2018
New York and Pennsylvania Pest Management Guidelines for Grapes

Cornell Cooperative Extension

PennState Extension

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

1 Pesticide Information

1.1 Pesticide Classification and Certification

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) created two classifications of pesticides – general-use and restricted-use. **General-use pesticides** may be purchased and used by anyone. **Restricted-use pesticides can** only be purchased by a certified applicator. Restricted-use pesticides must also be used by a certified applicator or someone under their supervision.

The same federal law that classifies pesticides divided applicators into two groups: private and commercial. **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. A farmer must be certified as a private applicator in order to purchase and use restricted-use pesticides on agricultural commodities. (No certification is needed if a farmer does not use restricted-use pesticides.)

A **commercial applicator** uses or supervises the use of pesticides for any purpose or on any property not covered by the private applicator classification. In New York, a commercial applicator must be certified to purchase or use any pesticide whether it is general- or restricted-use.

Information about pesticide certification and classification is available from your Cornell Cooperative Extension office (cce.cornell.edu/localoffices), regional NYSDEC pesticide specialist (www.dec.ny.gov/about/ 558.html), the Pesticide Applicator Training Manuals (store.cornell.edu/c-876-manuals.aspx), or the Pesticide Management Education Program (PMEP) at Cornell University (psep.cce.cornell.edu).

1.2 Use Pesticides Safely

Using pesticides imparts a great responsibility on the user to protect their health and that of others and to protect the environment. Keep in mind there is more to "pesticide use" than the application. Pesticide use 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 are also regulated by state and federal laws and regulations intended to protect the user, the community, and the environment from any adverse effects pesticides may cause.

1.2.1 Plan Ahead

Many safety precautions should be taken *before* you actually begin using pesticides. Too many pesticide applicators are dangerously and needlessly exposed to pesticides while they are preparing to apply them. Most pesticide accidents can be prevented with informed and careful practices. **Always read the label on the pesticide container before you begin to use the pesticide.** Make sure you understand and can follow all directions and precautions on the label. Be prepared to handle an emergency exposure or spill. Know the first aid procedures for the pesticides you use.

1.2.2 Move Pesticides Safely

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

1.2.3 Personal Protective Equipment and Engineering Controls

Personal protective equipment needs depend on the pesticide being handled. ***Required personal protective equipment (PPE) are listed on pesticide labels.*** The required PPE are based on the pesticide's toxicity, route(s) of exposure, and formulation. Label required PPE are the minimum that must be worn during the pesticide's use. Pesticide users can always wear more protection than the label requires.

The type of protective equipment used depends on the type and duration of the activity, where pesticides are being used, and exposure of the handler. Mixing/loading procedures often require extra precautions. Studies show you are at a greater risk of accidental poisoning when handling pesticide concentrates. Pouring pesticide concentrates from one container to another is the most hazardous activity. More information on personal protective equipment can be found online at umes.edu/ NC170/Default.aspx?id= 7184.

Engineering controls are devices that help prevent accidents and reduce a pesticide user's exposure. One example is a closed mixing/loading system that reduces the risk of exposure when dispensing concentrated pesticides. More information on engineering controls can be found online at umes.edu/NC170/Default.aspx?id=7196.

1.2.4 Avoid Drift, Runoff, and Spills

Pesticides that move out of the target area can injure people, damage crops, and harm the environment. Choose weather conditions, pesticides, application equipment, pressure, droplet size, formulations, and adjuvants that

2 Introduction

2.1 Overview

How do you decide which pest management strategy is right for you? The variety of choices can be daunting: integrated pest management, sustainable, integrated crop management, organic, best management practices, biodynamics, or traditional, just to name a few. However, what it boils down to is that it doesn't really matter what you call your pest management strategy. Consider which practices work best for you in a particular vineyard. Take the best tools from each of the different programs to provide you with the management strategy that fits your needs and pocketbook.

The one component that every successful pest management strategy shares is information. By gathering and compiling the right information, you will be able to make the best choices in putting together your vineyard pest management strategy.

2.2 Specific Fungicide, Insecticide, and Herbicide Information

The following materials have been registered for the control of certain insects, diseases, and weeds affecting grapes. The trade name and (common) name are given, as well as selected uses for each material. The signal word associated with each pesticide indicates its relative level of toxicity. High toxicity indicates that small quantities of the chemical may cause serious illness or death.

2.2.1 Pesticide Toxicity

The toxicity of a chemical typically is measured with a Lethal Dose 50 (LD50) value. This value is the dosage necessary to kill 50 percent of a laboratory population of test animals (rats, mice, or rabbits). These toxicity values may be expressed in terms of a single dosage in milligrams per kilogram of body weight. LD50 values are useful in comparing different pesticides, as the degree of hazard to a person handling a pesticide is directly related to toxicity.

The following classification was established to aid users of pesticide chemicals:

High toxicity: Acute oral LD50 from a trace to 50 mg/kg. From 4 to 100 drops (1 teaspoon) of technical pesticide may be lethal to a 150-pound person. Label must carry signal word DANGER. A skull and crossbones on the label indicates poison.

Moderate toxicity: Acute oral LD50 from 50 to 500 mg/kg. From 1 teaspoon to 1 ounce of technical pesticide may be lethal to a 150-pound person. Label must carry signal word WARNING.

Low toxicity: Acute oral LD50 greater than 500 mg/kg. From 1 ounce to 1 pint of technical pesticide may be lethal to a 150-pound person. Label must carry signal word CAUTION.

2.2.2 Pesticide Compatibility

Some pesticides are unstable or incompatible under alkaline conditions. Well or pond water used to fill sprayers can be alkaline, and pH should be tested and adjusted if over 7.0. Do not apply tank-mix combinations unless your previous experience indicates the mixture is effective and will not result in application problems or plant injury. If tank-mix compatibilities are unknown, the mixture should be combined in the proper proportions using a jar test. CAUTION: Fixed copper formulations and lime should not be used with Captan, Imidan, or Sevin.

2.2.3 Adjuvants with Fungicides and Insecticides

The addition of adjuvants (spreader-stickers, penetrants, etc.) to spray mixtures of fungicides and insecticides is not recommended unless suggested on the pesticide label or supported by reliable data. Many fungicide and insecticide formulations already include an adjuvant; thus, addition of another adjuvant is often counterproductive or a waste of money.

2.2.4 Restricted-Use Pesticides

Restricted-use pesticides recommended in this publication are identified by an asterisk (*). They may be purchased and used only by certified applicators or used by someone under the direct supervision of a certified applicator.

