

## **Diseases and Insects**

*Douglas G. Pfeiffer, Extension Entomologist, Virginia Tech*  
*Keith S. Yoder, Extension Plant Pathologist, Alson H. Smith Jr. AREC*  
*Chris Bergh, Extension Entomologist, Alson H. Smith Jr. AREC*

Effective control of pests that occur in commercial small fruit crops is obtained only through the judicious use of pesticides combined with sound management practices, nutrition, and sanitation. Close observation should be used to determine which pests are present and when treatments should be applied to be most effective. Pesticides are used most frequently by the grower for pest control, and they usually are applied as sprays or occasionally as dusts. The problem of selecting the correct pesticide to do a specific job continues to be challenging to commercial growers. The success or failure of any spray program is not due entirely to the specific pesticide or amount placed in the sprayer tank, but is also influenced by proper timing, thorough application, and weather conditions at the time of application.

The pesticides recommended here have proven to be effective and useful in the control of various common diseases and insects. Differences may exist among them in their effectiveness against specific pest organisms. It has become increasingly evident that no spray program can provide equally satisfactory results in all plantings for all pests. Use extreme caution and read label thoroughly when using highly toxic pesticides.

Integrated Pest Management (IPM) is the use of all suitable tactics to maintain a pest population below an economically damaging level. One such tactic is that of chemical control. Growers may use insecticides to quickly reduce a pest population that is not controlled by other means. Contrary to a commonly held belief, organic growers utilize chemical control as well as other, "conventional" growers. The difference lies in the nature of the insecticides selected – organic growers are restricted to naturally derived materials, generally botanical or mineral products, while conventional growers usually use synthetic materials. Many naturally derived insecticides are substantially less toxic and more environmentally selective than older materials.

Other IPM tactics are appropriately used by both types of growers, namely biological control (use of predators, parasites and pathogens), cultural control (modifying crop production procedures to suppress problems), physical control (exclusion and hand-picking), and resistant varieties.

### **Organically approved tools listed in this guide for small fruit insect pests include:**

**Strawberry:** Mites – Stylet oil, predatory mites. Leafrollers – Entrust. Thrips – Aza-Direct and Entrust. Aphids – virus-free plants. Sap beetles – sanitation.

**Caneberries:** Rednecked cane borer – remove galled canes. Raspberry cane borer – remove infested canes. Blackberry psyllid – Surround. Mites – Stylet oil. Japanese beetle – Aza-Direct, Surround.

**Blueberries:** Blueberry tip borer – remove infested tissue when pruning. Plum curculio – Surround. Cranberry/cherry fruit-worms – Entrust. Mites – Stylet oil.

In selecting a pesticide for control of small fruit pests, there are several factors that must be considered. Degree of control desired, type of fruit finish required by the market, type of spray used, compatibility with other pesticides, and effectiveness against other pests are some of the important factors that must be weighed. There are a large number of pesticides available for grower use which vary somewhat in their spectrum of activity and effectiveness on an individual pest.

Generally, pesticides may be used alone for a specific pest or in combination for various pests occurring at any one time.

The recommended concentration of pesticides for control of small fruit pests is based on a regular dilute (1X) spray. The application rate for strawberries is based on 100 to 150 gal per acre. The application rate on caneberries is based on 150 to 250 gal per acre.

For information on small fruit pests and their control, request Virginia Cooperative Extension (VCE) Publications 444-567, 456-232, 456-018, as well as elsewhere in this volume. Also, additional information on strawberry diseases and their control is available in VCE Publication 456-038. Information on pest and beneficial species identification and monitoring is also available on-line at <http://www.virginiafruit.ento.vt.edu/>. For additional information regarding pest management and small fruit production, consult the Mid-Atlantic Berry Guide, Virginia Cooperative Extension publication 423-020.

**Be alert for pesticide label changes, particularly with regard to post-application re-entry and pre-harvest interval restrictions.**

**Note about fungicide resistance management:** Several strobilurin fungicides, which are prone to the development of resistance, have been registered for use on one or more small fruits and are now included in these recommendations. It is important to recognize that the strobilurin (Group 11) fungicides azoxystrobin (Quadris and Abound), and pyraclostrobin (Cabrio) have similar modes of action; this could result in cross resistance. The recently registered product Pristine is also a Group 11 fungi-

## 2-2 Commercial Small Fruit: Diseases and Insects

cide, being a package mix of pyraclostrobin and boscalid (a Group 7 fungicide). To limit the potential for development of resistance to all of these products, do not exceed the total number of sequential applications of Group 7 or Group 11 fungicides or their total number of applications per season. Do not make more than two sequential applications of Pristine before alternating to a fungicide with a different mode of action.

### Strawberries

**Table 2.1 - Strawberry Diseases**

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Acre Concentration	Spray Timing and Remarks
Leaf Spot ( <i>Mycosphaerella fragariae</i> )	Captan 80WDG	—	1.9-3.7 lb	Use approximately 150 gal of spray/A. Apply the spray at 7- to 10-day intervals from the time new growth starts. Do not apply more than 30 lb of captan/A/year. Do not apply more than 115 oz of Pristine/A/ year. Do not apply more than 70 oz of Cabrio/A/year. Do not apply more than 16 fl oz of Orbit/A/year. Do not apply more than 30 oz of Rally/A/year.
	or Thiram 65WSB	—	4.0-5.0 lb	
Leaf Scorch ( <i>Marssonina fragariae</i> )	PLUS	—	PLUS	Note Restricted Entry Intervals (REI) and Pre-harvest Intervals (PHI) in Table 1.
	Topsin-M 70W	—	1.0 lb	
Leaf Blight ( <i>Dendrophoma obscurans</i> )	or Rally 40WSP	—	2.5 oz	Note Restricted Entry Intervals (REI) and Pre-harvest Intervals (PHI) in Table 1.
	or Pristine 38WG	—	18.5-23.0 oz	
	or Cabrio 20EG	—	12.0-14.0 oz	
	or Orbit 3.6E	—	4.0 fl oz	
Powdery Mildew ( <i>Sphaerotheca</i> sp.)	Rally 40WSP	1.6 oz	2.5 oz	Begin applications when disease first appears. Repeat applications at 7- to 14-day intervals. Do not apply more than 30 oz of Rally/A/year.
	or Orbit 3.6E	—	4.0 fl oz	
Gray Mold Fruit Rot ( <i>Botrytis cinerea</i> )	Topsin-M 70W	0.7 lb	1.0 lb	Because of potential for resistance to Topsin-M and Rovral and because of ineffectiveness against leather rot, it is recommended that these compounds be combined with Captan or Thiram when possible. Although the preharvest interval for Captan is 0 days, protective clothing must be worn if entering the planting within 1 day after Captan application. Do not apply Rovral more than once per season or after first fruiting flower. Elevate, Switch, and Scala are registered for control of gray mold only. Apply Elevate or Scala alone or in tank-mix combinations with the recommended rate of another fungicide (such as Captan) registered for gray mold control, beginning at early bloom prior to establishment. Continue applications every 7 to 14 days, but avoid making more than two consecutive applications before alternating with another registered gray mold fungicide. In tank-mix combinations, Elevate may be used at the rate of 1.0 to 1.5 lb/A and Scala may be used at 9 fl oz/A. Pristine, Cabrio, and Abound may be applied the day of harvest. Scala may be applied to 1 day of harvest. Maximum/A/year: Captan 80WDG - 30 lb; Elevate - 6 lb; Switch - 56 oz; Abound - 1.9 qt; Pristine - 115 oz; Cabrio - 70 oz; Topsin M - 4 lb; and Scala - 54 fl oz.
	or Rovral 4F	—	1.5-2.0 pt	
Leather Rot ( <i>Phytophthora cactorum</i> )	PLUS	—	1.9-3.7 lb	<b>Caution: Abound is extremely phytotoxic to some apple cultivars including 'Gala.'</b> <b>Prevent spray drift and keep leftover residue in the spray tank from contact with apples.</b>
	or Captan 80WDG	—	1.9-3.7 lb	
	or Thiram 65WSB	—	4.0-5.0 lb	
	or Elevate 50WDG	—	1.5 lb	
	or Switch 62.5WDG	—	11.0-14.0 oz	
	or Abound 2.08F	—	6.2-15.4 oz	
	or Pristine 38WG	—	18.5-23.0 oz	
	or Cabrio 20EG	—	12.0-14.0 oz	
or Scala 600SC	—	18.0 fl oz		

