

Commercial Small Fruit: Diseases and Insects

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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.

Insecticides approved for organic production and noninsecticidal management tactics listed in this guide for small fruit insect pests include:

Strawberry: Mites – Stylet oil, Trilogy, 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, Neemix/Trilogy, Surround.

Blueberries: Blueberry tip borer – remove infested tissue when pruning. Plum curculio – Surround. Cranberry/cherry fruitworms – Entrust. Mites – Stylet oil. Japanese beetle – Neemix/Trilogy.

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. Fruit rot fungicide sprays should focus the entire spray volume on the plants on the top of the beds, and should be applied using spray pressures and tips that generate fine droplets (using hollow cone or similar type nozzles). The application rate on caneberries is based on 150-250 gal per acre.

For information on small fruit pests and their control, request Virginia Cooperative Extension (VCE) Publications 444-567, 456-232, and 456-018, as well as those listed 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, <http://pubs.cas.psu.edu/freepubs/MABerryGuide.htm>; and the Southern Region Small Fruit Consortium, <http://www.smallfruits.org/SmallFruitsRegGuide/index.htm>.

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

Fungicide Resistance Guidelines: The gray mold and anthracnose pathogens are now resistant to multiple fungicides in many strawberry fields in Virginia and nearby states. Resistance to Topsin-M has been found in every survey sample from Virginia, and resistance to many other fungicides has also been commonly found. Strawberry growers should focus on fruit rot fungicide spray programs on broad-spectrum, “multi-site” products such as Captan and Thiram and use other products, when necessary, to increase efficacy and/or to control other diseases like anthracnose. Fruit rot spray programs should focus on the bloom period, starting promptly at first bloom. After peak bloom, sprays are usually beneficial only when wet weather conditions favor pathogen infection. Fungicide-resistant pathogens react similarly to products with the same mode of action, indicated by the same “FRAC Group number”. Resistance to fungicides in FRAC Group 11 (Abound, Azaka, Quadris, Cabrio and Pristine, Flint, Luna Sensation, Merivon, Quadris Top, and Quilt Xcel) and FRAC Group 7 (Fontelis, Kenja, Luna Privilege, Pristine, Merivon, Luna Privilege, Luna Tranquility) is of particular concern. While some strawberry fungicides contain multiple FRAC Group ingredients (Pristine, Merivon, Quadris Top, Quilt Xcel, Luna Sensation, and Luna Tranquility), resistance is now also showing up to the partner fungicides in these products. Therefore, except for Captan (FRAC Group M4) and Thiram (FRAC Group M3), fungicides in the same FRAC Group (having the same mode of action) should NOT be applied more than twice during a single growing season, and especially not in sequential sprays. Use of FRAC Group 11 fungicides should focus on controlling anthracnose versus other diseases, and so shouldn’t be used in the fall or early in the bloom period unless anthracnose is already present. Other fruit rot fungicides should be tank-mixed with Captan or Thiram whenever possible to avoid development of fungicide resistance. Growers can obtain a “fungicide resistance profile” of their strawberry fields by working with their county extension agent to submit blossom or fruit-swab samples to Clemson University for analysis. Information on this program can be accessed at: http://www.clemson.edu/extension/horticulture/fruit_vegetable/peach/diseases/gm_collectioninstructions.pdf#new.

Strawberries

Table 2.1a - Strawberry Diseases, Post-Planting

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Rate per Acre	Spray Timing and Remarks
Anthracnose	Abound 2.08F	5.0-8.0 fl oz	—	For suppression only. Wash roots of bare-root plants to remove excess soil, and then immerse entire plants for 2 to 5 minutes, planting the same day, if possible. For continued control, follow-up with foliar fungicide applications 2 to 3 weeks after transplant. FRAC-11
Crown Rot (<i>Colletotrichum gloeosporioides</i> ; <i>C. fragariae</i>)	Azaka	5.0-8.0 fl oz	—	For suppression only. Wash roots of bare-root plants to remove excess soil, and then immerse entire plants for 2 to 5 minutes, planting the same day, if possible. For continued control, follow-up with foliar fungicide applications 2 to 3 weeks after transplant. FRAC-11
	Switch 62.5WG	5.0-8.0 fl oz	—	For suppression only. Wash roots of bare-root plants to remove excess soil, and then immerse entire plants for 2 to 5 minutes, planting the same day, if possible. For continued control, follow-up with foliar fungicide applications 2 to 3 weeks after transplant. FRAC-12 and FRAC-9
<i>Rhizoctonia</i> sp. (seedling root & basal stem rot)	Abound 2.08F	—	0.4-0.8 fl oz	Spray before infection in band no wider than 7 inches, centered over (non-tarped) rows. FRAC-11
	Azaka	—	/1,000 row feet	

Table 2.1b - Strawberry Diseases, At Planting

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Rate per Acre	Spray Timing and Remarks
<i>Rhizoctonia</i> sp. (seedling root & basal stem rot)	Abound 2.08F	—	0.4-0.8 fl oz /1,000 row feet	Drip-irrigate plug plants with poor root systems or plants in non-fumigated beds or excessively wet beds and heavy soils. FRAC-11
	Azaka	—		
Anthracnose	Captan 50W	—	3-6 lb	Begin sprays when disease is suspected or as soon as observed and continue on a 10-14 day schedule. Other than Quilt Xcel, Qol fungicides are no more effective than Captan (FRAC-M4), Thiram (FRAC M3) and Switch (FRAC-9 and FRAC-12) for anthracnose crown rot. In general, Qol fungicides should be saved for anthracnose fruit rot control. Except for Captan or Thiram, do not apply any fungicides with the same mode of action (same FRAC Group number) more than twice in a single growing season. Captan fungicides are FRAC-M4, while Thiram is FRAC-M3, Captevate is FRAC-M4+17, and Switch is FRAC-9+12. Quilt Xcel and Quadris Top are FRAC-11+3; Pristine, Merivon and Luna Sensation are both FRAC-11 and FRAC-7; Cabrio, Abound, and Azaka are only FRAC-11; Protocol is FRAC-1 and FRAC-3.
Crown Rot: (<i>Colletotrichum gloeosporioides</i> ; <i>C. fragariae</i>)	Captan 80WDG	—	1.9-3.8 lb	
	Captan Gold 80WDG	—	1.9-3.8 lb	
	Captan Gold 4L	—	2.5 qt	
	Captec 4L	—	2.5 qt	
	Captevate 68WDG	—	5.25 lb	
	Switch 62.5WG	—	11.0-14.0 oz	
	Thiram 75 WDG or	—	4.4 lb	
	Thiram 24/7	—	2.6 qt	
	Qol fungicides (FRAC-11):			
	Quilt Xcel	—	14.0 fl oz	
	Quadris Top	—	12.0-14.0 fl oz	
	Pristine 38WDG	—	18.5-23.0 oz	
	Merivon	—	5.5-8.0 fl oz	
	Luna Sensation	—	4.0-7.6 fl oz	
	Cabrio 20EG	—	12.0-14.0 oz	
Abound 2.08F	—	6.2-15.4 fl oz		
Azaka	—	6.2-15.4 fl oz		
Protocol	—	1.33 pt		
Anthracnose	First bloom:			When risk is high for anthracnose fruit rot, <u>begin sprays at first bloom</u> and continue on a 7 to 10-day schedule. The 1st spray should apply a Captan product, or Thiram (FRAC-M3), tank-mixed with a Qol fungicide (FRAC-11), Orbit and Tilt are FRAC-3, while Protocol is FRAC-1+3, but do not repeat use of a Qol product in the 2nd spray. Use the same products in the 3rd spray that were used in the 1st, but rotate the fungicides applied each week thereafter. Except for Captan or Thiram, do not apply any fungicides with the same mode of action (same FRAC Group number) more than twice in a single growing season. Orbit and Tilt are FRAC-3, while Protocol is FRAC-1+3. Under high anthracnose disease pressure, Pristine, Merivon, Cabrio, or Luna Sensation (FRAC-11+7) show the best efficacy. Incorporate Switch (FRAC 9+12) into the fungicide rotation program when Botrytis pressure is also high. Quilt Xcel and Quadris Top = FRAC-11+3; Cabrio = FRAC-11.
Fruit Rot: (<i>C. acutatum</i> ; <i>C. fragariae</i>)	Captan 50W	—	3-6 lb	
	Captan 80WDG	—	1.9-3.8 lb	
	Captan Gold 80WDG	—	1.9-3.8 lb	
	Captan Gold 4L	—	1.5-3.0 qt	
	Captec 4L	—	1.5-3.0 qt	
	Captevate 68WDG	—	5.25 lb	
	Thiram 75 WDG	—	4.4 lb	
	Thiram 24/7	—	2.6 qt	
	Orbit	—	4.0 fl oz	
	Tilt	—	4.0 fl oz	
	Protocol	—	1.33 pt	
	Qol fungicides (FRAC-11):			
	Pristine 38WDG	—	18.5-23.0 oz	
	Merivon	—	5.5-8.0 fl oz	
	Luna Sensation	—	4.0-7.6 fl oz	
Quilt Xcel	—	14.0 fl oz		
Quadris Top	—	12.0-14.0 fl oz		
Cabrio 20EG	—	12.0-14.0 oz		

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

Table 2.1b - Strawberry Diseases, Post-Planting (cont.)

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Rate per Acre	Spray Timing and Remarks
Gray Mold Fruit Rot (<i>Botrytis cinerea</i>)	Rovral 4F	—	1.5-2.0 pt	Do not apply Rovral after first flower or more than once/season.
	Captevate 68WDG	—	3.5-5.25 lb	
	Elevate 50WDG	—	1.5 lb	Preventative fungicide sprays should begin at first bloom and continue on a 7- to 14-day interval. Other than Captan (FRAC-M4) or Thiram (FRAC-M3), do not apply any fungicide with the same fungicidal mode of action (same FRAC Group number) more than twice in any growing season. Ph-D, and OSO (FRAC-19) can be substituted for Captan in the beginning of the season, but may have less activity against anthracnose. Captevate contains both Captan (FRAC-M4) and Elevate (FRAC-17). Rates of Elevate may be lowered to 1.0 lb/A when tank-mixed with Captan or Thiram. For early spring sprays, 9.0 fl oz Scala (FRAC-9) can be sprayed when tank-mixed with Captan or Thiram. Fontelis and Kenja are both FRAC-7 fungicides.
	Switch 62.5WSB	—	11.0-14.0 oz	
	Luna Tranquility	—	16-27 fl oz	
	Luna Privilege	—	6.8 fl oz	
	Fontelis	—	16-24 fl oz	
	Kenja 400SC	—	13.5-15.5 fl oz	
	—	—	—	
	Captan 50W	—	3.0-6.0 lb	
	Captan 80WDG	—	1.9-3.8 lb	
	Captan Gold 80WDG	—	1.9-3.8 lb	
	Captan Gold 4L	—	1.5-3.0 qt	
	Captec 4L	1.5-3.0 qt	1.5-3.0 qt	
	Thiram 65WSB	—	4.0-5.0 lb	
	Thiram 24/7	—	2.6 qt	
	Ph-D WDG	—	6.2 oz	
	OSO 5SC	—	6.5-13 fl oz	
	Scala 600SC	—	18.0 fl oz	
	QoI Fungicides (FRAC-11)	—	—	Use of QoI fungicides should be delayed in order to avoid encouraging development of fungicide resistance in the anthracnose fruit rot pathogen. Luna Sensation, Pristine and Merivon also contain a FRAC-7 fungicide as well as FRAC-11.
Luna Sensation	—	6.0-7.6 fl oz		
Pristine 38WSB	—	18.5-23.0 oz		
Merivon	—	8.0-11.0 fl oz		
Phytophthora	Ridomil Gold SL	—	1.0 pt	Actual rate applied should be rate per treated acre for oomycete fungicides for crown rot or red stele control. This equates to ~0.5 pt Ridomil Gold, 1 pt Ultra Flourish, or 2 pt MetaStar per acre of crop, depending on row spacing and bed width. FRAC-4.
Crown Rot (<i>P. cactorum</i>)	Ultra Flourish	—	1 qt (2.0 pt)	
	MetaStar 2E AG	—	2 qt (4.0 pt)	
Red Stele (<i>P. fragariae</i>)	Phosphite products			
	Aliette WDG	2.5 lb (dip)	2.5-5.0 lb (spray)	
Leather Rot (<i>P. cactorum</i>)	Agri-Fos	2.5 pt (dip)	2.5 pt (spray)	Phosphite products may be applied as drip treatments just prior to (same day as) planting or as foliar sprays after planting. For dip treatments, submerge roots and crowns in fungicide solution for 15-30 minutes. Foliar sprays after planting avoid possible spread of angular leaf spot. FRAC-33
	Phostrol	2.5 pt (dip)	2.5-5.0 pt (spray)	
	ProPhyt	2.0 pt (dip)	2.0-4.0 pt (spray)	

Table 2.1b - Strawberry Diseases, Post-Planting (cont.)

