the glyphosate application. Contact with leaves or small branches or trunks, via overspray or drift, especially in young trees, may result in severe damage or tree death.

Halosulforon-methyl, is a sulfonylurea, dry flowable herbicide registered as Sandea for pre- and post-emergent weed control in apples for certain broadleaf weeds and nutsedge. It is absorbed through weed roots, shoots, and foliage and is translocated within the plant. Do not apply to trees established less than 1 year. Best results require application with a broad spectrum burndown herbicide. Nutsedge control is best at 3-5 leaf stage for first germination flush, then followup again for the second flush.

Indaziflam is registered in tree fruit as *†Alion formulated as a suspension concentrate for pre-emergent control of annual grass and broadleaf weeds in pome and stone fruit. *†Alion can only be applied to trees established for 3 years. This herbicide inhibits cellulose biosynthesis and requires moisture for activation by rain or irrigation within 21 days after the application but before weed seed germination. Weeds that have already germinated will not be controlled. *†Alion will be most effective if applied to a “clean” soil surface to assure uniform distribution on the soil surface. If dense foliage is present, control emerged weeds with post-emergent herbicide, and follow with *†Alion when surface is cleaner. *†Alion can also be applied to farmstead areas. Do not apply within 25 feet of ponds, rivers, streams, wetlands and habitat with aquatic vegetation. Do not apply to cracked or disturbed soils. Do not allow contact with foliage, green bark or fruit. Not registered for use in Nassau and Suffolk Counties.

Norflurazon is formulated as a dry flowable in *†Solicam 80 DF. Apply as a directed spray before bud-break. Norflurazon at rates recommended provides control of most annual grasses and many annual broadleaf weeds plus suppression of quackgrass and nutsedge. It is absorbed by roots and translocated to growing points where it inhibits pigment formation. The material must be applied and moved into the soil by rainfall or irrigation before seed germination. Rates of application depend on organic matter and clay contents of the soil and crop. Norflurazon is most frequently used in tank-mix combinations that will increase effectiveness of broadleaf weed control. Established perennial weeds are not effectively controlled by norflurazon. Registered for use in APPLE, PEAR, APRICOT, CHERRY, NECTARINE, PEACH, PLUM, and PRUNE, depending on tree age.

Oryzalin is available as an aqueous suspension (Surflan A.S.) containing 4 lb AI per gallon. It provides effective control of most annual grasses and some annual broadleaf weeds. Oryzalin has controlled triazine-resistant pigweed, but has not been sufficiently effective on ragweed or Pennsylvania smartweed. It is not effective against established weeds or grasses. Oryzalin is absorbed by roots of germinating seedlings and interferes with cell division. To be effective, it must be applied and moved into the soil by 1/2-1 inch of rainfall-before seed germination. Oryzalin can be used in newly planted orchards as soon as the soil settles around the roots and no open cracks are present. It can be used in all tree fruit crops.

Oxyfluorfen is available as a 2 lb AI per gallon formulation in Goal 2XL, GoalTender, and others. Oxyfluorfen has pre-emergence and post-emergence activity as a contact herbicide. Uptake can be through leaves, stems, or roots, but very little translocation occurs in the plant. Destruction of membranes occurs when treated plant parts are exposed to light. Oxyfluorfen is primarily effective against seedling broadleaf weeds. It does not control established perennial weeds or grasses and is best used in tank-mix combinations with other appropriate herbicides.

Table 8.4.1. Minimum time between planting and herbicide use.

§ Sinbar + Karmex tank mix at lower rates – Apples and peaches established at least 2 yr.
* Restricted-use pesticide; may be purchased and used only by certified applicators or used under the supervision of a certified applicator.
† Not registered for use in Nassau or Suffolk Counties
[1] Not less than 6 mo after fall transplanting nor less than 1 yr after spring transplanting of labeled crops.
[2] Low rate for newly planted and young, non-bearing fruit trees. Higher rate for apple and peach, 3yr.
[3] Can be applied to trees less than 1 year old if non-porous wraps, grow tubes, or waxed containers are used.
[4] Do not allow contact with green bark areas of newly planted tree.

Table 8.4.2. Effectiveness of herbicides in tree fruit crops.

Trade Name(s) (*active ingredient*)	WSSA Group	AG	AB	PG	PB	WBV	YN	BW	HN	CT	SB	PW	RW
2,4-D (multiple trade names)	4	—	G	—	G	F	—	G	F	F	—	G	G
Aim EC (*carfentrazone-ethyl)*	14	—	G	—	P	—	—	P	—	—	—	G	G
*†Alion *(indaziflam)*	29	G	G	—	—	—	—	—	—	—	—	G	G
Casoron 4G (*dichlobenil*)	20	G	G	G	G	—	G	—	G	G	—	G	G
Chateau SW (*flumioxazin*)	14	G	G	P	P	P	P	P	P	P	P	G	G
†Fusilade (*fluazifop*)	1	G	—	F	—	—	—	—	—	—	—	—	—
Goal (*oxyfluorfen*)	14	F	G	—	—	—	—	—	—	—	—	G	G
*Gramoxone (*paraquat*)	22	G	G	F	F	F	G[3]	F	F	F	—	G	F
Karmex (*diuron*)	7	G	G	F	—	—	—	—	—	—	—	G	G
Kerb (*pronamide*)	3	G	—	G	—	—	—	—	—	—	—	—	—
Matrix (*rimsulfuron*)	2	G	G	P	P	P	F	P	P	F	P	G	F
Poast (*sethoxydim*)	1	G	—	F	—	—	—	—	—	—	—	—	—
*†Princep (*simazine*)	5	F	G	—	—	—	—	—	—	—	—	G[4]	—
Prowl, Prowl H20 (*pendimethalin*)	3	G	F	—	—	—	—	—	—	—	—	G	—
†Rely 280 *(glufosinate-ammonium)*	10	G	G	F	F	P	G	F	F	F	—	G	G
Roundup (*glyphosate*)	9	G	G	G	G	G[1]	G[2]	G	G[1]	G[1]	F	G	G
Sandea *(halosulforon-methyl)*	2	P	G	—	P	—	G	—	G	P	—	G	G
*Sinbar (*terbacil*)	5	G	G	F	F	—	F	—	F	—	—	F	G
*†Solicam (*norflurazon*)	12	G	F	F	—	—	F	—	—	—	—	F	—
*†Stinger [5] (*clopyralid*)	4	—	F[5]	—	F[5]	—	—	—	F	G	—	—	F
Surflan (*oryzalin*)	3	G	F	—	—	—	—	—	—	—	—	G	P
*†TreeVix *(saflufenacil)*	14	—	G	—	—	—	—	P	—	P	—	G	G
Venue (*pyraflufen-ethyl*)	14	—	G	—	F-P[6]	—	—	P	—	P	F	G	G

Key: G = good; **F** = fair; **P** = poor

* Restricted-use pesticide.
† Not for use in Nassau or Suffolk Counties.

[1] Combination with 2,4-D amine has improved effectiveness.
[2] Best results with late-summer (after August 1) applications.
[3] Best results with early mid-summer (before July 15) applications.
[4] Resistant types may require use of alternative materials.
[5] Not broad spectrum; see label for specific weed targets.
[6] Requires tank mix.

Abbreviations:
AG = Annual grasses; **PG** = Perennial grasses;
AB = Annual broadleaves; **PW** = Pigweeds;
BW = Bindweeds; **RW** = Ragweed;
CT = Canada thistle; **SB** = Smooth bedstraw;
HN = Horsenettle; **WBV** = Woody brush, vines;
PB = Perennial broadleaves; **YN** = Yellow nutsedge.

Table 8.4.3. Weed control guidelines for tree fruit.

