Agricultural Extension Service
The University of Tennessee

PB 1197

2003
Commercial Small Fruit Spray Schedules

NOT FOR USE IN HOME PLANTINGS

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Use of trade or brand names in this publication is for clarity and information; it does not imply approval of the product to the exclusion of others which may be of similar, suitable composition, nor does it guarantee or warrant the standard of the product.

Precautionary Statement

To protect people and the environment, pesticides should be used safely. This is everyone's responsibility, especially the user. Read and follow label directions carefully before you buy, mix, apply, store or dispose of a pesticide. According to laws regulating pesticides, they must be used only as directed by the label.

PESTICIDE EMERGENCY TELEPHONE NUMBERS

Medical information on treatment of pesticide or other kinds of poisoning can be obtained by calling the following poison control centers:

Chattanooga	778-6100	Johnson City	461-6572
Columbia	381-1111	Knoxville	544-9400
Cookeville	526-4818	Memphis	528-6048
Jackson	426-6000 or 322-6435	Nashville	322-6435

2003 Tennessee Commercial Small Fruit Spray Schedules

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Available on the Internet at http://web.utk.edu/~extepp/pubs/PB1197-2003.pdf

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PESTICIDE SAFETY

Pesticides are potentially hazardous to handlers and operators. Pesticide toxicities vary, but proper precautions should always be followed when using these materials.

- READ THE LABEL BEFORE USING PESTICIDES AND FOLLOW THE SAFETY DIRECTIONS.
- Wear proper protective equipment according to instructions on the pesticide label. Always wear a respirator.
- Comply with the Worker Protection Standard (WPS). Follow all label instructions on re-entry times for pesticides.
- Equip storage area with clean-up materials required by the WPS. Clean up spilled chemicals promptly and properly.
- Store pesticides in original containers under lock and key, out of the reach of children and animals, and away from food, feed and personal protection equipment. Mark the storage facility with a warning sign.
- Comply with the Right-To-Know law. Have complete product labels readily available for workers to see. Have the Material Safety Data Sheet (MSDS) for each product available for workers to see and for rescue or fire personnel to use in case of emergency.
- Apply pesticides so they do not endanger humans, livestock, crops, beneficial insects (such as bees), fish and wildlife.
- For safety's sake, do not spray alone, especially when using organophosphates or carbamates.
- If handling organophosphate insecticides regularly, you should go to your doctor periodically for blood cholinesterase determinations.
- Avoid contacting skin or clothing with spray materials. If an accident occurs, wash immediately with soap and water. If a pesticide is swallowed or gets in your eyes, follow the first-aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on the skin or clothing, remove the clothing immediately and wash skin thoroughly.
- Mix only as much pesticide as you will need for an application. If you mix too much, apply the material in the recommended manner to one of the crops listed on the label. Do not dump pesticides on the ground or pour them down sinks or other drains.
- Rinse empty pesticide containers three times with water, and pour the rinse water into the spray tank. Dispose of empty containers according to recommendations.
- Purchase or application of restricted-use pesticides requires certification. See your county Extension agent for certification or recertification.
- Maintain accurate spray records. Detailed records are required by law for restricted-use pesticides. See your county Extension agent for suggested forms to use.

BLACKBERRY AND RASPBERRY INSECT CONTROL

The rates expressed as product/gal are based on a spray volume of 100 gal/acre. Spoonful measures are level, not heaping.

Pests	Pesticide	Product/Acre	Product/Gal	Minimum Days to Harvest
Aphid, thrips	malathion 57%EC	3 pt/200 gal	1.5 tsp	1
Red-necked cane borer	No insecticide is currently labeled for this pest.			
	Remarks: Larval tunneling causes gall like swellings. As a preventive measure, canes with swellings (if <5% galled) should be removed and burned during the dormant season. Elimination of wild brambles in close proximity to cultivated patches may reduce this pest. The adult bronzed, blue-black beetle is about 1/3 inch long. Look for presence of adults in your planting from early May through early June.			
Raspberry crown borer	No insecticide is currently labeled for this pest.			
	Remarks: Larva hollows out roots and crown for two years before emerging as a clearwing moth in July and August. Eggs are laid on foliage and larvae overwinter in a silken case (hibernacula) on roots and crowns, usually 1 to 3 inches below ground. In the spring, the larvae leave the hibernacula to enter the roots and crowns of canes. All borers-attacked (appear wilted) canes and crowns (larvae present) should be removed and destroyed by late July.			
Raspberry cane borer	No insecticide is currently labeled for this pest.			
	Remarks: Prune and destroy canes that exhibit wilted tips in July and August. The adult, a 1/2 inch long black longhorn beetle with a yellow thorax, appears from June to August. Female lays egg in cane, then girdles cane 1/4 inch above and below egg puncture, causing shoot tip to wilt and die. Larva tunnels down and overwinters near point of girdling. The next season, larva tunnels to crown, where it overwinters.			
Japanese beetle	carbaryl (Sevin 80WSP),	1.25 - 2.5 lb	1 - 2 Tbsp	7
	or carbaryl (Sevin 4F),	1 - 2 qt	2 - 4 Tbsp	7
	or malathion 57%EC	3 pt/200 gal	1.5 tsp	1
	Remarks: Foliar spray for adult beetles as needed. Adults begin to emerge in late May and peak in early July.			
Raspberry sawfly	carbaryl (Sevin 80WSP)	2.5 lb	2 Tbsp	7
	Remarks: Foliar sprays for larvae as needed. Look for this occasional pest in May and June.			
Spider mites	malathion 57%EC,	3 pt/200 gal	1.5 tsp	1
	or Savey 50-WP,	4-6 oz	–	3
	or Savey 50 DF	4-6 oz	–	3
Strawberry weevil (clipper)	malathion 57% EC,	3 pt/200 gal	1.5 tsp	1
	or Brigade 10 WSB,	8-16 oz	–	3
	or carbaryl (Sevin 80 WSP),	1.25 - 2.5 lb	1 -2 Tbsp	7
	or carbaryl (Sevin 4F),	1 -2 qt	2 - 4 tsp	7
	or Capture 2 EC	3.2 - 6.4 fl oz	–	3
	Remarks: The weevil adult is small (3mm long) and brown with black areas on the side of each wing cover. The weevil feeds on the blossom buds and lays its eggs in the feeding punctures. It then partially cuts the stem so that the bud wilts, falls over and eventually falls off. The immature stages develop by mid-summer in the bud on the ground. Spray the foliage when the weevils are present.			

BLACKBERRY DISEASE CONTROL

The rates expressed as product/gal are based on a spray volume of 100 gal/acre. Spoonful measures are level, not heaping.

Disease	Pesticide	Product/Acre	Product/Gal	Min. Days to Harvest
Anthracnose,	liquid lime-sulfur (dormant spray)	10 gal	12 fl oz	--
cane blight	Cabrio 20EG (growing season spray)	14 oz	0.5 Tbsp	0
	Remarks: If these diseases are confirmed by lab, apply lime-sulfur at delayed dormant, but prior to 3/4-inch shoot stage, to avoid leaf burn. Begin Cabrio applications at early bloom and repeat at 7- to 14-day intervals. The label requires alternation with a non-related fungicide such as copper after two consecutive applications have been made.			
Gray mold	Elevate 50WDG,	1.5 lb	--	0
(Botrytis)	or Rovral 50W	1 - 2 lb	1 Tbsp	0
	Remarks: Use only if previous experience or continuous wet weather indicate that gray mold control is needed. Over-use of either product can result in build-up of resistant Botrytis strains. Apply at early-bloom and full- to late-bloom. Additional applications can be made through harvest, abiding by label limitations.			
Orange rust	Cabrio 20EG,	14 oz	0.5 Tbsp	0
	or Nova 40W	1.25 - 2.5 oz	0.33 - 0.67 tsp	0
	Remarks: In infected plantings or plantings at risk of infection, begin applications in spring, before orange pustules appear on undersides of leaves. Continue at 10- to 14-day intervals until early summer. Will not benefit systemically-infected plants.			
Rosette	Bordeaux mixture	4-4-50	1.25 oz	0
(Double blossom)	Remarks: Very good control obtained when applied at critical times. In severe cases, up to 5 applications following the bloom period, at 14-day intervals, are needed. Bordeaux mixture, which consists of 4 lb bluestone and 4 lb spray lime per 50 gal water, can be used to extend the protection period. To mix, dissolve the bluestone in one-half tank of water with constant agitation. Then add the lime as the tank fills. Bordeaux mixture will cause leaf burn if applied on very hot days or if combined with insecticides. Pruning rosettes out before they bloom in the spring aids in control, but chemical sprays may still be needed.			