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Rate per Acre	Spray Timing and Remarks	
Powdery Mildew (<i>Sphaerotheca spp.</i>)	Rally 40W or WSP	1.6-3.2 oz	2.5-5.0 oz	Initiate applications at the first sign of infection. Repeat applications every 7-14 days. Do not apply fungicides with the same mode of action (same FRAC Group number) more than twice in a growing season. Rally and Procure are FRAC-3; Quintec is FRAC-13.	
	Procure 50WS	—	4.0-8.0 oz		
	Procure 480SC	—	4.0-8.0 fl oz		
	Quintec	—	4.0-6.0 fl oz		
	Fontelis	—	10-24 fl oz		
	Kenja 400SC	—	13.5-15.5 fl oz		
	Protocol	—	1.3 pt		
	Tilt	—	4.0 fl oz		
	Luna Tranquility	—	16-27 fl oz		
	Orbit	—	4.0 fl oz		
	Mettle	—	3.0-5.0 fl oz		Repeat Mettle sprays should be applied on a 14- to 21-day schedule.
	Rhyme	—	5.0-7.0 fl oz		Apply preventatively or when conditions favor disease; repeat as necessary up to 4 times/year (FRAC-3).
	Sulfur	—	5.0-10.0 lb		Only 2 Torino sprays per year, 14 days apart.
	Torino	—	3.4 oz		
		QoI Fungicides (FRAC-11)			
	Flint	—	2.0-3.2 fl oz		
	Quadris Top	—	12.0-14.0 fl oz		
	Quilt Xcel	—	14.0 fl oz		
	Flint	—	2.0-3.2 fl oz		
Angular Leaf Spot (<i>Xanthomonas fragariae</i>)	Various formulations of:		See labels	Scout fields regularly for first sign of disease after plant establishment. Avoid overhead irrigation/frost protection. Begin sprays at first sign of disease and continue on 7- to 10-day interval until conditions improve or first sign of crop injury from sprays.	
	Basic copper sulfate	2.0-3.0 lb	-		
	Copper hydroxide		0.35-0.58 lb a.i.		
	Copper salts of fatty & rosin acids		3.0-4.0 pt		
	Cuprous Oxide		1.05-4.2 lb a.i.		
	Actigard 50W		0.5-0.75 oz	Do not apply Actigard within 5 days of transplanting, or to plants stressed by drought or excessive moisture, cold, etc.	

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

Table 2.1b - Strawberry Diseases, Post-Planting (cont.)

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Rate per Acre	Spray Timing and Remarks
Leaf Spot (<i>Mycosphaerella fragariae</i>)	Rally 40W or WSP	—	2.5-5.0 oz	Powdery mildew in the field rarely causes damage significant enough to justify fungicide application. However, high tunnel environments can often favor powdery mildew infection. Begin applications as symptoms first appear and continue on a 7- to 14-day schedule as conditions warrant. Rally, Orbit, Tilt and Mettle are FRAC-3 products; Protocol contains a FRAC-1 fungicide as well as FRAC-3; Captans and Captec are FRAC-M4; Topsin-M is FRAC-1; Rovral is FRAC-2. The 3 fl oz rate is only for tank-mixes with non-FRAC-3 fungicides. Begin Mettle applications before disease occurs and repeat on a 21-day interval for low-to-moderate disease pressure, 14-day interval under heavy disease pressure. (FRAC -3)
	Protocol	—	1.3 pt	
Leaf Scorch (<i>Marssonina fragariae</i>)	Captan 50W	—	3.0-6.0 lb	
	Captan 80WDG	—	1.9-3.8 lb	
Leaf Blight (<i>Phomopsis obscurans</i>)	Captan Gold 80WDG	—	1.9-3.8 lb	
	Captan Gold 4L	—	1.5-3.0 qt	
Leaf Blotch (<i>Gnomonia spp.</i>)	Captec 4L	—	1.5-3.0 qt	
	Mettle	—	3.0-5.0 fl oz	
	Orbit 3.6E	—	4.0 fl oz	
	Tilt	—	4.0 fl oz	
	Topsin M WSB	—	0.75-1.0 lb	Topsin applications should include a Captan or Thiram (FRAC-M3) product to minimize fungicide resistance. Do not apply Rovral when plants are flowering.
	Topsin 4.5FL	—	15.0-20.0 fl oz	
	Rovral 4F	—	1.5-2.0 pt	
	Qol Fungicides (FRAC-11)			Use of Qol fungicides for powdery mildew control may select for fungicide resistance in the anthracnose pathogens. Do not apply any Qol fungicide more than twice in a growing season. Luna Sensation, Merivon, and Pristine also contain a FRAC-7 fungicide, while Quadris Top also contains a FRAC-3 fungicide.
Luna Sensation	-	7.6 fl oz		
Merivon	-	8-11 fl oz		
Pristine	-	18.5-23 fl oz		
	Quadris Top	-	12.0-14.0 fl oz	

Phytophthora diseases (crown rot, red stele, leather rot)

Phosphite-based products are less effective than Ridomil Gold, but should be considered when the pathogen is Ridomil-resistant or if root systems are significantly damaged but plants possess adequate foliage to absorb the product. For crown rot control, phosphite products may be applied by dipping transplants into a fungicide solution for 30 minutes just before (the same day as) planting. Foliar sprays with phosphites should begin 2-3 weeks after planting and be repeated on 30-60 day intervals. Begin spraying perennial plantings when plants start active growth in the spring. For leather rot control, begin phosphite sprays at 10% bloom and early fruit set and continue on a 7-14 day interval as long as conditions favor disease. Aliette may be applied the day of harvest (REI = 12 hr). Although Agri-Fos, Phostrol, and ProPhyt are labeled similarly to Aliette, check their labels for specific use instructions.

Ridomil Gold, MetaStar, and Ultra Flourish may each be applied up to 3 times/cropping season. For control of crown rot or red stele in annual plantings, applications can be made after transplanting, 30 days prior to harvest or fruit set, and during harvest. In established plantings, the first application should occur in the spring after the ground thaws and before first bloom, and the second in the fall after harvest. A supplemental application can be made at fruit set for leather rot control. Apply Ridomil Gold or MetaStar in sufficient water to move the product into the root zone. In drip-treatments, reduce the rate applied according to the ratio of bed-width to row spacing (example: 32 inch-wide bed/60 inch [5 ft] row spacing = 0.53; 0.53*1.0 pt/acre = 0.53 pt/acre for Ridomil Gold; 0.53 gal/acre for MetaStar).

Caution: Abound is extremely phytotoxic to some apple cultivars, including ‘Gala’ and ‘McIntosh’. Contact with apples should be prevented between spray drift and leftover residue in spray tanks.

Pre-Harvest Spray Intervals: Abound, Actigard, Azaka, Cabrio, Captevate, Elevate, Flint, Fontelis, Inspire Super, Kenja, Mettle, MetaStar, Orbit, OSO, the phosphite products, Ph-D, Pristine, Quadris Top, QuiltXcel, Rally, Ridomil Gold, Switch, Torino, and Ultra Flourish may be applied the day of harvest. Luna Tranquility, Procure, Protocol, Quintec, Scala and Topsin-M may be applied the day before harvest. Although the pre-harvest interval for Captan and Captec is 0 days, protective clothing must be worn if entering the planting within 1 day after Captan application. Preharvest intervals for most copper products are 2 days, and 3 days for Thiram.

Maximum Fungicide Uses per year: Abound – 1.9 qt; Actigard – 6.0 oz; Aliette – 30.0 lb; Azaka – 61.5 fl oz; Cabrio – 70.0 oz; Captan 80WDG – 30.0 lb; Captevate – 21.0 lb; Elevate – 6.0 lb; Flint – 19.2 oz; Fontelis – 72.0 fl oz; Kenja – 54 fl oz; Luna Sensation – 27.1 fl oz; Luna Tranquility – 54.7 fl oz; Mettle – 20 fl oz; MetaStar – 6.0 qt; Orbit – 16.0 fl oz; OSO – 78.0 fl oz ; Ph-D – 18.6 oz; Pristine – 115.0 oz; Procure – 32.0 oz; Protocol – 5.3 pt; Quadris Top – 56 fl oz; QuiltXcel – 56 fl oz; Quintec – 24.0 fl oz; Rally – 30.0 oz; Rhyme - 28 fl oz; Ridomil Gold – 3.0 pt; Scala – 54.0 fl oz; Switch – 56.0 oz; Topsin-M – 4.0 lb; Torino – 6.8 oz; Ultra Flourish – 6.0 pt.

Table 2.2 - Strawberry Insects

Crop and Pest	Chemical and Formulation	Rate per 100 Gal Dilute	Rate per Acre	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 Pro at or just before transplanting, or in drip irrigation just before bud opening. Incorporate Admire Pro into soil with at least 0.25 inches of irrigation or rainfall within 2 hrs of application.	
	Admire Pro	—	7.0-10.5 fl oz		
Aphids	Admire Pro	—	10.5-14.0 fl oz		
<i>First Cover</i>					
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 for REI and PHI. It is advisable to delay use of Danitol if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications.	
	Danitol 2.4EC	10.6 fl oz	—		
	Assail 30SG	—	1.9-4.0 oz		
Strawberry clipper	Lorsban 4E	1.0 pt	1.0 qt		
	Brigade WSB	3.2-16.0 oz	6.4-32.0 oz		
Spider mites	Savey 50DF	—	2.0-3.0 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 2.7 for REI and PHI. Acramite may be applied once per season. Use an organosilicone (See label.) ¹ Consult distributors.
	Zeal 72WDG	—			
	Oberon 2SC	—	12.0-16.0 oz		
	Acramite 50WS	0.4-0.5 lb	0.75-1.0 lb		
	Agri-Mek 0.15EC	8.0 fl oz	16.0 fl oz		
	Vendex 50WP	8.0 oz	2.0 lb		
	Stylet Oil	3.0 qt	—		
	Predatory mites ¹	—	—		
	Aza-Direct	—	11.5-42.0 fl oz		
	Kanemite 15SC	—	21.0-31.0 fl oz		
Trilogy	—	2% solution			
Nealta 1.67WSP	—	13.7 fl oz	Nealta should be applied at the first sign of infestation. No more than one application of Nealta should be applied before changing to an acaricide of differing mode of action.		
<i>Second Cover</i>					

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

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Table 2.2 - Strawberry Insects (cont.)