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

Crop						Tree Age				PRODUCT NAME (*active ingredient, weight of active per unit of herbicide*)
Apples	Pears	Cherries	Peaches	Apricots	Plum/Prune	Planting Year	1 year plus	2 years plus	3 years plus	*Notes:*
X	X	X	X	X	X		X	X		***2,4-D AMINE, *WEEDAR 64, or other labeled formulation** (*2,4-D, 3.8 lb/gal*) *Weeds Controlled:* broadleaves, *Rate (per acre):* 3 pt. *AI per acre (lbs/acre):* 1.4 *Days to harvest:* Apples and pears: 14; apricots, cherries, peaches, and plums: 40 *REI (hours):* 48 *Comments:* Established perennials, woody brush and vines can also be controlled by using in tank mix with glyphosate; fall applications of glyphosate may cause crop injury. To control dandelions and other broadleaf weeds in sod cover, apply in the fall (best) or early spring BEFORE TREES OR DANDELIONS BEGIN TO BLOOM. Yearly application is needed to control dandelions. Avoid contact with fruit, foliage, stems, or limbs of trees. Not all products may be labeled for all crops. Do not apply before irrigation or rainfall events. Do not apply to bare ground. Do not apply under windy conditions, under high temperatures or in temperature invesions. Maximum use and application timing restrictions apply, see label.
X	X	X	X		X		X	X		***UNISON or other labeled formulation** (*2,4-D, 1.74 lb/gal*) *Weeds Controlled:* broadleaves *Rate (per acre):* 3 pt. *AI per acre (lbs/acre):* 0.6525 *Days to harvest:* Apples and pears: 14; cherries, peaches, plums: 40 *REI (hours):* 48 *Comments:* Established perennials, woody brush and vines can also be controlled by using in tank mix with glyphosate; fall applications of glyphosate may cause crop injury. To control dandelions and other broadleaf weeds in sod cover, apply in the fall (best) or early spring BEFORE TREES OR DANDELIONS BEGIN TO BLOOM. Yearly application is needed to control dandelions. Avoid contact with fruit, foliage, stems, or limbs of trees. Not all products may be labeled for all crops. Do not apply before irrigation or rainfall events. Do not apply to bare ground. Do not apply under windy conditions, under high temperatures or in temperature invesions. Maximum use and application timing restrictions apply, see label.
X	X	X	X	X	X	X	X	X		**AIM EC** (*carfentrzone-ethyl, 2 lb/gal*) *Weeds Controlled:* annual grasses and broadleaves *Rate (per acre):* 1-2 oz, 2 oz. for green rootsucker control. *AI per acre (lbs/acre):* 0.03 *Days to harvest:* All tree fruits: 3 *REI (hours):* 12 *Comments:* Apply in tank mix with paraquat or glyphosate to extend the range of broadleaf and grass control, but avoid contact with green bark and foliage in new to 2 year old trees. Suckers must be young and succulent (when used for sucker control). Nonionic surfactants or crop oil concentrate improve control.

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.

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

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.

The lime recommendations in Tables 10.4.2, 10.4.3 and 10.4.4 are for 100% effective neutralizing value. The actual lime rate to be applied is calculated by dividing the

10.6.3 Special Considerations in Foliar Application of Nutrients

To minimize the number of sprays applied in the orchard, it is frequently desirable to combine various nutrient materials or to add them in tank mixes with pesticides. Before doing so, however, one needs to make sure they are compatible.

Generally, urea, Solubor, and Zn-EDTA are compatible. Urea, Solubor, and Zn-EDTA have been used together safely in prebloom sprays on apples and pears. A tank mix of urea and Epsom salts has sometimes injured young apple foliage; if both are required, they should be applied separately. Epsom salts and some of the boron products listed in Table 10.6.5 may increase the pH of the tank mix, and if used with pH-sensitive pesticides, pH of the tank mix should be tested and adjusted by using a suitable acidifying agent. Solubor and presumably other forms of boron should not be tank-mixed with any pesticide contained in water-soluble plastic packages because it inhibits the dissolution of the plastic. In general foliar nutrients should not be mixed with oil. Solubor in particular should not be tank-mixed with oil.

Although Epsom salts, Solubor and Zn-EDTA are compatible for use in postbloom sprays, many orchardists prefer not to add all three to one tank. A petal fall spray may then contain Epsom salts alone or with Solubor; the first cover spray a combination of Epsom salts and Solubor; the second cover spray a combination of Epsom salts and Zn-EDTA; and the third cover spray a combination of Solubor and Zn-EDTA.

Calcium chloride may be physically incompatible with Epsom salts, resulting in plugging of sprayer nozzles. Calcium chloride cannot be tank-mixed with Zn-EDTA because some of the dissolved calcium may displace Zn, causing phytotoxicity.

It should be pointed out that some Zn-chelate products contain a large percentage of unchelated Zn, which may cause injury to foliage and fruit. Therefore, before using a new Zn product in your orchard, test the product by spraying a few trees at the label rate to see if any phytotoxicity occurs.

More detailed information concerning nutrient management for orchards can be found in Cornell Cooperative Extension Information Bulletin 219, *Orchard Nutrition Management* by Warren Stiles and Shaw Reid. See the section on "Tree Fruit Reference Materials" at the end of this publication for ordering information.

Prepared by Lailiang Cheng, Section of Horticulture, Ithaca, and Terence Robinson, Section of Horticulture, Geneva.

10.6.4 Characteristics of Commonly Available Fertilizers

Table 10.6.2. Nitrogen fertilizers

Common name	% N	Pounds per lb N	Acidity or Basicity (lb $CaCO_3$/lb	
			Acidity	*Basicity*
Ammonia, anhydrous	82	1.22	1.8	—
Ammonia, aqua	20	5.00	1.8	—
Ammonium nitrate	33.5	2.98	1.8	—
Ammonium polyphosphate	12	8.33	4.1	—
Ammonium sulfate	20.5	4.88	5.4	—
Calcium nitrate	15.5	6.45	—	1.3
Diammonium phosphate	16-18	5.56	4.1	—
Monoammonium phosphate	11	9.09	5.3	—
Nitrate of soda-potash	15.5	6.45	—	1.3
Potassium nitrate	13	7.69	—	2.0
Sodium nitrate	16	6.25	—	1.8
Urea	45	2.22	1.6	—
Nitrogen solutions	variable[1]	—	—	—

[1]Nitrogen solutions may consist of mixtures of urea plus ammonium nitrate, aqua ammonia, or anhydrous ammonia plus urea or ammonium nitrate or both of these materials. Consult supplier for analysis.

Table 10.6.3. Phosphorus fertilizers

Common name	P_2O_5(%)	Pounds per lb P_2O_5	N (%)
Ordinary superphosphate	20	5	0
Concentrated superphosphate	46	2.27-2.17	0
Ammoniated superphosphate	40*	2.5*	5*
Monoammonium phosphate	52*	1.92*	13*

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	BM02	Howler EVO	2.5-7.5 lb/acre	0	4	High	
	7 + 9	*†Luna Tranquility	11.2-16 fl oz/acre	72	12	High	
	M01 + M01	Badge SC	3.5-7.0 pts/acre	0	48		[8.4]
	M01 + M01	Badge X2	3.5-7.0 lb/acre	0	48		[8.4]
Bitter Rot	BM02	Howler EVO	2.5-7.5 lb/acre	0	4	High	
	BM02	Theia	1.5-5 lb/acre	0	4	High	
Blister Spot	P07	Phostrol	2.5-5.0 pts/acre	0	4	High	[5.1]
Cedar Apple Rust	BM02	Theia	1.5-5 lb/acre	0	4	Moderate	
Crown rot	4	Ridomil Gold SL	2 qt/acre 0.5 pt/100 gal water		48		[7.2]
	P07	Aliette WDG	2.5-5 lb/acre 0.5-1 pt/100 gal water	14	24		
	P07	Phostrol	2.5-5.0 pts/acre	0	4	High	
	P07	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	25	*Agri-mycin 50	8-16 oz/acre	50	12		[8.5]
	BM02	Howler EVO	2.5-7.5 lb/acre	0	4	High	
	M01	Kocide 3000-O	3.5-7.0 lb/acre	HIG	48		
	M01	Previsto	2-4 qt/acre	See label	48		
	M01 + M01	Badge SC	3.5-7.0 pts/acre	0	48		[8.4]
	M01 + M01	Badge X2	3.5-7.0 lb/acre	0	48		[8.4]
Phytophthora rots	P07	Phostrol	2.5-5.0 pts/acre	0	4	High	[7.3]
	P07	Prophyt	2-4 pt/acre	0	4	High	[7.3]
Powdery Mildew	BM02	Howler EVO	2.5-7.5 lb/acre	0	4	Moderate	
	BM02	Theia	1.5-5 lb/acre	0	4	Moderate	
Woolly apple aphid	9D	*†Sefina Inscalis	7.0 fl oz/acre	7	12		[46.1]
Green Tip							
Apple scab		Polyram 80DF	3.0-4.5 lb/acre	BL, 77(A)	24		[1.3,2.2]
		Syllit FL	1.5 pts/acre		48	High	[2.15]
	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 9	*†Tesaris Vangard WG	4.5 fl oz/acre 3.0-5.0 oz/acre	0 0	12 12	High	
	19	OSO 5% SC Fungicide	6.5-13.0 oz/acre	0	4	Low	

11.2 Apple Disease Notes

11.2.1 Apple Scab

• Biology & Cultural

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

• Pesticide Application Notes

[1.3] The EBDC fungicides (mancozeb, maneb, Polyram) are labeled for use on apples in one of two different ways: (i) at a rate of 1.5-2 lb/100 gal (maximum 6 lb/A, no more than 24 lb/A per year), not to be applied after bloom; OR (ii) at a reduced rate of 3 lb/A (maximum 21 lb/A per year), which may be applied to within 77 days of harvest. The latter rate is adequate for control of rust diseases, and the extended timing is necessary to control rust infections on terminal leaves. It is illegal to combine or integrate the two treatment regimes.