Table 1. Restrictions for blackberry and raspberry pesticides.

Material	Re-entry Interval	Preharvest Interval (days)	Remarks
FUNGICIDES			
Aliette	12 hours	60	Do not make more than 4 applications per acre per year. Do not mix with copper compounds, adjuvants, or foliar fertilizers. If applied prior to or after copper compounds, raise the spray pH to 6.0 or above with an alkaline buffer.
basic copper sulfate	24 hours	0	
Cabrio	24 hours	0	Do not make more than 2 consecutive applications before rotating to a non-related fungicide, and no more than 4 strobilurin applications per year.
Elevate	12 hours	0	Do not apply more than 6 pounds of product per acre per season.
Nova	24 hours	0	Do not apply more than 10 oz per acre per growing season.
Ridomil Gold EC	48 hours	45	Not for blackberries. Make 1 application in the spring and another in the fall after harvest.
Ronilan	12 hours	9	Not for blackberries. Do not apply more than 8 lb per acre per season.
Rovral	24 hours	0	Do not make more than 4 applications per acre per season.

Material	Re-entry Interval	Preharvest Interval (days)	Remarks
INSECTICIDES AND MITICIDES			
Guthion	48 hours/ 4 days	14	REI is 48 hours for mowing, irrigating, and scouting only; 4 days for all other purposes. Do not make more than 2 applications per acre per season. Application by backpack or hand-wand sprayers is prohibited.
Malathion	12 hours	1	
Savey	12 hours	3	Do not make more than one application per year.
Sevin	12 hours	7	Do not apply more than 12.5 pounds of Sevin 80WSP per acre per crop.
Brigade	24 hours mecanically harvested 4 days all others	3	One application may be made pre-bloom and as second application may be made post-bloom.

RASPBERRY DISEASE CONTROL

The rates expressed as product/gal are based on a spray volume of 100 gal/acre, with the exception of basic copper sulfate (see remarks). Spoonful measures are level, not heaping.

Disease	Pesticide	Product/Acre	Product/Gal	Min. Days to Harvest
Anthracnose	liquid lime-sulfur	10 gal	12 fl oz	--
	Remarks: If anthracnose is confirmed by lab, apply lime-sulfur at delayed dormant, but prior to 3/4-inch shoot stage, to avoid leaf burn. Begin Cabrio applications at early bloom and repeat at 7- to 14-day intervals. The label requires alternation with a non-related fungicide such as copper after two consecutive applications have been made.			
Gray mold (Botrytis)	Elevate 50WDG,	1.5 lb	--	0
	or Ronilan 50EG,	1 - 2 lb	1 Tbsp	9
	or Rovral 50W	1 - 2 lb	1 Tbsp	0
	Remarks: Apply at early-bloom and full- to late-bloom. Additional applications can be made through harvest, abiding by label limitations. Bloom and harvest periods are the most critical. Use only if previous experience or continuous wet weather indicate that gray mold control is needed.			
Phytophthora root rot	Ridomil Gold EC,	See remarks		45
	or Aliette 80W	5 lb	3.5 Tbsp	60
	Remarks: Use only if needed. The Ridomil GoldEC label reads: "Apply 1/4 pt/1000 linear feet of row to the soil surface in a 3-foot band over the row. Make one application in the spring and another in the fall after harvest. Use the formula in the General Information section of this label to calculate the amount of Ridomil GoldEC needed per acre." Aliette can be applied to the foliage up to 4 times per year at 45-60 day intervals, beginning after bud break and ending 30 days prior to leaf drop.			
Leaf spot (Septoria)	basic copper sulfate 53W,	4 lb	0.67 Tbsp	0
	or Cabrio 20EG,	14 oz	0.5 Tbsp	0
	or Nova 40W	1.25 - 2.5 oz	0.33 - 0.67 tsp	0
	Remarks: Begin sprays in late spring or earlier, if disease appears earlier. Use copper at 2 lb per acre (0.67 Tbsp per gal) in spring, increasing gradually to 4 lb per acre as plant canopy increases in size, but do not concentrate the product greater than 2 lb (1 lb metallic copper) per 100 gal water (0.67 Tbsp per gal). A 10-14 day schedule may be needed throughout the growing season if weather conditions remain favorable (warm, wet) for disease. Very destructive disease on some varieties.			

Raspberry Disease Control (continued)

Disease	Pesticide	Product/Acre	Product/Gal	Min. Days to Harvest
Powdery mildew	Cabrio 20EG, or Nova 40W	14 oz 1.25 - 2.5 oz	0.5 Tbsp 0.33 - 0.67 tsp	0 0
Remarks: Not a common problem in Tennessee. In infected plantings, make first application at white blossom bud stage and repeat 10 to 14 days later.				

Table 2. Effectiveness of fungicides for control of bramble diseases (0-3 scale).

Fungicide	Raspberry (Septoria) Leaf Spot	Phytophthora Root Rot	Botrytis Gray Mold	Anthracnose	Blackberry Rosette	Cane Blight
Aliette	--	1	--	--	--	--
Benlate	--	--	2	2	2	1
copper	1	--	--	1	2	--
Elevate	--	--	3	--	--	--
lime sulfur	--	--	--	1	--	1
Nova	3	--	--	--	--	--
Ridomil	--	2	--	--	--	--
Ronilan	--	--	3	--	--	--
Rovral	--	--	3	--	--	--

-- = not effective; 1 = slightly effective; 2 = moderately effective; 3 = highly effective.

WEED CONTROL IN BLACKBERRIES AND RASPBERRIES (Brambles)

Developing A Weed Management Program: For optimum production of blackberries and raspberries (brambles), weed management requires a planned approach. In terms of weed control or management, the floor can be divided into two zones with different weed management objectives. Within the row, the weed management objective is to maintain a strip (minimum width of 4 ft. or 2 ft. on either side of the crop) devoid of vegetation (of both grass and broadleaf weeds) year round. Ideally, for optimum production, the soil should be covered with a layer of organic mulch (6 inches depth) for the benefits of stabilizing soil temperature and moisture in addition to weed suppression. Between the rows and around the perimeter of the planting maintain close-mowed sod. Within the row, season-long weed control is achieved by making at least two directed-applications of herbicides per year. In each application, apply a tank-mix combination of a postemergence herbicide (to control existing weeds) with preemergence herbicides (to provide residual control or to slow the re-emergence of weeds). Often a combination of two preemergence herbicides is required to achieve broadspectrum control. For the postemergence herbicide option in this combination it is often desirable to use a non-selective herbicide when both established grass and broadleaf weeds are present. As a result, planning the time of application is very critical as these non-selective postemergence herbicide options can only be applied at certain stages in the bramble development cycle. One of the two application timings for the tank-mix combination can be applied in the fall to early winter. The second application can be applied in late winter to early spring up to the time of bud break and before new shoot emergence. After this timing, no non-selective postemergence herbicide should be applied again until the fall. Additionally, in regards to the preemergence herbicides in these two applications, options should be alternated to avoid the development of weed populations tolerant to a particular herbicide or herbicide combination. Thus, in choosing the most appropriate herbicides consider present weed populations and past populations; choose a postemergence herbicide that will control existing vegetation, that is safe to the crop given the intended time of application and; choose a preemergence herbicide treatment that will provide residual control of all grass and broadleaf weeds anticipated.