Crop and Pest	Chemical and Formulation	Rate per 100 Gal Dilute	Rate per Acre	Spray Timing and Remarks
Tarnished plant bug	Rimon 0.83EC	—	6.0 oz	When blossoms separate in flower cluster. Treatment threshold is 1 nymph in every 1 to 2 flower clusters. See Table 2.7 for PHI and REI. Actara provides suppression only. Use of Danitol or Brigade should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications..
	Brigade WSB	3.2-16.0 oz	—	
	Danitol 2.4EC	10.7 fl oz	11.5-42.0 fl oz	
	Aza-Direct	—	4.0-6.9 oz	
	Assail 30SG	—	2.0-3.0 oz	
	Actara 25 WDG	—	4.0 oz	
Strawberry leafroller	Sevin XLR	—	2.0 qt	Strawberry leafroller is seldom a problem. Entrust is for organic management. Use of Radiant should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications.
	Dipel DF	—	0.5-1.0 lb	
	Entrust 80WP	—	1.25-1.5 oz	
	Radiant 1SC	—	6.0-10.0 fl oz	
	Assail 30SG	—	4.0-6.9 oz	
	Coragen 1.67SC	—	3.5-5.0 fl oz	
Thrips	Aza-Direct	—	12.5-42.0 fl oz	
	Entrust 80WP	—	1.25-1.5 oz	
	Radiant 1SC	—	6.0-10.0 fl oz	
	Assail 30SG	—	4.0-6.9 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>				
Tarnished plant bug	See Second Cover	—	—	Berries half-grown, 7 to 10 days after fourth cover. This second TPB spray may be needed. See note in Second Cover.
Spittlebugs	See First Cover	—	—	—
Leafroller	See Second Cover	—	—	—
Spider mites	See First Cover	—	—	—
Strawberry aphid	Actara 25WG	—	1.5-3.0 oz	Use virus-free plants.
	Assail 30SG	—	1.9-4.0 oz	
	M-Pede	—	2% solution	
	Aza-Direct	—	11.5-42.0 fl oz	
<i>Preharvest</i>				
Sap beetles	Assail 30SG	—	4.0-6.9 oz	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.
	Malathion 5EC	—	1.5 pt	
	Danitol 2.4EC	—	—	
	Rimon 0.83EC	16.0-21.3 fl oz 12.0 fl oz	— —	
Spotted wing Drosophila	Entrust 80 WP	—	1.25–2.0 oz	Harvest fruit promptly and completely. Rotate among available modes of action to slow development of pesticide resistance. Use of malathion or Brigade should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications.
	Entrust 2SC	—	4.6 fl oz	
	Brigade WSB	—	16.0 oz	
	PyGanic 1.4 EC	—	64.0 fl oz	
	Azera	—	2.0–3.0 pt	
	Malathion 5EC	—	1.5 pt	
Radiant 1SC	—	6-10 fl oz		

¹Predatory mites (*Amblyseius fallacis*) 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	Rate per Acre	Spray Timing and Remarks
<i>Post-Harvest</i>				
Strawberry root weevil	Brigade WSB Malathion 5EC	8.0-16.0 oz —	16.0-32.0 oz 1.5-2.5 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 Pro	—	7.0-10.5 fl oz	Apply at renovation; incorporate into soil and furrow with 0.25 inches of water (irrigation or rain).

Caneberries

Table 2.3 - Blackberry and Raspberry Diseases

Crop and Pest	Chemical and Formulation	Rate per 100 Gal Dilute	Rate per Acre	Spray Timing and Remarks
Anthracnose (<i>Elsinoe veneta</i>)	<u>Dormant or late dormant sprays</u> Liquid lime sulfur (24-31% solution)	—	See specific product label	See fungicide use comments and Table 2.7 for specifics on fungicide use and for REI's, PHI's & maximum use rates for each fungicide. <u>Dormant or late dormant sprays:</u> Spray in late winter or early spring when new growth is less than ¼ inch long. Lime-sulfur will likely burn any exposed green tissue, and will burn applicators as well as plants. At least 200 gallons of dilute spray per acre is recommended.
Cane Blight (<i>Leptosphaeria coniothyrium</i>)				Only the copper-based products are labeled for Cane & Spur Blight.
Spur Blight (<i>Didymella applanata</i>)	Copper-based products	—	See specific product label	Apply copper products (FRAC-M1) before shoots are 3-4 inches long to avoid leaf burn. Copper can cause phytotoxicity on black raspberry, and occasionally on red raspberry, if used with formulated phosphorus acid products (Aliette - FRAC-33, for example). Be sure to thoroughly clean equipment after using a copper product or liquid lime sulfur.
	Shoots 6" long to After-Harvest			Apply at bloom (shoots 8"-10" long), 2 weeks later, and in the fall after old canes have been removed.
	Cabrio	—	14.0 oz	Shoots 6" long to After-Harvest
	Abound	—	6.2-15.4 fl oz	See fungicide use comments and Table 2.7 for specifics on fungicide use and for REI's, PHI's & maximum use rates for each fungicide. Cabrio, Abound and Azaka are FRAC-11 products. Pristine contains FRAC-11 and FRAC-7 fungicides, while Quilt Xcel contains a FRAC-11 and a FRAC-3 fungicide. Captan products are FRAC-M4, while OSO and Ph-D are FRAC-19 fungicides.
	Azaka	—	18.5-23 oz	
	Pristine	—	6.0-15.5 fl oz	
	Quilt Xcel	—	14.0-21.0 fl oz	

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Table 2.3 - Blackberry and Raspberry Diseases (cont.)

Crop and Pest	Chemical and Formulation	Rate per 100 Gal Dilute	Rate per Acre	Spray Timing and Remarks
Spur Blight (<i>Didymella applanata</i>) (cont.)	Captan products		see specific product label	
	OSO	—	3.75-13.0 fl oz	
	Ph-D	—	6.2 oz	
Gray mold (<i>Botrytis cinerea</i>)	Pristine 38WDG	—	18.5-23.0 oz	Resistance to the active ingredients in Elevate (FRAC-17) and Pristine is increasingly common, and may become an issue with the Luna fungicides. Therefore, a protectant fungicide (Captan, for example) should always be mixed with Elevate. Make no more than 2 sequential applications of Pristine or Luna Tranquility before alternating to a product with a different mode of action (FRAC Group). Switch contains a FRAC-9 and a FRAC-12 fungicide. Rovral, Nevado, and Iprodione are FRAC-2 products. Caution: Abound (FRAC-11) is extremely phytotoxic to some apple cultivars. Prevent spray drift and leftover residue in the spray tank which may come in contact with apples.
	Luna Tranquility	16-27 fl oz		
	Elevate 50WDG		1.5 lb	
	Switch 62.5WG		11.0-14.0 oz	
	Rovral 4F, Nevado 4F, Iprodione 4L AG	0.5-1.0 pt	1.0-2.0 pt	
	Captan products		See labels	
	OSO		3.75-13.0 fl oz	
	Ph-D		6.2 oz	
	Abound 2.08F		6.2-15.4 fl oz	
Cane and Leaf Rust (<i>Kuehneola uredines</i>)	Rally 40WSP	—	1.25-2.5 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. Rally, Orbit, Tilt, and Propimax are all FRAC-3 fungicides, while Cabrio, Abound and Azaka are FRAC-11 products. Pristine and Quilt Xcel both also contain a FRAC-11 fungicide, but Pristine also includes a FRAC-7 compound while Quilt Xcel also includes a FRAC-3 fungicide.
	Orbit 3.6EC	—	6.0 fl oz	
	Tilt 3.6EC	—	6.0 fl oz	
Orange Rust <i>Arthuriomyces peckianus</i> , <i>Gymnoconia nitens</i>)	PropiMax 3.6E	—	6.0 fl oz	
	Cabrio	—	14 oz	
	Abound FL	—	6.2-15.4 fl oz	
Yellow Rust (<i>Phragmidium rubi-idaei</i>)	Azaka		6.0-15.5 fl oz	
	Pristine WG		18.5-23.0 oz	
	Quilt Xcel		14.0-21.0 fl oz	
Rosette or Double Blossom (<i>Cercospora rubi</i>)	Abound FL	—	6.2-15.4 fl oz	
	Azaka	—	6.0-15.5 fl oz	
	Pristine W	—	18.5-23 oz	
	Quilt Xcel	—	14.0-21.0 fl oz	
	Switch 62.5WG		11.0-14.0 oz	
	Bordeaux mixture	8 lb Copper sulfate + 8 lb Calcium hydroxide		

Table 2.3 - Blackberry and Raspberry Diseases (cont.)

Crop and Pest	Chemical and Formulation	Rate per 100 Gal Dilute	Rate per Acre	Spray Timing and Remarks
Powdery mildew (<i>Sphaerotheca macularis</i>)	Rally 40WSP	—	1.25-2.5 oz	Rally, Orbit, Tilt, and Propimax are FRAC-3 fungicides. Cabrio, Abound, and Azaka are FRAC-11 fungicides, while Pristine is a FRAC-11 + FRAC-7 product and Quilt Xcel contains a FRAC-11 and a FRAC-3 fungicide. OSO and Ph-D are FRAC-19 fungicides, while sulfur products are FRAC-M2. Use sulfur products only as dormant or late dormant sprays in late winter or early spring when new growth is less than ¼ inch long. Lime-sulfur will likely burn any exposed green tissue, and will burn applicators as well as plants. At least 200 gallons of dilute spray per acre is recommended.
	Cabrio	—	14.0 oz	
	Abound FL	—	6.2-15.4 fl oz	
	Azaka	—	6.0--15.5 fl oz	
	Pristine WG	—	18.5-23 oz	
	Sulfur-based products	—	See product label	
	Orbit 3.6EC	—	6.0 fl oz	
	Tilt 3.6EC	—	6.0 fl oz	
	PropiMax 3.6E	—	6.0 fl oz	
	Quilt Xcel	—	14.0-21.0 fl oz	
	OSO	—	3.75-13.0 fl oz	
PhD	—	6.2 oz		
Leaf spots (<i>Sphaerulina rubi</i> .)	Quilt Xcel	—	14.0-21.0 fl oz	Sprays for anthracnose, Botrytis gray mold, double blossom, and fruit rots should prevent Septoria infections. Quilt Xcel contains both a FRAC-11 fungicide and a FRAC-3 fungicide. Orbit, Tilt, and Propimax are FRAC-3 fungicides. Cabrio, Abound, and Azaka are FRAC-11 fungicides. Pristine contains a FRAC-11 fungicide and a FRAC-7 fungicide, while Luna Tranquility combines a FRAC-7 and a FRAC-9 fungicide. Captan products are FRAC-M4 fungicides.
	Orbit 3.6EC	—	6 fl oz	
	Tilt 3.6EC	—	6 fl oz	
	Propimax	—	6 fl oz	
	Cabrio	—	14 oz	
	Abound FL	—	6.2-15.4 fl oz	
	Azaka	—	6.0-15.5 fl oz	
	Pristine WG	—	18.5-23 oz	
	Luna Tranquility	16-27 fl oz		
Captan Products		See specific product label		

Fungicide Use for Caneberry Diseases

See fungicide use comments and Table 2.7 for specifics on fungicide use and for REI's, PHI's & maximum use rates for each fungicide.

“Bordeaux mixture” can be prepared using the following procedure: 1-Fill spray tank to ½ the desired water volume; 2-Turn-on agitator; 3-dissolve powdered bluestone (copper sulfate) in spray tank at a rate of 4 lb bluestone/50 gallons of water; 4-make a “milk of lime” suspension by dissolving 4 lb of hydrated lime (calcium hydroxide) in 5 gallons of water in a container, for a rate of 4 lb hydrated lime/50 gallons water; 5-Slowly add “milk of lime” suspension into spray tank; 6-Fill spray tank to desired water volume; 7-maintain constant agitation and apply immediately. Do not mix with Topsin-M or Sevin. Bordeaux mixture will severely burn leaves if applied on very hot days or if combined with insecticides. Slight phytotoxicity will have relatively minor impact.

Captivate and MetaStar are labeled for raspberry but not blackberry.

If used, Quilt Xcel sprays should begin before disease develops. Because resistance to the active ingredients in QoI (FRAC Group 11) fungicides is increasingly common, Cabrio, Abound, Azaka, Luna Tranquility, Pristine, and Quilt Xcel should be applied no more than twice in a single growing season. Resistance to Elevate (FRAC = 17) is also a rising issue, and is a possibility with polyoxin-D products like Ph-D. Therefore, Ph-D should be applied in no more than 4 sprays per season, while no more than 6 applications of OSO are allowed. Do not make more than 4 applications of Elevate, or of iprodione products like Rovral or Nevado, per season. **Caution: Fungicides containing azoxystrobin (Abound, for example) may be extremely phytotoxic to some apple cultivars. Prevent spray drift and leftover residue in the spray tank which may come in contact with apples.**

2-12 Commercial Small Fruit: *Diseases and Insects*

Pre-Harvest Spray Intervals: Abound, Agri-Fos, Azaka, Cabrio, Elevate, Lime Sulfur, Luna Tranquility, Nevado, OSO, Ph-D, Phostrol, Pristine, ProPhyt, Rally, Rovral, and Switch may be applied the day of harvest. The preharvest interval for Captan, Captec and Captevate is 3 days. Preharvest intervals for most copper products are 2 days, but check the product label to be sure. Orbit, PropiMax, Tilt, and Quilt Excel must be applied at least 30 days before harvest, while MetaStar, Ridomil Gold, and Ultra Flourish have a preharvest interval of 45 days. Aliette can be applied no closer than 60 days before harvest.