2.2.5 Pesticide Resistance Management

The ability of various fungicides, insecticides, and herbicides to control specific grape pests has been reduced (and, in some cases, eliminated) because pests developed resistance to these materials. Resistance occurs when some individual pests survive treatment with the pesticide. They multiply and pass this resistance on to their young. Because individuals that are controlled by the chemical die, or reproduce poorly, over time the population becomes dominated by individuals that are resistant to it. This process is favored by a number of factors, the most common of which are:

1. Multiple applications of a single product or class of compounds (strobilurin fungicides, organophosphate insecticides, etc.);
2. An exclusive reliance on a single product (or class) to manage the pest;
3. Repeated treatments of large pest populations with the products (e.g., "rescue" treatments); and, in some cases

3 Vineyard Disease Management

3.1 Pest Information – Diseases

Several important insects and diseases that occur in New York and Pennsylvania vineyards are described below to help growers manage these pests with practices and pesticides appropriate for their production systems.

ANGULAR LEAF SCORCH was first described in 1985. Symptoms of this fungal disease are similar to those of rotbrenner, a disease of grapevines found in the cool grape-growing regions of Europe, which is caused by a very closely related fungus. Angular leaf scorch occurs sporadically, and is most likely to become a problem in years when high rainfall occurs between bud break and early summer, especially if this should happen in consecutive years. Riesling appears to be a particularly susceptible cultivar.

Disease symptoms occur mainly on the leaves and first appear as faint chlorotic spots. As these lesions grow larger, they change from yellow to reddish-brown and the margin often becomes sharply defined (depending on the cultivar, the margin may be yellow, red, or absent). Lesions are confined by major veins, becoming "angular" or wedge-shaped. They eventually kill the infected tissue, sometimes crossing the major veins in the process and often causing diseased leaves to fall prematurely.

The fungus survives winter in infected leaves on the vineyard floor. Mature spores are ready for discharge in spring when grape buds begin to grow. During rainfall, spores are released into the air from fruiting structures, and susceptible tissue is infected.

Cultural practices that increase air circulation through the canopy can shorten periods of leaf wetness that favor disease development. Destruction of leaf litter by cultivation, before bud break, can also reduce disease pressure. Where needed, effective fungicides applied from the 3-inch stage and continuing through fruit set will provide significant control. Although there are no specific labels for the control of this disease, mancozeb products (e.g., Dithane, Penncozeb) applied according to label directions to control Phomopsis, black rot, and downy mildew also have provided good control of angular leaf scorch in commercial experience. In Europe, the strobilurin fungicides (Abound, Flint, Pristine, Sovran) have provided good control of the closely related disease, rotbrenner. However, experience with angular leaf scorch is lacking. The DMI fungicide, difenoconazole (Revus Top, Quadris Top; CAUTION: Quadris Top causes injury to Concord and some other cultivars) is labeled for control of rotbrenner and should provide significant post-infection control of this disease in addition to moderate protective activity (excellent protective activity for Quadris Top). See Table 3.1.2 for varietal susceptibility to this disease.

ANTHRACNOSE is a disease that occurs most commonly in years that are wet during the first half of the growing season, with damage typically limited to a few highly susceptible cultivars. In NY/PA, most outbreaks historically occurred on Vidal Blanc and a few seedless table grape varieties, especially Reliance. In recent years, however, there have been regular outbreaks on some of the newer cold-hardy cultivars that are gaining in popularity and expanding the geographical range of grape production. Marquette appears to be particularly susceptible, although Frontenac and La Crescent also have been affected. Some older cold-hardy cultivars (Edelweiss, Esprit, Brianna, St. Pepin, and Swenson White) also can be problematic. In some Midwestern states, Concord, Catawba, and Leon Millot have been reported as encountering problems, although such occurrences are rare in NY and PA. Symptoms occur on leaves, green shoots, and clusters. On leaves, numerous small, circular brown spots appear which later turn gray in the center and develop dark brown to black margins. In severe attacks, lesions may coalesce and cause large dead zones, distortion of the leaf blade, and eventually death of the entire leaf. Infected shoots develop dark, noticeably sunken lesions, typically on the first several internodes near the base of the new shoot. These lesions resemble the internode lesions typical of Phomopsis cane and leaf spot but they usually are more aggressive, expanding farther along the shoot and deeper into its center than those caused by Phomopsis. On berries, spots approximately 0.25-in in diameter develop, with whitish-gray centers surrounded by reddish brown to black margins, sometimes producing an appearance that superficially resembles a bird’s eye. Severely affected berries may shrivel and dry into mummies.

The fungus overwinters primarily on infected canes, although the previous year's berries can also be a source. In spring, spores are produced from the fungal structures on these sources and are dispersed by splashing raindrops to young, susceptible tissues, where they cause infection if wetness persists for a sufficient length of time. Temperatures in the mid-70s to mid-80s Fahrenheit (25-30°C) are optimal and require only 3 to 4 hours of leaf wetness for infection to occur. However, infection can also occur across a much wider range of temperatures, including those that typically prevail during the early growing season in upstate NY, if it remains wet for long enough. Additional spores, which also are splash dispersed, are produced from new infections, and these can rapidly spread the disease through multiple repeating cycles of new infection and additional spore production. Hence, outbreaks occur most frequently in years with multiple rain events early and mid-season. Young tissues are most susceptible, becoming resistant as they are mature; for example, berries become relatively resistant by about 7 weeks post-bloom.

mix alternatives or combination products available for control of strobilurin-resistant downy mildew populations.

FRACTURE 2.1SC (BLAD protein) - read the label

Signal word: CAUTION

Medical emergency: (800) 331-3148

Chemical/fungicide family: biopesticide

Resistance Group Number: N/A

Resistance risk: unknown

Physical mode of action: protectant; some post-infection versus powdery mildew?

Selected uses: Botrytis, powdery mildew, sour rot

Comments: Fracture is a product whose active ingredient is derived from a naturally occurring plant protein, which acts by breaking down fungal cell walls. In limited NY and PA trials, which began in 2015, it provided good control of Botrytis and sour rot; it also provided good control against powdery mildew in one low-pressure NY trial in 2016 and moderate control against powdery mildew in two PA trials in 2016 and 2017. Fracture has a 4-hr REI and a 1-day PHI.