Selecting Herbicides: The following table provides discussion on herbicide options available for use in bramble production. The table groups the herbicides based on herbicide type and stage of weed control provided. For each herbicide, use directions and precautions are provided to aid in selection and ensure product performance. In addition to this table, refer to the WEED RESPONSE TO HERBICIDES tables at the back of this publication to aid in selecting the most appropriate herbicide combination for control of existing weeds and those weeds that can be anticipated based on field history.

Herbicide Application: To ensure successful herbicide application refer to the SUMMARY OF REQUIREMENTS FOR HERBICIDE APPLICATION table at the back of this publication. This table assists you with a quick reference or check list of all the requirements for successful herbicide application and optimum herbicide performance.

HERBICIDE	RATE PER ACRE (Broadcast) Active Ingredient (lbs.)	Formulation	DIRECTIONS AND PRECAUTIONS
Postemergence Control: Grass Weeds			
Clethodim - SELECT 2EC	0.094 - 0.125	6 - 8 fl. oz.	For postemergence control of annual and perennial grasses. Use low rate for annual grasses up to 6 inches tall. Use high rate for perennial grasses including rhizome johnsongrass and bermudagrass. Repeat application may be required for re-growth of perennial grasses. For repeat applications, make on a minimum of a 14 day interval. For bermudagrass, make first application (high rate) when runners are less than 6 inches and repeat before 6 inches of regrowth occurs. Add crop oil concentrate (containing 80% oils and 15% emulsifier) at 1% volume per volume (or 2 pts. per 25 gallons of water carrier). Can be tank-mixed with certain preemergence herbicides (see label). **Do not apply within one year of harvest**. Thus, as a result, cannot be used on primocane fruiting raspberries.

WEED CONTROL IN BLACKBERRIES AND RASPBERRIES (Brambles)

HERBICIDE	RATE PER ACRE (Broadcast) Active Ingredient (lbs.)	Formulation	DIRECTIONS AND PRECAUTIONS
Fluazifop - FUSILADE DX-2EC	0.25 - 0.375	16 - 24 fl. oz.	For postemergence control of annual and perennial grasses. Use low rate for annual grasses before they exceed 4 inches tall. Use high rate for perennial grasses. Repeat application may be required for re-growth of perennial grasses. For bermudagrass, make first application when runners are 4 to 8 inches long, and repeat when 4 inches of regrowth occurs. Add either crop oil concentrate at 1% volume/volume (or 2 pts./ 25 gallons of water carrier) or non-ionic surfactant (at least 75% active ingredient) at 0.5% volume/volume (or 1 pt./ 25 gallons of water carrier). Can be tank-mixed with certain preemergence herbicides (see label). Do not apply a total of more than 72 fluid ounces of Fusilade DX per acre per season. **Do not apply within one year of harvest**. Thus, as a result, cannot be used on primocane fruiting raspberries.
Sethoxydim - POAST 1.53EC	0.188 - 0.469	16 - 40 fl. oz.	For postemergence control of annual and perennial grasses. For annual grasses, use low rate before 4 inches in height is reached. For perennial grasses, use high rate and conduct at least one timely retreatment based on regrowth. Add crop oil concentrate at 1% volume/volume (or 2 pts. per 25 gallons of water carrier). Do not apply more than 80 ounces of Poast per acre per season. Can be tank-mixed with certain preemergence herbicides (see label). **Do not apply within 45 days of harvest.**
Postemergence Control: Grass and Broadleaf Weeds			
Paraquat - BOA 2.5SL - GRAMOXONE EXTRA 2.5SL - GRAMOXONE MAX 3 SL **Restricted-Use Pesticide**	 0.5 - 1 0.5 - 0.94 0.56 - 1.01	 1.6 - 3.2 pts. 1.6 - 3.0 pts. 1.5 - 2.7 pts.	Provides non-selective, contact control (non-systemic) of annual grass and broadleaf weeds and suppression of perennial weeds. Can be applied in fall through to spring but before new cane emergence (do not apply after new cane emergence or injury will result). Apply as a post-directed or shielded spray [low pressure with coarse droplet size (in 50 gallons of water carrier per acre)] to avoid crop injury from fine spray mist. Requires the addition of either non-ionic surfactant at 0.25% volume/volume (or 0.5 pts. per 25 gallons of water carrier) or crop oil concentrate at 1.0% volume/volume (or 2 pts. per 25 gallons of water carrier). Can be mixed with certain pre-emergence herbicides for residual control (see label).

WEED CONTROL IN BLACKBERRIES AND RASPBERRIES (Brambles)

HERBICIDE	RATE PER ACRE (Broadcast) Active Ingredient (lbs.)	Formulation	DIRECTIONS AND PRECAUTIONS
Glyphosate - ROUNDUP ULTRA 4SL - ROUNDUP ULTRA MAX 5SL - ROUNDUP WEATHER MAX 5.5SL - TOUCHDOWN 3SL*	 1 - 5 1.25 - 5 1.375 - 5 1 - 5	 1 - 5 qts. 1 - 4 qts. 1 - 3.3 qts. 1 - 5 qts.	Provides non-selective, systemic control of annual and perennial grass and broadleaf weeds. Can be applied in spring but before new cane emergence (do not apply after new shoot emergence and do not apply in the fall or injury will result). Has systemic activity, thus, do not allow spray to contact foliage, green bark or any new growth. Apply as a post-directed or shielded application only to the base of the crop. Can be mixed with certain preemergence herbicides for residual control (see label). * TOUCHDOWN requires addition of non-ionic surfactant at 0.25% volume/volume (or 0.5 pts. per 25 gallons of water carrier). **Do not apply within 14 days of harvest.**
Preemergence (Residual) Control:			
Dichlobenil - CASORON 4G	 4	 100 lbs.	Provides preemergence and limited postemergence activity towards annual and perennial grass and broadleaf weeds. Product is applied as a granular not as a liquid. Apply in the early winter up to no later than mid-February. Soil temperature needs to be 55°F or less to limit decomposition and volatilization losses. For brambles in a year, do not use more than the rate listed. **Used on established plantings only.**
Napropamide - DEVRINOL 50WDG - DEVRINOL 10G	 4	 8 lbs. 40 lbs.	Provides preemergence control of certain grasses and small seeded broadleaf weeds. Shallow incorporation or irrigation (wet soil 2-4" deep) should be performed if rainfall is not received within 5 to 14 days after application. Ideally, make application in fall through to early spring. Apply to weed free soil or can be tank-mixed with glyphosate or paraquat. Best results obtained when tank-mixed with a second preemergence herbicide. In establishment year and beyond, can be tank-mixed with oryzalin for improve residual control spectrum. **Can be used during establishment** or in established plantings.
Norflurazon - SOLICAM 80WDG	Soil Texture Course 2 Medium 3 Fine 4	Soil Texture Course 2.5 lbs. Medium 3.75 lbs. Fine 5 lbs.	Provides preemergence control of predominantly annual grasses and certain broadleaf weeds. Can be tank-mixed with certain herbicides including simazine for more complete residual control. Can be tank-mixed with glyphosate or paraquat**.** Apply from fall to early spring when planting is dormant. Temporary whitening or pigment loss in the leaf veins may occur from normal use. **Planting must be established for at least one year. Do not apply within 60 days of harvest.**

WEED CONTROL IN BLACKBERRIES AND RASPBERRIES (Brambles)