[2.1] See discussion of inoculum reduction in the disease management section. Scab fungicide sprays beginning at green tip are absolutely essential in orchards with high carry-over inoculum or orchards where scab control with SI fungicides was less than satisfactory in previous years. If early season infections are allowed to become established, even the best fungicide programs will not prevent development of fruit scab in orchards where the scab fungus has developed resistance to all three of the fungicide groups (dodine, benzimidazoles, SI's) that previously provided presymptom and postinfection activity against apple scab.

[2.2] Fungicide rates per acre should never be reduced below either (i) 50% of the per-acre rate listed on the label or (ii) 1.5 multiplied by the Amt/100 gal listed on the label. This applies even when spraying small trees. Although tree-row volume calculations may suggest that lower rates are appropriate, applying less than 50% of the per-acre rate has frequently resulted in unsatisfactory scab control and/or more rapid development of fungicide resistance.

In orchards with SI-resistant scab, a combination of a mancozeb fungicide at 3 lb/A plus a captan formulation that supplies 1.5 lb of active ingredient/A has provided excellent scab control when used in prebloom and bloom sprays. (A captan rate of 1.5 lb active ingredient/A translates to 3 lb/A of Captan 50W, 30 oz/A of 80W, or 1.5 qt/A for the 4L formulations.) This combination provides a better residual activity through heavy rains than would be available from either product used alone and it preserves the option of using mancozeb sprays after petal fall. The mancozeb-captan combination cannot be used close to prebloom oil sprays because of captan-oil incompatibilities.

For reasons of economy and resistance management, it is recommended that SI and strobilurin fungicides not be used until pink, even when fungicidal protection is needed earlier; in such cases, make a single application of an alternative fungicide (captan, copper, EBDC) at green tip and half-inch green, then begin the SI/strobilurin program at pink. Do not apply captan or sulfur within 10 days of an oil spray. Do not apply liquid captan formulations with sulfur on sulfur-sensitive varieties. A further discussion of apple scab fungicide characteristics is presented in the section "Apple Scab Fungicides" and in Table 6.1.3.

[2.4] *†Sovran and Flint are excellent protectants, but they have only 48-72 hours of post-infection activity compared with 72-96 hr for the SI fungicides. *†Sovran and Flint also lack the presymptom activity that makes the SI fungicides so effective (in the absence of SI resistance) for arresting scab epidemics after primary scab lesions become visible in trees. *†Sovran and Flint have proven very effective against apple scab when applied at 7-9-day intervals to control primary scab, but they have not performed as well when used to control secondary scab in trees where scab lesions are already visible. *†Sovran and Flint control rust diseases fairly well when used as protectants, but they have little or no post-infection activity against rust diseases.

CAUTION: *†Sovran has caused moderate to severe phytotoxicity (leaf burning) on several sweet cherry varieties. Do not apply Sovran near or allow drift onto cherries and thoroughly rinse spray equipment (tanks, hoses, nozzles) after spraying *†Sovran and before using this equipment on sensitive cherry varieties.

[2.6] Primary inoculum pressure is generally at a peak from pink through bloom—this is a critical time to maintain full coverage with proper fungicide rates.

[2.7] Serious losses from apple scab are usually the result of secondary spread to developing fruits. Therefore, it is important to carefully check blocks for the presence of primary scab lesions from petal fall through the early cover spray period. This is particularly important because fruit are most susceptible to infection during the first few weeks of their development. If scab is detected, the management strategy should be to (i) thoroughly protect the sensitive young fruitlets from fungal spores that are present, AND (ii) limit the number of new spores that can be produced. To protect fruitlets, use (a) the full rate of captan (e.g., 2 lb/100 gal of the 50WP formulation), or (b) the reduced rate of an EBDC fungicide (if allowable) supplemented with a half rate of captan, or (c) a strobilurin fungicide combined with a contact fungicide. To limit new spore production, use (a) an DMIfungicide through 2nd cover (to prevent new leaf lesions), or (b) a registered QoIfungicide (to prevent new leaf lesions and suppress spore production from existing lesions). SI's should be used only in orchards where there is no resistance to these fungicides. With repeated use, these options will speed the development of resistance. Thus, they should be viewed as emergency "rescue" operations, and increased care should be taken in future seasons to avoid the development of primary scab that necessitated their use.

[2.8] It is illegal to use the 6 lb/A rate of the EBDC fungicides after bloom. It also is illegal to use the reduced rate (3 lb/A) after bloom if the rate for any of the sprays prior to petal fall exceeded 3 lb/A.

[2.9] The danger of primary scab is over after 1st cover except when drought conditions delay spore release. If primary scab has been well controlled, fungicide schedules and rates can be relaxed after the danger of primary

11.5 Notes on Scald Control

11.5.1 Materials

All DPA (diphenylamine) formulations are suspensions and become weaker with use. Replenishment with full-strength material does not replace the DPA removed by the apples. Test kits are available to determine concentrations of make-up material. Do not exceed 30 bins or 750 bushels/100 gal of made-up DPA; empty the reservoir tank and start again with fresh material.

Cartons containing apples that have been treated postharvest with DPA and fungicide must be so labeled.

11.5.2 Application Equipment

Bins of apples are sometimes dipped into a tank containing postharvest preservatives, but more often the bins are moved by conveyors, rollers, or truck bed under a cascade of the preservatives. The bins should be moved slowly under the cascade, with 35-40 gal of preservatives being delivered into each bin. The pump should be sized to deliver 35-40 gal of preservatives/bin at the desired rate of bin movement under the cascade. If stacked bins are moved under the cascade, the top bins should receive 35-40 gal and side nozzles should be positioned to deliver additional gallonage to the lower bins, even though drainage holes are provided in the bin floors. Application equipment is commercially available, but operators usually fabricate their applicators to meet the needs of their own operation. Dirty truckloads should be rinsed with clean water before treatment to minimize the accumulation of dirt in the reservoir tank.

11.5.3 Variety Requirements

Materials and concentrations for the major apple varieties in New York are listed in Table 11.5.1. Important: DPA retards chlorophyll loss in Golden Delicious and, therefore, should not be used unless the apples have developed full yellow color at harvest.

The very low susceptibility of Empire to scald indicates that it can be safely stored without any preservative treatment. However, if preservative treatment is demanded, then use 1000 ppm DPA in the drench solution.

11.6 Growth Regulator Use In Apples

11.6.1 Chemical Thinning

Fruit thinning is a management practice that reduces yield in the current season but results in increased fruit size and also increased return bloom and yield in the next season. Large fruit size is best obtained with consistent cropload 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

Table 11.5.1 Recommended diphenylamine concentrations for varieties in New York subject to scald.

Variety	Diphenylamine (ppm)	Variety	Diphenylamine (ppm)
Baldwin	1000-1500	Idared	1000
Braeburn	1000	Jonagold	1000
Cortland	2000	McIntosh	1000
Delicious	1000-1500	Mutsu	2000
Empire	1000	Rome	1500
Golden Delicious	1000	Stayman	1500

beginning at petal fall and continued every 7-10 days. The most susceptible varieties to russeting are: Golden Delicious, Fuji, Rome, Cortland, Idared, Crispin Jonagold and Sweetango. The use of a 4 spray program of GA 4+7 can induce some thinning. We recommend a lower rate of chemical thinners when GA 4+7 is used for russet control (see Table 11.6.2 for specific variety recommendations). The use of GA 4+7 may interact with the use of other growth regulators such as Apogee, since GA 4+7 is a gibberellin and Apogee inhibits synthesis of gibberellins.

BA (Maxcel Exilis, Riteway) are commercial formulations of benzyl adenine (a cytokinin). They are used to stimulate growth of fruits and/or lateral branches. Their primary effect on fruit growth is to increase fruit size by stimulating cell division. At low rates or without carbaryl there is often little thinning from these chemicals but there can be a significant improvement in fruit size.