Maximum Fungicide Uses per year: Abound – 92.3 fl oz; Aliette – 4 applications; Azaka - 92.3 fl oz; Cabrio – 56.0 oz; Captan 80WDG – 12.5 lb; Captevate – 21.0 lb; Elevate – 6.0 lb; MetaStar – 2 applications; Luna Tranquility - 54.7 fl oz; Orbit – 30.0 fl oz; OSO - 78 fl oz; Ph-D - 18.6 oz; Pristine – 92.0 oz; PropiMax – 30.0 fl oz; Quilt Xcel – 105 fl oz; Rally – 10.0 oz; Ridomil Gold – 3.6 pt; Switch – 56.0 oz; Tilt – 30.0 fl oz; Ultra Flourish – 2 applications.

Cane Blights

Spray from Delayed Dormant to After Harvest.

Cane blights can cause significant losses to brambles, but in Virginia are often associated with winter injury. Cane blights can also be associated with pruning canes when they are over 3-4 feet in height (resulting in larger pruning wounds) and/or under wet, humid conditions. Cultural practices that promote quick drying of foliage, such as a weed-free strip under the canopy, will help reduce infection. If fungicides are applied, applications should be made as soon as possible after each pruning in order to maximize effectiveness. Applications made after pruning wounds have healed may not be effective. See <http://www.smallfruits.org/bramble/pestinformation/caneblightfactsheetii.pdf> for additional information.

Anthracnose

Nearby wild blackberries (within 500-1,000 ft) can be a source of infection and should be destroyed. Floricanes should be removed as soon as possible after harvest; new canes with signs of disease or insect injury should also be removed and burned or buried prior to budbreak. Good weed control below the canopy and proper thinning and sucker control will help reduce infection by allowing faster drying of canes and foliage. Cultivars that are thornless or procumbent blackberries are generally less susceptible than those that are thorny or erect. Liquid lime sulfur sprays should start before $\frac{3}{4}$ " green tissue has formed. Additional liquid lime sulfur sprays may be applied after primocanes become 6" tall and thereafter at 14-day intervals through harvest.

Orange Rust

Orange rust systemically infects black raspberry, blackberry, and wild dewberry. Blackberry varieties Cherokee, Cheyenne, Comanche, Choctaw (erect, thornless), Arapaho (erect, thornless), and Shawnee are considered resistant, although some disease has been observed on all varieties. Wild blackberries within 0.25 mile of planting should be eradicated. Preventative fungicide (Rally, etc.) applications can be effective, but new canes 12-18 inches tall should be inspected thoroughly, early in the season. 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.

Leaf and Cane Rust

Nearby wild blackberries (within 500-1,000 ft) can be a source of infection and should be destroyed. Floricanes should be removed as soon as possible after harvest; new canes with signs of disease or insect injury should also be removed and burned or buried prior to budbreak. Good weed control below the canopy and proper thinning and sucker control will help reduce infection by allowing faster drying of canes and foliage. Fungicide sprays should be applied at green tip and prior to bloom, and then resumed after harvest until floricanes have been removed. Further sprays after primocane removal should be delayed until new infections are observed on primocanes.

Phytophthora Root Rot

Orondis Gold 200 has a supplemental label to control *Phytophthora* root rot on blackberry and red or black raspberry. First applications of 4.8-9.6 fl oz/acre should be made before plants start to grow in the spring, with a second application during a period favorable for root growth and at least 7 days after the first application. Orondis Gold 200 should be applied in at least 20 gal/acre of water and as a band directed to the soil along the side of each crop, near and under the lower leaves. The higher rate should be used for moderate to severe infections. Apply $\frac{1}{4}$ - $\frac{1}{2}$ inch of water after each application, either by overhead sprinkler irrigation or as a drench on the row. No more than two applications are allowed per year, for a total of 19.2 fl oz/acre/year. When more than 3 applications of a *Phytophthora* fungicides are made, Orondis should be used in no more than 33% of the sprays, or a maximum of 4 applications, whichever is fewer.

Ridomil Gold GR, MetaStar 2E, are labeled for control of *Phytophthora* root rot on raspberries only. Make one application in the spring before new growth starts and another in the fall after harvest. Use the formula in the general information section of the appropriate label

to calculate the amount of fungicide needed per acre. On a broadcast basis, Ridomil Gold GR is applied at 72.0 lb/A. Do not apply any of these fungicides within 45 days before harvest or possibly illegal residues may result.

Aliette 80WDG (FRAC = 33) 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 of 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 (FRAC = 33) are labeled as foliar sprays for *Phytophthora* root rot control, including Agri-Fos, Phostrol, and ProPhyt. Ridomil Gold SL and Ultra Flourish are registered for use on both blackberries and raspberries. However, Ridomil Gold GR and MetaStar 2E are labelled for use on raspberries, but not blackberries. Apply 4 fl oz of Ridomil Gold EC, 5.0 lb of Ridomil Gold GR and MetaStar 2E/1,000 linear feet of row to the soil surface in a three-foot band over the row.

Botrytis Gray Mold

Blossom blight and disease spread to ripening fruit can be controlled by sprays starting at early bloom and continuing through full bloom to near harvest. However, the pathogen has developed resistance to multiple fungicides. Growers should follow fungicide resistance management recommendations closely to avoid crop losses. Pre-harvest sprays are usually not necessary for blackberry unless weather is cool and wet.

Rosette (double blossom)

Blackberry varieties can vary in resistance to rosette or double blossom: Apache, Navaho, and Humble are largely resistant, while Shawnee, Choctaw, Chickasaw and Black Satin are highly susceptible. Sprays should start when rosettes are blooming and primocanes begin to grow. Witches-brooms should be clipped-out as they develop and before they flower. Prompt removal and destruction of floricanes after final harvest will help prevent or limit this disease. If disease pressure is high, cut all canes after harvest to 12-18 inches tall, fertilize heavily, and irrigate regularly to increase cane production for the following year.

Powdery mildew

Powdery mildew is usually not a problem, but some western cultivars are very susceptible. Fungicide treatments should begin at the first sign of disease and continue at 10-14 day intervals.

Crown Gall

All caneberries can be affected by crown gall, which causes canker-like growths on roots and stems. Galls look greenish-white at first, but then turn tan-to-brown, and then black. Planting tissue-cultured stock will help avoid introducing the disease to a field. This is particularly important because the bacterial pathogen can persist in soil once introduced. Wounds in roots and lower stems are required for infection. Allow wounded root pieces to heal before planting; prune above-ground plant parts when several days of dry weather are expected, and avoid wounding plants during cultivation or from herbicides. Dips for root cuttings at planting can provide additional insurance against this disease

Viruses

A number of viruses are common and can be significant problems in bramble production. However, apparent symptoms don't always reliably indicate their presence. Specific tissue tests must be conducted to verify a virus diagnosis. No control measures are available for bramble viruses, other than rapid removal of symptomatic plants in order to slow plant-to-plant spread. Since viruses can be introduced through propagation, clean planting stock is essential. Although tissue-cultured plants can't be guaranteed to be virus-free, they are more likely to be free of viruses and crown gall, and are highly recommended. Destruction of wild blackberries within 100-200 yards of a commercial planting may help reduce possible spread. Avoiding or minimizing dagger nematodes in the soil can also be important, as these nematodes can be virus vectors.

Comments about the use of copper fungicides on caneberries

Copper fungicides have been used for caneberry disease control (rusts, for example), even though these materials can be phytotoxic to caneberries and cause damage. However, other products of different chemical classes are now registered that are highly effective on targeted diseases. For example, Rally, Orbit and PropiMax should be effective for managing rust diseases. These products do not have the broad phytotoxicity concerns of the copper materials, but they do have potential fungicide-resistance concerns. Thus, you may want to consider using copper fungicides 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, as application timing and target diseases may vary with the formulation. Again, caution is advised in using any copper product.

2-14 Commercial Small Fruit: Diseases and Insects

Table 2.4 - Caneberry Insects				
Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Rate per Acre	Spray Timing and Remarks
<i>Dormant</i>				
Raspberry crown borer and red-necked cane borer	—	—	—	Removal of infested canes during winter pruning is an effective cultural control for these borers.
<i>Prebloom</i>				
Leafrollers	Confirm 2F	—	16.0 fl oz	When buds are breaking or new canes are 6 to 8 inches long. See label for timing. Confirm sprays. See Table 2.7 for REI and PHI. Use of Delegate, Brigade or Sniper should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications.
	Delegate 25WG	—	3.0-6.0 oz	
	Dipel ES	—	1.0-4.0 pt	
	M-Pede	2.0 gal	2% solution	
	Brigade 10WSB	—	8.0-16.0 oz	
	Entrust 80WP	—	1.25-2.0 oz	
	Sniper	—	3.2-6.4 fl oz	
Raspberry sawfly	M-Pede	2.0 gal	2% solution	Use of Delegate should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications.
	Delegate 25WG	—	3.0-6.0 oz	
	Entrust 80WP	—	1.25-2.0 oz	
Blackberry psyllid	Malathion 57EC	—	3.0 pt	Spray for psyllid when adults appear on plants. Surround provides suppression. Use of malathion should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications.
	Surround 95WP	—	12.5-50.0 lb	
Raspberry cane borer	Malathion 57EC	—	3.0 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	Delegate 25WG	—	3.0-6.0 oz	Use of Delegate should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications.
	Entrust 80WP	—	1.25-2.0 oz	
Stink bug (inc. Brown marmorated stink bug) and Tarnished plant bug	Brigade 10WSB	—	8.0-16.0 oz	Apply when one TPB (Tarnished plant bug) in every two flower clusters. Do not apply more than 6.0 oz/A of Actara per session. After an Actara application, wait at least five days before placing beehives in treated fields.
	Actara 25WDG	—	3.0 oz	
	Sniper	—	3.2-6.4 fl oz	
Thrips	Aza-Direct	—	12.5-42.0 fl oz	Just before blossoms open. Admire Pro soil-applied.
	Assail 30SG	—	4.5-5.3 oz	
	Malathion 57EC	—	1.5 pt	
	Admire Pro	—	2.8 fl oz	
	Entrust 80WP	—	1.25-2.0 oz	
	Delegate 25WG	—	3.0-6.0 oz	
Clipper	Brigade 10WSB	—	16.0 oz	Use of Brigade or Danitol should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications.
	Danitol	—	10.66-16.0 fl oz	
Raspberry crown borer	Brigade 10WSB	—	16.0 oz	Apply as a drench in at least 200 gal of water/A, either prebloom or post harvest but not both. Use of Brigade or Sniper should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications.
	Sniper	—	6.4 fl oz	

Table 2.4 - Caneberry Insects (cont.)