***NY GAVEL 75DF** (zoxamide + mancozeb) - read the label

Signal word: CAUTION

Medical emergency: (888) 478-0798

Chemical/fungicide family: benzamide + EBDC

Resistance Group Number: 22

Resistance risk: moderate (zoxamide) + low (mancozeb)

Mode of action: protectant, post-infection, antisporulant (?)

Selected uses: downy mildew

Comments: *NY Gavel is a product that combines two active ingredients: (i) zoxamide, a downy mildew-specific fungicide unrelated to any other materials on the market; and (ii) mancozeb. When applied at the labeled rate of 2.0-2.5 lb/A, it provides the same amount of mancozeb as 1.8-2.2 lb of standard 75DF formulations of other mancozeb products such as Dithane, Penncozeb, etc. Thus, for control of diseases other than downy mildew, *NY Gavel should be applied with sufficient quantities of another mancozeb product to provide a dosage equivalent to 3-4 lb/A of the 75DF formulations of a solo mancozeb product. *NY Gavel has provided fair to good control of downy mildew when applied at 14-day intervals in several NY trials.

INSPIRE SUPER 2.82SC (8.4% difenoconazole + 24.1% cyprodinil) - read the label

Signal word: CAUTION

Medical emergency: (800) 888-8372

Chemical/fungicide family: sterol inhibitor [DMI subgroup] + analinopyrimidine

Resistance Group Numbers: 3, 9

Resistance risk: moderate (difenoconazole) + high (cyprodinil)

Physical mode of action: post-infection, antisporulant, limited protectant

Selected uses: anthracnose**,** black rot, Botrytis, powdery mildew

Comments: Inspire Super contains a mixture of two active ingredients: (i) difenoconazole, a DMI fungicide (also found in Revus Top and Quadris Top) with excellent activity against powdery mildew, black rot, and anthracnose; and (ii) cyprodinil, the active ingredient in Vangard, which provides Botrytis activity. The label rate is 16-20 fl oz/A; 20 fl oz of this product contains the same amount of difenoconazole as 7 fl oz of Revus Top (label rate) or 14 fl oz of Quadris Top (maximum label rate) and also contains the same amount of cyprodinil as 7 oz of Vangard (70% of label rate). Inspire Super has a 12 hr REI and a 14 day PHI.

RESISTANCE WARNING: Powdery mildew resistance to the DMI fungicides (difenoconazole products [Inspire Super, Quadris Top, Revus Top], flutriafol products [†Rhyme, †Topguard EQ], Mettle, Rally, tebuconazole products, triflumizole products [*NY Procure, *NY Viticure]) is a common problem throughout the world, including New York and Pennsylvania. Although many of these fungicides continue to provide significant commercial control in most vineyards, they generally are less effective than they were in the past and most should not be relied upon as the primary tool for powdery mildew management, especially during the critical bloom through early post-bloom period. Nevertheless, the DMI fungicides will continue to be valuable in rotational programs with other powdery mildew fungicides, so it is important to implement four basic resistance management strategies to maintain their usefulness:

- Limit the total number of DMI (Group 3) sprays to a maximum of three per year, ideally with no two sprays in a row.
- Maintain full recommended rates on the vine (i.e., full rates in the tank PLUS excellent spray coverage).
- Do not use the DMIs if more than a very modest amount of powdery mildew is present (i.e., use early season or to maintain a clean vineyard postbloom).
- Do not exceed 14-day spray intervals, even when labels allow it - most of these labels were written years ago, when the fungicides were more active than they are now.

In addition to use rate and spray coverage, efficacy of any specific DMI product is affected by the "intrinsic" activity of its active ingredient, i.e., how much of it is needed to provide a certain level of control. Recent laboratory tests and field trials indicate that difenoconazole is significantly more active than the other DMIs with which it has been

4 Vineyard Insect & Mite Management

4.1 Pest Information – Insects

BANDED GRAPE BUG is a sporadic pest of grapes in the Finger Lakes and Lake Erie regions and does not require treatment in most years. Nymphs of this insect emerge in the spring and feed on flowers and young berries, using their sucking and piercing mouth parts. The nymphs range in size from 1/8- to 1/2-inch in length, depending on the stage. Injury by small nymphs, occurring between 3- to 5-inch shoot growth (around May 15) and early June, results in floret drop, reduced berry set, and fewer clusters. Subsequent feeding by larger nymphs and adults does not affect cluster development. Economic injury can occur when more than 1 nymph per 10 shoots are present. This injury only occurs in the prebloom stages. Subsequent feeding by nymphs does not reduce berry set. Adults appear to be predaceous and do not cause injury to berries. Look for nymphs on grape clusters and shoot tips prior to the bloom period. They can be recognized by their long, banded antennae.

BROWN MARMORATED STINK BUG (BMSB) is a new invasive species in New York that may present problems for grapes. This stink bug, originally from Asia, was first observed in PA and has spread to many regions and has become particularly abundant in the mid-Atlantic states. It is present in NY and PA grape-growing regions, although at this time at relatively low numbers. BMSB uses its sucking mouthparts to feed on reproductive structures of many different crop plants, including grapes. At high densities, damage can be extensive. BMSB also produces strong odors that have the potential of tainting grape juice. Recent research indicates the offending compounds are not very stable and break down during fermentation. Even without fermentation, odors are relatively unstable and may not be of significant concern except when consumed close to harvest.

CLIMBING CUTWORMS are known to feed on grapes. Larvae hide in the soil litter below the grape trellis and climb onto vines on warm nights to feed on developing primary buds. Only during bud swell are cutworms able to inflict serious damage to a vineyard. To examine vines for cutworms, search under the bark and in the soil litter beneath a vine with damaged buds, or search the vine with a flashlight after dark.

EUROPEAN CORN BORER is an important lepidopteran pest of corn, but it is also known to feed on over 200 other plant species, including grapes. Corn borer problems are rare, but under some circumstances, may require management. They are usually found in *Vinifera* varieties, especially vines with excessive foliage or where vineyards are weedy or surrounded by corn, sorghum, Sudan grass, or related crops. Young vineyards or nursery stock may be more seriously affected by borer injury than mature vines. The larvae vary in color, ranging from creamy to light gray to faint pink, with very small, round, dark brown spots on each segment and a dark-colored head capsule. After initially feeding on young leaves, larvae bore into canes. This weakens or kills shoots, especially when the larvae enter the middle or lower sections. Adult moths are a creamy yellowish-brown and approximately one inch long. Eggs are white and laid in masses resembling overlapping fish scales on the underside of leaves. Egg laying can occur in late May, late June to early July, or early August, depending on the genetic race of corn borer present. See the section on pest management schedules for minor insects (4.3) for pesticide recommendations and other comments.