HERBICIDE	RATE PER ACRE (Broadcast) Active Ingredient (lbs.)	Formulation	DIRECTIONS AND PRECAUTIONS
Oryzalin - SURFLAN 4AS	2 - 6	2 - 6 qts.	Provides preemergence control of predominantly annual grasses and certain broadleaf weeds. Use high rate for long-term weed control (6 - 8 months) and low rate for short-term control (2 - 4 months). Can be tank-mixed with certain herbicides including either simazine or napropamide for more complete residual control. Can be tank-mixed with glyphosate or paraquat. Maximum rate is 12 qts. per acre per year with a minimum of 2 ½ months between applications. **Can be applied to first year plantings.**
Simazine - PRINCEP 4L - PRINCEP 90WDG - SIMAZINE 4L - SIMAZINE 90DF - SIMAZINE 90WDG	2 - 4	2 - 4 qts. 2.2 - 4.4 lbs. 2 - 4 qts. 2.2 - 4.4 lbs. 2.2 - 4.4 lbs.	Provides preemergence control of many annual grass and broadleaf weeds. Apply either the full rate in the spring or a split application of ½ rate in the spring (before bud break) and then again in the fall (after harvest). Can be tank-mixed with certain herbicides including oryzalin or norflurazon for more complete residual control spectrum. Can be tank-mixed with glyphosate or paraquat. Do not apply when fruit is present or illegal residues may result. **On plantings less than 6 months old, use only half of the lowest rate.**
Terbacil - SINBAR 80WP	0.8 - 1.6	1 - 2 lbs.	Provides preemergence and early postemergence control of many annual and some perennial grass and broadleaf weeds. Can be applied in the fall after harvest through to spring/early summer but prior to fruit set. Do not spray foliage. Can be tank-mixed with glyphosate or paraquat. Do not use on eroded areas where subsoil or roots are exposed. Do not apply to plantings that are under stress. **Planting must be established for at least one year. Do not apply within 70 days of harvest.**

Summary of Possible Pre-emergence Treatments: The following lists provides a summary of possible preemergence (or residual) herbicide combinations for improved residual control spectrum listed based on the age of the planting. Please refer to the weed susceptibility table to aid in decision making and the above discussion for use directions and precautions. Note, the addition of a post-emergence herbicide to pre-emergence treatment may be needed for application of preemergence or residual herbicides that do not also provide control of existing vegetation.

Planting to Six Months Old	Six to 12 Months Old	One Year or Older
1. DEVRINOL plus - SURFLAN	1. DEVRINOL plus - SURFLAN	1. DEVRINOL plus - SURFLAN
2. PRINCEP (½ rate) plus - SURFLAN	2. PRINCEP plus - SURFLAN	2. PRINCEP plus - SURFLAN or - SOLICAM
		3. SINBAR
		4. CASORON

BLUEBERRY SPRAY SCHEDULE

Note: Diseases and insects are not often a major problem in blueberry and spraying according to a schedule may not be necessary. Use scouting and previous years' pest problems to assist in selection of pesticides and timing of applications.

Name/Time	Pest	Material and Rate Per Acre	Notes
Dormant	Scales	2 - 3 gal Dormant oil (70 sec.)	
Green Tip	Mummy berry, twig blight	6.2 - 15.4 fl oz Abound 2F, or 14 oz Cabrio 20EG, or 5 lb captan 50WP, or 3 lb ziram 76DF	1
7 - 10 days later	Same as Green Tip	Same as Green Tip	1
Full Bloom	Twig blight, anthracnose fruit rot, mummy berry, Botrytis blight	6.2 - 15.4 fl oz Abound 2F, or 14 oz Cabrio 20EG, or 5 lb captan 50WP	1
Petal Fall	Plum curculio, cranberry fruitworm, cherry fruitworm	2.8 - 3.2 pt malathion 57%EC per 200 gal, or 2 - 3 pt Guthion 2L, or 1.875 - 2.5 lb Sevin 80WSP, or 16 fl oz Confirm 2 F	 2 3
	Twig blight, anthracnose fruit rot	Same as Full Bloom	
10 - 14 days later	Anthracnose fruit rot, leaf spots	Same as Petal Fall	
After adults have been observed for 2 - 3 consecutive weeks and every 7 - 10 days during egg laying. Observe harvest restrictions.	Blueberry maggot	2 - 3 pt Guthion 2L, or 1 lb diazinon 50WP per 100 gal, or 0.25 - 0.5 lb Lannate 90SP, or 1.875 - 2.5 lb Sevin 80WSP	4
Immediately after harvest and repeat 6 to 8 weeks later.	Bud mite	2 qt Thiodan 3EC per 300 gal, or 2 gal Superior oil	5
2 weeks, 4 weeks and 3 months after harvest	Leafhoppers	1.25 - 2.5 lb Sevin 50WP, or 0.5 lb Lannate 90SP	

NOTES

1. Do not apply a strobilurin fungicide (Abound, Cabrio) more than twice consecutively before using a non-strobilurin fungicide.

2. Watch for mite buildup when using Sevin.

3. Confirm 2 F is not for control of plum curculio. For control of cranberry fruitworm or cherry fruitworm, apply at initiation of egg laying [approximately 400 Day Degrees (DD) base 50 F] following biofix. Make a second application at 100% petal fall l (usually 7 to 14 days following the first application). Additional applications at 10 to 14 day intervals may be required under high pressure or sustained moth flight.

4. Adults usually appear last week of May, but do not lay eggs until seven to 10 days later.

5. Do not apply Thiodan after buds are well formed.

Phytophthora root rot: Ridomil Gold EC can aid in the control of Phytophthora root rot. The label reads as follows: Established plantings: Apply 1/4 pt/1000 linear ft of row in a 3-ft band over the row before plants start growth in the spring. One additional application

may be made to coincide with periods most favorable for root rot development. New plantings: Apply in 18-inch band over the row at broadcast rate of 3.6 pt/A at or after the time of planting. One additional application should be made to coincide with periods most favorable for root rot development.

Aliette WDG can also be used for Phytophthora control. Aliette is applied at 5 lb product per acre as a foliar spray, beginning at the pink bud stage and repeating every 14 - 21 days, up to 4 applications. Aliette also provides some control of anthracnose fruit rot and Phomopsis twig blight.

Table 3. Restrictions for blueberry pesticides.

Material	Re-entry Interval	Preharvest Interval (days)	Remarks
FUNGICIDES			
Abound	4 hours	0	Do not apply more than 2 consecutive sprays before alternating with a fungicide with a different mode of action, i.e. not with Cabrio. No more than 3 applications per season. Avoid spray drift to apple trees, and do not use spray equipment that has been previously used to apply Abound to spray apple trees.
Aliette	12 hours	0	Do not make more than 4 applications per year. Do not mix with copper compounds, adjuvants, or foliar fertilizers. If applied prior to or after copper compounds, raise the spray pH to 6.0 or above with an alkaline buffer.
Cabrio	24 hours	0	Do not apply more than 2 consecutive sprays before alternating with a fungicide with a different mode of action, i.e. not with Abound. Do not make more than 4 applications of strobilurin fungicides per season.
captan	4 days	0	Do not apply more than 35 lb a.i., e.g. 70 lb of Captan 50WP, per acre per season.
chlorothalonil	12 hours	42	Do not apply after full bloom. Can cause phytotoxicity. See label for restrictions on tank mix partners. Re-treatment interval of no less than 10 days. Maximum use of 9 lb ai per acre per season.
Elevate	12 hours	0	Do not apply more than 6 pounds of product per acre per season.
Ridomil Gold EC	48 hours	--	No time limit. On new plantings, do not apply more than 0.9 gal per acre broadcast during the 12 months before harvest.
ziram	48 hours	*	*Do not apply later than 3 weeks after full bloom.
INSECTICIDES AND MITICIDES			
Diazinon	24 hours	7	Allow 14 days between applications. Do not apply more than 1 lb a.i. per acre per season.
Guthion	48 hours/ 4 days	7	REI is 48 hours for mowing, irrigating, and scouting only; 4 days for all other purposes. Do not make more than 3 applications per crop season. Allow at least 10 days between applications. Application by backpack or hand-wand sprayers is prohibited.
Lannate	48 hours	3	Do not apply more than 3.6 lb a.i. per acre per crop. Do not make more than 4 applications per crop. Do not apply during bloom.
Malathion	12 hours	1	
Confirm	4 hours	14	
Sevin	12 hours	7	Do not apply more than 12.5 lb of Seven 80WSP per acre per crop.
Thiodan	24 hours	*	*Post-harvest applications only. Do not apply after buds are well formed. Do not make more than 2 applications per year.