**Table 2.1 - Strawberry Diseases (cont.)**

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Acre Concentration	Spray Timing and Remarks
Fruit Rots	Abound 2.08F	—	6.2-15.4 oz	Begin applications before anthracnose development and continue on a 7- to 10-day schedule, following resistance management guidelines. Do not apply more than two sequential applications before alternating with a fungicide that has a different mode of action. Do not make more than four applications of Abound or Pristine per year. Abound, Pristine, and Cabrio may be applied the day of harvest. The REI for Captevate is 24 hrs. Maximum/A/year: Abound - 1.9 qt; Pristine - 115 oz; Cabrio - 75 oz; Orbit - 16 fl oz; Captevate - 21 lb. Caution: Abound is extremely phytotoxic to some apple cultivars. Prevent spray drift and leftover residue in the spray tank which may come in contact with apples.
Anthracnose ( <i>Colletotrichum fragariae</i> )	or Pristine 38WG	—	18.5-23.0 oz	
	or Cabrio 20EG	—	12.0-14.0 oz	
	or Captevate 68WDG	—	5.25 lb	
	or Orbit 3.6E	—	4.0 fl oz	

### **Red stele (*Phytophthora fragariae*) and leather rot control:**

Ridomil Gold EC is registered for red stele and leather rot control. For established plantings apply at 1 pt/treated acre. Make one application in the spring before first bloom. A second application may be applied after harvest in the fall. For supplemental leather rot control, an application may be made during harvest. Consult the label for use with irrigation and for rates for band application. For new plantings make one application after transplanting, a second one 30 days before the beginning of harvest. A third application may be made during harvest season. Do not apply more than 1.5 qt of Ridomil Gold/A/year.

Aliette 80WDG is also registered for red stele and leather rot control. For red stele control at planting time, strawberry roots and crowns may be dipped 15-30 minutes at the rate of 2.5 lb per 100 gal. Plant within 24 hr after dipping. Aliette may also be applied as a foliar spray for red stele control at the rate of 2.5-5.0 lb/A 14-21 days after planting and continued on a 30-60 day interval as long as conditions favor disease development. In perennial plantings, begin applications when the plants start active growth in the spring. While red stele conditions persist, make additional applications on a 30-60 day interval. For leather rot control begin applications of Aliette at 2.5-5.0 lb/A at 10% bloom and early fruit set and continue on a 7-14 day interval as long as conditions favor disease development. Aliette may be applied the day of harvest (REI=12 hrs). Do not exceed 30 lb of Aliette/A/year. Several other phosphorous acid products are labeled similarly for red stele and leather rot control, including Agri-Fos, Phostrol, and ProPhyt. See labels for specific use instructions and rates for each product.

**Table 2.2 - Strawberry Insects**

Crop and Pest	Chemical and Formulation	Rate per 100 Gal Dilute	Acre Concentration	Spray Timing and Remarks
<i>Preplant</i>				
White grubs	diazinon AG500	1.0 pt	—	Apply diazinon in 100 gal/A with boom sprayer. Do not plant strawberries immediately following sod. Fumigant may be also used. Apply Admire at or just before transplanting, or in drip irrigation just before bud opening. Incorporate Admire into soil with at least 0.25 inches of irrigation or rainfall within 2 hrs of application.
	Admire 2F	—	16.0-24.0 fl oz	
Aphids	Admire 2F	—	24.0-32.0 fl oz	

#### *First Cover*

<sup>1</sup>Predatory mites (*Amblyseius fallacis*) are available commercially; these have been used effectively. Avoid use of Sevin, Brigade, and Danitol if predatory mites are used.

## 2-4 Commercial Small Fruit: Diseases and Insects

**Table 2.2 - Strawberry Insects (cont.)**

Crop and Pest	Chemical and Formulation	Rate per 100 Gal Dilute	Acre Concentration	Spray Timing and Remarks
Spittlebug	Sevin XLR	—	2.0 qt	First cover: When blossom buds emerge 1/2 inch from crown. Apply with ground equipment with adequate water for uniform coverage (100-300 gal/A). See Table 2.7 on REI and PHI.
	Danitol 2.4EC	10.6 fl oz	—	
Strawberry clipper	Lorsban 4E	1.0 pt	1.0 qt	Clipper: First cover, repeat 10-14 days later. Early control is important. Prebloom use only, no closer than 21 days before harvest. Treat when an average of 0.6 clipped buds/foot of row are found. Do not apply when berries are present. See Table 2.7 on REI and PHI
	Brigade WSB	3.2-16.0 oz	6.4-32.0 oz	
Spider mites	Savey 50DF or 50WP	—	3.0-4.0 oz	Do not spray for mites on a preventive basis. Rotate acaricides to delay resistance. Do not apply an acaricide more than twice/season. Savey may be applied at the rate of 6.0 oz/A under intense population pressure. See table on PHI and REI (Table 2.7). Acramite may be applied once per season. Use an organosilicone adjuvant. (See label.) <sup>1</sup> Consult distributors. Avoid use of Sevin, Brigade, or Danitol if predatory mites are used.
	Zeal 72WDG	—	2.0-3.0 oz	
	Oberon 2SC	—	12.0- 16.0 oz	
	Acramite 50WS	0.4-0.5 lb	0.75-1.0 lb	
	Agri-Mek 0.15EC	8 fl oz	16.0 fl oz	
	Vendex 50WP	8.0 oz	2.0 lb	
	Stylet Oil	3.0 qt	—	
	Danitol 2.4EC	16.0-21.3 fl oz	—	
	Brigade WSB	8.0 - 16.0 oz	16.0 - 32 oz	
	Predatory mites <sup>1</sup>	—	—	
Aza-Direct	—	11.5-42.0 fl oz		
<i>Second Cover</i>				
Tarnished plant bug	Thionex 50W	1.0 lb	2.0 lb	When blossoms separate in flower cluster. Treatment threshold is 1 nymph in every 1-2 flower clusters. See Table 2.7 on days to harvest and REI.
	Brigade WSB	3.2-16.0 oz	6.4-32.0 oz	
	Danitol 2.4EC	10.7 fl oz	—	
	Aza-Direct	—	11.5-42.0 fl oz	
Strawberry leafroller	Sevin XLR	—	2.0 qt	Strawberry leafroller is seldom a problem. Entrust is an organically approved alternative to SpinTor.
	Dipel DF	—	0.5-1.0 lb	
	SpinTor 2SC	—	4.0-6.0 pt	
	Entrust 80WP	—	1.25-1.5 oz	
	Radiant 1SC	—	6.0-10.0 fl oz	
Thrips	SpinTor 2SC	—	4.0-6.0 pt	
	Aza-Direct	—	12.5-42.0 fl oz	
	Entrust 80WP	—	1.25-1.5 oz	
	Radiant 1SC	—	6.0-10.0 fl oz	
Strawberry clipper	See First Cover	—	—	—
<i>Third Cover</i>				
No insecticides at this time	—	—	—	At 10% bloom.
<i>Fourth Cover</i>				
No insecticides at this time	—	—	—	At 50% bloom.
<i>Fifth Cover</i>				
<sup>1</sup> Predatory mites ( <i>Amblyseius fallacis</i> ) are available commercially; these have been used effectively. Avoid use of Sevin, Brigade, and Danitol if predatory mites are used.				

**Table 2.2 - Strawberry Insects (cont.)**

Crop and Pest	Chemical and Formulation	Rate per 100 Gal Dilute	Acre Concentration	Spray Timing and Remarks
Tarnished plant bug	See Second Cover	—	—	Berries half-grown, 7-10 days after fourth cover. This second TPB spray may be needed. See note in Second Cover. Do not apply Thionex within 15 days of first spray or more than twice within 35 days after fruit are formed.
Spittlebugs	See First Cover or Provado 1.6F	—	— 3.75 fl oz	—
Leafroller	See Second Cover	—	—	—
Spider mites	See First Cover	—	—	—
Strawberry aphid	Thionex 50W Aza-Direct Provado 1.6F	1.0 lb — —	2.0 lb 11.5-42.0 fl oz 3.75 fl oz	Use virus-free plants. Provado will not knock down heavy aphid populations.
<i>Preharvest</i>				
Sap beetles	malathion 8EC Danitol 2.4EC	1.0 pt 16.0-21.3 fl oz	2.0 pt —	Harvest ripe fruit promptly and completely and remove from field. Pesticides not as effective as cultural methods. See Table 2.7 on REI and PHI.
<i>Post-Harvest</i>				
Strawberry root weevil	Brigade WSB malathion 8EC	8.0-16.0 oz 1.0 pt	16.0-32.0 oz 2.0 pt	Where root weevil has been a problem, spray when leaf feeding appears.
Strawberry leafrollers	See Second Cover.	—	—	Leafrollers and aphids may need to be controlled to ensure continued growth, especially in young plantings.
Strawberry aphid	See Fifth Cover.	—	—	—
White grubs	Admire 2E	—	16.0-24.0 fl oz	Apply at renovation; incorporate into soil and furrow with 0.25 inches of water (irrigation or rain).