EUROPEAN RED MITES are spider mites. Adult mites are small, dark red, and have eight legs. When viewed with a hand lens, the mites appear hairy because they have white spines called “setae.” Nymphs range in color from pale to dark orange. Both adults and nymphs pierce the leaf cells and extract plant juices. This leads to the characteristic bronze coloration, which impairs the photosynthetic capacity of the leaf. Two-spotted spider mites are often found in mixed populations with European red mites. Two-spotted spider mites are light in color with two black spots on their backs. *Vinifera* and French hybrid varieties appear to be the most susceptible to infestations, although native varieties can also develop large densities under some conditions. Mites may be found on the upper or lower leaf surface. Four to nine generations occur in a season. Susceptible vineyards in production areas prone to damaging infestations should be monitored, starting at the bud break stage, for presence of this pest. Although problems can develop at any time after bud break, pay particular attention to the 1- to 4-inch growth stage and the postbloom period, especially after early July. Given a head start, the vine can tolerate a fair amount of feeding damage on lower leaves. Heavy mite infestations early in the season can cause stunted, chlorotic shoots with small leaves and pinpoint necrotic areas on leaves. Later in the season, as shoot growth rate declines and the vine allocates more resources to fruit, mites may also have an increased capacity to cause damage. Infestations can be severe on Long Island and in southeastern Pennsylvania vineyards. Serious infestations in the Finger Lakes region have occurred more frequently in recent years. Problems with spider mites in the Lake Erie region are uncommon. Predatory mites, when present in the vineyard at sufficient densities, can provide excellent biological control of spider mites. Recent research indicates that frequent use of mancozeb fungicides reduces predatory mite populations, although mancozeb use does not necessarily lead to mite problems.

is a generic of soil applied imidacloprid that is also labeled for foliar application.]

***AGRI-MEK** (abamectin) - RESTRICTED-USE PESTICIDE - read the label

Signal word: WARNING

Medical emergency: (800) 888-8372

Selected use: two-spotted spider mite

Comments: REI = 12 hrs, DTH = 28 days. Product must be applied in combination with nonionic surfactant. Do not make more than two applications per season. Amount of product per growing season cannot exceed 32 fl oz/A of ^*Agri-Mek 0.15EC or 7.0 fl oz *Agri-Mek SC. Ground application only. Currently, European red mite is not on the label. [^*ABBA 0.15 EC, and *Epimek 0.15 EC are generic miticides that have abamectin as active ingredient]

***NY†ALTACOR** (chlorantraniliprole) – RESTRICTED-USE IN NY

Signal word: None

Medical emergency: (800) 441-3637

Selected use: Grape berry moth, climbing cutworm and Japanese beetle adults (use high rate)

Comments: Not registered for use in Nassau, Suffolk, Kings and Queens Counties of New York State. Also in NY, this product cannot be used within 100 feet of water body and aerial application is prohibited. Chlorantraniliprole is in the anthranilic diamide class of insecticides with a new mode of action that is selective against Lepidoptera and some other insect groups.

ASSAIL (acetamiprid) - read the label

Signal word: CAUTION

Medical emergency: (303) 623-5716

Selected uses: leafhoppers, plant bugs, grape phylloxera, mealybug, Japanese beetle and rose chafer

Comments: The active ingredient is in the same chemical class as *NYProvado (neonicotinoid) and is particularly effective against sucking insects such as leafhopper, but also has activity against some beetles such as Japanese beetle and rose chafer.

AVAUNT (indoxacarb) – read the label

Signal word: CAUTION

Medical emergency: (800) 441-3637

Selected use: Japanese beetle, grape berry moth

Comments: REI = 12 hrs, DTH = 7 days. Avaunt has activity against a number of chewing insects including Japanese beetle and grape berry moth. It will help suppress leafhoppers. Conserves some beneficial arthropods. Two applications per season with minimum of 21 days between applications.

***BAYTHROID XL** (beta-cyfluthrin) – RESTRICTED USE PESTICIDE –read the label

Signal word: WARNING

Medical emergency: (800) 334-7577

Selected uses: leafhoppers, grape berry moth, minor insects

Comments REI = 12 hrs, DTH = 3 days. This is a broad-spectrum insecticide in the same chemical class as fenpropathrin and bifenthrin. Harsh on natural enemies and bees as well as aquatic organisms. Maximum use allowed per 14-day interval is 3.2 fl. ounces/A and maximum allowed per crop season is 12.8 fl. ounces/A. *Tombstone Helios insecticide is a generic pyrethroid that contains cyfluthrin as its active ingredient.

***NY†BELT SC** (flubendiamide) – RESTRICTED USE PESTICIDE IN NY – read the label

Signal word: Caution

Medical emergency: (800) 334-7577

Selected uses: Lepidoptera pests

Comments: Not registered for use in Nassau and Suffolk Counties of New York State. Also in NY, this product cannot be used within 100 feet of water body. Aerial application is prohibited. Do not apply *NY†Belt SC more than 3 times per crop season and do not apply more than 12 fl oz per acre per crop season. *NY†Belt SC has a 7 days DTH and 12 hr REI.

BIOBIT, DIPEL (biological insecticides, active ingredient - *Bacillus thuringiensis* var. *kurstaki*) - read the label

Signal word: CAUTION

Medical emergency: (800) 892-0099,

Selected use: grape berry moth

Comments: Biobit and Dipel are highly selective insecticides. Larvae must eat deposits of the insecticide to be affected. Close scouting with early attention to infestation is recommended. Apply when larvae are young. Thorough coverage is needed to provide a uniform deposit at the site of larval feeding. Larvae stop feeding after eating a lethal dose of the insecticide and will die within several days. Consult the label for information concerning active ingredient, application, and tank-mix compatibility.

***BRIGADE** (bifenthrin) – RESTRICTED USE PESTICIDE –read the label

Signal word: WARNING

Medical emergency: (800) 331-3148

Selected uses: leafhoppers, grape berry moth, minor insects

Comments: REI = 12 hrs, DTH = 30 days. This is a broad-spectrum insecticide in the same chemical class as fenpropathrin and cyfluthrin. Replaces *Capture 2 EC. There is also a WSB formulation. Harsh on natural enemies and bees as well as aquatic organisms.