Blueberry (continued)

Table 4. Effectiveness of fungicides for control of blueberry diseases (0-3 scale).

Fungicide	Anthracnose (Ripe Rot)	Botrytis Blight	Mummy Berry	Phomopsis Twig Blight	Phytophthora Root Rot
Aliette	1	0	0	1	2
Abound	3	1	1	1	0
Cabrio	3	1	1	2	0
captan	2	1	2	2	0
chlorothalonil	1	1	1	--	0
Elevate	0	3	--	0	0
Ridomil	0	0	0	0	3
ziram	1	1	1	2	0

-- = not effective; 1 = slightly effective; 2 = moderately effective; 3 = highly effective.

WEED CONTROL IN BLUEBERRIES

Developing A Weed Management Program: For optimum blueberry production, weed management requires a planned approach. In terms of weed control or management, the floor can be divided into two zones with different weed management objectives. Within the row, the weed management objective is to maintain a strip (minimum width of 4 ft. or 2 ft. on either side of the crop) devoid of vegetation (of both grass and broadleaf weeds) year round. Ideally, for optimum production, the soil should be covered with a layer of organic mulch (6 inches depth) for the benefits of stabilizing soil temperature and moisture in addition to weed suppression. Between the rows and around the perimeter of the planting maintain close-mowed sod. Within the row, season long weed control is achieved by making at least two directed-applications of herbicides per year. In each application, apply a tank-mix combination of a postemergence herbicide (to control existing weeds) with preemergence herbicides (to provide residual control or to slow the re-emergence of weeds). Often a combination of two preemergence herbicides is required to maintain broadspectrum control. For the postemergence herbicide option in this combination it is often desirable to use a non-selective herbicide when both established grass and broadleaf weeds are present. As a result, planning the time of application is very critical as these non-selective postemergence herbicide options can only be applied at certain stages in the blueberry development cycle. One of the two application timings for the tank-mix combination can be applied in the fall to early winter. The second application can be applied in late winter to early spring up to the time of bud break and before new shoot emergence. After this time, no non-selective postemergence herbicide should be applied again until the fall. Additionally, in regards to the preemergence herbicides in these two applications, options should be alternated to avoid the development of weed populations tolerant to a particular herbicide or herbicide combination. Thus, in choosing the most appropriate herbicides consider present weed populations and past weed populations; choose a postemergence herbicide that will control existing vegetation that is safe to the crop given the intended time of application and; choose a preemergence herbicide treatment that will provide residual control of all grass and broadleaf weeds anticipated.

Selecting Herbicides: The following table provides discussion on herbicide options available for use in blueberry production. The table groups the herbicides based on herbicide type and stage of weed control provided. For each herbicide, use directions and precautions are provided to aid in selection and ensure product performance. In addition to this table, refer to the WEED RESPONSE TO HERBICIDES tables at the back of this publication to aid in selecting the most appropriate herbicide combination for control of existing weeds and those weeds that can be anticipated based on field history.

Herbicide Application: To ensure successful herbicide application refer to the SUMMARY OF REQUIREMENTS FOR HERBICIDE APPLICATION table at the back of this publication. This table assists you with a quick reference or check list of all the requirements for successful herbicide application and optimum herbicide performance.

	RATE PER ACRE (Broadcast)		
HERBICIDE	**Active Ingredient (lbs.)**	**Formulation**	**DIRECTIONS AND PRECAUTIONS**
Postemergence Control: Grass Weeds			
Clethodim - SELECT 2EC	0.094 - 0.125	6 - 8 fl. oz.	For postemergence control of annual and perennial grasses. Use low rate for annual grasses up to 6 inches tall. Use high rate for perennial grasses including rhizome johnsongrass and bermudagrass. Repeat application may be required for re-growth of perennial grasses. For repeat applications, make on a minimum of a 14 day interval. For bermudagrass, make first application (high rate) when runners are less than 6 inches and repeat before 6 inches of regrowth occurs. Add crop oil concentrate (containing 80% oils and 15% emulsifier) at 1% volume per volume (or 2 pts. per 25 gallons of water carrier). Can be tank-mixed with certain preemergence herbicides (see label). **Do not apply within one year of harvest**.

WEED CONTROL IN BLUEBERRIES

HERBICIDE	RATE PER ACRE (Broadcast) Active Ingredient (lbs.)	Formulation	DIRECTIONS AND PRECAUTIONS
Fluazifop - FUSILADE DX-2EC	0.25 - 0.375	16 - 24 fl. oz.	For postemergence control of annual and perennial grasses. Use low rate for annual grasses before they exceed 4 inches tall. Use high rate for perennial grasses. Repeat application may be required for re-growth of perennial grasses. For bermudagrass, make first application when runners are 4 to 8 inches long, and repeat when 4 inches of regrowth occurs. Add either crop oil concentrate at 1% volume/volume (or 2 pts. in 25 gallons of water carrier) or non-ionic surfactant (containing 75% active ingredient) at 0.5% volume/volume (or 1 pt. in 25 gallons of water carrier). Can be tank-mixed with certain preemergence herbicides (see label). Do not apply a total of more than 72 fluid ounces of Fusilade DX per acre per season. **Do not apply within one year of harvest**.
Sethoxydim - POAST 1.53EC	0.188 - 0.469	16 - 40 fl. oz.	For postemergence control of annual and perennial grasses. For annual grasses, use low rate before 4 inches in height is reached. For perennial grasses, use high rate and conduct at least one timely retreatment based on regrowth. Add crop oil concentrate at 1% volume/volume (or 2 pts. per 25 gallons of water carrier). Can be tank-mixed with certain preemergence herbicides (see label). Do not apply more than 80 fluid ounces of Poast per acre per season. **Do not apply within 30 days of harvest.**
Postemergence Control: Grass and Broadleaf Weeds			
Paraquat - BOA 2.5SL - GRAMOXONE EXTRA 2.5SL - GRAMOXONE MAX 3SL **Restricted-Use Pesticide**	 0.5 - 1.0 0.5 - 0.94 0.56 - 1.01	 1.6 - 3.2 pts. 1.6 - 3.0 pts. 1.5 - 2.7 pts.	Provides non-selective, contact control (non-systemic) of annual grass and broadleaf weeds and suppression of perennial weeds. Can be applied in fall through to spring but before new cane emergence (do not apply after new cane emergence or injury will result). Apply as a post-directed or shielded spray [low pressure with coarse droplet size (in a minimum of 50 gallons of water carrier per acre)] to avoid crop injury from fine spray mist. Requires the addition of either non-ionic surfactant at 0.25% volume/volume (or 0.5 pts. per 25 gallons of water carrier) or crop oil concentrate at 1.0% volume/volume (or 2 pts. per 25 gallons of water carrier). Can be mixed with certain pre-emergence herbicides for residual control (see label).