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Rate per Acre	Spray Timing and Remarks
<i>First Cover: at petal fall</i>				
Aphids	Malathion 57EC	—	3.0 pt	Admire Pro soil-applied. Use of malathion should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications.
	Asana XL	—	4.8-9.6 fl oz	
	Sevin XLR Plus	—	2.0 qt	
	M-Pede	2.0 gal	2% solution	
	Assail 30SG	—	2.5-5.3 oz	
	Actara 25WG	—	2.0-3.0 oz	
	Admire Pro	—	2.8 fl oz	
Red-necked cane borer	Malathion 57EC	—	3.0 pt	Spray every 7 to 12 days from early May to early June if this pest has been a problem. Remove galled canes in early spring. Use of malathion or Brigade should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications.
	Brigade 10WSB	—	8.0-16.0 oz	
Thrips	See Prebloom Spray			
	Admire Pro		2.8 fl oz	
Leafrollers	See Prebloom Spray			
Blackberry psyllid	See Prebloom Spray			
Leafhoppers	Malathion 57EC	—	1.5 pt	Use of malathion should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications.
	M-Pede	2.0 gal	2% solution	
	Assail 30SG	—	2.5-5.3 oz	
	Admire Pro	—	2.8 fl oz	
Rose scale	Admire Pro	—	2.8 fl oz	Use of Brigade should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications.
	Assail 30SG	—	4.0 - 5.3 oz	
	Brigade 2EC	—	3.2-6.4 fl oz	
	Tri-Tek	—	2% solution	
<i>Second Cover: ten days after petal fall</i>				
Aphids	See First Cover			
Brown marmorated stink bug	Actara 25WDG	—	3.0 oz	Do not apply more than 6 oz/A of Actara per season. After an Actara application, wait at least 5 days before moving bee hives into treated fields. Use of malathion, Brigade or Sniper should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications.
	Brigade 10WSB	—	8.0-16.0 oz	
	Malathion 57EC	—	3.0 pt	
	Sniper	—	3.2-6.4 fl oz	
Spider mites	Agri-Mek 8SC	—	1.75-3.5 fl oz	Savey is highly effective against mite eggs. If many active mites are present, an adulticide should be applied. PHI is 3 days.
	Savey 50DF	—	6.0 oz	
	Stylet Oil	3.0-6.0 qt	—	
	Acramite 50WS	—	0.75-1.0 lb	
	Zeal 72WSB	—	2-3 oz	
	Kanemite 15SC	—	31 fl oz	
Broad mites	Agri-Mek 8SC	—	3.5 fl oz	Broad mites are very small and will require a 20x hand lens to see. Agri-Mek must be combined with a non-ionic wetting/spreading/penetrating adjuvant.

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Table 2.4 - Caneberry Insects (cont.)					
Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Rate per Acre	Spray Timing and Remarks	
<i>Third Cover</i>					
Japanese beetle	Sevin 80S	1.0 lb	2.0 lb	Twenty days after petal fall.	
	Sevin XLR Plus	—	2.0 qt		
	Admire Pro	—	7.0 - 14.0 fl oz (soil) 2.8 fl oz (foliar)		
	Aza-Direct	—	12.5-42.0 fl oz		
	Assail 30SG	—	4.5-5.3 oz		
	Actara 25WG	—	3.0 oz		
	Neemix 4.5 plus	—	7.0-16.0 fl oz +		Neemix/Trilogy mix every 7-10 days. See label for Trilogy mixing instructions. Neemix and Trilogy are OMRI-certified.
	Trilogy 70	—	2% solution		
	Surround 95WP	—	12.5-50.0 lb	Surround provides suppression. Recommended only for 1st three weeks following fruit set in fresh market berries because of visible residues.	
Spotted Wing Drosophila	Entrust 80WP	—	1.25-2.0 oz	Open pruning will aid in SWD management, as will prompt harvest of ripe berries. Keep berries as cool as possible after harvest. Spray timing must be at least every 7 days in many cases. Rotate modes of action in order to delay the development of pesticide resistance. Observe seasonal maximum number of applications: Danitol 2 applications, malathion 4 applications, bifenthrin 2 applications, Entrust and Delegate 6 applications. Season limits to product applied may also apply; check the label. Addition of table sugar at the rate of 30 oz per 100 gal will aid in efficacy of chemical control of SWD.	
	Entrust 2SC	—	4.0-6.0 fl oz		
	Delegate 25WDG	—	3.0-6.0 oz		
	Malathion 57EC	—	3.0 pt		
	Mustang Maxx	—	4.0 oz		
	Asana	—	4.8-9.6 fl oz		
	Brigade 10WSB	—	16.0 oz		
	PyGanic 1.4EC	—	64.0 fl oz		
Azera	—	2.0-3.0 pt			
Brown marmorated stink bug	Actara 25WDG	—	3.0 oz		
	Assail 30SG	—	4.5-5.3 oz		
	Azera	—	2.0-3.0 pt		
	Brigade 10WSB	—	8.0-16.0 oz		
	Malathion 57EC	—	3.0 pt		
	PyGanic 1.4EC	—	64.0 fl oz		
	Sniper	—	3.2-6.4 fl oz		
Click beetles	Malathion 57EC	—	2.0 pt	Spray for pests as needed. Do not apply within 1 day of harvest.	
Aphids	See First Cover				
Mites	See Second Cover				
<i>Post Harvest</i>					
Raspberry crown borer	Sevin XLR Plus	—	2.0 qt	Sevin may be applied as foliar spray. Apply Brigade as drench in at least 50 gal of water either postharvest or prebloom but not both.	
	Brigade 10WSB	—	16.0 oz		
	Altacor 35WDG	—	4.0 - 5.3 oz		
Aphids	See First Cover				
Mites	See Second Cover				

Table 2.4 - Caneberry Insects (cont.)

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Rate per Acre	Spray Timing and Remarks
Leafhoppers	See First Cover Spray			
Rose Scale	Admire Pro	—	2.8 fl oz	
	Brigade 2EC	—	3.2-6.4 fl oz	
	Tri-Tek	—	2% solution	

Blueberries

Table 2.5 - Blueberry Diseases

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Rate per Acre	Spray Timing and Remarks
Mummy Berry Cups (<i>Monilinia vaccinii-corymbosi</i>)	50% urea mix	—	200.0 lb	Apply when cups appear (usually). Delayed Dormant 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</i> spp.)	Indar 2F	—	6.0 fl oz	Begin applications before disease development and continue on a 7-to-14-day schedule, following resistance management guidelines. For Phomopsis twig blight control, make the first Indar application at early green tip and make subsequent applications at 8-to-14 day intervals. Applying Indar alone during bloom can increase fruit rots, so tank-mix Captan with Indar for bloom sprays to alleviate this problem. Apply Ziram at loose bud scale stage and 7 days later. Do not apply more than two sequential applications of FRAC-3 or FRAC-11 fungicides before alternating with a fungicide that has a different mode of action. Caution: Abound and Azaka are extremely phytotoxic to some apple cultivars including 'Gala.' Prevent spray drift and leftover residue in the spray tank which may come in contact with apples.
	Quash	—	2.5 oz	
	Ziram 76DF	—	30.0 lb	
	Pristine 38WG	—	18.5-23.0 oz	
	Luna Sensation	—	4.0-7.6 fl oz	
	Switch 62.5WG	—	11.0-14.0 oz	
	Omega 500F	—	1.25 pt	
	Abound 2.08F	—	.2-15.4 fl oz	
	Azaka	—	.0-15.5 fl oz	
	OSO	—	3.75-13.0 fl oz	
	Ph-D	—	6.2 oz	
	Captan products	—	See product labels	
Mummy Berry Twig/fruit infection	Indar 2F	—	6.0 fl oz	Begin applications before disease development and continue on a 7-to-14-day schedule, following resistance management guidelines. Start applications of FRAC-3 fungicides (Indar, Orbit, Tilt, Bumper, Propimax, or Quilt Xcel (FRAC-3 and FRAC-11), at early green tip and make subsequent applications at 7-to-14 day intervals. Serenade (FRAC-44) applications should begin at bud-break and continue at 7-to-10 day intervals. Applying Indar alone during bloom can increase fruit rots, so tank-mix Captan (FRAC-M4) with Indar for bloom sprays to alleviate this problem. Do not make more than two sequential applications any fungicide within the same FRAC group before alternating with a fungicide that has a different mode of action. Caution: Caution: Abound and Azaka are extremely phytotoxic to some apple cultivars, including 'Gala'. Prevent spray drift and leftover residue in the spray tank which may come in contact with apples.
	Orbit	—	6.0 fl oz	
	Tilt 3.6E	—	6.0 fl oz	
	Propimax 3.6E	—	6.0 fl oz	
	Bumper 41.8EC	—	6.0 fl oz	
	Quash 50WDG	—	2.5 oz	
	Quilt Xcel	—	14.0-21.0 fl oz	
	Proline 480SC	—	5.7 fl oz	
	Pristine 38WG	—	18.5-23.0 oz	
	Luna Tranquility	—	13.6-27 fl oz	
	Switch 62.5WG	—	11.0-14.0 oz	
	Abound 2.08F	—	6.2-16.5 fl oz	
	Azaka - 6.0	—	15.5 fl oz	
	Serenade MAX	—	1.0-3;0 lb	
Serenade ASO	—	2.0-6.0 qt		

Table 2.5 - Blueberry Diseases (cont.)

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Rate per Acre	Spray Timing and Remarks
Fruit Rots (Anthracnose, Alternaria rot, <i>Glomerella cingulata</i>)	Pristine 38WDG		18.5-23.0 oz	Early Bloom to Post Bloom: Begin applications before disease development and continue on a 7-to-10-day interval, following resistance management guidelines. Observe pre-harvest and re-entry restrictions. Do not make more than two sequential applications of any fungicides within the same FRAC group before alternating with a fungicide that has a different mode of action. Caution: Abound and Azaka are extremely phytotoxic to some apple cultivars, including 'Gala'. Prevent spray drift and leftover residue in the spray tank which may come in contact with apples. OSO is labelled for suppression only for anthracnose: see labels for precautions.
	Luna Sensation	—	6.84 fl oz	
	Luna Tranquility	—	13.6-27 fl oz	
	Switch 62.5 WG	—	11.0-14.0 oz	
	Abound 2.08F	—	6.2-15.4 fl oz	
	Azaka	—	6.0-15.5 fl oz	
	Captevate 68WDG		4.7 lb	
	Captan products	—	See product labels	
	Omega 500F	—	1.25 pt	
	Serenade MAX	—	1-3 lb	
	Ziram 76F	—	1.5 lb	
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>)	OSO	—	3.75-13.0 fl oz	
	Ph-D	—	6.2 oz	
	Pristine WG	—	18.5-23.0 oz	Post Bloom to August at 7-to-10 day intervals. Observe pre-harvest and re-entry regulations. For leaf spot control after harvest, resume spray schedule 1 to 2 times. Arrange season-long schedule to include no more than two sequential sprays of Pristine, Abound or Azaka (FRAC-11), Quash (FRAC-3), Switch (FRAC-9 and FRAC-12), Luna Tranquility (FRAC-7 and FRAC-9), or Luna Sensation (FRAC-7 and FRAC-11). Caution: Abound and Azaka are extremely phytotoxic to some apple cultivars, including 'Gala'. Prevent spray drift and leftover residue in the spray tank which may come in contact with apples. Foliage and fruit can be damaged if Aliette, Agri-Fos, K-Phos, or ProPhyte are tank-mixed with copper or foliar fertilizers, or applied in acidic water. Apply a minimum of 16 fl oz of Luna Tranquility for Mycosphaerella or Septoria leaf spots. Orbit, Tilt, Bumper, Propimax and Proline (all FRAC-3 fungicides) have good activity against Septoria and anthracnose leaf spots, but activity against other leaf spots is unknown. Luna Sensation suppresses leaf spots but doesn't control them. Captan is more effective against anthracnose leaf spot than against Septoria. Serenade is a FRAC-44 fungicide.
	Luna Tranquility	—	13.6-27 fl oz	
	Quilt Xcel	—	14.0-21.0 fl oz	
	Abound	—	6.2-15.4 fl oz	
	Azaka	—	6.0-15.5 fl oz	
	Indar	—	6.0 fl oz	
	Quash	—	2.5 oz	
	Orbit 3.6EC	—	6 fl oz	
	Tilt 3.6EC	—	6 fl oz	
	Bumper	—	6 fl oz	
	Propimax	—	6 fl oz	
	Proline	—	5.7 fl oz	
Switch	—	11-14 oz		
Captan products	—	See product labels		
Luna Sensation	—	7.6 fl oz		
Serenade MAX	—	Serenade MAX		

Phytophthora root rot control

Ridomil Gold EC, MetaStar 2E, and Ultra Flourish are labeled for control of Phytophthora root rot of blueberries. **Established plantings:** Apply 4 fl oz of Ridomil Gold EC, 1 pt of MetaStar 2E, or 0.5 pt (8.0 fl oz) of Ultra Flourish per 1000 linear feet of rot (3.6 pt per acre of Ridomil Gold EC, 14.5 pt of MetaStar 2E, or 7.2 pt of Ultra Flourish on a 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:** Broadcast apply 3.6 pt per acre of Ridomil Gold, 2 gal per acre of MetaStar 2E, or 7.2 pt of Ultra Flourish to the soil at or after planting. Supplemental applications of Ridomil Gold or MetaStar should be made at 2- to 3-month intervals or to coincide with periods most favorable for root rot development. An 18-inch width is recommended for banded applications. Use the formula in the general sections of the labels to calculate the amount of fungicide needed per acre. On new plantings, do not broadcast apply more than 0.9 gal per acre of Ridomil Gold EC, 3.6 gal per acre of MetaStar 2E AG, or 7.2 pt per acre of Ultra Flourish 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.