5 Pest Management Schedules for Diseases and Major and Minor Insects

5.1 Introduction

This section provides guidelines pertaining to management programs for control of diseases and major insects in vineyards of New York and Pennsylvania. Although this section is organized along a phenological schedule to reflect important events during the growing season, there is no implication that every spray listed will be necessary. Rather, this is a schedule of the various times when individual diseases and insects might require that sprays be integrated into a management program; refer to the notes to help determine which sprays are generally necessary and which ones apply only to certain conditions. Refer to the pictures in the front of this publication for help in identifying critical growth stages during the season. Note comments in right-hand column address precautions or considerations necessary for use of particular methods or materials. Be especially alert to the notations that certain chemicals may not be approved for your state or for certain growing areas within a state.

5.2 Pest Management Schedules for Diseases and Major Insects

Pest(s)	Materials	Rate per Acre	Comments
5.2.1 DORMANT			
Canker diseases (Eutypa, Botryosphaeria)	Topsin M 70 WSB	3.2 oz/gal water	Apply Topsin M as a paint or directed spray to wounded surfaces after pruning and before the next rain. This recommendation is primarily for large pruning cuts, and has been shown to be beneficial. Application is allowed only in NY, under Special Local Needs (SLN) label # NY-07002. A copy of the SLN label and the federal product label must be in possession of the user at the time of application. There is a 7-day re-entry interval following application.
	Mettle 1ME	5 fl oz/A	Mettle is labeled in all states for spray application in 25 to 50 gpa within 24 hr after pruning, with a 12-hr REI. Consult the label for further use difrections. Unlike Topsin, no trials have been conducted in NY or PA to evaluate the efficacy of Mettle for this purpose.
5.2.2 DELAYED DORMANT			
Soft scale insects and mealybugs	petroleum oil	2.5%	Apply early in the spring at bud swell but before any leaf tissue is exposed. Apply in 250 to 300 gallons of water. Thorough coverage is essential for good results. Avoid use with Captan or sulfur due to phytotoxicity. Also avoid use within 24 hours before or after freezing temperatures. Field data indicate only short-term benefits for reducing mealybug populations. Oil more effective against soft scale.
	*Lorsban Advanced	1 qt	Apply no later than late budbreak in at least 50 gallons. Only one application of *Lorsban Advanced allowed per season.
Anthracnose, black rot, Phomopsis, powdery mildew	*[NY]Miller Lime Sulfur	1 gal/10 gal water	This spray is most likely to be beneficial on cultivars highly susceptible to anthracnose (e.g., Marquette, Reliance), where it can be important in blocks with a history of the disease, or in blocks where black rot and/or Phomopsis control is regularly problematic and conventional fungicides will not be used during the growing season. Otherwise, it is unlikely to be cost effective. THOROUGH coverage of the vines is essential for acceptable results. If practical, application to individual vines with a handgun or using some other system that minimizes loss of these expensive materials to non-grapevine surfaces (e.g., hooded-boom, recirculating
OR	*[NY]Sulforix	1-2 gal	

Pest(s)		Materials	Rate per Acre	Comments
5.2.7 IMMEDIATE PREBLOOM (just before blossoms open)				
Phomopsis cane and leaf spot (fruit and rachis infections)	Fruit infections can occur during the bloom and early postbloom period then remain dormant until preharvest. In vineyards with a previous history of this disease, continued protection against fruit and rachis infections may be beneficial from the pre-bloom through pea-sized berry period if the weather is wet during this time.			
		*[NY]Dithane DF	3-4 lb	
		or Dithane M45		
		or Manzate Pro-Stick 75DF		
		or Penncozeb 75DF		
	OR	Dithane F-45	2.4-3.2 qt	
		or *[NY]Manzate Max 4F		
	OR	Captan 50WP	3-4 lb	
	OR	Captan 80WDG	2-2.5 lb	
	OR	Captec 4L	1.5-2.0 qt	
	OR	Abound 2SC	11-15 fl oz	Abound, Azaka, Pristine, Quadris Top, †Topguard EQ, and Sovran are only moderately effective against Phomopsis, but may be adequate now if more effective materials were used earlier. **CAUTION: ABOUND, AZAKA, QUADRIS TOP, AND †TOPGUARD EQ CAN CAUSE INJURY TO NEARBY APPLE TREES AND THEIR USE IS RESTRICTED IN SOME LOCALES. PRISTINE AND QUADRIS TOP CAN CAUSE INJURY TO SOME GRAPE CULTIVARS, INCLUDING CONCORD. REFER TO THE ABOUND ENTRY IN SECTION 3.2 ("FUNGICIDE INFORMATION") FOR ADDITIONAL INFORMATION ABOUT THESE ISSUES.**
	OR	Azaka 2SC	11-15 fl oz	
	OR	Sovran 50WG	3.2-4.0 oz	
	OR	Quadris Top 2.7SC	12-14 fl oz	
	OR	†Topguard EQ 4.29SC	6-8 fl oz	
	OR	Pristine 38WG	8-12.5 oz	
Black rot	Do not delay black rot sprays beyond this stage. The immediate prebloom through early postbloom periods are critical for management of black rot. Although several other fungicides have some activity against black rot, the listed products are those with the most reliable activity at this critical time.			
		*[NY]Dithane DF,	3-4 lb	
		or Dithane M45		
		or Manzate Pro-Stick 75DF		
		or Penncozeb 75DF		
	OR	Dithane F-45	2.4-3.2 qt	
		or *[NY]Manzate Max 4F		
	OR	Ziram 76DF	3-4 lb	
	OR	Mettle 1 ME	5 oz	Most DMI (Group 3) fungicides – specifically, difenoconazole (Revus Top, Inspire Super, Quadris Top), Rally, generic tebuconazole products, Mettle, and flutriafol (†Rhyme, †Topguard EQ)-are highly effective against black rot. They provide limited (several days) "forward" protective activity and up to one week of postinfection ("backward") activity. This combination of "forward" and "backward" activity accounts for their high efficacy when applied at regular 10- to 14-day spray intervals, but their limited protective activity should be considered when
	OR	†Rhyme 2.08SC	5 fl oz	
	OR	Revus Top 4SC	7 fl oz	
		or Inspire Super	16-20 fl oz	
	OR	†Topguard EQ 4.29SC	5-6 fl oz	

6 Vineyard Weed Management

6.1 Introduction

Weeds are part of the vineyard ecosystem. Weed management decisions are based on balancing the positive and negative aspects of weed growth in the vineyard. Weeds can compete for water and nutrients, reducing vine growth; contaminate mechanically harvested fruit; provide alternate hosts for vineyard pests; and interfere with vineyard operations. Weed growth can also alter the microclimate around vines, leading to higher disease pressure and increasing the risk of spring frost. However, managing weed or cover crop growth in row middles can be a powerful tool for managing overly vigorous vines, minimizing erosion, and improving equipment access in wet seasons.