<sup>1</sup>Predatory mites (*Amblyseius fallacis*) are available commercially; these have been used effectively. Avoid use of Sevin, Brigade, and Danitol if predatory mites are used.

## Caneberries

**Table 2.3 - Blackberry and Raspberry Diseases**

Crop and Pest	Chemical and Formulation	Rate per 100 Gal Dilute	Acre Concentration	Spray Timing and Remarks
Anthracnose ( <i>Elsinoe veneta</i> )	<i>Dormant or late dormant sprays</i> liquid lime sulfur (24-31% solution) or Copper material (See copper comments below)	10.0 gal  See label	— — —	Apply spray in late winter or early spring when new growth is less than 1/2 inch long. Be sure to thoroughly clean equipment after using a copper product or liquid lime sulfur.

## 2-6 Commercial Small Fruit: Diseases and Insects

**Table 2.3 - Blackberry and Raspberry Diseases (cont.)**

Crop and Pest	Chemical and Formulation	Rate per 100 Gal Dilute	Acre Concentration	Spray Timing and Remarks
Fruit Rots <i>Botrytis cinerea</i> etc.	Rovral 4F or Pristine 38WDG or Elevate 50WDG or Captan 80WDG or Switch 62.5WG or Abound 2.08F	0.5-1.0 pt — — — — — —	1.0-2.0 pt 18.5-23.0 oz 1.5 lb 2.5 lb 11.0-14.0 oz 6.2-15.4 fl oz	Do not make more than 4 applications of Rovral or Elevate or more than 3 applications of Pristine or Abound per season. Consult all labels for use and timing information. May be applied day of harvest. Do not apply Captan within 3 days of harvest. Do not apply more than 92.0 oz of Pristine or 12.5 lb of Captan 80WDG or 56.0 oz of Switch/A /year. <b>Caution: Abound is extremely phytotoxic to some apple cultivars. Prevent spray drift and left-over residue in the spray tank which may come in contact with apples.</b>
Rusts ( <i>Kuehneola</i> sp., <i>Arthuriomyces</i> sp., <i>Phragmidium</i> sp.)	Rally 40WSP or Orbit 3.6E or PropiMax 3.6E	— — — —	1.25 oz 6.0 fl oz 6.0 fl oz	Applications should be initiated as early as bud break and repeated at 10- to 14-day intervals, depending on the diseases to be controlled. Orange rust: April-June; cane and leaf rust: green tip and just before bloom; yellow leaf rust: April-May; late leaf rust: June-Sept.; powdery mildew: early white bud to full bloom; leaf spot: June-Aug. Do not apply more than 10 oz of Rally/A/growing season. Rally may be applied up to the day of harvest, but observe label restrictions. Do not apply Orbit or PropiMax within 30 days of harvest or more than 30 fl oz/A/year.
Powdery Mildew ( <i>Sphaerotheca</i> sp.)				
Leaf Spot ( <i>Sphaerulina</i> sp.)				

### **Phytophthora root rot control**

Aliette 80WDG is registered for control of Phytophthora root rot on all caneberries. Apply as a foliar spray at the rate of 5 lb/A in new plantings. Applications should begin when plants produce 1-3 inches of new growth. Applications in established plantings should begin when conditions favor disease development. Begin foliar sprays in the spring after bud break (1-3 inches new growth) and continue spraying on a 45-60 day schedule, up to a maximum of 4 sprays during the growing season. The last fall application should be applied at least 30 days prior to leaf drop. Do not mix Aliette with surfactants or foliar fertilizers. Do not apply Aliette within 60 days of harvest. Several other phosphorous acid products are labeled as foliar sprays for Phytophthora root rot control, including Agri-Fos, Phostrol, and ProPhyt. See labels for specific use instructions and rates.

Ridomil Gold EC and Ridomil Gold GR formulations are labeled for control of Phytophthora root rot on raspberries only. Apply 4 fl oz of the EC or 5 lb of the GR/1000 linear feet of row to the soil surface in a three-foot band over the row. Make one application in the spring and another in the fall after harvest. Use the formula in the general information section of this label to calculate the amount of Ridomil Gold GR needed per acre. On a broadcast basis, Ridomil Gold GR is applied at 72.5 lb/A. Do not apply either Ridomil formulation within 45 days before harvest or illegal residues may result.

### **Comments about the use of copper fungicides on caneberries**

Previously, when there was a shortage of other effective fungicides registered for caneberry disease control, information about the use of copper fungicides to address concerns such as the rust diseases was presented here. Many different copper formulations have had a federal registration for use on one or more caneberry crops. Recent developments affect the usage outlook of copper fungicides. Growers should be advised that, as of September 2007, agricultural uses of copper fungicides are undergoing re-registration, and some changes in product labeling should be expected in the next year or two. In the past five years there have been registrations of several new products of different chemical classes that are highly effective on targeted diseases. For example, myclobutanil Rally (Nova), registered about ten years ago, and recently Orbit and PropiMax, should be effective for management of the rusts. These new products do not have the broad phytotoxicity concerns of the copper materials, but they do have potential fungicide-resistance concerns. If copper usage is still permitted after re-registration, you may want to con-

sider using them according to their labels for economic and/ or resistance management reasons. Always use a product only in accordance with the label for that particular formulation. Application timing and target diseases may vary with the formulation. Again, caution is advised in using any copper product.

### Orange rust

Rally 40WSP is registered for control of several rust diseases and should be highly effective, but it is important to scout plantings early in the season for orange rust, which causes a systemic infection of black raspberry, blackberry, and wild dewberry. Note spindly emerging canes with fluorescent orange rust lesions on the underside of leaves. Uproot the entire plant, place it in a plastic bag and remove it from the planting as soon as possible to reduce spread to healthy plants.

**Table 2.4 - Caneberry Insects**

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Acre Concentration	Spray Timing and Remarks
<i>Prebloom</i>				
Leafrollers	Confirm 2F	—	16 fl oz	When buds are breaking or new canes are 6-8 inches long. See label for timing. Confirm sprays. See Table 2.7 on REI and PHI.
	SpinTor 2SC	—	4.0-6.0 fl oz	
	Delegate 25WG	—	3.0-6.0 oz	
	Dipel ES	—	1.0-4.0 pt	
	M-Pede	2 gal	2% solution	
	Brigade 10WSB	—	8.0-16.0 oz	
Raspberry sawfly	SpinTor 2SC	—	4.0-6.0 fl oz	
	M-Pede	2.0 gal	2% solution	
	Delegate 25WG	—	3.0-6.0 oz	
Blackberry psyllid	malathion 8F	1.0 pt	2.0 pt	Spray for psyllid when adults appear on plants. Surround provides suppression.
	Surround 95WP	—	12.5-50.0 lb	
Raspberry cane borer	malathion 8F	1.0 pt	2.0 pt	For cane borer remove all infested canes; prune within a few days after wilted tips appear to minimize tissue removed. Spray just before blossoms open.
	M-Pede	2.0 gal	2% solution	
Raspberry fruitworm	SpinTor 2SC	—	4.0-6.0 fl oz	
	Delegate 25WG	—	3.0-6.0 oz	
Stink bug and Tarnished plant bug	Sevin XLR Plus 44EC	—	2.0 qt	Apply when one TPB (Tarnished plant bug) in every two flower clusters.
	Brigade 10WSB	—	8.0-16.0 oz	
	Assail 30SG	—	4.5 - 5.3 oz	
Thrips	Aza-Direct	—	12.5-42.0 fl oz	Just before blossoms open.
	or Assail 30SG	—	4.5 - 5.3 oz	
	or malathion 8F	—	1.0 - 4.0 pt	
	or SpinTor 2SC	—	4.0-6.0 fl oz	
Raspberry crown borer	Brigade 10WSB	—	16.0 oz	Apply Brigade as a drench in at least 200 gal of water/A, either prebloom or post harvest but not both.
<i>First Cover: at petal fall</i>				
Aphids	malathion 8F	1.0 pt	2.0 pt	
	Asana XL	—	4.8-9.6 fl oz	
	Sevin XLR Plus 44EC	—	2.0 qt	
	M-Pede	2 gal	2% solution	
	Assail 30 SG	—	2.5-5.3 oz	