Pre-Harvest Spray Intervals: Do not apply Bumper, Indar, Orbit, Propimax, Quilt Xcel, or Tilt within 30 days of harvest. Abound, Azaka, Captan, Captevate, Luna Privilege, Luna Sensation, Luna Tranquility, Omega 500, OSO, Ph-D, Pristine, Proline, Quash, Switch, and Tavano may be applied the day of harvest. Ziram must be applied within 3 weeks of full bloom. Do not apply Indar, Orbit, Bumper, Propimax, Tilt, or Quilt Xcel within 30 days of harvest.

Maximum Fungicide Uses per year: Do not apply more than 1.44 qt of Abound, 46 fl oz of Azaka, 30 fl oz of Bumper, 43.7 lb of Captan, 21.0 lb of Captevate, 24 fl oz (4 applications) of Indar, 13.7 fl oz of Luna Privilege, 21.7 fl oz of Luna Sensation, 54.7 fl oz of Luna Tranquility, 7.5 pt Omega 500, 30.0 oz of Orbit, 78.0 fl oz of OSO or Tavano, or 18.6 oz of Ph-D, 92 oz of Pristine, 11.4 fl oz of Proline, 30 fl oz of Propimax EC, 7.5 oz of Quash, 82 fl oz of Quilt Xcel; 56 oz of Switch, or 20 lb of Ziram 76F per acre per year.

Caution: Fungicides containing azoxystrobin (Abound, Azaka, and Quilt Xcel, for example) may be extremely phytotoxic to some apple cultivars. Prevent spray drift and leftover residue in the spray tank which may come in contact with apples.

Table 2.6 - Blueberry Insects

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Rate per Acre	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	—	2.0 qt	Removing dead canes at pruning aids in control of tip borer. Use of Malathion should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications.
	Malathion 57EC	—	1.5 pt	
Plum curculio	Sevin XLR Plus	—	2.0 qts	Two applications may be required for plum curculio. Surround provides suppression.
	Surround 95WP	—	12.5-50.0 lb	
	Imidan 70W	—	1.5 lb	Recommended only for 1st three weeks following fruit set for fresh berries because of visible residues. Use of Malathion or Exirel should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications.
	Malathion 57EC	—	2.0 pt	
	Exirel 0.83	—	13.5-20.5 fl oz	

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Table 2.6 - Blueberry Insects (cont.)

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Rate per Acre	Spray Timing and Remarks
<i>First Cover: at petal fall. (Petal fall spray is the single most important spray for blueberry insects) (cont.)</i>				
Cranberry fruitworm and cherry fruitworm	Altacor	—	3.0-4.5 oz	Do not apply more than 64.0 fl oz of Confirm/A/ season. Use of Delegate, Malathion or Mustang Maxx should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications. Use of Exirel should be delayed if spotted wing drosophila will be a target later.
	Intrepid 2F	—	10.0-16.0 fl oz	
	Entrust 80W	—	1.25-2.0 oz	
	Entrust 2SC	—	4.0-6.0 fl oz	
	Diazinon 50W	—	1.0 lb	
	Sevin XLR Plus	—	1.0-2.0 qt	
	Dipel ES	—	1.0-4.0 pt	
	Esteem 0.86EC	—	16 fl oz	
	Delegate 25WG	—	3.0-6.0 oz	
	Malathion 8F	—	1.25 pt	
	Assail 30SG	—	4.5-5.3 oz	
	Asana XL	—	4.8-9.6 fl oz	
	Rimon 0.83EC	—	20.0-30.0 fl oz	
	Confirm 2F	—	16.0 fl oz	
	Mustang Maxx 1.5EC	—	4.3 fl oz	
	Avaunt	—	3.5 - 6.0 oz	
Exirel 0.83EC	—	10-13.5 fl oz		
Gall midge	Diazinon AG500	—	1 pt	Use of Exirel, Delegate or Entrust should be delayed if spotted wing drosophila will be a target later.
	Delegate 25WG	—	3.0 - 6.0 oz	
	Entrust 80W	—	1.25 - 2.0 oz	
	Entrust 2SC	—	4.0-6.0 fl oz	
	Malathion 57EC	—	1.5 fl oz	
	Exirel 0.83EC	—	13.5-20.5 fl oz	
Thrips	Sivanto 200SL	—	10.5-14.0 fl oz	
<i>Second Cover: ten days after first cover</i>				
Cranberry fruitworm and cherry fruitworm	See First Cover			
Brown marmorated stink bug	Actara 25WDG	—	4.0 oz	After an Actara application, wait at least 5 days before placing beehives in treated fields. If flowering plants are present in the ground cover, mow before applying Actara. Use of Malathion should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications.
	Lannate SP	—	1.0 lb	
	Malathion 57EC	—	1.5 pt	
Leafrollers	Confirm 2F	—	16.0 fl oz	See label for timing Confirm sprays. Use of Delegate should be delayed if spotted wing drosophila will be a target later, in order to comply with the seasonal maximum number of applications.
	Delegate 25WG	—	3.0-6.0 oz	
Aphids	M-Pede	2.0 gal	—	Repeated sprays of M-Pede may be needed. Do not apply M-Pede within 3 days of sulfur.
	Admire Pro	—	1.0-1.4 fl oz	
	Actara 25WG	—	3.0-4.0 oz	Use of Exirel should be delayed if spotted wing drosophila will be a target later.
	Assail 30SG	—	4.5-5.3 oz	
	Exirel 0.83EC	—	13.5-20.5 fl oz	
	Sivanto 200SL	—	7.0-10.5 fl oz	
Blueberry tip borer	See First Cover			
Plum curculio	See First Cover			

Table 2.6 - Blueberry Insects (cont.)

Crop and Pest	Chemical and Formulation	Rate Per 100 Gal Dilute	Rate per Acre	Spray Timing and Remarks
<i>Preharvest</i>				
Blueberry maggot	Entrust 80W	—	1.25-2.07 oz	Spray if flies trapped for two consecutive weeks, or three flies/week. Delegate provides suppression. See Table 2.7 for PHI. See footnote petal fall spray. GF-120 NF Naturalyte fruit fly bait. Spot or strip spray several areas of inner canopy (1.0-3.0 fl oz/tree). OMRI-approved
	Entrust 2SC	—	4.0-6.0 fl oz	
	Imidan 70W	—	1.5 lb	
	Surround 95WP	—	12.5-50.0 lb	
	Danitol 2.4EC	—	10.7-18.0 fl oz	
	Delegate 25WG	—	3.0-6.0 oz	
	Malathion 57EC	—	1.5 pt	
	Admire Pro	—	2.1 - 2.8 fl oz	
	Assail 30SG	—	4.5-5.3 oz	
	Asana XL	—	9.6 fl oz	
	Sevin XLR	—	1.0-2.0 q	
	Rimon 0.83EC	—	20.0-30.0 fl oz	
	GF-120	—	10.0-20.0 fl oz	
	Exirel 0.83EC	—	13.5-20.5 fl oz	
Sivanto 200SL	—	7.0-10.5 fl oz		
Brown marmorated stink bug	Actara 25WDG	—	4.0 oz	After an Actara application, wait at least 5 days before placing beehives in treated fields. If flowering plants are present in the ground cover, mow before applying Actara. No more than 5 applications per season of Assail. Residual activity of Azera will be short.
	Assail 30SG	—	4.5-5.3 oz	
	Azera	—	2.0-3.0 pt	
	Lannate SP	—	1.0 lb	
	Malathion 57EC	—	1.5 pt	
Spotted Wing Drosophila	Entrust 80WP	—	1.25-2.0 oz	Open pruning will aid in SWD management, as will prompt harvest of ripe berries. Spray timing must be at least every 7 days in many cases. Rotate modes of action in order to delay the development of pesticide resistance. There is a 24(c) label for malathion 8F allowing 2.5 pt for SWD. Addition of table sugar at the rate of 30 oz per 100 gal will aid in efficacy of chemical control of SWD.
	Entrust 2SC	—	4.0-6.0 fl oz	
	Malathion 57EC	—	2.0 pt	
	Imidan 70W	—	1.5 lb	
	Lannate SP	—	0.25-0.5 lb	
	Delegate 25WG	—	3.0-6.0 oz	
	Mustang Maxx	—	4.0 oz	
	Danitol 2.4EC	—	10.7-18.0 fl oz	
	Asana XL	—	9.6 fl oz	
	Brigade 10WSB	—	16.0 oz	
	PyGanic 1.4EC	—	64.0 fl oz	
	Azera	—	2.0-3.0 pt	
Exirel 0.83EC	—	13.5-20.5 fl oz		
Mites	Stylet oil	3.0-6.0 qt	—	Acramite non-bearing only. Spray Stylet oil every 7 to 10 days while mite eggs persist.
	Acramite 50WS	—	0.75-1.0 lb	
	Kanemite 15SC	—	21.0-31.0 fl oz	
	Oberon 2SC	—	12.0-16.0 fl oz	
Japanese beetle	Admire Pro	—	1.0-1.4 fl oz	Apply Neemix/Trilogy over 7-10 days. See Trilogy label for mixing instructions. Neemix and Trilogy are OMRI-certified.
	Danitol 2.4EC	—	10.7-18.0 fl oz	
	Malathion 57EC	—	1.5 pt	
	Assail 30SG	—	4.5-5.3 oz	
	Asana XL	—	4.8-9.6 fl oz	
	Sevin XLR Plus	—	1.0-2.0 qt	
	Actara 25WG	—	4.0 oz	
	Neemix 4.5 plus Trilogy 70	—	7.0-16.0 fl oz + 2% solution	
<i>Special Soil Treatment</i>				
Japanese beetle	Admire Pro	—	7.0 - 14.0 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
Fungicides					
Abound (Azoxystrobin)	Syngenta	4 hours	0 days	0 days	0 days
Actigard	Syngenta	12 hours	0 days	—	0 days
Agri-Fos	Monterey	4 hours	0 days	0 days	0 days
Aliette (fosetyl Al)	Bayer CropScience	12 hours	12 hours	60 days	12 hours
Azaka	Cheminova	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 for eye protection require- ments up to 6.5 days after REI expires.)	—	—	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) 48 hours (blueberries & raspberries)	0 days	3 days (raspberries)	0 days
Elevate (fenhexamid)	Arysta	12 hours	0 days	0 days	0 days
Flint (trifloxystrobin)	Syngenta	12 hours	0 days	—	—
Fontelis (penthiopyrad)	DuPont	12 hours	0 days	—	0 days
Fracture	FMC	4 hours	1 day	—	—
Indar (fenbuconazole)	Dow AgroSciences	12 hours	—	30 days	30 days
Inspire Super (difenoconazole)	Syngenta	12 hours	0 Days	—	—
Kenja 400SC	ISK Biosciences	12 hours	0 days	—	0 days
Lime sulfur	various	48 hours	—	0 days	—
Luna Privilege	Bayer CropScience	12 hours	0 days (drip)	—	—
Luna Sensation		12 hours	0	—	0
Luna Tranquility		12 hours	1	0	1
Merivon (pyra- clostrobin & fluxapyroxad)	BASF	12 hours	0 day PHI for strawberry	not labelled	not labelled
MetaStar (metalaxyl)	LG life Science	48 hours	0 days	45 days	—
Mettle (tetraconazole)	Isagro USA	12 hours	0 days	—	0 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
Orbit (propiconazole)	Syngenta	24 hours	0 days	30 days	30 days
Orondis Gold 200	Syngenta	4 hr REI &	0 days	1 day	0 days
OSO 5SC	Certis U.S.A.	4 hours	0 days	0 days	0 days
PhD	Arysta LifeScience	4 hours	0 days	0 days	0 days
Phostrol	Nufarm Americas	4 hours	0 days	0 days	0 days
Procure	Chemtura	12 hours	1 day	—	—
Protocol	Loveland Products	24 hours	1 day	—	—
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
Quadris Top (azoxystrobin & difenoconazole)	Syngenta	12 hours	0 days	—	—
QuiltXcel	Syngenta	12 hours	0 days	30 days	30 days
Rally (myclobutanil)	Dow AgroSciences	24 hours	0 days	0 days	—
Rhyme	FMC	12 hours	0 day PHI	—	—
Ridomil Gold	Syngenta	0 hours (soil-injected or incorporated appli- cations) 48 hours (soil- directed or foliar sprays)	0 days 0 days	— 45 days	— 45 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	—	—
Tilt	Syngenta	12 hours	0 days	30 days	30 days
Topsin-M	United Phosphorus	12 hours	1 day	—	—
Torino (cyflufenamid)	Gowan	4 hours	0 days	—	0 days
Ultra FLourish	New Farm Americas	48 hours	0 days	45 days	0 days
Ziram	United Phosphorus, Taminco	48 hours	—	(see label)	(see label)