This portion of the guide primarily addresses chemical methods to control weeds in vineyards. We have attempted to include all herbicides labeled for use in grapes even though some are not commonly used in eastern United States vineyards. Herbicides are listed in the sections, "preemergence herbicides," "postemergence herbicides," and "herbicides for nonbearing vineyards." Herbicides that are registered for vineyard use and may have applicability under specific circumstances are listed in the section, "specialty use herbicides."

Cultivation is sometimes used as a weed management tool in vineyards. Low vine size restricts productivity of own-rooted *Vitis labruscana* varieties such as 'Concord' that generally have shallow root systems. Effective herbicide use has been shown to increase vine size and subsequent yields as compared with under-the-row cultivation, but this may be less of a concern when deep-rooted rootstocks are used, when vines are overly vigorous, or when maximum yields are not desired. Under trellis mowing and growing cover crops under the row are currently being researched in New York and Virginia. These methods might also be considered where vine growth is overly vigorous.

Cultivation and organic mulches can also be used as tools for row middle management. Excessive cultivation can lead to undesirable consequences such as soil erosion, reduced soil organic matter, and breakdown in soil structure resulting in compaction and reduced permeability. Recently cultivated soil can restrict equipment mobility needed for critical vineyard operations such as timely pesticide applications and mechanical harvest. If cultivation is used for row middle management it is suggested that negative effects be limited by not cultivating more often than necessary to suppress weed growth, to shallow (1-2") depths only, and with the goal of reducing, rather than completely eliminating, weed or cover crop growth. Fall planting of ryegrass or other cover crops can be used in conjunction with cultivation to provide winter cover. Organic mulches are most effective where soil moisture and fertility are low and where low vine size restricts vineyard productivity.

6.2 Resources

Several resources are available to aid in determining and addressing vineyard weed management goals. The concepts and tools for weed management are covered in the Cornell vineyard weed management fact sheets, listed below and at the back of this guide. They are available online at www.nysipm.cornell.edu/publications/grapeman/index.html (table of contents for Grape IPM in the Northeast), through Cornell Cooperative Extension offices, or directly through the Bulletin Room at the New York State Agricultural Experiment Station, Geneva, NY.

The fact sheets in this series are:

- Choosing a weed management program, which discusses goals and management options, including cultivation, mowing, mulching, and the use of chemical weed control agents (herbicides);
- Chemical control of vineyard weeds, which discusses weed types, herbicide types, and factors to consider in using herbicides effectively;
- Pre-emergence herbicides, which discusses all the available residual herbicide options, including their behavior in soil, persistence, and means of loss from the soil;
- Post-emergence herbicides, which discusses available contact and systemic herbicides and how they affect plants and soil; and
- Managing vineyard floors using no-tillage, which discusses the reasons for avoiding tillage and practical factors to consider in using no-tillage as a weed management tool.

Additionally, ***Weeds of the Northeast*** is an excellent resource covering weed identification and aspects of weed biology and ecology that relate to weed management. ***Weeds of the Northeast*** is available through Cornell University Press and the Lake Erie Regional Grape Program office in Portland, NY.

6.3 Effective Use of Herbicides

Most herbicides are degraded in the soil by microbes. Repeated use of the same herbicides, or those with similar chemistry, can lead to a buildup of tolerant weeds, development of resistant biotypes, and more rapid microbial decomposition that can reduce the length of time soil active herbicides are effective. Although herbicide options in vineyards are somewhat limited, weed management programs should not rely on the repeated use of the same herbicides or herbicides with related chemistry.

CHATEAU SW (flumioxazin) - read the label

Signal word: CAUTION

Medical emergency: (800) 892-0099

Selected uses: Preemergence control of broadleaf weeds and annual grasses

Rate: 6-12 oz. per acre surface sprayed. Two applications per season are allowed up to a maximum of 24 oz, but do not make a sequential application within 30 days of the first application, nor within 60 days of harvest. A maximum rate of 6 oz. per application should be used on any soil that has a sand content over 80% if vines are less than 3 years of age. Refer to the "Herbicides for nonbearing vineyards" section for additional comments for use on young vines.

Timing: Applications are allowed at any time except within 30 days of a previous application or within 60 days of harvest. Do not apply after grape bloom unless using hooded or shielded application equipment and the applicator can ensure spray drift will not contact fruit or foliage with the exception of undesirable suckers.

Comments: Chateau provides preemergence control of most annual broadleaf weeds and grasses. Chateau also provides some postemergence activity on many weeds and grapevine suckers, however, it should be tank mixed with a labeled postemergence herbicide for control of emerged weeds. Observe any restrictions associated with the postemergence herbicide (glyphosate, paraquat, †Rely or Aim). Quicker burn down activity may be observed from tank mixes with the preemergence herbicide than with the postemergence herbicide alone. In some situations, a single application of 12 oz. Chateau provides season-long control of annual weeds in vineyards. In other situations including heavy soil type, heavy weed pressure, or high precipitation, a split application may be necessary to achieve season-long weed control. In our experience, two applications of 6 oz. Chateau plus a postemergence herbicide, applied in early May and around grape bloom, have provided excellent season-long weed control. The label states to avoid direct or indirect spray contact to foliage and green bark, with the exception of undesirable suckers. Applications made after bud break through harvest require shielded application to ensure spray drift will not come into contact with crop fruit or foliage. There is a use precaution that shielded applications made after bud break through harvest should not be made with glyphosate or products containing glyphosate, meaning the manufacturer is not liable if you use Chateau in this manner.

GOAL 2XL, GOALTENDER (oxyfluorfen) - read the label

Signal word: WARNING (Goal 2XL), CAUTION (GOALTENDER)

Medical emergency: (800) 992-5994

Selected uses: Preemergence control of broadleaf weeds and early season control of annual grasses in established vineyards.

Rate: Apply 5-8 pt Goal 2XL, or 2.5-4 pt GoalTender, per acre surface sprayed.