WEED CONTROL IN BLUEBERRIES

HERBICIDE	RATE PER ACRE (Broadcast) Active Ingredient (lbs.)	Formulation	DIRECTIONS AND PRECAUTIONS
Glyphosate - ROUNDUP ULTRA 4SL - ROUNDUP ULTRA MAX 5SL - ROUNDUP WEATHER MAX 5.5SL - TOUCHDOWN 3SL*	 1 - 5 1.25 - 5 1.375 - 5 1 - 5	 1 - 5 qts. 1 - 4 qts. 1 - 3.3 qts. 1 - 5 qts.	Provides non-selective, systemic control of annual and perennial grass and broadleaf weeds. Can be applied in spring but before new cane emergence [do not apply after new cane emergence or injury will result and do not apply in the fall (crop must be dormant)]. Has systemic activity, thus, do not allow spray to contact foliage, green bark or any new growth. Apply as a post-directed or shielded application only to the base of the crop. Can be mixed with certain preeemergence herbicides for residual control (see label). * TOUCHDOWN requires addition of non-ionic surfactant at 0.25% volume/ volume (or 0.5 pts. per 25 gallons of water carrier). **Do not apply within 14 days of harvest.**
Preemergence (Residual) Control:			
Dichlobenil - CASORON 4G	 4 - 6	 100 - 150 lbs.	Provides preemergence and limited postemergence activity towards annual and perennial grass and broadleaf weeds. Product is applied as a granular not as a liquid. Use high rate for activity towards existing perennial weeds. Apply in the early winter up to no later than mid-February. Soil temperature needs to be 55°F or less to limit decomposition and volatilization losses. New plantings, do not apply until 4 wks after transplanting.
Napropamide - DEVRINOL 50WDG - DEVRINOL 10G	 4	 8 lbs. 40 lbs.	Provides preemergence control of certain grasses and small seeded broadleaf weeds. Formulations available for a granular or a spray application. Shallow incorporation or irrigation (wet soil 2-4" deep) should be performed if rainfall is not received within 5 to 14 days after application. Ideally, make application in fall through to early spring. Apply to weed-free soil or can be tank-mixed with glyphosate or paraquat. Best results are obtained when application is combined with a second preemeregence herbicide. In establishment year and beyond, can be tank-mixed with oryzalin for improve residual control spectrum. **Can be used during establishment** or in established plantings.
Norflurazon - SOLICAM 80WDG	Soil Texture Course 2 Medium 3 Fine 4	Soil Texture Course 2.5 lbs. Medium 3.75 lbs. Fine 5 lbs.	Provides preemergence control of predominantly annual grasses and certain broadleaf weeds. Can be tank-mixed with certain herbicides including simazine for more complete residual control. Can be tank-mixed with glyphosate or paraquat**.** Apply from fall to early spring when planting is dormant. **Planting must be established for at least six months.**

WEED CONTROL IN BLUEBERRIES

HERBICIDE	RATE PER ACRE (Broadcast) Active Ingredient (lbs.)	Formulation	DIRECTIONS AND PRECAUTIONS
Oryzalin - SURFLAN 4AS	2 - 6	2 - 6 qts.	Provides preemergence control of predominantly annual grasses and certain broadleaf weeds. Use high rate for long-term weed control (6 - 8 months) and low rate for short-term control (2 - 4 months). Can be tank-mixed with certain herbicides including either napropamide or simazine for more complete residual control. Maximum rate is 12 qts. per acre per year with a minimum of 2 ½ months between applications. Can be tank-mixed with glyphosate or paraquat. **Can be applied to first year plantings.**
Propamide - KERB 50WP	1 - 2	2 - 4 lbs.	Provides preemergence and early postemergence control of certain winter annual grass and broadleaf weeds. Apply as a directed spray in late fall or winter when temp. does not exceed 55°F. Can be tank-mixed with certain herbicides including simazine for improved residual control spectrum. Do not apply more than 4 lb of Kerb per acre per year. **Apply only to established plantings.**
Simazine - PRINCEP 4L - PRINCEP 90WDG - SIMAZINE 4L - SIMAZINE 90DF - SIMAZINE 90WDG	2 - 4	2 - 4 qts. 2.2 - 4.4 lbs. 2 - 4 qts. 2.2 - 4.4 lbs. 2.2 - 4.4 lbs.	Provides preemergence control of many annual grass and broadleaf weeds. Apply either the full rate in the spring or a split application of ½ rate in the spring (before bud break) and then again in the fall (after harvest). Can be tank-mixed with certain herbicides including oryzalin or norflurazon for more complete residual control spectrum. Can be tank-mixed with glyphosate or paraquat. Do not apply when fruit is present or illegal residues may result. **On plantings less than 6 months old, use only one-half of the lowest rate.**
Terbacil - SINBAR 80WP	1.6 - 2.4	2 - 3 lbs.	Provides preemergence and early postemergence control of many annual and some perennial grass and broadleaf weeds. Use rate is dependent on soil type and organic matter content (refer to product label). Apply as a directed or shielded spray (avoid contact with foliage). Can be applied in the fall after harvest, through to spring/early summer but prior to fruit set. Can be tank-mixed with glyphosate or paraquat. Do not use on eroded areas where subsoil or roots are exposed. Do not apply to plantings that are under stress. **Planting must be established for at least one year.**

WEED CONTROL IN BLUEBERRIES

Summary of Possible Pre-emergence Treatments: The following lists provides a summary of possible preemergence (or residual) herbicide combinations for improved residual control spectrum listed based on the age of the planting. Please refer to the weed susceptibility table to aid in decision making and the above discussion for use directions and precautions. Note, the addition of a post-emergence herbicide to pre-emergence treatment may needed for application of preemergence or residual herbicides that do not also provide control of existing vegetation.

Planting to Six Months Old	Six to 12 Months Old	One Year or Older
1. DEVRINOL plus - SURFLAN	1. DEVRINOL plus - SURFLAN	1. DEVRINOL plus - SURFLAN
2. PRINCEP (½ rate) plus - SURFLAN	2. PRINCEP plus - SURFLAN or - SOLICAM	2. PRINCEP plus - SURFLAN or - SOLICAM
3. CASORON (wait 4 wks after transplanting)	3. CASORON	3. CASORON
		4. SINBAR
		5. KERB
		6. KERB plus - PRINCEP

GRAPE SPRAY SCHEDULE

Name/Time	Pest	Material and Rate Per Acre	Notes
Dormant (before buds swell)	Scale insects, mites	4 gal Dormant Oil (70 sec.)	1,2
	Anthracnose	10 gal liquid lime sulfur (if needed)	
Bud Break (when new shoots are about 1 inch long)	Black rot, Phomopsis cane and leaf spot, downy mildew	11 fl oz Abound 2F, or 2.0 oz Flint 50WG, or 3.2 oz Sovran 50WG, or 2 lb captan 50WP, or 2 lb mancozeb 80WP, or 2 lb maneb 80WP, or 3 lb ziram 76DF	6,7,8
1st New Shoot Spray (when new shoots are 3-5 inches long)	Grape berry moth, flea beetles, plant bugs, grape phylloxera	2-3 lb Thiodan 50WP, or 3 pt malathion 5 EC, or 1-2 pt Diazinon AG500 (4E), or 2-3 lb Imidan 50-WP, or 1.33-2.12 lb Imidan 70-WP	11
	Black rot, Phomopsis cane and leaf spot, downy mildew	11-15.4 fl oz Abound 2F, or 2.0 oz Flint 50WG, or 3.2-4.8 oz Sovran 50WG, or 3 lb mancozeb 80WP, or 3 lb maneb 80WP, or 3-4 lb ziram 76DF	6,7,8
2nd New Shoot Spray (when new shoots are 8-10 inches long)	Same as 1st New Shoot Spray	Same as 1st New Shoot Spray	
	European red mite	2.5 lb Kelthane 50 WSP, or 1-2.5 lb Vendex 50 WP, or 4.4-6.6 oz Pyramite 60 WP (1-1.5 bags)	
3rd New Shoot Spray/Pre-bloom (just before bloom)	Grape berry moth, rose chafer, flea beetles, leafhopper	3 pt malathion 5 EC, or 1.5-2 lb Guthion 50WP, or 0.5-1 lb Lannate 90SP, or 1-2 pt Diazinon AG500 (4E), or 2-3 lb Imidan 50-WP, or 1.33-2.12 lb Imidan 70-WP	3,4,5
	Grape berry moth	10.67 fl oz Danitol 2.4EC	
	Leafhopper, flea beetles	5.33-10.67 fl oz Danitol 2.4EC	
	Black rot, powdery mildew	2-6 oz Bayleton 50DF, or 4 oz Elite 45DF, or 3-5 oz Nova 40WP	7
	Black rot, Phomopsis cane and leaf spot, downy mildew	2 lb/100 gal ferbam 76WG, or 3-4 lb mancozeb 80WP, or 3-4 lb maneb 80WP, or 2.5 lb Ridomil Gold MZ, or 3-4 lb ziram 76DF	

continued

Grape (continued)