2-24 Commercial Small Fruit: *Diseases and Insects*

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

Chemical	Manufacturer	Re-entry Interval	Preharvest Interval		
			Strawberry	Caneberries	Blueberry
<i>Insecticides</i>					
Actara (thiamethoxam)	Syngenta	12 hours	3 days	3 days	3 days
Admire Pro (imidacloprid)	Bayer CropScience	12 hours	14 days (soil) 7 days (foliar)	7 days (soil) 3 days (foliar)	7 days (soil) 3 days (foliar)
Agri-Mek (abamectin)	Syngenta	12 hours	3 days	7 days	—
Altacor (chlorantraniliprole)	DuPont	4 hours	—	3 days	1 day
Asana (esfenvalerate)	DuPont	12 hours	—	7 days	14 days
Assail (acetamiprid)	United Phosphorus	12 hours	1 day	1 day	1 day
Aza-Direct (azadirachtin)	Gowan	4 hours	0 days	0 days	0 days
Azera (azadirachtin and pyrethrins)	MGK	12 hours	0 days	0 days	0 days
Altacor (chlorantraniliprole)	DuPont	4 hours	—	3 days	1 day
Brigade (bifenthrin)	FMC	12 hours	0 days	3 days	1 day
Confirm (tebufenozide)	Gowan	4 hours	—	14 days	14 days
Coragen (chlorantraniliprole)	DuPont	4 hours	1 day	—	—
Danitol (fenpropathrin)	Valent	24 hours	2 days	3 days	3 days
Delegate (spinetoram)	Dow AgroSciences	4 hours	—	1 day	3 days
Diazinon (diazinon)	Helena	5 days	7 days	—	5 days
Dipel	Valent	4 hours	0 days	0 days	0 days
Entrust (spinosad)	Dow AgroSciences	4 hours	1 day	1 day	3 days
Esteem (pyriproxyfen)	Valent	12 hours	—	—	7 days
Exirel (cyantraniliprole)	DuPont	12 hours	—	—	3 days
Imidan (phosmet)	Gowan	3 days	—	—	3 days
Intrepid (methoxyfenozide)	Dow AgroSciences	4 hours	—	—	7 days
Lannate (methomyl)	DuPont	48 hours	—	—	3 days
Lorsban (chlorpyrifos)	Dow AgroSciences	24 hours	21 days	—	—
Malathion (malathion)	Gowan, UAP	12 hours	3 days	1 day	1 day

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

Chemical	Manufacturer	Re-entry Interval	Preharvest Interval		
			Strawberry	Caneberries	Blueberry
<i>Insecticides (cont.)</i>					
M-Pede (insecticidal soap)	Dow AgroSciences	12 hours	0 days	0 days	0 days
Mustang Maxx (zeta cypermethrin)	FMC	12 hours	—	1 day	1 day
Neemix (azadirachtin)	Certis	4 hours	0 days	0 days	0 days
PyGanic (pyrethrin)	MGK	12 hours	0 days	0 days	0 days
Radiant (spinetoram)	Dow AgroSciences	4 hours	1 day	—	—
Rimon (novaluron)	Chemtura	12 hours	1 day	—	8 days
Sevin (carbaryl)	Bayer CropScience	12 hours	7 days	7 days	7 days
Sivanto (flupyradifurone)	Bayer	4 hours	—	—	3 days
Sniper (bifenthrin)	Loveland Products	12 hours	—	3 days	1 day
Surround (kaolin)	Engelhard	4 hours	—	0 days	0 days
Trilogy (clarified neem extract)	Certis	4 hours	0 days	0 days	0 days
Tri-Tek (oil)	Brandt	4 hours	0 days	0 days	0 days
<i>Acaricides</i>					
Acramite (bifenazate)	Chemtura	12 hours	1 day	7 day	1 day
Brigade (bifenthrin)	FMC	12 hours	0 days	3 days	1 day
Kanemite (acequinocyl)	Arysta LifeScience	12 hours	1 day	1 day	1 day
Nealta (cyflumetofen)	BASF	12 hours	1 day	—	—
Oberon (spiromesifen)	Bayer CropScience	12 hours	3 days	—	3 days
Savey (hexythiazox)	Gowan	12 hours	3 days	3 days	3 days
Stylet Oil	JMS Flower Farms	4 hours	0 days	0 days	0 days
Vendex (fenbutatin oxide)	United Phosphorus	48 hours	1 day	—	—
Zeal (etoxazole)	Valent	12 hours	1 day	0 days	1 day
<i>Nematicides</i>					
Majestene (heat-killed Burkholderia A396)	Marrone Bio Innovations	4 hours	0 days	0 days	0 days
Nimitz or Fluensulfone 480EC (fluensulfone)	ADAMA	0 hours	0 days	—	—

Commercial Small Fruit: Nematodes

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

Pests/Pathogens Controlled	Soil Fumigant		Remarks
	Product	Rate	
Plant parasitic nematodes only	1,3-dichloropropene 94% (Telone II)	15-27 gal or 153-275 lb per treated acre	Follow detailed label instructions carefully. Shank-applied soil fumigant.
	1,3-dichloropropene 94% (Telone EC)	9-24 gal (91-242 lb) per treated acre	Follow detailed label instructions carefully. Soil fumigant formulated for drip-application under plastic mulch. Efficacy dependent on good distribution through soil profile.
	Fluensulfone 40% (Nimitz)	3.5-7 pt per treated acre	Apply via drip or incorporated spray at least 7 days before planting; only 1 application per year. Soil temperature must be 60° or above. Soil incorporation in the top 6-8 inches is critical. Irrigating (0.5-1 inches) 2-5 days after application is recommended. Strawberries only.
	Heat-killed Burkholderia spp. strain A396, 94% (Majestene)	4-8 qt/acre	Can be applied as a preplant-incorporated, in-furrow or banded spray as long as spray volume is sufficient to thoroughly soak the root zone. Can also be drip-applied prior to planting, at or shortly after planting, and again later in the growing season. Higher rates likely more effective, and repeated applications also increase the extent and duration of control. Another product may also be necessary when nematode populations are high. Nematode suppression only for blackberries and raspberries.
Certain soil fungi only	Chloropicrin	11-26 gal (150-350 lb) per treated acre	Follow detailed label instructions carefully. Shank-injected uses
	Tri-Pic 100 EC	11-26 gal (150-350 lb) per treated acre	Follow detailed label instructions carefully. Shank injected uses
		7-22 gal (100-300 lb) per broadcast equivalent acre	Follow detailed label instructions carefully. Special formulation for drip application under plastic mulch
Plant parasitic nematodes and certain soil fungi	<u>Shank Application</u>		
	1,3-dichloropropene, 65% + chloropicrin, 35% (Telone C-35)	39-50 gal (437-560 lb) per treated acre	Also moderate nutsedge control when Telone C-35 is tarped with VIF.
	1,3-dichloropropene, 40% + chloropicrin, 60% (PicClor 60)	48.6 gal (588 lb) per treated acre	Lower rates with VIF tarps have been associated with losses in weed control.
	1,3-dichloropropene, 20% + chloropicrin, 80% (PicClor 80)	34 gal (440 lb) per treated acre	Lower rates with VIF tarps have been associated with losses in weed control.

2-28 Commercial Small Fruit: *Nematodes*

Plant-parasitic nematodes & certain soil fungi	Metam potassium (K-Pam HL)	30-62 gal (318-657 lb) per treated acre	Limited experience with this recently registered product; 10-day plant back interval. AITC is chemically-related to metam products, so may perform similarly against a similar range of target pests.
	Allyl isothiocyanate or AITC (Dominus)	25-40 gal (213-340 lb) per broadcast equivalent acre	
	Dimethyl disulfide (Paladin) should be formulated with 21% chloropicrin.	35-51 gal (310-455 lb) per treated acre	Paladin can provide good nutsedge control, but poor control of certain small-seeded broadleaf weeds and grasses.
Plant-parasitic nematodes & certain soil fungi.	<u>Drip Application</u>		Drip Application:
	InLine	29-58 gal (325-645 lb) per treated acre (See Label)	Products for drip-application are specially formulated for use under plastic mulch. Efficacy dependent on good distribution through soil profile.
	Pic-Clor 60 EC	42.6 gal (503 lb) per treated acre	
	Tri-Pic 100 EC	8-24 gal (100-300 lb) per treated acre	
	Paladin EC	37-54 gal (326-479 lb) per treated acre	

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

Methyl bromide is no longer available for purchase, although growers may apply product already in hand. Small fruit growers should select a nematicide or soil fumigant based on the types of soil pathogens and pests present in their field(s). Soil assays for plant-parasitic nematode populations should indicate the need for a nematode control product. Products containing 1,3-dichloropropene do so in order to control nematodes, while the chloropicrin, metam sodium, metam potassium, or AITC are included primarily to control fungal pathogens and weed seeds. All soil fumigants are restricted use pesticides, with all the associated requirements, including respirator fit-testing, mandated use of full-face respirators for many soil fumigants, written “fumigant management plans” (FMPs), restrictions on cutting and removal of tarps, air monitoring in special circumstances, posting of treated fields and buffer zones surrounding treated fields, and 3-day “entry restricted periods (ERPs)”. FMPs must be completed *before* application, and include documenting the site(s) to be fumigated, handler information, compliance with mandatory good agricultural practices (GAPs), as well as weather conditions surrounding soil fumigation. A “post-application summary” must also be completed for each fumigation. FMPs and post-application summaries must be maintained for 2 years. Most soil fumigant labels also now include minimum distances between treated fields and sites that would be difficult to evacuate (schools, etc.) and official notification requirements.

Growers who fumigate soil or contract with others to fumigate their fields need to familiarize themselves with all requirements. Fumigant applicators must be certified by the Virginia Department of Agriculture and Consumer Services in order to purchase soil fumigants from their dealer. Certifications are valid for a 3 year period.

The mandatory GAPs included in soil fumigant labels document practices long recommended for soil fumigant application. Prior to fumigation, soil should be cultivated deeply and thoroughly, breaking up all clods and crop debris so that the area to be gassed is in good “seed bed” condition and as free as possible of un-decayed organic matter. *Adequate soil moisture and soil temperatures between 50° and 80°F at the depth of injection are critical to effective soil fumigation.* Fumigation characteristics vary significantly among soil fumigants, so check product labels for specific directions regarding shank spacing and outlet depth for specific products and target pests. For example, shank spacing is often narrower and outlet depth shallower for application of metam sodium products. Soil should be smoothed and compacted and/or covered with plastic mulch immediately after application of all soil fumigants in order to minimize gas escape.

Broadcast fumigation may provide more lengthy nematode control when the crop to be planted will be maintained for multiple years, but the “in-row” fumigation common in annual strawberry plasticulture typically provides excellent control

over a single growing season using less total fumigant, because less soil is actually treated. The amount of product needed for in-row fumigation is calculated based upon the area treated relative to the total area of land devoted to the crop. *Important note: the area to be fumigated is based on the width of the “bed” at the bottom versus the top.* VIF (virtually impermeable film) and TIF (totally impermeable film) plastic mulches increase fumigant activity and reduce fumigant emissions into the atmosphere. Using VIF or TIF mulches may enable applicators to reduce the fumigant rates, sometimes reducing the size of buffer zones, but these reductions can also reduce fumigant effectiveness for some products and target pests. Formulations of soil fumigants are also now available that enable application of these products through drip-lines, similar to in-row fumigation. Be sure to read, understand, and follow instructions in these labels carefully.