Timing: Must be applied before bud swell, as later applications may result in significant vine injury. Do not apply to vines established less than 3 years unless vines are on a trellis at least 3 feet above the soil surface.

Comments: GoalTender is a newer, water-based formulation of oxyfluorfen, and contains 4 lb active ingredient per gallon, while the EC formulation contains 2 lb active ingredient per gallon. Oxyfluorfen primarily controls annual broadleaf weeds and is quite effective in controlling pigweed species. Some control of annual grasses may be achieved, but season-long control of grasses is not expected. For season-long control of annual grasses, use a tank mix with †Solicam, Prowl H_2O, oryzalin, or diuron.

KARMEX DF, *[NY]KARMEX XP, DIREX DF, DIREX 4L, others (diuron) - read the label

Signal word: CAUTION

Medical emergency: (888) 324-7598; (800) 441-3637; (877) 250-9291

Selected uses: Preemergence control of broadleaf weeds and annual grasses in established vineyards.

Rate: The allowable use rate for diuron products depends on which manufacturer's product is being used. Some product labels allow a single application of 2-6 lb of 80 DF or 1.6-4.8 qt of 4L per acre surface sprayed, while others allow two applications of 2-5 lb of 80 DF or 1.6-4 qt of 4L per acre surface sprayed. All the labels urge caution for use on soils low in clay or organic matter (1-2%) and, under those conditions, limits the rate to 2-3 lb 80 DF or 1.6-2.4 qt 4L. Depending on the product label, use 3-5 lb or 3-6 lb 80 DF, or 2.4-4qt or 2.4-4.8 qt 4L, on soils high in clay or organic matter.

Timing: Apply in the spring just prior to germination and growth of annual weeds. Older product labels allow a single application per year as a directed spray avoiding contact of foliage or fruit with spray or drift. Newer product labels allow two annual applications at least 90 days apart, while avoiding direct or indirect spray contact to foliage and green bark, with the exception of undesirable suckers. Use only in vineyards established at least 3 years.

Comments: Diuron controls a broad spectrum of annual weeds but may not provide season-long control of some annual grasses, such as foxtail species. Tank mixing with a longer residual grass herbicide such as †Solicam, Prowl H_2O, or oryzalin may be necessary to obtain season-long control of annual grasses. Observations suggest that repeated use of diuron over many years results in shorter residual weed control, probably due to enhanced microbial decomposition. Use of other herbicides in a rotational program is advised.

7 Sprayer Technology

7.1 Preparing the Airblast Sprayer for Work

7.1.1 Checking the Sprayer

Surveys have shown that many farmers are using inaccurate sprayers. Faulty sprayers contribute to increased drift levels and waste money through inefficiency and overuse of chemicals. For example, the cost of replacing a faulty pressure gauge that has been indicating at 15% below the actual pressure is recouped in around two hours' operation. Maintenance measures such as fitting a new set of nozzles at the beginning of each season also save money. Even when overdosing occurs by as little as 5%, the cost of a new set of nozzles would be recovered in less than a day's work. Sprayers must be checked over regularly to ensure that proper maintenance has been carried out and that no outstanding repairs need to be done. Before attempting any work on a machine, make sure that it is fully supported on stands and that all necessary protective clothing is on hand.

7.1.2 Fitting the Sprayer to the Tractor

The selected tractor must always be powerful enough to operate the sprayer efficiently under the working conditions that will be encountered. All its external services - hydraulic, electrical, and pneumatic - must be clean and in working order. Tractors fitting with cabs must have efficient air filtration systems. All protective guards must be in place. Trailed sprayers are often close-coupled to the tractor, so it is essential that the drawbar and the PTO shaft are correctly adjusted for turning. PTO shafts must be disengaged when making very tight turns.

CAUTION

- Take great care when adjusting a sprayer while the tractor engine is running.
- Always ensure that the fan is stationary before approaching the rear of the sprayer.
- Engage the handbrake when leaving tractor seat.

7.1.3 Checking the Operation of the Sprayer

Partially fill the tank with clean water and move the sprayer to uncropped waste ground. Remove the nozzles. Although you are not using any chemical at this point, get into the habit of wearing a coverall, gloves and a face visor when working with the sprayer. Engage the PTO and gently turn the shaft, increasing speed slowly to operating revs. Test the on/off and pressure relief valves, and check the agitation system. Flush through the spray lines, and then switch off the tractor. Refit the nozzles and check the liquid system again for leaks.

It is a valuable exercise to assess the spray deposits at various points in the canopy and on upper and lower leaf surfaces of the vines to be sprayed. This is particularly important if the foliage is dense or if the vines are grown in beds of three or more rows. Water-sensitive papers or fluorescent tracers are available for this purpose. An increase in spray volume or adjustment of the nozzles and their locations may be necessary in order to achieve the correct deposits.

7.1.4 Pre-season Maintenance

Use the following checklists before you begin spraying**:**

Hoses

- ✓ for splits and cracks
- ✓ connections to ensure they are water-tight
- ✓ for hose chafe, particularly in routing clips

Action:
Replace damaged hoses.

Filters

- ✓ for missing filter elements and seals
- ✓ for leakage
- ✓ for blocked or damaged filters

Action:
Replace any damaged or blocked filters.

Tank

- ✓ for fractures and any other damage
- ✓ that the tank sits firmly in its mount
- ✓ that the securing straps are correctly adjusted
- ✓ that the agitation is working
- ✓ that the tank is clean

Action:
See the supplier/manufacturer now about fractures and any other repairs.

Controls

- ✓ the control circuitry (electrical, hydraulic or air) for correct operation
- ✓ valves for both internal and external leaks

Action:
Replace leaky valves, which waste money and are potentially dangerous to operators and the environment.

Pump

- ✓ lubrication levels
- ✓ for leaks
- ✓ that the air pressure in the pulsation chamber (if fitted) is at the recommended level
- ✓ that the pump rotates freely without friction or noise. (Do so by rotating manually or starting at low speed, as corrosion may cause seizing up)

Pressure Gauge

- ✓ The pressure gauge is vital for indicating whether the nozzles are delivering the correct amount of chemical

Hardi Air Induction nozzles are similar in construction to Spraying Systems AI nozzles. They are one-piece plastic nozzles.

Albuz nozzles are similar in construction to Spraying Systems AI nozzles. They are one-piece plastic nozzles with a ceramic tip.

Current research
Trials are underway at Cornell University to compare air induction nozzles. Although the nozzles physically reduce drift, we need to see how effective they are at delivering materials used to control disease and insects. They certainly work well at delivering materials used to control weeds.