BA is also used to induce lateral branching of nursery trees and young orchard trees, but at rates of 5-10 times those used for thinning. Applications are made on nursery trees when the tree is 28-48" high (mid-June through late July), while on young trees planted in the orchard trees, applications are made earlier, when shoots are ½ inch long (near half inch green). BA can also be applied at bud break by painting or spraying it on the swollen buds.

Ethephon is a growth regulator that stimulates ethylene production by the plant. It can be used to thin apples and improve flower bud development when used within a few weeks of bloom, and to improve fruit color and advance fruit maturation when used near harvest. Its use near harvest significantly reduces fruit storage life and shelf life, and can cause excessive fruit drop if fruits are not harvested within 10 days after application.

Aminocyclopropanecarboxylic acid (ACC) is a growth regulator which is a precursor to ethylene and in the plant is converted to ethylene by an enzyme. It is used for fruit thinning from petal fall until 20mm fruit size. It is sold as Accede which is a 10% formulation. ACC has shown the greatest efficacy when fruit sizes are 10mm-20mm and is one of the few products that will give thinning when fruits are larger than 15mm. In NY is has not been effective when fruit size is larger than 20mm. It thinning action is strongly increased by temperatures above 90°F. It has resulted in imporved return bloom when it is used at large fruit sizes (15-20mm).

Naphthaleneacetic acid (NAA) is an auxin-type growth regulator that can induce fruit thinning early in the season and reduce fruit drop late in the season. At very high rates, it can stop the development of watersprouts and rootsuckers. Its use as a chemical thinner is described in the thinning section. Its primary use as a growth regulator is to reduce preharvest drop. When it is used to reduce drop, it does not delay ripening, which may result in overripe fruit that have a shorter storage life if harvest is delayed. The level of drop control depends on rate, with 20 ppm giving better control than 10 ppm; however, the higher rate also advances ripening and may shorten fruit storage life. When combined with ReTain its negative effects on fruit ripening and storage life can be mitigated.

The use of NAA to control rootsuckers is with a formulation that is more active (Tre-Hold) and at rates 1,000 times that of its use as a chemical thinner or for drop control. The Tre-Hold formulation must never be used for thinning or drop control.

Prohexadione-calcium (Apogee, Kudos) is a growth regulator that reduces vegetative growth by inhibiting the synthesis of gibberellins, which are naturally occurring plant hormones that control cell elongation. Growers can expect about a 40-50% reduction in growth from Apogee.

Prohexadione-calcium also limits fire blight development in apple shoots but will not protect against blossom blight infection. Although Prohexadione-calcium has no pesticidal activity on the fire blight bacteria itself, it affects the development of the shoot blight by causing a cessation of shoot growth, which in turn makes the shoots less susceptible to fire blight development. In order to get the maximum benefit in growth reduction and fireblight protection, it is important to make the first application when shoots are 1-3 inches long. This means Prohexadione-calcium must be applied at or before petal fall to have a large effect on shoot growth. Later applications will be less effective at stopping shoot growth. The onset of shoot growth control and resistance against shoot fire blight infections occurs 10 to 14 days after treatment. Thus, apple trees must be treated in a protective manner before shoot blight symptoms develop. After resistance is acquired, it should last from 4-6 weeks. To maintain fire blight protection, a second spray is required if shoots begin to grow again. A low dose provides growth controls for only about 3-4 weeks, while a high dose controls growth for 6-8 weeks. At least two applications will be required to achieve season-long growth control in most New York orchards.

Prohexadione-calcium -treated apple trees usually set more fruit than untreated trees and often Prohexadione-calcium negates the efficacy of chemical thinners, thus it is important that no Prohexadione-calcium be applied either 10 days before or 10 days after the application of chemical thinners. It may also be necessary to use a more agressive thinning strategy. This may mean using an increased dosage of a chemical thinner (30-50% more) or multiple applications of chemical thinners to achieve desired crop load and fruit size. High rates of Prohexadione-calcium (>18 oz/acre/year) can reduce return bloom in some years. Prohexadione-calcium may cause fruit finish and cracking problems on Empire apples.

Table 11.7.1. Growth regulator uses in apples. *(continued)*

Timing	Product	Concentration	Rate of Formulated Product
Induction of Lateral Branching in Nursery Trees			
When terminal shoot is 28-48" long	Promalin	125-500 ppm	0.25-1 pt/5 gal
	Maxcel, Riteway or Exilis	250-500 ppm	8-16 oz/5 gal
Include a non-ionic surfactant and apply as a directed spray to areas where additional branching is desired when terminal shoot is at the height where branches are desired. Apply a second, third and fourth spray at 2 week intervals to stimulate additional branching as the shoot grows.			
Suppression of "Physiological" Fruit Russeting			
Petal Fall	ProVide 10 SG	15-25 ppm	60-100 g/acre
Apply 2-4 applications beginning at petal fall and continuing at 7-10 day intervals. Spray at 100 gallons per acre. Max of 40 oz of ProVide per season. Do not use a surfactant when applying ProVide.			
Increased Flower Bud Development			
Non bearing trees			
2-4 weeks after full bloom	Ethephon	300-450 ppm	1-1.5 pt/100 gal
Bearing trees			
2-7 weeks after full bloom	Ethephon or	150-300 ppm	0.5-1 pt/100 gal
	NAA	10 ppm	4 oz*/100gal
3-4 weeks after full bloom	Accede	200-400ppm	24-46 fl oz/100gal
Spray trees with enough water to uniformly cover the canopy. Apply 4 weekly applications of Ethephon or NAA. Applyu on one applications of Accede. Avoid use of Ethephon on Macoun, Honeycrisp and McIntosh after July 15 due to possible advanced ripening.			
Preharvest Fruit-Drop Control			
2-4 weeks before anticipated harvest	ReTain	30-260 ppm	84-666g/acre or ¼- 2 pouch
Varieties differ significantly in their sensitivity to ReTain. With some varieties the full rate reduces fruit color excessively. For October varieties including Empire, Delicious, Jonagold, NY1, NY2, Amborsia, Idared and Rome, we recommend a full rate of ReTain (1 pouch per acre) applied 4 weeks before harvest. For McIntosh we recommend a half rate of ReTain (1/2 pouch per acre) applied 3 weeks before harvest combined with 10ppm NAA. This will give 2 weeks of drop control. Apply a second spray of a half rate of ReTain (1/2 pouch) at 1 week before harvest. For Gala we recommend a 1/2 rate (1/2 pouch per acre) applied 3 weeks before harvest. For Honeycrisp, which is the most sensitive variety to ReTain, we recommend a 1/3 rate (1/3 pouch per acre) applied 2 weeks before harvest. Apply in sufficient water to ensure thorough but not excessive coverage. For mature trees, this should be 100 gal/acre. An organosilicone surfactant (12 oz/100 gal) should be used with ReTain. In hot years apply ReTain at least 4 weeks before harvest. In cooler years apply ReTain 3 weeks before anticipated harvest.			
1 week before anticipated harvest	Harvista	According to manufacturer recommendation	
Harvista can be applied closer to harvest than ReTain but is ineffective if not applied properly. Follow closely the application suggetions of the manufacturer.			
Drop of first sound fruit	Fruitone-N, Fruitone-L	10-20 ppm	4-8 oz*/ 100 gal
	Pomaxa	10-20 ppm	0.6-1.2 fl. oz./100 gal
Varieties such as McIntosh which are highly prone to preharvest drop require careful monitoring to determine when fruit drop is beginning. Limb-tapping should be used to help determine the onset of drop as fruit near maturity. Approximate duration of drop control varies with dosage: 10 ppm = 6 days; 20 ppm = 10 days. Do not make more than 2 applications. High rates of NAA advance fruit maturity and may shorten fruit storage life.When NAA is combined with ReTain at 3 or 2 weeks before harvest the negative effects of NAA on fruit maturity and storage life can be eliminated.			
Promote Fruit Coloring, Promote Uniform Ripening, Advance Fruit Maturation			
2 weeks before normal harvest	Ethephon	150-300 ppm	0.5-1 pt / 100 gal
If fruit is to placed in CA storage then harvest should be done 7 days after application. If fruit is to be left on the tree longer than 7 days after application of Ethephon then apply NAA at 10-20 ppm 3 days after Ethephonapplication to help control preharvest drop. Ethephonwill cause excessive fruit preharvest drop about 10 days after application if NAA is not used. Any delay in harvest or cooling of fruit treated with Ethephonwill result in unacceptable softening and short storage life.			