## 2-8 Commercial Small Fruit: Diseases and Insects

**Table 2.4 - Caneberry Insects (cont.)**

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Acre Concentration	Spray Timing and Remarks
Red-necked cane borer	malathion 8F Brigade 10WSB	1.0 pt —	2.0 pt 8.0-16.0 oz	Spray every 7-12 days from early May to early June if this pest has been a problem. Remove galled canes in early spring.
Thrips	See Prebloom Spray			
Leafrollers	See Prebloom Spray			
Blackberry psyllid	See Prebloom Spray			
Leafhoppers	malathion 8F M-Pede Assail 30SG	1.0 pt 2 gal —	2.0-2.5 pt 2% solution 2.5-5.3 oz	
<i>Second Cover: ten days after petal fall</i>				
Aphids	See First Cover			
Mites	Savey 50DF Stylet Oil Brigade 10WSB	— 3.0-6.0 qt —	6.0 oz — 8.0-16.0 oz	Savey is highly effective against mite eggs. If many active mites are present, an adulticide should be applied. PHI is 3 days.
<i>Third Cover</i>				
Japanese beetle	Sevin 80S Sevin XLR Plus 44EC Aza-Direct Assail 30SG Surround 95WP	1.0 lb — — — —	2.0 lb 2.0 qt 12.5-42.0 fl oz 4.5-5.3 oz 12.5-50 lb	Twenty days after petal fall.  Surround provides suppression. Recommended only for 1st three weeks following fruit set in fresh market berries because of visible residues.
Click beetles	malathion 8F	1.0 pt	2.0 pt	Spray for pests as needed. Do not apply within 3 days of harvest.
Aphids	See First Cover			
Mites	See Second Cover			
<i>Post Harvest</i>				
Raspberry crown borer	Sevin XLR Plus 44EC or Brigade 10WSB	— —	2.0 qt 16.0 oz	Sevin may be applied as foliar spray. Apply Brigade as drench in at least 200 gal of water either postharvest or prebloom but not both.
Aphids	See First Cover			Spray for pests if needed.
Mites	See Second Cover			
Leafhoppers	See First Cover Spray			

## Blueberries

**Table 2.5 - Blueberry Diseases**

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Acre Concentration	Spray Timing and Remarks
Mummy Berry Cups ( <i>Monilinia vaccinii- corymbosi</i> )	50% urea mix	—	200.0 lb	Apply when cups appear (usually). <b>Delayed Dormant</b> Urea mix is 50% Urea sprills plus 50% inert materials. It supplies 45 lbs/A nitrogen. Cups may also be covered with 1 to 2 inches soil by discing or raking.
Phomopsis Twig Blight ( <i>Phomopsis spp.</i> )	lime sulfur	2.5 gal	5.0 gal	Lime sulfur : Make <b>One Delayed Dormant</b> application. Do not use lime sulfur within 14 days of an oil spray or when temperature is above 75°. Leaf burn may occur when used during periods of warm temperature. Apply Ziram at loose loose bud scale stage and 7 days later. Do not apply more than two sequential applications of Abound or Pristine before alternating with a fungicide that has a different mode of action. Begin applications before disease development and continue on a 7- to 14-day schedule, following resistance management guide lines. Do not apply more than 1.44 qt of Abound or 92 oz of Pristine or 56 oz of Switch/A/year. Abound, Pristine, and Switch may be applied the day of harvest. <b>Caution: Abound is extremely phytotoxic to some apple cultivars including 'Gala.'</b> Prevent spray drift and leftover residue in the spray tank which may come in contact with apples.
	or Ziram 76DF	1.5 lb	3.0 lb	
	or Abound 2.08F	—	6.2-15.4 fl oz	
	or Pristine 38WG	—	18.5-23 oz	
	or Switch 62.5WG	—	11.0-14.0 oz	
Mummy Berry Twig/fruit infection	Captan 80WDG	—	3.1 lb	Apply Ziram at loose bud scale stage and 7 days later. Begin Bravo applications at budbreak and repeat through early bloom at 10-day intervals. Read the Bravo label for cautions regarding tank mixing and phytotoxicity. Do not apply Bravo after full bloom or within 42 days of harvest. Do not apply more than 12 pt of Bravo/A/year. Do not apply more than two sequential applications of Abound, Pristine, or Captevate before alternating with a fungicide that has a different mode of action. Begin applications before disease development and continue on a 7- to 14-day schedule, following resistance management guidelines. For control of mummy berry with Indar or Orbit, make the first application at early greentip and make subsequent applications at 8- to 10-day intervals. Do not make more than 4 applications of Indar. Do not apply more than 24.0 fl oz of Indar, 30.0 oz of Orbit, 43.7 lb of Captan, 92.0 oz of Pristine, 21.0 lb of Captevate, 1.44 qt of Abound, or 56.0 oz of Switch/A/year. Do not apply Indar or Orbit within 30 days of harvest. Pristine, Abound, and Switch may be applied the day of harvest. <b>Caution: Abound is extremely phytotoxic to some apple cultivars including 'Gala.'</b> Prevent spray drift and keep leftover residue in the spray tank from contact with apples.
	or Ziram 76DF	1.5 lb	3.0 lb	
	or Bravo Weather Stik 6F	—	3.0-4.0 pt	
	or Abound 2.08F	—	6.2-15.4 fl oz	
	or Pristine 38WG	—	18.5-23.0 oz	
	or Captevate 68WDG	—	4.7 lb	
	or Switch 62.5WG	—	11.0-14.0 oz	
	or Indar 2F	—	6.0 fl oz	
	or Orbit 3.6E	—	6.0 fl oz	
	or PropiMax 3.6E	—	6.0 fl oz	

## 2-10 Commercial Small Fruit: Diseases and Insects

**Table 2.5 - Blueberry Diseases (cont.)**

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Acre Concentration	Spray Timing and Remarks
Fruit Rots (Anthracnose, Alternaria rot, <i>Glomerella cingulata</i> )	Captan 80WDG	—	3.1 lb	<b>Early Bloom to Post Bloom</b> , 7- to 10-day intervals. Observe pre-harvest and re-entry restrictions. Do not apply more than 43.7 lb of Captan/A/year. Begin Bravo applications at budbreak and repeat through early bloom at 10-day intervals. Read the Bravo label for cautions regarding tank-mixing and phytotoxicity. Do not apply Bravo after full bloom or within 42 days of harvest. Do not apply more than 12 pt of Bravo/A/year. Begin Abound applications before disease development and continue on a 7- to 14-day schedule, following resistance management guidelines. Do not apply more than two sequential applications of Abound or Pristine before alternating with a fungicide that has a different mode of action. Do not apply more than 1.44 qt of Abound, 92.0 oz of Pristine, or 56.0 oz of Switch/A/year. Pristine, Switch, and Abound may be applied the day of harvest. <b>Caution: Abound is extremely phytotoxic to some apple cultivars including 'Gala.'</b> Prevent spray drift and leftover residue in the spray tank which may come in contact with apples. Do not apply Orbit within 30 days of harvest or more than 30 fl oz/A/year.
	or Ziram 76DF	1.5 lb	3.0 lb	
	or Bravo Weather Stik 6F	—	3.0-4.0 pt	
	or Abound 2.08F	—	6.2-15.4 fl oz	
	or Pristine 38WG	—	18.5-23.0 oz	
	or Switch 62.5WG	—	11.0-14.0 oz	
	or Orbit 3.6E	—	6.0 fl oz	
	Leaf Spots ( <i>Gloeosporium minus</i> , <i>Gloeocercospora inconspicua</i> , <i>Septoria albopunctata</i> , <i>Dothichiza caroliniana</i> , <i>Alternaria tenissima</i> and <i>Glomerella cingulata</i> )	Captan 80WDG	—	
or Pristine 38WG		—	18.5-23.0 oz	

### **Phytophthora root rot control**

Ridomil Gold EC is labeled for control of Phytophthora root rot of blueberries. Established plantings: Apply 4 fl oz per 1000 linear feet of row (3.6 pts per acre broadcast basis) in a three foot band over the row before the plants start growth in the spring. One additional application may be made to coincide with periods most favorable for root rot development. New plantings: Apply 3.6 pts per acre broadcast at or after the time of planting. Supplemental applications should be made at 2- to 3-month intervals or to coincide with periods most favorable for root rot development. For banded applications, an 18-inch band over the row is recommended. Use the formula in the general information section of the label to calculate the amount needed per acre. On new plantings, do not apply more than 0.9 gal per acre broadcast during the 12 months before bearing harvestable fruit or illegal residues may result.