Name/Time	Pest	Material and Rate Per Acre	Notes
3rd New Shoot Spray *continued*	Black rot, Phomopsis cane and leaf spot, downy mildew, powdery mildew	11-15.4 fl oz Abound 2F, or 2.0 oz Flint 50WG, or 3.2-4.8 oz Sovran 50WG	8
Bloom	Botrytis bunch rot	10 oz Vangard 75WG, or 1 lb Elevate 50WG, or 1-2 lb Rovral 50WP	13
Petal Fall (immediately after bloom)	Same as Pre-bloom Spray, plus Japanese beetle, grape rootworm	Same as Pre-bloom Spray	
For grape root borer control, see Note 10.			
Cover Sprays (every 10-14 days until no longer needed. Follow all harvest restrictions.)	Leafhopper, grape berry moth, Japanese beetle, grape root borer	3 pt malathion 5 EC, or 4 lb Sevin 50WP, or 1.5-2 lb Guthion 50WP, or 2-3 lb Imidan 50-WP, or 1.33-2.12 lb Imidan 70-WP	14
	Grape berry moth, Japanese beetle	10.67 fl oz Danitol 2.4EC	
	Leafhopper	5.33-10.67 fl oz Danitol 2.4EC	
	European red mite	2.5 lb Kelthane 50WSP, or 1-2.5 lb Vendex 50WP, 4.4-6.6 oz Pyramite 60 WP (1-1.5 bags)	12
	Two-spotted spider mite	8-16 fl oz Agri-Mek 0.15 EC plus a nonionic surfactant, or 2.5 lb Kelthane 50 WSP, or 1-2.5 lb Vendex 50 WP, or 0.75-1 lb Acramite-50 WS, or 8.8-13.2 oz Pyramite 60 WP (2-3 bags)	
continued	Botrytis bunch rot	10 oz Vangard 75WG, or 1 lb Elevate 50WG, or 1.5-2 lb Rovral 50WP	13

Grape (continued)

Name/Time	Pest	Material and Rate Per Acre	Notes
Cover Sprays *continued* (every 10-14 days until no longer needed. Follow all harvest restrictions.)	Black rot, powdery mildew, downy mildew	Apply one of the following two choices: (1) A strobilurin-type fungicide, applied alone: 11-15.4 fl oz Abound 2F, or 2.0 oz Flint 50WG (do not apply to Concord), or 3.2-4.8 oz Sovran 50WG OR (2) A tank-mix of a multi-site inhibitor* such as: 4 lb captan 50WP, or 3-4 lb ziram 76DF plus a sterol inhibitor: 3-5 oz Nova 40WP, or 2-3 oz Bayleton 50DF, or 4 oz Elite 45DF, or 4-8 oz Procure 50WS, or 6 oz Rubigan 1EC	8 9
Post-Harvest	Downy mildew, powdery mildew	Same as Cover Spray fungicides for downy mildew and powdery mildew.	

* Multi-site inhibitors are fungicides that affect the pathogen at several sites in its metabolic pathway. This feature makes it highly unlikely that a fungal pathogen will develop resistance to any of these products. They may be used alone or in tank mixes with fungicides that are prone to the development of resistance. Multi-site inhibitors include several classes of compounds, and include the products captan, ferbam, ziram, and copper. For additional information, see the Pesticide Classification for Resistance Management section of this publication.

NOTES

1. Do not apply dormant spray if freezing temperatures are expected within 24 hours. Dormant oils have a viscosity of about 70 seconds. Do not substitute crop oil concentrate.

2. Remove old, dead bark before spraying in order to get insects.

3. A clean vineyard will greatly reduce pest problems. Keep weeds and tall grass under control. Remove or cover trash under trellis for at least 15 days before and after bloom.

4. Get pests under control during the early part of the season to avoid having to spray close to harvest. Spray thoroughly. Late sprays can leave objectionable color residues on grapes.

5. Lannate and Guthion are extremely toxic. A total of 3 applications of Guthion 50 WP may be applied per crop season. Allow at least 14 days between applications.

6. For varieties very susceptible to powdery mildew, a fungicide for powdery mildew control (see Table 6) may be needed in the early sprays. If so, choose a fungicide or a tank mix that also provides good black rot control.

7. The early-season sprays are critical for black rot control. Captan can be used during this time, but may not provide adequate control if used alone when black rot becomes very active. Bayleton, Elite, or Nova can be used in the early-season sprays, but should be tank-mixed with captan, mancozeb, or maneb for Phomopsis control.

8. A resistance management program is recommended for the strobilurin fungicides (Abound, Flint, Sovran). Refer to Table 5 and the product label for information. SEE THE ABOUND LABEL REGARDING THE PHYTOTOXICITY OF THIS PRODUCT TO APPLE TREES.

Grape (continued)

9. Including a broad-spectrum fungicide such as Abound, Flint, Sovran, captan, ferbam, ziram, or copper in the cover sprays broadens the range of disease control and helps to discourage fungal resistance to the other fungicides. Do not mix copper fungicides with Nova. Under conditions for severe downy mildew development, higher rates of Flint (4 oz per acre) and Sovran (4-6.4 oz per acre) will be needed for adequate control.

PESTS

10. **Grape root borer:** Mix 4.5 pints of Lorsban 4E with 100 gallons of water and apply 2 quarts of the diluted spray mixture to the soil surface on a 15-square foot area around the base of each vine. Do not allow spray to contact fruit or foliage. Apply before the pest emerges. Do not make more than 1 application per season or apply within 35 days before harvest.

11. **Phylloxera:** Thiodan is the most effective material. Do not use Thiodan on Baco Noir, Baco No. 1, Concord, Seibel 7053 (Chancellor), Colobel, Cascade varieties, as severe injury is likely to occur.

12. **Mites**: Treat when mites first appear and before serious bronzing occurs.

13. **Bunch rot (Botrytis)**: Control needed on certain varieties (especially French hybrids or Vinifera) in rainy weather. Vangard is applied at early bloom and at berry touch, veraison, or preharvest. Rovral and Elevate may be applied at early to midbloom, prior to bunch closing, beginning of ripening, and prior to harvest, if needed.

14. **Japanese beetle**: If using Imidan 50-W or Imidan 70-W, the higher rates are needed for control of Japanese beetle.

Table 5. Restrictions for grape pesticides.

Material	Re-entry Interval	Preharvest Interval (days)	Remarks (Refer to product label for details)
FUNGICIDES			
Abound	4 hours	14	Do not make more than 4 applications per year. Do not make more than 3 consecutive applications before alternating to fungicides with a different mode of action (see Table 9). Avoid spray drift to apple trees, and do not use spray equipment that has been previously used to apply Abound to spray apple trees.
Bayleton	12 hours	14	Do not apply more than 18 oz per acre per year.
captan	4 days	1	Do not apply more than 12 lb a.i., e.g. 24 lb of Captan 50WP, per acre per year.
copper, fixed	24 - 48 hours	0 - 14	Do not use on copper-sensitive varieties. Copper is especially likely to cause injury under cool temperatures and slow drying conditons.
Elevate	4 hours	0	Do not apply more than 3 lb per acre per year.
Elite	12 hours	14	Do not apply more than 2 lb per acre per year.
ferbam	24 hours	7	Do not make more than 3 applications per acre per year.
Flint	12 hour	14	Do not apply to Concord variety. Do not apply more than 8 oz or 4 applications per acre per year. Do not make more than 3 consecutive applications before alternating to fungicides with a different mode of action (see Table 9).
mancozeb, maneb	24 hours	66	Do not apply more than 19.2 lb a.i. per acre per year.
Nova	24 hours	14	Do not apply more than 18 oz per acre per year. Do not mix with copper.
Procure	12 hours	7	Do not apply more than 32 oz per acre per year.
Ridomil Gold MZ	48 hours	66	Do not make more than 4 applications per acre per year.
Ridomil Gold Copper	48 hours	66	Do not make more than 4 applications per acre per year.
Rovral	48 hours	7	Do not make more than 4 applications per acre per year.
Rubigan	12 hours	30	Do not apply more than 19 fl oz per acre per year.