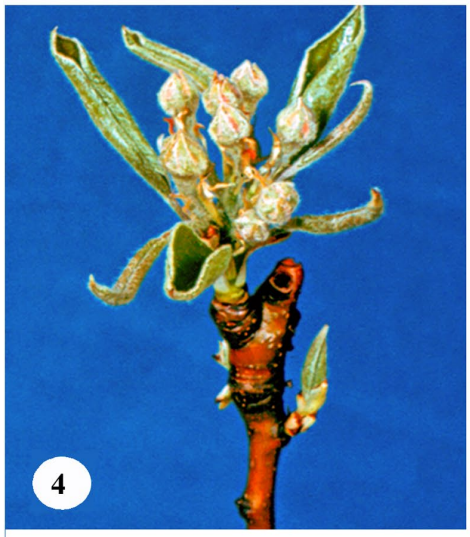


FIGURE 16.

GROWTH STAGES IN PEAR

1. Dormant
2. Swollen bud
3. Bud burst
4. Green cluster
5. White bud
6. Bloom
7. Petal fall
8. Fruit set

12 Pears

12.1 Insecticides and Fungicides for Pears

See Sections 12.2 and 12.3 for comments related to this table.

Table 12.1.1 Pesticide Spray Table – Pears.

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

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Dormant							
Crown rot	P07	Prophyt	2-4 pts/acre	0	4	High	[7.3a]
Fire Blight		oil	1.0 qt/100 gal water				[2.3]
	M 01	§Bordeaux mixture, 8-10-10	8.0 lb/100 gal water				[2.3]
	M01 + M01	C-O-C-S WDG	12.0-15.6 lb/acre	BL	24		
Pear psylla		oil	3 gal/100 gal water			High	[12.1,12.4]
	28	*†Exirel	13.5-20.5 fl oz/acre	3	12	High	[1.1,1.0a,1.2, 12.2,12.5]
Pearleaf blister mite	1B 1B	*Diazinon 50W oil	1 lb/100 gal water 1-1.5 gal/100 gal water	21	96	High	[14.1]
Phytophthora rots	P07	Prophyt	2-4 pts/acre	0	4	High	[7.3a]
San Jose scale	4A	*Assail 30SG	8 oz/acre	7	12	Moderate	[20.1,20.1a,20.2]
	16	*†Centaur 0.7WDG	34.5-46 oz/acre	14	12	High	[20.1,20.2]
Sooty Blotch & Flyspeck	11 + 7	*†Merivon Xemium	4-5.5 fl oz/acre	0	12		
White "Peach" (Prunicola) Scale		oil	2 gal/100 gal water			High	[21.1]
Swollen Bud							
Crown rot	P07	Prophyt	2-4 pts/acre	0	4	High	[7.3a]
Pear midge	3A	§PyGanic 1.4EC	16 fl oz/acre	Until Dry	12	Moderate	[11.1]
	UN	Aza-Direct	11.5-42 fl oz/acre	0	4	Moderate	[11.1]
Pear psylla		DES-X	2 gal/100 gal water	0	12	Moderate	[12.3]
		M-Pede	2 gal/100 gal water	0	12	Moderate	[12.3]
		oil	3 gal/100 gal water			High	[12.1,12.4]
		§Surround 95WP	50 lb/acre	UDH	4	Moderate	[12.6]
	3A	*Asana XL	9.6-19.2 fl oz/acre 7.3-12.8 fl oz/100 gal water	28	12	Moderate	[12.2,12.2a,12.5]
	3A	*Danitol 2.4EC	16 fl oz/acre	14	24	Moderate	[12.2,12.2a,12.5]
	3A	*Mustang MAXX	1.28-4.0 fl oz/acre	14	12	Moderate	[1.1,6.1b,9.1a, 12.2,12.5]
	3A	*Pounce 25 WP	12.8-25.6 oz/acre	PB	12	Moderate	[12.2,12.2a]
	3A	*Warrior II	1.28-2.56 fl oz/acre	21	24		[12.2,12.2a,12.5]
	4A	*†Actara	5.5 oz/acre	14/35(A)	12	High	[5.1c,7.1a,12.2, 12.5]
	4A	*Assail 30SG	4-8 oz/acre	7	12	Moderate	[12.2,12.5]

13 Cherries

13.1 Insecticides and Fungicides for Cherries

See Sections 13.2, 13.3, and 13.4 for comments related to this table.

Table 13.1.1 Pesticide Spray Table – Cherries.

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

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Late Dormant							
Bacterial Canker	M01	Cueva Fungicide Concentrate	0.5 - 2.0 gal/acre	UDH	4	Moderate	[1.1,1.2]
	M01	Cuprofix Ultra 40 Disperss	5.0-8.0 lb/acre	BL, PH	48		[1.2]
	M01	Kocide 3000-O	3.5-7.0 lb/acre 1.11-2.3 lb/100 gal water	BL, PH (C)	48		[1.1]
	M01	Previsto	0.1 - 10 qt/acre	See label	48		[1.1]
	M01 + M01	Badge SC	3.5 - 14 pts/acre	0	48	High	[1.1,1.2]
	M01 + M01	Badge X2	3.5 - 7 lb/acre	0	48		[1.1,1.2]
European Fruit Lecanium	7C	Esteem 35WP	4-5 oz/acre	14	12	High	[16.1,16.1a]
	16	*†Centaur 0.7WDG	34.5 oz/acre	14	12	High	[16.1]
European Red Mite		oil	2 gal/100 gal water			High	[11.1]
Phytophthora rots	4	Ridomil Gold SL	2.0 qt/acre	0	48		[5.2]
	P07	Prophyt	2 pt/acre	0	4	High	[7.3b]
Powdery Mildew	3	*Procure 480SC	8.0-16.0 oz/acre	1	12		
	50	Vivando	15.2 fl oz/acre	7	12		
	3 + 9	Inspire Super	16-20 fl oz/acre	2	12		[4.4,6.1]
San Jose scale		oil	2 gal/100 gal water			High	[16.1]
	4A	*Assail 30SG	5.3-8 oz/acre	7	12	Moderate	[16.1,16.1a,16.2, 16.2a]
	4D	*†Sivanto Prime	10.5-14.0 fl oz/acre	14	4	High	[16.1a,16.2]
	7C	Esteem 35WP	4-5 oz/acre	14	12	High	[16.1,16.1a,16.2]
	16	*†Centaur 0.7WDG	34.5 oz/acre	14	12	High	[16.1,16.2]
White "Peach" (Prunicola) Scale		oil	2 gal/acre			High	[20.1]
	7C	Esteem 35WP	4-5 oz/acre	14	12	High	[20.1a]
White Bud							
Black cherry aphid		Grandevo WDG	2.0-3.0 lb/acre	0	4	Moderate	[9.1,9.2]
		M-Pede	2 gal/100 gal water	0	12	Moderate	[9.1,9.2]
	1B	Malathion 57 EC	1.5 pt/acre	3	12	Moderate	[9.1,9.2]
	3A	*Asana XL	4.8-14.5 fl oz/acre 2-5.8 fl oz/100 gal water	14	12	High	[9.1,9.2]
	3A	*Baythroid XL	2.4-2.8 fl oz/acre	7	12	High	[9.1,9.2]
	3Af	*Warrior II	1.28-2.56 fl oz/acre	14	24	High	[9.1,9.2]
	4A	*Assail 30SG	2.5-5.3 oz/acre	7	12	High	[9.1,9.2]
	4D	*†Sivanto Prime	7.0-14.0 fl oz/acre	14	4	High	[9.1,9.2]
	9D	*†Versys Inscalis	1.5 fl oz/acre			High	[10.1,10.1c]
	28	*†Exirel	13.5-20.5 fl oz/acre	3	12	High	[2.0,9.1,9.2, 10.1c]

14 Peaches and Nectarines

14.1 Insecticides and Fungicides for Peaches and Nectarines

Table 14.1.1 Pesticide Spray Table – Peaches and Nectarines.