Aliette 80WDG is registered on blueberries at 5.0 lb per acre for control of Phytophthora root rot and suppression of some fruit rots. Begin foliar sprays at approximately the pink bud stage and continue on a 14- to 21-day interval. Do not exceed four applications or 20 lbs per acre per year. Do not apply in less than 10 gal per acre of water or closer than 12 hours to harvest. Several other phosphorous acid products are labeled as foliar sprays for Phytophthora root rot control, including Agri-Fos, Phostrol, and ProPhyt. See labels for specific use instructions and rates.

**Table 2.6 - Blueberry Insects**

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Acre Conc.	Spray Timing and Remarks
<i>First Cover: at petal fall. (Petal fall spray is the single most important spray for blueberry insects)</i>				
Blueberry tip borer	Sevin XLR Plus malathion 8F	—	2.0 qt 1.5-2.5 pt	Removing dead canes at pruning aids in control of tip borer.
Plum curculio	Sevin XLR Plus Surround 95WP Imidan 70W malathion 8F	— — — —	2.0 qts 12.5-50.0 lb 1.5 lb 1.5-2.5 pt	Two applications may be required for plum curculio. Surround provides suppression. Recommended only for 1st three weeks following fruit set for fresh berries because of visible residues.
Cranberry fruit-worm and cherry fruitworm	Confirm 2F SpinTor 2SC Entrust 80W diazinon 50W Sevin XLR Plus Dipel ES Esteem 35WP Delegate 25WG malathion 8F Assail 30SG Asana XL	— — — — — — — — — — —	16.0 fl oz 4.0-6.0 pt 1.25-2.0 oz 1.0 lb 1.0-2.0 qt 1.0-4.0 pt 5.0 oz 3.0-6.0 oz 1.5-2.5 pt 4.5-5.3 oz 4.8-9.6 fl oz	A maximum of three applications of azinphosmethyl may be made /season. Do not apply more than 64.0 fl oz of Confirm/A/season.
<i>Second Cover: ten days after first cover</i>				
Cranberry fruit-worm and cherry fruitworm	See First Cover			
Leafrollers	Confirm 2F	—	16.0 fl oz	See label for timing Confirm sprays.
Aphids	M-Pede Provado 1.6F	2.0 gal —	— 3.0-4.0 fl oz	Repeated sprays of M-Pede may be needed. Do not apply M-Pede within 3 days of sulfur.
Blueberry tip borer	See First Cover			
Plum curculio	See First Cover			
<i>Preharvest</i>				
Blueberry maggot	SpinTor 2SC Entrust 80W Imidan 70W Surround 95WP Danitol 2.4EC Delegate 25WG malathion 8F Assail 30SG Asana XL Sevin XLR	— — — — — — — — — —	4.0-6.0 fl oz 1.25-2.07 oz 1.5 lb 12.5-50.0 lb 10.7-18 fl oz 3.0-6.0 oz 1.5-2.5 pt 4.5-5.3 oz 9.6 fl oz 1.0-2.0 qt	Spray if flies trapped for two consecutive weeks, or three flies/week. Delegate provides suppression. See Table 2.7 on PHI. See footnote petal fall spray.
Mites	Stylet oil Acramite 50WS	3.0-6.0 qt —	— 0.75-1.0 lb	Acramite non-bearing only. Spray Stylet oil every 7-10 days while mite eggs persist.
Japanese beetle	Provado 1.6F Danitol 2.4EC malathion 8F Assail 30SG Asana XL Sevin XLR	— — — — — —	6.0-8.0 fl oz 10.7-18 fl oz 1.5-2.5 pt 4.5-5.3 oz 4.8-9.6 fl oz 1.0-2.0 qt	
<i>Special Soil Treatment</i>				
Japanese beetle	Admire 2F	—	16.0-32.0 fl oz	Apply as chemigation or in band followed by irrigation.

## Small Fruit Pesticides

**Table 2.7 - Chemical Names, Re-entry Intervals (REI) and Preharvest Intervals (PHI)**

Chemical	Manufacturer	Re-entry Interval	Preharvest Interval		
			Strawberry	Caneberries	Blueberry
<b>Fungicides</b>					
Agri-Fos	Monterey	4 hours	0 days	0 days	0 days
Aliette (fosetyl Al)	Bayer CropScience	12 hours	12 hours	60 days	12 hours
Azoxystrobin (Abound)	Syngenta	4 hours	0 days	0 days	0 days
Bordeaux mixture (coppers)	various	24 hours	—	(see label)	—
Bravo Weather Stik (Chlorothalonil)	Syngenta	12 hours (See label caution about eye protection or 6.5 days)	—	—	42 days
Cabrio (pyraclostrobin)	BASF	24 hours 12 hours (strawberries)	0 days	0 days	0 days
Captan (Captan, Captec)	Micro Flo, etc.	see label	0 days (see label)	3 days (Captan 80WDG)	0 days (see label)
Captevate (Captan & fenhexamid)	Arysta	24 hours (strawberries) 72 hours (blueberries & raspberries)	0 days	3 days (raspberries)	0 days
Elevate (fenhexamid)	Arysta	12 hours	0 days	0 days	0 days
Indar (fenbuconazole)	Dow AgroSciences	12 hours	—	30 days	30 days
Lime sulfur	various	48 hours	—	0 days	—
Orbit (propiconazole)	Syngenta	24 hours	0 days	30 days	30 days
Phostrol	Nufarm Americas	4 hours	0 days	0 days	0 days
Pristine (pyraclostrobin & boscalid)	BASF	24 hours 12 hours (strawberries)	0 days	0 days	0 days
ProPhyt	Helena	4 hours	0 days	0 days	0 days
PropiMax (propiconazole)	Dow AgroSciences	24 hours	—	30 days	30 days
Rally (myclobutanil)	Dow AgroSciences	24 hours	0 days	0 days	—
Rovral (iprodione)	Bayer CropScience	24 hours	prebloom	0 days	—
Scala	Bayer CropScience	12 hours	1 day	—	—
Switch (cyprodinil & fludioxonil)	Syngenta	12 hours	0 days	0 days	0 days
Thiram	Taminco	24 hours	3 days	—	—

**Table 2.7 - Chemical Names, Re-entry Intervals (REI) and Preharvest Intervals (PHI) (cont.)**

Chemical	Manufacturer	Re-entry Interval	Preharvest Interval		
			Strawberry	Caneberries	Blueberry
<b>Fungicides (cont.)</b>					
Topsin-M	United Phosphorus	12 hours	1 day	—	—
Ziram	United Phosphorus, Taminco	48 hours	—	(see label)	(see label)
<b>Insecticides</b>					
Admire (imidacloprid)	Bayer CropScience	12 hours	14 days	—	7 days
Agri-Mek (avermectin)	Syngenta	12 hours	3 days	—	—
Asana (esfenvalerate)	DuPont	12 hours	—	7 days	14 days
Assail (acetamiprid)	United Phosphorus	12 hours	—	1 day	1 day
Aza-Direct (azadirachtin)	Gowan	4 hours	0 days	0 days	0 days
Brigade (bifenthrin)	FMC	12 hours	0 days	3 days	—
Confirm (tebufenozide)	Dow AgroSciences	4 hours	—	14 days	14 days
Danitol (fenpropathrin)	Valent	24 hours	2 days	—	21 days
Delegate (spinetoram)	Dow AgroSciences	4 hours	—	1 day	3 days
diazinon	Makhteshim-Agan	3 days strawberries 5 days blueberries	5 days	—	7 days
Dipel	Valent	4 hours	0 days	0 days	0 days
Entrust (spinosad)	Dow AgroSciences	4 hours	1 day	—	3 days
Esteem (pyriproxyfen)	Valent	12 hours	—	—	7 days
Imidan (phosmet)	Gowan	3 days	—	—	3 days
Lorsban (chlorpyrifos)	Dow AgroSciences	24 hours	21 days	—	—
malathion	Gowan, UAP	12 hours	3 days	1 day	1 day
M-Pede (insecticidal soap)	Dow AgroSciences	12 hours	0 days	0 days	0 days
Provado (imidacloprid)	Bayer CropScience	12 hours	7 days	—	3 days
Radiant (spinetoram)	Dow AgroSciences	4 hours	1 day	—	—
Sevin (carbaryl)	Bayer CropScience	12 hours	7 days	7 days	7 days
SpinTor (spinosad)	Dow AgroSciences	4 hours	1 day	1 day	3 days