Because fumigant residues can severely damage new plantings, a waiting period is required for all soil fumigants, but broadcast soil fumigation for perennial crops is typically timed in the fall to allow at least a 4 to 8 week “waiting period” to allow the fumigant to dissipate from treated soil. Waiting periods vary for different fumigants and are also highly influenced by environmental conditions. Check fumigant labels for recommended procedures to ensure fumigant residues have dissipated sufficiently to avoid crop injury.

Commercial Small Fruit: Weeds

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Table 2.9 - 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 broadleaf weeds	flumioxazin 0.19-0.375 lb (Chateau 51 WDG 6.0-12.0 oz in highbush blueberry, 6 oz in caneberries)	Do not apply to blueberries established less than 2 years unless stems are protected by grow tubes, wraps, or waxed containers. Do not apply after bud-break through final harvest. Avoid contact with foliage and green bark.
	Annual broadleaf weeds	isoxaben 0.52-1.0 lb (Trellis SC 16-31 fl oz)	Nonbearing only - allow at least one year between application and harvest. Preemergence control of annual broadleaf weeds. Combine with an annual grass herbicide such as oryzalin for broader spectrum control. Include a postemergence herbicides if emerged weeds are present.
	Annual broadleaf and certain annual grassy weeds	mesotrione 0.09-0.18 lb (Callisto 3.0-6.0 fl oz)	Blueberries only. Apply preemergence or early postemergence. For improved postemergence control, apply 3.0 fl oz Callisto followed 3 weeks later by a second application at that rate. Apply prior to bloom. Include a crop oil concentrate tolerated by blueberries if applied postemergence to weeds.
	Annual grasses and certain broadleaf weeds	napropamide 4.0 lb (Devrinol 50DF 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 DF 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)	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.

Table 2.9 - Herbicides (cont.)

Crop	Weeds Controlled	Chemical Rate/A (Product/A)	Remarks
	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.
	Certain annual weeds plus yellow nutsedge	sulfentrazone 0.25-0.375 lb (Zeus XC 8-12 fl oz)	Apply as a directed spray avoiding crop foliage. Crop needs to be established at least 3 years. Do not apply more than 12 fl oz/A/year. Preemergence control of annual broadleaf weeds and certain annual grasses. Provides postemergence control of yellow nutsedge.
	Annual grasses and broadleaf weeds plus some perennial broadleaf weeds	terbacil 0.8-1.6 lb (Sinbar WDG 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.
<i>Postemergence directed</i>			
Blueberries, Blackberries, and Raspberries	Yellow nutsedge and certain broadleaf weeds	bentazon 0.75-1.0 lb (Basagran 1.2-2 pt/A + 1 qt/A crop oil concentrate)	Nonbearing only - allow at least one year between application and harvest. Apply when yellow nutsedge and annual broadleaf weeds are small and actively growing.
	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 nonionic 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.
	Annual and perennial grasses	clethodim 0.09-0.12 lb Select 2EC 6.0-8.0 fl oz or Select Max 9.0-16.0 fl oz + 0.25% v/v nonionic surfactant)	Apply to actively growing grasses. Will control annual bluegrass. For spot treatment, use 0.33-0.65 fl oz Select 2EC or 0.44-0.88 fl oz Select Max per gallon plus 0.33 fl oz nonionic surfactant. A repeat application may be required for perennial grass control. The preharvest interval is 14 days for highbush blueberry and 7 days for both raspberry and blackberry.
	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 0.88-1.5 lb (Rely 280 48.0-82.0 fl oz)	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 1.7 fl oz Rely 280/gal.
	Annual and perennial grasses and broadleaf weeds	glyphosate 0.75-3.75 lb ae (Roundup UltraMax 26.0 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.

Table 2.9 - Herbicides (cont.)

Crop	Weeds Controlled	Chemical Rate/A (Product/A)	Remarks
	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 + 1.0-2.0 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. RESTRICTED USE PESTICIDE
	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 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.
	Yellow nutsedge and certain broadleaf weeds	halosulfuron 0.024-0.047 lb (Sanda 0.5-1.0 oz/A plus a nonionic surfactant at 0.25-0.5% V/V in highbush blueberry, Sandea 0.75-1.5 oz/A plus a nonionic surfactant at 0.25-0.5% V/V in blackberry and raspberry)	Do not allow spray to contact crop foliage. 14-day preharvest interval. Use the lower rate on highbush blueberry plants less than 4 years old. Can also be applied to raspberry and blackberry. Highbush blueberry, raspberry, and blackberry must be established at least 1 year. Do not allow spray to contact crop foliage. Treat when yellow nutsedge is actively growing under good soil moisture.
Strawberries	Annual and perennial grasses	clethodim 0.09-0.125 lb (Select 2EC 6.0-8.0 fl oz + 1% crop-oil concentrate or Select Max 9.0-16.0 fl oz + 0.25% nonionic surfactant)	Apply to actively growing grasses. Will control annual bluegrass. For spot treatment, use 0.33-0.65 fl oz Select 2EC or 0.44-0.88 fl oz Select Max per gallon plus 0.33 fl oz nonionic surfactant. A repeat application may be required for perennial grass control. Allow at least 4 days between application and harvest.
	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 nonionic surfactant between the rows in plasticulture. Can be tank mixed with other herbicides for broader-spectrum weed control.
	Annual grasses and broadleaf weeds	flumioxazin 0.09 lb (Chateau WDG 3.0 oz/A)	Apply before laying plastic to formed beds at least 30 days before transplanting. 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. Dormant applications can be made to plants in the matted row production system.
	Annual grasses and certain broadleaf weeds	D CPA 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 in the matted row production system.

Table 2.9 - Herbicides (cont.)

Crop	Weeds Controlled	Chemical Rate/A (Product/A)	Remarks
Strawberries (cont.)	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 in the matted row production system. 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. Can also be applied to row middles in plasticulture production systems.
	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 weeds	acifluorfen 0.25-0.375 lb (UltraBlazer 1.0-1.5 pt)	Apply prior to laying plastic and transplanting. Can also be applied to row middles as a shielded directed spray. Do not allow spray to contact strawberry plants. Apply after last harvest or following bed renovation in matted row production. Can also be applied in late fall or winter when plants are dormant in matted row production. Do not apply the last application within 120 days before harvest.
	Annual weeds and suppression of perennials	paraquat 0.5 lbs (Gramoxone Inteon 2.0 pt)	Directed spray to row middles using a shielded spray. Do not allow spray to contact strawberry plants. Do not apply within 21 days of harvest.
	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. Do not tank mix with other pesticides.
	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 to 10 days before renovation in matted row production. 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 WDG 2-6 ounces/A)	Use only on plants established at least 6 months in a matted row production system. Apply after postharvest renovation before new growth begins or in late fall to control winter annuals. Do not apply more than 8.0 oz of Sinbar/A/ growing season. Do not use on soils less than 2% organic matter.

Table 2.10 - Relative Effectiveness of Preemergence Herbicides in Small Fruit

	Dichlobenil	Bentazon	DCPA	Flumioxazin	Mesotrione	Napropamide	Norflurazon	Oryzalin	Oxyfluorfen	Simazine	Terbacil
<i>Annual Grasses</i>											
Barnyardgrass	G	N	G	F	P	G	E	G	F	F-G	G
Cheat	G	N	—	—	—	G	G	G	—	G	G
Crabgrass	G	N	G	F-G	F	E	E	E	F	F-G	F-G
Fall panicum	F	N	G	F	P	G	E	G	—	F-G	G
Foxtails	G	N	G	F-G	P	E	E	E	F	G	G
Goosegrass	F	N	G	F-G	P-F	E	G	E	F	E	—
Johnsongrass (seedling)	F	N	—	P-F	N	P	G	F-G	—	N	—
<i>Annual Broadleaf Weeds</i>											
Annual fleabane	E	—	—	—	—	G	F	G	G	G	E
Annual morningglory	G	P	N	F-G	F	N	F	P-F	F	E	G
Black nightshade	G	N	N	G	P	N	F-G	P-F	G	E	—
Carpetweed	G	—	F	G	—	G	G	G	G	E	E
Common chickweed	G	—	G	—	—	G	G	G	G	E	G
Common lambsquarter	G	G	G	F-G	G	F-G	G-E	G	G	E	G
Common ragweed	G	G	N	G	P	F	F	P	F	E	G
Hairy galinsoga	G	—	N	—	G	G	—	P	G	E	E
Henbit	G	—	—	G	G	F	—	G	G	E	G
Horseweed	G	N	—	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	G	N	—	—	P	—	P-F	G	E	G
Pigweeds	G	—	F	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	—	G	—	—	—	—	—	—
Velvetleaf	—	G	N	G	—	N	F	P-F	F	G	G
Virginia pepperweed	G	—	—	—	—	F	G	G	—	E	—
<i>Perennial Grasses And Sedges</i>											
Bermudagrass	N	—	N	N	P	N	P	N	N	N	F
Dallisgrass	—	—	N	N	P	N	P	N	N	N	F-G
Fescues	G	N	N	N	N	N	F	N	N	P	F
Johnsongrass (rhizome)	—	N	N	N	N	N	P	N	N	N	P
Nimblewill	—	N	N	N	F-G	N	F	N	N	P	P
Orchardgrass	G	N	N	N	—	N	F	N	N	P-F	G-E

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

Table 2.10 - Relative Effectiveness of Preemergence Herbicides in Small Fruit (cont.)

	Dichlobenil	Bentazon	DCPA	Flumioxazin	Mesotrione	Napropamide	Norflurazon	Oryzalin	Oxyfluorfen	Simazine	Terbacil
<i>Perennial Grasses And Sedges (cont.)</i>											
Purpletop, Redtop	—	N	N	N	—	N	F-G	N	N	N	F-G
Quackgrass	G	N	N	N	—	N	P	N	N	P-F	G
Yellow nutsedge	P-F	F-G	N	N	F	P	P-F	N	N	N	F-G
<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 2.11 - Relative Effectiveness of Postemergence Herbicides in Small Fruit

	Acifluorfen	Carfentrazone	Fluazifopbutyl	Glyphosate	Sethoxydim	2,4-D	Clopyralid	Paraquat	Clethodim
<i>Annual Grasses</i>									
Barnyardgrass	N	N	E	E	E	N	N	G	E
Cheat	—	—	G	E	G	N	N	G	-
Crabgrass	N	N	E	E	E	N	N	G	E
Fall panicum	P	N	E	E	E	N	N	G	E
Foxtails	P	N	E	E	E	N	N	G	E
Goosegrass	N	N	E	E	E	N	N	G	E
Johnsongrass (seedling)	P	N	E	E	E	N	N	G	E
<i>Annual Broadleaf Weeds</i>									
Annual fleabane	—	—	N	E	N	G	—	E	N
Annual morningglory	G-E	F	N	E	N	E	N	G	N
Black nightshade	F-G	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	P-F	G	N	E	N	G	P	E	N
Common ragweed	E	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	G	—	N	E	N	P	F	G	N
Pigweeds	G-E	G	N	E	N	G	P	G	N
Prickly lettuce	—	—	N	E	N	P	—	G	N
Prickly sida	N	—	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	P	E	N	E	N	G	P	E	N
Virginia pepperweed	—	—	N	E	N	G	—	G	N
<i>Perennial Grasses And Sedges</i>									
Bermudagrass	—	N	G	G	G	N	N	P	G
Dallisgrass	—	N	G	E	G	N	N	P	—
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 2.11 - Relative Effectiveness of Postemergence Herbicides in Small Fruit (cont.)

	Acifluorfen	Carfentrazone	Fluazifopbutyl	Glyphosate	Sethoxydim	2,4-D	Clopyralid	Paraquat	Clethodim
<i>Perennial Grasses And Sedges (cont.)</i>									
Purpletop, Redtop	—	N	G	E	G	N	N	P	—
Quackgrass	—	N	G	G	G	N	N	P	G
Yellow nutsedge	—	N	N	G	N	N	N	P	N
<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)