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

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Dormant							
Bacterial Canker	M01	Kocide 3000-O	3.5-7.0 lb/acre 1.11-2.3 lb/100 gal water	BL	48		
	M01	Previsto	0.1 - 10 qt/acre	See label	48		
Bacterial Spot	M01	Cueva Fungicide Concentrate	1.0 - 2.0 gal/acre	UDH	4		
	M01	Cuprofix Ultra 40 Disperss	1.0-2.5 lb/acre	SS	48		
	M01	Previsto	0.1 - 10 qt/acre	See label	48		
	M01 + M01	C-O-C-S WDG	12.0-15.6 lb/acre	BL, PF	48		
European Fruit Lecanium		oil	2-3 gal/100 gal water			High	[11.1]
	7C	Esteem 35WP	4-5 oz/acre	14	12	High	[11.2]
European Red Mite		oil	2-3 gal/100 gal water			High	
Leaf Spot	M01	Previsto	0.1-10 qt/acre	See label	48		
Peach Leaf Curl		Echo 720	3.125-4.125 pt/acre	SS	12		
		Echo 90DF	2.25-3.5 lb/acre	SS	12		
	M03	Ziram 76DF	1.5 lb/100 gal water	14	48		
	M01 + M01	Badge SC	3.5 - 14 pts/acre	0	48	High	[3.1]
	M01 + M01	Badge X2	3.5 - 7 lb/acre	0	48	High	
	M01 + M01	C-O-C-S WDG	12.0-15.6 lb/acre	BL, PF	48		
Peach Scab	7 + 3	*†Luna Experience	8.0 to 10 fl oz/acre	0	12	High	
Phytophthora rots	4	Ridomil Gold SL	2.0 qt/acre	0	48		[6.2]
	P07	Prophyt	2 pt/acre	0	4		[7.3c]
San Jose scale	4A	*Assail 30SG	5.3-8 oz/acre	7	12	Moderate	[11.2]
	4D	*†Sivanto Prime	10.5-14.0 fl oz/acre	14	4	High	[11.1a,11.2]
	7C	Esteem 35WP	4-5 oz/acre	14	12	High	[11.2]
	16	*†Centaur 0.7WDG	34.5 oz/acre	14	12	High	[11.2]
White "Peach" (Prunicola) Scale		oil	2 gal/100 gal water			High	[24.1]
	7C	Esteem 35WP	4-5 oz/acre	14	12	High	[24.1a]
Early Spring							
Bacterial Canker	M01	Previsto	0.1 - 10 qt/acre	See label	48		
Bacterial Spot	M01	Previsto	0.1 - 10 qt/acre	See label	48		
Brown Rot	7 + 3	*†Luna Experience	6.0 to 10 fl oz/acre	0	12	High	
Leaf Spot	M01	Previsto	0.1-10 qt/acre	See label	48		
Peach Leaf Curl	7 + 3	*†Luna Experience	6.0 to 10 fl oz/acre	0	12	High	

15 Apricots

15.1 Insecticides and Fungicides for Apricots

See sections 15.2, 15.3, and 15.4 for comments related to this table.

Table 15.1.1 Pesticide Spray Table – Apricots.

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

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Late Dormant							
Bacterial Canker	M01	Cuprofix Ultra 40 Disperss	5.0-8.0 lb/acre	BL	48		[1.1]
	M01	Kocide 3000-O	3.5-7.0 lb/acre 1.11-2.3 lb/100 gal water	BL	48		[1.1]
Bacterial Spot	M01	Cueva Fungicide Concentrate	1.0 - 2.0 gal/acre	UDH	4		
European Fruit Lecanium		oil	2 gal/100 gal water			High	[11.1]
	7C	Esteem 35WP	4-5 oz/acre	14	12	High	[11.1,11.2]
	16	*†Centaur 0.7WDG	34.5 oz/acre	14	12	High	[11.1,11.2]
European Red Mite		oil	2 gal/100 gal water			High	[6.1]
Phytophthora rots	4	Ridomil Gold SL	2.0 qt/acre	0	48		[5.1]
	P07	Prophyt	2 pts/acre	0	4	High	[7.3d]
San Jose scale	4A	*Assail 30SG	5.3-8 oz/acre	7	12	Moderate	[11.1,11.2]
	4D	*†Sivanto Prime	10.5-14.0 fl oz/acre	14	4	High	[11.1,11.1a,11.2]
	7C	Esteem 35WP	4-5 oz/acre	14	12	High	[11.1,11.2]
	16	*†Centaur 0.7WDG	34.5 oz/acre	14	12	High	[11.1,11.2]
White "Peach" (Prunicola) Scale		oil	2 gal/100 gal water			High	[17.1]
	7C	Esteem 35WP	4-5 oz/acre	14	12	High	[17.1a]
Popcorn							
Blossom Blight	3	*Cevya	3.0-5.0 fl oz/acre	0	12	High	
	7	Kenja 400SC	12.5 fl oz/acre	1	12	High	
	7	*†Tesaris	3.5 to 5.5 fl oz/acre	0	12	High	
Brown Rot		Echo 720	3.125-4.125 pts/acre	SS	12		
		Echo 90DF	2.25-3.5 lb/acre	SS	12		
		*†Fontelis	14.0-20.0 fl oz/acre	0	12		[2.4]
	2	Rovral Brand 4 Flowable	1-2 pts/acre	PF	24		
	3	Indar 2F	6.0 fl oz/acre	UDH	12		
	3	Quash	2.5-3.5 oz/acre	14	12		
	3	Rally 40WSP	2.5-6.0 oz/acre 1.25-2.0 oz/100 gal water	UDH	24		
	3	Tilt	4.0 fl oz/acre	0	24		
	7	Kenja 400SC	12.5 fl oz/acre	1	12	High	
	9	Vangard WG	5.0 oz/acre	2	12		
	11	Flint Extra	3.8 fl oz/acre	1	12	Moderate	
	11	GEM 500 SC	2.9-3.8 fl oz/acre	1	12		
	17	Elevate 50WDG	1.0-1.5 lb/acre 0.33-0.5 lb/100 gal water	0	12		
	M04	Captan 50WP	3.0-5.0 lb/acre 2.0 lb/100 gal water	0	24		[2.1]

FIGURE 16.1.1

GROWTH STAGES IN PLUM AND PRUNE

1. Dormant
2. Swollen bud
3. Bud burst
4. Green cluster
5. White bud
6. Bloom
7. Petal fall
8. Fruit set

16 Plums and Prunes

16.1 Plum and Prune Spray Table

Table 16.1.1 Pesticide Spray Table – Plums and Prunes.

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

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Bud Burst							
Black Knot	1	Topsin 4.5 FL	20-30 fl oz/acre	1	48		[1.4]
Blossom Blight	3	*Cevya	3.0-5.0 fl oz/acre	0	12	High	
	7	Kenja 400SC	12.5 fl oz/acre	1	12	High	
	7	*†Tesaris	3.5 to 5.5 fl oz/acre	0	12	High	
Brown Rot	7	Kenja 400SC	12.5 fl oz/acre	1	12	High	
	11 + 7	*†Merivon Xemium	4-6.7 fl oz/acre	0	12	High	[3.9d]
European Fruit Lecanium		oil	2 gal/100 gal water			High	[14.1]
European Red Mite		oil	2 gal/100 gal water			High	[8.1]
Phytophthora rots	P07	Prophyt	2 pts/acre	0	4	High	[7.3e]
San Jose scale		oil	2 gal/100 gal water			High	[14.1]
	4A	*Assail 30SG	5.3-8 oz/acre	7	12	Moderate	[14.1,14.2]
	4D	*†Sivanto Prime	10.5-14.0 fl oz/acre	14	4	High	[14.1,14.1a,14.2]
	7C	Esteem 35WP	4-5 oz/acre	14	12	High	[14.1,14.2]
	16	*†Centaur 0.7WDG	34.5 oz/acre	14	12	High	[14.1,14.2]
White "Peach" (Prunicola) Scale		oil	2 gal/100 gal water			High	[18.1]
	7C	Esteem 35WP	4-5 oz/acre	14	12	High	[18.1a]
White Bud to Petal Fall							
Black Knot	1	Topsin 4.5 FL	20-30 fl oz/acre	1	48		[1.4]
	1	Topsin M WSB	1.0-1.5 lb/acre 0.3-0.5 lb/100 gal water	1	48		[1.4]
Blossom Blight	3	*Cevya	3.0-5.0 fl oz/acre	0	12	High	
	7	Kenja 400SC	12.5 fl oz/acre	1	12	High	
	7	*†Tesaris	3.5 to 5.5 fl oz/acre	0	12	High	
Brown Rot		Echo 720	3.125-4.125 pts/acre 1.0-1.4 pt/100 gal water	SS	12		
		Echo 90DF	2.25-3.5 lb/acre	SS	12		
		*†Fontelis	14.0-20.0 fl oz/acre	0	12		[2.6]
	3	*Cevya	3.0-5.0 fl oz/acre	0	12	High	
	3	Indar 2F	6.0 fl oz/acre	UDH	12		
	3	Quash	2.5-3.5 oz/acre	14	12		
	3	Rally 40WSP	2.5-6.0 oz/acre 1.25-2.0 oz/100 gal water	UDH	24		
	3	Tilt	4.0 fl oz/acre	0	24		[2.5]
	7	Kenja 400SC	12.5 fl oz/acre	1	12	High	
	7	*Miravis	5.1 fl oz/acre	0	12	High	