2-14 Commercial Small Fruit: Diseases and Insects

<b>Table 2.7 - Chemical Names, Re-entry Intervals (REI) and Preharvest Intervals (PHI) (cont.)</b>					
<b>Chemical</b>	<b>Manufacturer</b>	<b>Re-entry Interval</b>	<b>Preharvest Interval</b>		
			<b>Strawberry</b>	<b>Caneberries</b>	<b>Blueberry</b>
<b><i>Insecticides (cont.)</i></b>					
Surround (kaolin)	Engelhard	4 hours	—	0 days	0 days
Thionex (endosulfan)	Makhteshim-Agan	24 hours	4 days	—	before buds form
Zeal (etoxazole)	Valent	12 hours	1 day	—	—
<b><i>Acaricides</i></b>					
Acramite	Uniroyal	12 hours	1 day	non-bearing only	non-bearing only
Brigade (bifenthrin)	FMC	12 hours	0 days	3 days	—
Oberon (spiromesifen)	Bayer CropScience	12 hours	3 days	—	—
Savey (hexythiazox)	Gowan	12 hours	3 days	3 days	—
Stylet Oil	JMS Flower Farms	4 hours	0 days	0 days	0 days
Vendex (fenbutatin oxide)	Griffin	48 hours	1 day	—	—

## Nematodes

Keith S. Yoder, Extension Plant Pathologist, Alson H. Smith Jr. AREC

**Table 2.8 - Preplant Fumigation: Blackberries, Blueberries, Raspberries, and Strawberries**

Nematodes Controlled	Chemical	Rate	Remarks
All plant parasitic nematodes	1,3-dichloropropene 94%(Telone II) or 1,3-dichloropropene 74% chloropicrin 16.5% (Telone C-17)	27.0-35.0 gal/A 32.0-41.0 gal/A	Broadcast treatment: Fall application preferred, 30 days or more prior to planting; space chisels 12 inches apart and apply chemical 10 inches deep. Soil temperature should be between 50° and 80°F. Observe all label precautions.
All plant parasitic nematodes, certain root rot fungi, and certain weed seeds	Vapam HL 42% (sodium methyl dithiocarbamate)	37.5-75.0 gal/A	Before Vapam application, cultivate thoroughly the area to be treated, breaking up clods and loosening the soil deeply and thoroughly. Approximately one week before treatment, moisten soil after cultivation to the desired depth (sprinkle or flood). Immediately before application, cultivate lightly if soil has crusted. For soil injection, space injection shanks 5 inches apart and inject 4 inches deep into well prepared soil. Follow immediately with a roller to smooth and compact soil. Light watering or a tarp (plastic) helps prevent gas escape. Apply when the soil temperature is 40-90°F (do not apply Vapam to the soil surface, as in the sprinkler method, when the air temperature is over 90°F or during high winds). <b>Sprinkler system uses 75-100 gal/A.</b> Use sprinkler system that has large droplets and appropriate hardware to prevent water source contamination from back flow. First run sprinkler 5 to 10 minutes, then during the next 10 to 20 minutes, inject into the sprinkler system the amount of Vapam required for the area to be treated. On light soils, keep surface moist for 2-3 days. Before applying Vapam, have your dealer contact a product representative about how to meter Vapam into the sprinkler system. Read the label instructions about cultivation and planting after application.
	Basamid 99% granular	(see label)	See label for application preparation, rates, method, general restrictions, and limitations. Do not harvest produce for one year after application.

**CAUTION:** Vapors from fumigants are toxic. **Read the label completely and strictly follow the directions.**

## 2-16 Commercial Small Fruit: Nematodes

**Table 2.9 - Postplant Treatment: Raspberries**

Nematodes Controlled	Chemical	Rate	Remarks
Nematodes	Nemacur 3	1.0-2.0 gal/A	<p>Band application: Apply specified dosage in not less than 10 gallons of solution per acre to the soil with ground equipment and incorporate immediately using mechanical incorporation or irrigation. Center the treated band on the row using a band width of 50% of the row spacing and covering the feeder root system of the plant. Apply during the period of October 1-December 31 when adequate rainfall can be expected. Do not apply within six months of harvest. Do not apply more than once per year. Use the high rate in fields with high populations of nematodes or in fields having a history of serious nematode damage.</p> <p><b>Sales of Nemacur were prohibited after May 31, 2008. Existing stocks may continue to be used until depleted.</b></p>

**Table 2.10 - Postplant Treatment: Strawberries**

Nematodes Controlled	Chemical	Rate	Remarks
Nematodes	Nemacur 3	4.0-6.0 qt/A (on double-row beds spaced 48 inches apart)  12-in band-width row 5.9 fl oz/1000 ft or 4.0 qt/A (on 48-inch rows)  18-in band-width row 8.8 fl oz/1000 ft or 6.0 qt/A (on 48-inch rows)	<p>Apply specified dosage per 1000 ft of row in a 12- to 18-inch band over the row and incorporate immediately by cultivation prior to transplanting. Do not apply more than one application. Do not exceed 6.0 qt/A/season regardless of row spacing. Do not apply within 110 days of harvest. Apply by ground equipment only. Use the maximum band width and rate in fields with high populations of nematodes or in fields having a history of serious nematode damage.</p> <p><b>Sales of Nemacur are prohibited after May 31, 2008. Existing stocks may continue to be used until depleted.</b></p>

## Weeds

Jeffrey F. Derr, Extension Weed Scientist, Hampton Roads AREC

**Table 2.11 - Herbicides**

Crop	Weeds Controlled	Chemical Rate/A (Product/A)	Remarks
<i>Preemergence directed</i>			
Blueberries, Blackberries, and Raspberries	Most annuals, fescue, quackgrass, dandelions, dock, and other herbaceous perennials	dichlobenil 4.0-6.0 lb (Casoron 4G 100.0-150.0 lb or 2.3-3.4 lb/1000 sq ft)	Apply dry granules in late winter or early spring. Shallow incorporation may improve weed control. Do not apply within 4 weeks after transplanting. Short residual activity, regrowth usually occurs in late summer. Do not graze livestock in treated areas. Do not make application within one month of harvest. Do not apply over 4.0 lb of dichlobenil to blackberries or raspberries and do not apply during new shoot emergence.
	Annual grasses and certain broadleaf weeds	napropamide 4.0 lb (Devrinol 50 DF 8.0 lb)	Apply to a weed-free surface or include an appropriate postemergence herbicide. May be applied to newly planted and established crop. Must be incorporated by rainfall or irrigation within 24 hours of application for optimum results. May be tank-mixed with other herbicides for broader-spectrum weed control.
	Annual grasses, certain broadleaf weeds, and suppression of perennial grasses and nutsedge	norflurazon 2.0-4.0 lb (Solicam 80DF 2.5-5.0 lb)	Apply only to blueberries established at least 6 months and to raspberries and blackberries established at least 12 months. Apply when crop is dormant. Apply to weed-free soil or include an appropriate postemergence herbicide. Combine with simazine for improved broadleaf control.
	Annual grasses and certain broadleaf weeds	oryzalin 2.0-6.0 lb (Surflan 4AS 2.0-6.0 qt, Oryzalin 4AS 2.0-6.0 qt, Surflan DF 2.4-7.1 lb)	May be used immediately after planting or in established plantings. Apply to weed-free soil or include an appropriate postemergence herbicide. Use lowest rate for short-term control, 4.0 lb for full-season control, and the highest rate for long-term (8–12 months) control. May be tank-mixed with such herbicides as simazine or terbacil to control a broader spectrum of weeds in established plantings.
	Annual grasses and broadleaf weeds	simazine 2.0-4.0 lb (Princep 4L 2.0-4.0 qt)	Apply to weed-free soil or include an appropriate postemergence herbicide. Split application possible with 1/2 rate in fall and 1/2 rate in spring. On plantings less than 6 months old use 1/2 the total rate of application.
	Annual grasses and broadleaf weeds plus some perennial broadleaf weeds	terbacil 0.8-1.6 lb (Sinbar 80W 1.0-2.0 lb)	Only treat plantings established for one year or more. Use higher rate on heavy (clay) soils with high organic matter (3% +). May be applied in early spring or late fall.
	Annual broadleaf weeds	carfentrazone-ethyl 0.016-0.031 lb (Aim 2EC, 1.9 EW 1.0-2.0 fl oz/A)	Apply post-directed using a hooded sprayer for control of small annual broadleaf weeds less than 4 inches tall. Add a crop-oil concentrate or non-ionic surfactant. Can be tank mixed with other herbicides for broader-spectrum weed control. Can also be used for control of primocanes – see label rates and directions for this use.