7.4 Sprayer Calibration

A simple vertical patternator can be constructed in the farm workshop using readily available materials; a build list and photographs can be found online at: www.nysaes.cornell.edu/ent/faculty/landers/pdf/Patternator.pdf.

Videos showing calibration and nozzle selection may be found on the internet at: www.youtube.com. Type in: "Calibration of airblast sprayers for orchards part 1 selecting and changing nozzles" or "Calibration of airblast sprayers for orchards part 2 measuring liquid flow"

7.4.1 Travel Speed Calibration

Sprayer travel speed will influence spray deposition and is a critical factor in maintaining accurate application rates. Although results of studies to determine the effect of travel speed on average spray deposition have been inconsistent, all studies have been in agreement that the higher the travel speed, the greater the variability in spray deposit. This variability is an important factor where uniformity of spray coverage throughout the canopy is required. Conclusions from research were drawn using travel speeds of 1-4 mph.

Factors that will affect travel speed include**:**
- weight of sprayer to be pulled
- slope of terrain
- ground conditions traveled over (wheel slippage)

The best way to measure travel speed is to pull a sprayer half full of water over the same type of terrain on which the actual sprayer will be operated.
Using a tape measure, set up a test course at least 100 feet long. Do not pace the distance. The longer the course, the smaller the margin of error.

Run the course in both directions. Use an accurate stopwatch to check the time required to travel the course in each direction. Average the two runs and use the following to calculate the speed in MPH.

Formula $\frac{\text{Ft. traveled}}{\text{Sec. traveled}} \times \frac{60}{88} = \text{MPH}$

Your figures:

Tractor gear_____ Engine revs._____

$\frac{\text{\_\_\_\_ft.}}{\text{\_\_\_\_sec}} \times \frac{60}{88} = \text{\_\_\_\_MPH}$

7.4.2 Airblast Sprayer Calibration

- use clean water

1. Pressure check
Place the pressure gauge on the nozzle fitting farthest away from the pump and turn the sprayer on. If pressure is lower at the nozzle than specified, increase pressure at the regulator.

Pressure at nozzle _____psi

Pressure at sprayer gauge _____psi

2. Nozzle output
Use a flow meter (obtainable from Gemplers, Spraying Systems, etc.) attached to individual nozzles OR
a. Connect hoses to each of the nozzles and measure the flow from each nozzle into a calibrated jug. Record and total your results using Figure 7.4.1.
b. Replace all nozzle tips which are more than 5% inaccurate.
c. Calculate gallons per acre using the following formula.

Formula: $\frac{\text{Total GPM X 495}}{\text{mph X row spacing (ft.)}} = \text{GPA}$

Your figures: $\frac{\text{\_\_\_\_GPM X 495}}{\text{\_\_\_\_mph X \_\_\_\_ft.}} = \text{GPA}$

7.4.3 Calibrating a Kinkelder Sprayer

-use clean water

Rate of spray **Forward speed** **Row spacing**

$\frac{\text{Gals/acre X mph X ft X 60}}{500}$ = gals/hr delivery or index setting

e.g.
50 gals/acre x 3 mph x 9 ft x 60 = 162 gals/hr delivery or index setting

Your figures:

$\frac{\text{gallons/acre X mph X ft X 60}}{500}$ = gals/hr delivery or index setting

This figure should be set on both scales.

8 Pesticides for New York and Pennsylvania Vineyards

8.1 Herbicides

Common Name	Trade Name	Formulation	WSSA Group Number (Resistance Management)	Days to Harvest	Reentry Interval	EPA Number
carfentrazone-ethyl	Aim EW	EC	14	3	12	279-3241
clethodim	*[NY]Select 2EC[a]	2EC	1	1 year	24 hr	59639-3
	^Volunteer	2 EC	1	1 year	24 hr	59639-3-55467
	*[NY]Select Max	0.97 EC	1	1 year	24 hr	59639-132
dichlobenil	Casoron 4G	4G	20	0	12 hr	400-168
	Casoron CS	1.4 L	20	0	12 hr	400-541
diuron	Karmex, Direx, and others	80DF	7	0	12 hr	^1812-362
	Direx, others	4L	7	0	12 hr	^1812-257
	Direx 4L	4L	7	0	12 hr	66222-54
	Karmex DF,	80 DF	7	0	12 hr	66222-51
	^Karmex XP	80 DF	7	0	12 hr	352-692
fluazifop-P-butyl	†Fusilade DX	2EC	1	50	12 hr	100-1070
flumioxazin	Chateau SW	51 WDG	14	60	12 hr	59639-99
glufosinate-ammonium	†Rely	1EC		14	12 hr	264-652
	†Rely 280	2.34 EC		14	12 hr	264-829
glyphosate	^Roundup Ultra	4L	9	14	4 hr	524-475
	^Touchdown Herbicide	3EC	9	14	12 hr	100-1117
	Touchdown Total, Traxion	4.17L	9	14	12 hr	100-1169
	Touchdown HiTech	5F	9	14	12 hr	100-1182
	^Roundup Ultramax	5L	9	14	4 hr	524-512
indaziflam	*[NY]†Alion	SC	29	14	12 hr	264-1106
isoxaben	^Gallery	75DF	21	1 year	12 hr	62719-145
napropamide	Devrinol	50DF	15	35	12 or 24 hr (see label)	70506-36
norflurazon	†Solicam	80DF	12	60	12 hr	100-849
oryzalin	Surflan	4AS	3	0	24 hr	70506-43
	Oryzalin	4AS	3	0	24 hr	66222-138
oxyfluorfen	Goal 2XL	2EC	14	b	24 hr	62719-424
	GoalTender	4 EC	14	b	24 hr	62719-447
paraquat	^*Gramoxone Max	3L	22	0	24 hr	100-1074
	*Gramoxone SL	2L	22	0	24 hr	100-1217
pelargonic acid	Scythe	4.2EC	22	0	12 hr	10163-325
pendimethalin	^Pendimax	3.3L	3	1 year	24 hr	68156-6-62719
	Prowl	3.3EC	3	1 year	24 hr	241-337
	ProwlH_20	3.8EC	3	90	24 hr	241-418
pronamide	*Kerb	50WSP	3	c	24 hr	62719-397
rimsulfuron	Matrix FNV	25DF	2	14	4 hr	352-671
sethoxydim	Poast	1.5EC	1	50	12 hr	7969-58