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
cyfluthrin						
*Baythroid XL 1E, 2EC, *Leverage 360	7	7	7	7	7	7
diazinon						
*Diazinon 50WP	21/PF(A)	21	21	21	21	21

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
Fungicides and Bactericides *(continued)*						
ziram						
Ziram 76DF	14	30	14	14	14	*NR*

Key:

BL Do not apply beyond bloom.
BS Do not apply between budswell and final harvest
GT Do not apply beyond green tip.
HIG Do not apply beyond 1/2-in green.
NB Non-bearing
NL None listed
PB Prebloom applications only.
PF Do not apply beyond petal fall.
PH Postharvest applications allowed. In the case of herbicides, apply after harvest before soil freezes.
SS Do not apply beyond shuck split.
UDH Up to day of harvest.
2C Do not apply after 2d cover spray.
(A) If more than one value is given, depends on rate, method and/or number of applications; check label.
(B) Nonbearing trees only.
(C) Tart cherries only.
(D) Sweet cherries only

[1] peaches/nectarines

NR Not registered for use on crop
— Follow REI as described on label.
* Restricted-use pesticide.
† Not for use in Nassau and Suffolk Counties.

Table 17.1.2. Common names, product names, formulations, and days-to-harvest for growth regulators.

Product Name	Common Name	Formulation	EPA Reg. No.	Crop	Preharvest Interval
Accede	aminocyclopropanecarboxylic acid (ACC)	10% LC	73049-517	Apple Peach	-
Amid-Thin W	naphthalene-acetamide	8.4 WP	5481-426	Apple, pear	—
Apogee	prohexadione calcium	27.5% DF	7969-188	Apple	45 days
Ethephon	ethephon	2 lb/gal	various	Apple, cherries	7 days
Exilis 9.5 SC	cytokinin	9.5% liquid	62097-33-82917	Apple	86 days
Falgro 4L	gibberellin 3	4.0% liquid	62097-2-82917	Cherry, stone fruit, prune	0 days
Fruitone L	naphthalene-acetic acid	3.5% liquid	5481-541	Apple, pear	2 days
Fruitone N	naphthalene-acetic acid	3.5% WP	5481-427	Apple, pear	2 days
Harvista	1-MCP	1.3% SC	71297-17	Apple, pear	3 days
Kudos	prohexadione calcium	27.5% WDG	62097-41-82917	Apple, pear cherry	45 days
Maxcel	cytokinin BA	1.9%	73049-407	Apple, pear	86 days
Perlan	cytokinin BA+gibberellin 4+7	1.8% + 1.8% liquid	62097-6-82917	Apple, pear, sweet cherry	—
Pomaxa	naphthalene-acetic acid	3.5% liquid	73049-487	Apple, pear	7 days
Pro-Gibb 4%	gibberellic acid 3	4% liquid	73049-15	Cherry, stone fruit, prune	0 days
Promalin	cytokinin BA+gibberellin 4+7	1.8% + 1.8% liquid	73049-41	Apple, pear, sweet cherry	—
ProVide 10SG	gibberellin 4+7	10% SG	73049-409	Apple	—
ReTain	AVG	15% SP	73049-45	Apple, pear, stone fruit	7 days
RiteWay	cytokinin BA	1.9% liquid	71368-60	Apple, pear	86 days
Typy	cytokinin BA+gibberellin 4+7	1.8% + 1.8% liquid	55146-78	Apple, pear, sweet cherry	—

— Preharvest interval information not provided on label.

17.2 EPA numbers and worker protection standard re-entry and personal protective equipment (PPE) guidelines.

Worker Notification: Under most circumstances, worker employers must make sure that workers are notified about areas where pesticide applications are taking place or where restricted-entry intervals are in effect. For details on notification requirements both for these products and those not represented below, refer to the product label and the Worker Protection Standard, 40 CFR part 170.

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
Acramite 50WS	70506-536	bifenazate	12	acfh	cfk
*†Actara	100-938	thiamethoxam	12	acf	cfk
*Admire Pro 4.6SC	264-827	imidacloprid	12	acf	cfk
§Agree WG	70051-47	Bt	4	abcl	bck
*†Agri-Flex SC	100-1350	abamectin, thiamethoxam	12	acf	cdf
*Agri-Mek 8SC	100-1351	abamectin	12	acf	cdf
*†Altacor 35 WDG	279-9607	chlorantraniliprole	4	ac	ac
Apollo SC	66222-47	clofentezine	12	acf	cfk
*Asana XL	59639-209	esfenvalerate	12	acfh	cfhk
*Assail 30SG	8033-36-70506	acetamiprid	12	acfj	bck
Avaunt	279-9587	indoxacarb	12	acf	efg
Aza-Direct 1.2L	71908-1-10163	azadirachtin	4	acf	cfk
Banter SC	70506-322	bifenazate	12	acif	cfk
Banter WDG	70506-316	bifenazate	12	abch	cfk
*Baythroid XL 1EC	264-840	beta-cyfluthrin	12	acfh	cfhk
Beleaf 50SG	71512-10-279	flonicamid	12	abc	bck
*†Besiege CS-SC	100-1402	lambda-cyhalothrin/ chlorantraniliprole	24	acf	cfk
*Brigade WSB	279-3108	bifenthrin	12	abcf	bck
*Brigade 2EC	279-3313	bifenthrin	12	acf	cfk
*†Centaur 0.7WDG	71711-21	buprofezin	12	abcfj	bce
§Checkmate CM 2.0	56336-37	pheromone	4	abcj	bcd
§Checkmate OFM-F 24.6S	56336-24	pheromone	0	abc	—
§Cidetrak CM-OFM Combo	51934-11	pheromone	0	fh	—
§Cidetrak CMDA+LR Dual Meso	51934-18	pheromone	0	fh	—
§Cidetrak CMDA Combo Meso-A	51934-16	pheromone	0	fh	—
§Cidetrak DA MEC	51934-12	pheromone	4	acfh	acfh
§Cidetrak OFM-L Meso	51934-20	pheromone	0	—	—
§Cyd-X 0.06SC	70051-44	Cydia pomonella granulosis virus	4	abc	bck
*Danitol 2.4EC	59639-35	fenpropathrin	24	acfh	cfhk
Delegate WG	62719-541	spinetoram	4	ac	cfk
Deliver 18WG	70051-69	Bt	4	abcl	bck
Des-X 4.07LC	67702-22-70051	insecticidal soap	12	dfghij	dfghj
*Diazinon 50W	66222-10	diazinon	96	acfi	efgj
*Dimethoate 400	34704-207	dimethoate	10 days	acfil	efgj
§Dipel DF	73049-39	*Bacillus thuringiensis*, subsp. *kurstaki*	4	abc	bck
*†Endigo ZC	100-1276	lambda-cyhalothrin, thiamethoxam	24	dfgij	dfgj
§Entrust 80WP	62719-282	spinosad	4	ac	bck
§Entrust 2SC	62719-621	spinosad	4	ac	cfk

Table continued on next page.