2-18 Commercial Small Fruit: Weeds

**Table 2.11 - Herbicides (cont.)**

Crop	Weeds Controlled	Chemical Rate/A (Product/A)	Remarks
Blueberries, Blackberries, and Raspberries (cont.)	Annual and perennial grasses	clethodim 0.09-0.12 lb (Select 6.0-8.0 fl oz + 0.25% v/v nonionic surfactant)	Apply to actively growing grasses. Will control annual bluegrass. For spot treatment use a 0.33 to 0.65 fl oz/gal solution plus 0.33 fl oz nonionic surfactant. A repeat application may be required for perennial grass control. Can only be used on nonbearing plants. Allow at least one year between application and harvest.
	Annual and perennial grasses	fluazifop-P-butyl 0.25-0.375 lb (Fusilade DX 16.0-24.0 fl oz + 2 pt crop oil concentrate or 1/2 pt nonionic surfactant/25.0 gal)	Use a directed spray on actively growing grasses. Treat annual grasses before tillering for optimum results. Perennial grasses may need repeat treatment for total control. Do not treat canes to be harvested within one year of application. For spot treatment use 0.75 oz Fusilade DX plus 1.5 fl oz crop-oil concentrate or 0.5 fl oz nonionic surfactant/gal.
	Annual and perennial weeds	glufosinate 0.75-1.25 lb Rely 3.0-5.0 pt	Blueberries only. Apply as a directed spray, keeping droplets off blueberry foliage and stems. Repeat application may be needed for perennial weed control. Do not apply within 14 days of harvest. For spot application apply 4.0 fl oz/gal.
	Annual and perennial grasses and broad-leaf weeds	glyphosate 0.75-3.75 lb ae (Roundup UltraMax 26 fl oz-4 qt, Touchdown 1.0-5.0 qt, or other labeled formulation. For wiper application use 1 part Roundup to 4 parts water)	Can be applied prior to planting or to control emerged weeds after planting. Avoid contacting leaves or stems of crop plants or systemic injury could occur. For spot- treatment use 2.0 fl oz Roundup UltraMax, or Touchdown/gal and spray to wet. Other glyphosate formulations are available. Check the label for appropriate rates.
	Annual weeds, contact activity only, will not control established perennial weeds	paraquat 0.5-1.0 lb (Gramoxone Inteon 2.0-4.0 pt/A + 1-2 pt nonionic surfactant/100 gal water)	Apply as coarse directed spray to thoroughly wet emerged weeds. Apply before emergence of new crop shoots. Do not allow spray to contact new shoots or green stems, otherwise injury is likely. <b>RESTRICTED USE PESTICIDE</b>
	Annual and perennial grasses	sethoxydim 0.28-0.47 lb a.i. (Poast 1.5-2.5 pt + 1.0 qt crop-oil concentrate)	Do not apply within 45 days of harvest in raspberries and blackberries or within 30 days of harvesting blueberries. Apply in a minimum of 10 gal/A of water. Apply the lower rate to annual grasses up to 6 inches tall and apply higher rate to annual grasses up to 12 inches tall and to perennial grasses. For spot treatment, use 1.25 fl oz Poast plus 1.25 fl oz crop-oil concentrate/gal.
Strawberries	Annual and perennial grasses	clethodim 0.09-0.125 lb (Select 6.0-8.0 fl oz + 1% crop-oil concentrate)	Apply to actively growing grasses. Will control annual bluegrass. For spot treatment use a 0.25% to 0.50% solution (0.33-0.65 fl oz/gal) plus 1% crop-oil concentrate. A repeat application may be required for perennial grass control. Allow at least 4 days between application and harvest.

**Table 2.11 - Herbicides (cont.)**

<b>Crop</b>	<b>Weeds Controlled</b>	<b>Chemical Rate/A (Product/A)</b>	<b>Remarks</b>
Strawberries (cont.)	Certain annual and perennial broadleaves	clopyralid 0.12-0.25 lb (Stinger 0.33-0.67 pt/A)	Apply to actively-growing broadleaf weeds. Primarily controls weeds in the legume and composite families. Stinger can be applied to strawberries at 0.33 pt/A in spring. Do not apply within 30 days of harvest. Up to 0.67 pt/A can be used after harvest. Growers who intend to use the product in strawberries must sign a waiver of liability.
	Annual broadleaf weeds	carfentrazone-ethyl 0.006-0.025 lb (Aim 40DF 0.33-1.0 oz, Aim 1.9EW or 2EC 0.5-1.6 fl oz)	Apply post-directed using a hooded sprayer for control of small annual broadleaf weeds less than 4 inches tall. Add a crop-oil concentrate or non-ionic surfactant. Can be tank mixed with other herbicides for broader-spectrum weed control.
	Annual grasses and broadleaf weeds	flumioxazin 0.9 lb (Chateau WDG 3.0 oz/A)	Apply to dormant strawberries for preemergence weed control. Addition of a crop-oil concentrate or nonionic surfactant may improve postemergence weed control. Can be applied using a hooded or shielded spray to row middles prior to fruit set. Do not apply overtop of strawberries.
	Annual grasses and certain broadleaf weeds	DCPA 6.0-9.0 lb (Dacthal W-75 8.0-12.0 lbs/A)	Can be used in new and established plantings. Apply prior to weed germination. Do not apply after first bloom through harvest.
	Annual grasses and certain broadleaf weeds	napropamide 4.0 lb (Devrinol 50 DF 8.0 lb)	Use on established strawberries. Delay application until daughter plants in the desired number have become established. Do not apply from bloom to harvest. Make only one application/season. Does not control established weeds. Apply in fall through early winter. Early spring applications may also be made, but rainfall or irrigation will be needed for optimum weed control.
	Annual broadleaf weeds	oxyfluorfen 0.25-0.5 lb (Goal 2XL 1.0-2.0 pt)	Apply to the surface of preformed fallow beds at least 30 days prior to transplanting strawberries. Incorporation prior to planting reduces the potential for crop injury. Plastic mulch can be applied anytime after application but ideally, soon after the Goal was applied.
	Annual and perennial grasses	sethoxydim 0.28-0.47 lb ai (Poast 1.5-2.5 pt + 1.0 qt crop-oil concentrate)	Do not apply within 7 days of harvest. Apply the lower rate to annual grasses up to 6 inches tall. Apply higher rate to taller annual grasses and perennial grasses. For spot treatment use 1.25 fl oz Poast plus 1.25 fl oz crop-oil concentrate/ gal.
	Annual broadleaf weeds	2,4-D amine 1.0-1.5 lb (Formula 40 1.0-1.5 qt)	Apply to established beds in late winter when the strawberries are dormant or immediately after last picking 7-10 days before renovation. Do not apply during bud, flower, or fruit stage, or during runner formation. Do not apply unless some injury is acceptable.
	Annual grasses and broadleaf weeds	terbacil 0.1-0.3 lb (Sinbar 80W 2-6 ounces/A)	Use only on plants established at least 6 months. Apply after postharvest renovation before new growth begins or in late fall to control winter annuals. Do not apply more than 8 oz of Sinbar/A/ growing season. Do not use on soils less than 2% organic matter.

**Table 2.12 - Relative Effectiveness of Preemergence Herbicides in Small Fruit**

	Dichlobenil	DCPA	Flumioxazin	Napropamide	Nor-flurazon	Oryzalin	Oxyfluorfen	Simazine	Terbacil
<i>Annual Grasses</i>									
Barnyardgrass	G	G	P	G	E	G	F	F-G	G
Cheat	G	-	-	G	G	G	-	G	G
Crabgrass	G	G	P	E	E	E	F	F-G	F-G
Fall panicum	F	G	P	G	E	G	-	F-G	G
Foxtails	G	G	P	E	E	E	F	G	G
Goosegrass	F	G	P	E	G	E	F	E	-
Johnsongrass (seedling)	F	-	N	P	G	F-G	-	N	-
<i>Annual Broadleaf Weeds-</i>									
Annual fleabane	E	-	-	G	F	G	G	G	E
Annual morningglory	G	N	F-G	N	F	P-F	F	E	G
Black nightshade	G	N	G	N	F-G	P-F	G	E	-
Carpetweed	G	F	-	G	G	G	G	E	E
Common chickweed	G	G	-	G	G	G	G	E	G
Common lambsquarter	G	G	G	F-G	G-E	G	G	E	G
Common ragweed	G	N	-	F	F	P	F	E	G
Hairy galinsoga	G	N	-	G	-	P	G	E	E
Henbit	G	-	-	F	-	G	G	E	G
Horseweed	G	-	G	P	G	F	F	E	G
Knotweed	G	-	-	G	F	G	G	E	G
Mustards	G	P	-	P	F	P-F	G	G	E
Pennsylvania smartweed	G	N	P	P	-	P-F	G	E	G
Pigweeds	G	F	G	G	F	G	G	E	G
Prickly lettuce	G	-	-	G	-	F	G	E	G
Prickly sida	F-G	-	G	N	P	P-F	G	G	-
Purslane	G	G	-	G	G	G	G	E	E
Shepherds' purse	G	P	-	F	G	G	G	E	G
Speedwells	-	G	-	-	-	-	-	-	-
Velvetleaf	-	N	P	N	F	P-F	F	G	G
Virginia pepperweed	G	-	-	F	G	G	-	E	-
<i>Perennial Grasses And Sedges</i>									
Fescues	G	N	N	N	F	N	N	P	F
Johnsongrass (rhizome)	-	N	N	N	P	N	N	N	P
Nimblewill	-	N	N	N	F	N	N	P	P
Orchardgrass	G	N	N	N	F	N	N	P-F	G-E
Quackgrass	G	N	N	N	P	N	N	P-F	G
Yellow nutsedge	P-F	N	N	P	P-F	N	N	N	F-G

(E=Excellent ; G=Good ; F=Fair ; P=Poor; N=None; --Unknown)

**Table 2.12 - Relative Effectiveness of Preemergence Herbicides in Small Fruit (cont.)**

	Dichlobenil	DCPA	Flumioxazin	Napropamide	Nor-flurazon	Oryzalin	Oxyfluorfen	Simazine	Terbacil
Purpletop, Redtop	-	N	N	N	F-G	N	N	N	F-G
Dallisgrass	-	N	N	N	P	N	N	N	F-G
Bermudagrass	N	N	-	N	P	N	N	N	F
<i>Perennial Broadleaf Weeds</i>									
Broadleaf plantain	G	N	-	N	P	N	N	G	F
Buckhorn plantain	G	N	-	N	P	N	N	G	F
Canada thistle	P-F	N	-	N	N	N	N	N	N
Chicory	G	N	-	N	N	N	N	P-F	G
Common dandelion	E	N	-	N	N	N	N	P-F	G-E
Common mallow	G	N	-	N	N	N	N	N	-
Common milkweed	-	N	-	N	N	N	N	N	N
Common yarrow	-	N	-	N	N	N	N	-	N
Docks (broadleaf, curly)	G	N	-	N	N	N	N	N	F
Goldenrod	F-G	N	-	N	N	N	N	N	P-F
Ground ivy	E	N	-	N	N	N	N	N	N
Hemp dogbane	N	N	-	N	N	N	N	N	N
Horsenettle	N	N	-	N	N	N	N	P	F-G
Mugwort	G-E	N	-	N	N	N	N	N	P
Red sorrel	G	N	-	N	N	N	N	N	P
Thistles (bull, musk, curly)	F	N	-	N	N	-	N	-	-
White flowered aster	G	N	-	N	N	N	N	N	N
Wild carrot	G	N	-	N	F	N	N	N	F
Wild strawberry	G	N	-	N	P	N	N	N	N
Yellow rocket	G	N	-	N	F	N	N	P	G
Yellow woodsorrel (from seed)	G	G	-	P	F	F	N	F	G
<i>Special Perennial Weed Problems</i>									
Bigroot morningglory	N	N	-	N	N	N	N	N	N
Brambles (Rubus spp.)	N	N	-	N	N	N	N	N	N
Common greenbriar	N	N	-	N	N	N	N	N	N
Japanese honeysuckle	N	N	-	N	N	N	N	N	N
Poison ivy	N	N	-	N	N	N	N	N	N
Virginia creeper	N	N	-	N	N	N	N	N	N
Wild garlic	F	N	-	N	N	N	N	N	N

(E=Excellent ; G=Good ; F=Fair ; P=Poor; N=None; --=Unknown)

**Table 2.13 - Relative Effectiveness of Postemergence Herbicides in Small Fruit**

	Carfentrazone	Fluazifopbutyl	Glyphosate	Sethoxydim	2,4-D	Clopyralid	Paraquat	Clethodim
<i>Annual Grasses</i>								
Barnyardgrass	N	E	E	E	N	N	G	E
Cheat	-	G	E	G	N	N	G	-
Crabgrass	N	E	E	E	N	N	G	E
Fall panicum	N	E	E	E	N	N	G	E
Foxtails	N	E	E	E	N	N	G	E
Goosegrass	N	E	E	E	N	N	G	E
Johnsongrass (seedling)	N	E	E	E	N	N	G	E
<i>Annual Broadleaf Weeds</i>								
Annual fleabane	-	N	E	N	G	-	E	N
Annual morningglory	F	N	E	N	E	N	G	N
Black nightshade	G	N	E	N	F-G	F	G	N
Carpetweed	G	N	E	N	E	-	E	N
Common chickweed	F	N	E	N	P	-	E	N
Common lambsquarter	G	N	E	N	G	P	E	N
Common ragweed	P	N	E	N	G	E	E	N
Hairy galinsoga	-	N	E	N	G	-	E	N
Henbit	G	N	E	N	G	-	E	N
Horseweed	-	N	E	N	G	G	G	N
Knotweed	-	N	E	N	F	-	F	N
Mustards	-	N	E	N	G	-	F	N
Pennsylvania smartweed	-	N	E	N	P	F	G	N
Pigweeds	G	N	E	N	G	P	G	N
Prickly lettuce	-	N	E	N	P	-	G	N
Prickly sida	-	N	E	N	G	-	E	N
Purslane	-	N	E	N	F	-	G	N
Shepherds' purse	-	N	E	N	G	-	G	N
Speedwells	G	N	E	N	P	-	P	N
Velvetleaf	E	N	E	N	G	P	E	N
Virginia pepperweed	-	N	E	N	G	-	G	N
<i>Perennial Grasses And Sedges</i>								
Fescues	N	P-F	E	P-F	N	N	F	F
Johnsongrass (rhizome)	N	G	E	G	N	N	P	G
Nimblewill	N	G	G-E	F-G	N	N	P	—
Orchardgrass	N	F	E	F	N	N	F	F

(E=Excellent; G=Good; F=Fair; P=Poor; N=None; --=Unknown)

**Table 2.13 - Relative Effectiveness of Postemergence Herbicides in Small Fruit (cont.)**

	Carfentrazone	Fluazifopbutyl	Glyphosate	Sethoxydim	2,4-D	Clopyralid	Paraquat	Clethodim
Quackgrass	N	G	G	G	N	N	P	G
Yellow nutsedge	N	N	G	N	N	N	P	N
Purpletop, Redtop	N	G	E	G	N	N	P	—
Dallisgrass	N	G	E	G	N	N	P	—
Bermudagrass	N	G	G	G	N	N	P	G
<i>Perennial Broadleaf Weeds</i>								
Broadleaf plantain	-	N	E	N	G	-	P	N
Buckhorn plantain	P	N	E	N	G	P	P	N
Canada thistle	-	N	F-G	N	F-G	G	P	N
Chicory	-	N	E	N	G	-	P	N
Common dandelion	P	N	E	N	G	F	P	N
Common mallow	-	N	E	N	—	-	P	N
Common milkweed	-	N	G	N	P-F	-	P	N
Common yarrow	-	N	G	N	F	-	P	N
Docks (broadleaf, curly)	P	N	G	N	G	-	P	N
Goldenrod	-	N	E	N	P-F	-	P	N
Ground ivy	-	N	G	N	P-F	-	P	N
Hemp dogbane	-	N	F	N	P-F	-	P	N
Horsenettle	-	N	F-G	N	P	-	P	N
Mugwort	-	N	F	N	P	P-F	P	N
Red sorrel	-	N	G	N	P	-	P	N
Thistles (bull, musk, curly)	-	N	G	N	F-G	G	P	N
White flowered aster	-	N	E	N	N	-	P	N
Wild carrot	-	N	E	N	P-F	-	P	N
Wild strawberry	-	N	E	N	P-F	-	P	N
Yellow rocket	-	N	E	N	P-F	-	P	N
Yellow woodsorrel	-	N	E	N	F	N	P	N
<i>Special Perennial Weed Problems</i>								
Bigroot morningglory	-	N	F-G	N	F-G	-	P	N
Brambles ( <i>Rubus</i> spp.)	-	N	G	N	P	-	P	N
Common greenbriar	-	N	P	N	N	-	P	N
Japanese honeysuckle	-	N	F-G	N	P-F	-	P	N
Poison ivy	-	N	G	N	F	-	P	N
Virginia creeper	-	N	F-G	N	F	-	P	N
Wild garlic	-	N	F	N	F	-	P	N

(E=Excellent; G=Good; F=Fair; P=Poor; N=None; —=Unknown)