17.4.2 Other References

Tree Fruit Field Guide to Insect, Mite, and Disease Pests and Natural Enemies of Eastern North America. NRAES-169, 238 pp.
Hard copy – https://www.cornellstore.com/PALS-Tree-Fruit-Field-Guide-NRAES-169
Online version: http://www.ipm.msu.edu/search

Lake Ontario Fruit Program Resources

Apple IPM for Beginners. 2015. http://lof.cce.cornell.edu/submission.php?id=271&crumb=pests|pests

Managing Codling Moth and Oriental Fruit Moth in Apples. 2013. http://rvpadmin.cce.cornell.edu/uploads/doc_72.pdf

Stone Fruit IPM for Beginners. Great Lakes Fruit Workers, Michigan State Univ. Extension & Cornell Cooperative Extension. 74 pp. http://bit.ly/stone-fruit-ipm

New York Fruit Quarterly

Online at **nyshs.org/fruit-quarterly/**

Scaffolds Newsletter (back issues, 1995-2020)

Online at: **www.scaffolds.entomology.cornell.edu**

Extension Bulletins

IB 219	Orchard Nutrition Management. 1991.	Online at: **hdl.handle.net/1813/3305**
IB 221	Predicting Harvest Date Windows for Apples. 1992.	Online at: **hdl.handle.net/1813/3299**

Food and Life Sciences Bulletins

Online at: **https://ecommons.cornell.edu/handle/1813/1498**

FLS 50	Green Fruitworms. 1974.	online
FLS 53	Empire, a High Quality Dessert Apple. Reprinted 1992.	online
FLS 58	Growth Stages in Fruit Trees – From Dormant to Fruit Set. 1976.	online
FLS 92	Biology and Control of Cytospora Fungi in Peach Plantings. 1982.	online
FLS 95	Blister Spot of Apple. 1982.	online
FLS 108	Diagnostic Keys for Diseases of Apple, Peach and Cherry. 1984.	online
FLS 116	Chemical Thinning of Apples. 1986.	online
FLS 117	Peach and Nectarine Varieties in New York State. 1986.	online
FLS 118	Preventing Decomposition of Agricultural Chemicals by Alkaline Hydrolysis in the Spray Tank. 1986.	online
FLS 119	IPM in New York Apple Orchards – Development, Demonstration, and Adoption. 1987.	online
FLS 123	Basing European Red Mite Control Decisions on a Census of Mites Can Save Control Costs. 1988.	online
FLS 124	Insects Associated with Apple in the Mid-Atlantic States. 1988.	online
FLS 127	Sweet and Tart Cherry Varieties: Descriptions and Cultural Recommendations. 1989.	online
FLS 128	The Effects of Ground Cover Manipulations on Pest and Predator Mite Populations on Apple in Eastern New York. 1989.	online
FLS 133	Northern Lights Apple. 1990.	online
FLS 134	Royal Empire Apple, a Highly Colored Sport of Empire. 1990.	online
FLS 142	Fruit Pest Events and Phenological Development According to Accumulated Heat Units. 1993.	online
FLS 143	Sampling Second Generation Spotted Tentiform Leafminer. 1993.	online
FLS 145	Minimal Processing of New York Apples. 1995.	online
FLS 147	Fortune Apple. 1995.	online
FLS 150	Jonagold, Apple Facts Varieties of Commercial Interest. 1997.	online
FLS 158	New York Integrated Fruit Production Protocol for Apples. 2006 plus appendix.	online

Organic Production Manual

NYS IPM Publication No. 223	A Grower's Guide to Organic Apples. 2009. Online at: ecommons.cornell.edu/handle/1813/42886

Brown Marmorated Stink Bug Fact Sheets and Links

Eastern NY Brown Marmorated Stink Bug Project
blogs.cornell.edu/jentsch/brown-marmorated-stink-bug/

New Jersey
njaes.rutgers.edu/stinkbug

17.7 Campus-Based Extension Faculty and Staff *(continued)*

Faculty/Staff Member	Area of Specialization	Phone/Email
Olga Padilla-Zakour NYS Food Venture Center Cornell AgriTech, Geneva	**Fruit processing, processing regulation**	315-787-2259 oip1@cornell.edu
Gregory M. Peck School of Integrative Plant Science, Horticulture Section Cornell University, Ithaca	**Sustainable fruit systems**	607-255-7122 gmp32@cornell.edu
Brad Rickard Dept. of Applied Economics and Management Cornell University, Ithaca	**Horticultural marketing/food policy**	607-255-7417 bjr83@cornell.edu
Monique Rivera Dept of Entomology Cornell AgriTech, Geneva	**Tree fruit arthropods**	mjr422@cornell.edu
Terence Robinson School of Integrative Plant Science, Horticulture Section Cornell AgriTech, Geneva	**Tree fruit culture and management**	315-787-2227 tlr1@cornell.edu
Lynn Sosnoskie School of Integrative Plant Science, Horticulture Section Cornell AgriTech, Geneva	**Weed management**	315-787-2231 lms438@cornell.edu
Christopher B. Watkins School of Integrative Plant Science, Horticulture Section Cornell University, Ithaca	**Postharvest handling**	607-255-1784 cbw3@cornell.edu
Anna Wallis Fruit IPM Coordinator Cornell IPM Program Cornell AgriTech, Geneva	**Fruit IPM**	443-421-7970 aew232@cornell.edu
Cornell Integrated Pest Management Program Pesticide Safety Education CALS Surge Facility 525 Tower Road Cornell University, Ithaca	**Pesticide registration, pesticide applicator certification, and pesticide information**	607-255-1866 psep.cce.cornell.edu pmep_webmaster@cornell.edu

Tips for Laundering Pesticide-Contaminated Clothing

Pre-Laundering Information

Remove contaminated clothing **before** entering enclosed tractor cabs.

Remove contaminated clothing **outdoors** or in an entry. If a granular pesticide was used, shake clothing outdoors. **Empty pockets and cuffs.**

Save clothing worn while handling pesticides for that use only. Keep separate from other clothing **before, during, and after** laundering.

Wash contaminated clothing after **each** use. When applying pesticides daily, wash clothing **daily**.

Clean gloves, aprons, boots, rigid hats, respirators, and eyewear by scrubbing with detergent and warm water. Rinse thoroughly and hang in a clean area to dry.

Take these **precautions** when handling contaminated clothing:

- Ventilate area.
- Avoid inhaling steam from washer or dryer.
- Wash hands thoroughly.
- Consider wearing chemical-resistant gloves.
- Keep out of reach of children and pets.

Air

Hang garments outdoors to air.

Pre-rinse

Use one of three methods:

1. Hose off garments outdoors.
2. Rinse in separate tub or pail.
3. Rinse in automatic washer at full water level.

Pretreat (heavily soiled garments)

Use heavy-duty liquid detergent.

Washer Load

Wash garments separate from family wash.

Wash garments contaminated with the same pesticide together.

Never use the “sudsaver” feature on your machine when laundering pesticide-soiled clothes.

Load Size

Wash only a few garments at once.

Water Level

Use full water level.

Water Temperature

Use **hot** water, as hot as possible.

Wash Cycle

Use **regular** wash cycle, at least 12-minutes.

Laundry Detergent

Use a **heavy-duty** detergent.

Use amount recommended on package or more for heavy soil or hard water.

Remember to use high-efficiency (HE) detergents in HE and front-loading washers.

Rinse

Use a **full** warm rinse.

Rewash

Rewash contaminated garments **two or three times** before reuse for more complete pesticide removal.

Dry

Line drying is preferable to avoid contaminating dryer.

Clean Washer

Run complete, but empty, cycle.
Use **hot water and detergent.**

Prepared by Charlotte Coffman, College of Human Ecology, Department of Fiber Science and Apparel Design, Cornell University

PESTICIDE EMERGENCY NUMBERS

Emergency responder information on pesticide spills and accidents…
CHEMTREC 800-424-9300

For pesticide information…
National Pesticide
Information Center 800-858-7378

To Report Oil and Hazardous Material Spills in New York State…
NYS Spill Hotline 800-457-7362

Poison Control Centers…
Poison Control
Centers Nationwide 800-222-1222

To order additional copies of this publication, contact your local Cornell Cooperative Extension office or order directly from the Cornell Store, Attn: PMEP, 135 Ho Plaza, Cornell University, Ithaca, NY 14853. Phone 844-688-7620. Additional copies and online access can also be ordered online at: https://www.cornellstore.com/books/cornell-cooperative-ext-pmep-guidelines.

This publication is issued to further Cooperative Extension work mandated by acts of Congress of May 8 and June 30, 1914. It was produced with the cooperation of the U.S. Department of Agriculture, Cornell Cooperative Extension, New York State College of Agriculture and Life Sciences, New York State College of Human Ecology, and New York State College of Veterinary Medicine, at Cornell University. Cornell Cooperative Extension provides equal program and employment opportunities.

Alternative formats of this publication are available on request to persons with disabilities who cannot use the printed format. For information call or write the Office of the Director, Cornell Cooperative Extension, 365 Roberts Hall, Ithaca, NY 14853 (607-255-2237).

This information is presented with the understanding that no product discrimination is intended and no endorsement of any product mentioned or criticism of unnamed products is implied.

Published by:
Cornell Integrated Pest Management Program
Pesticide Safety Education
CALS Surge Facility
525 Tower Road
Cornell University
Ithaca, New York 14853-7401
607.255.1866
Michael Helms, Managing Editor
(mjh14@cornell.edu)