Grape (continued)

Material	Re-entry Interval	Preharvest Interval (days)	Remarks (Refer to product label for details)
Sovran	12 hours	14	Do not make more than 3 consecutive applications before alternating to fungicides with a different mode of action (see Table 9) for at least 2 applications. Do not make more than 4 applications per acre per year.
sulfur	24 hours	0	May cause injury on certain varieties such as Concord and other American types. Do not use if temperatures during or immediately after spraying will exceed 85 F.
Vangard	12 hours	7	Do not apply more than 20 oz per acre per year.
ziram	48 hours	21	Do not apply more than 28 lb per acre per year.
INSECTICIDES AND MITICIDES			
Acramite	5 days or 12 hrs*	14	*Re-entry interval is 5 days for cane turning, tying or girdling, 12 hours for all other tasks, as long as at least long pants, long-sleeved shirts, shoes and socks are worn. Use only one application per harvested crop per year.
Agri-Mek	12 hours	28	Apply when mites first appear, but before motiles exceed 5 per leaf.
Danitol	24 hours	21	Do not exceed 2.67 pt per acre per season. Allow at least 7 days between applications.
Diazinon	24 hours	28	
Guthion	48 hours/ 4 days	10	REI is 48 hours for mowing, irrigating, and scouting only; 4 days for all other purposes. Do not make more than 3 applications per acre per year. Allow at least 14 days between applications. The minimum dosage specified may be applied up to harvest. With higher rates, allow at least 10 days between last application and harvest. Application by backpack or hand-wand sprayers is prohibited.
Imidan	24 hours	14	Incompatible with alkaline materials such as spray lime, lime sulfur and Bordeaux mixture, which will reduce the insecticidal activity of Imidan, as will a spray solution pH of 7 or higher.
Kelthane	48 hours	7	Do not make more than 2 applications per season.
Lannate	7 days	1 (fresh & raisin) 14 (wine grapes)	Do not make more than 5 applications per acre per year. Do not apply more than 4.5 lb a.i. per acre per year.
Malathion	12 hours	3	Injury may occur on Almeria, Cardinal, Italia and Ribier varieties if Malathion 5EC is applied after clusters appear.
Pyramite	12 hours	7	Should be applied when pest populations are beginning to build. Do not make more than 2 applications per year.
Sevin	12 hours	7	Do not make more than 5 applications per acre per year. Allow at least 7 days between applications.
Thiodan	24 hours	7	Do not use on Concord variety. Do not make more than 3 applications per acre per year. Do not exceed a maximum of 3.0 lb a.i. (i.e., 6 lb of Thiodan 50WP) per acre per year.
Vendex	48 hours	28	Do not make more than 2 applications per acre per year. Do not apply more than 4 lb per acre per year. Allow at least 21 days between applications.

Grape (continued)

Table 6. Effectiveness of fungicides for control of grape diseases (0-3 scale)

Fungicide	Black Rot	Bitter Rot	Botrytis Rot	Downy Mildew	Phomopsis Cane and Leaf Spot	Powdery Mildew
Abound	3	--	1	3	2	3
Bayleton	3	0	0	0	0	2
Captan	2	3	1	3	3	0
Elevate	0	0	3	0	0	0
Elite	3	0	0	0	0	3
Ferbam	3	2	0	1	1	0
Flint	3	- -	1	2	1	3
Fixed copper and lime	2	1	1	3	1	2
Mancozeb, maneb	3	3[a]	0	3[a]	3	0
Nova	3	1	0	0	0	3
Procure	2	0	0	0	0	3
Ridomil Gold MZ	3	3[a]	0	3[a]	3	0
Ridomil Gold Copper	1	1	1	3[a]	1	2
Rovral	0	0	3	0	0	0
Rubigan	1	0	0	0	0	3
Sovran	3	- -	1	2	2	3
Sulfur	0	0	0	0	1	3
Vangard	0	0	3	0	0	0
Ziram	3	0	1	3	2	0

[a] The lengthy preharvest interval for this material may result in lower effectiveness against this disease than the rating given.
3=highly effective. 2=moderately effective. 1=slightly effective. 0=not effective. - - =unknown.
Note: The above ratings may be reduced by the label restrictions of a fungicide, such as preharvest interval and number of applications allowed. Degree of control can also be affected by environmental conditions, varietal susceptibility, and resistant strains of the fungus.

WEED CONTROL IN GRAPES

Developing A Weed Management Program: A program approach to weed management is required for optimum grape production (refer to 'Vineyard Floor Management' section in PB1475 'Grape Growing in Tennessee'). In terms of weed control or management, the vineyard floor can be divided into two zones with different weed management objectives. Under the vines, the weed management objective is to maintain a strip (minimum width of 4 ft. or 2 ft. on either side of the vines) devoid of vegetation (of both grass and broadleaf weeds) year round. Then between the rows and around the perimeter of the vineyard maintain close-mowed sod. Under the vines, season-long weed control is achieved by making at least two directed-applications of herbicides per year. In each application, apply a tank-mix combination of a postemergence herbicide (to control existing weeds) with preemergence herbicides (to provide residual control or to slow the re-emergence of weeds). Often a combination of two preemergence herbicides is required to achieve broadspectrum control. For the postemergence herbicide option in this combination it is often desirable to use a non-selective herbicide when both established grass and broadleaf weeds are present. As a result, planning the time of application is very critical as certain non-selective postemergence herbicide options can only be applied at certain stages in the vine development cycle. The ideal program consists of one of the two application timings for the tank-mix combination being the fall to early winter and; the second application applied in late winter to early spring (ideally prior to bud-break) prior to extensive vine growth that may interfere with uniform application. Additionally, in regards to the preemergence herbicides in these two applications, options should be alternated to avoid the development of weed populations tolerant to a particular herbicide or herbicide combination. Thus, in choosing the most appropriate herbicides consider present weed populations and past populations; choose a postemergence herbicide that will control existing vegetation, that is safe to the crop given the intended time of application and; choose a preemergence herbicide treatment that will provide residual control of all grass and broadleaf weeds anticipated.

Selecting Herbicides: The following table provides discussion on herbicide options available for use in grape production. The table groups the herbicides based on herbicide type and stage of weed control provided. For each herbicide, use directions and precautions are provided to aid in selection and ensure product performance. In addition to this table, refer to the WEED RESPONSE TO HERBICIDES tables at the back of this publication to aid in selecting the most appropriate herbicide combination for control of existing weeds and those weeds that can be anticipated based on field history.

Herbicide Application: To ensure successful herbicide application refer to the SUMMARY OF REQUIREMENTS FOR HERBICIDE APPLICATION table at the back of this publication. This table assists you with a quick reference or check list of all the requirements for successful herbicide application and optimum herbicide performance.

	RATE PER ACRE (Broadcast)		
HERBICIDE	**Active Ingredient (lbs.)**	**Formulation**	**DIRECTIONS AND PRECAUTIONS**
Postemergence Control: Grass Weeds			
Clethodim - SELECT 2EC	0.094 - 0.125	6 - 8 fl. oz.	For postemergence control of annual and perennial grasses. Use low rate for annual grasses up to 6 inches tall. Use high rate for perennial grasses including rhizome johnsongrass and bermudagrass. Repeat application may be required for re-growth of perennial grasses. For repeat applications, make on a minimum of a 14 day interval. For bermudagrass, make first application (high rate) when runners are less than 6 inches and repeat before 6 inches of regrowth occurs. Add crop oil concentrate (containing 80% oils and 15% emulsifier) at 1% volume per volume (or 2 pts. per 25 gallons of water carrier). Can be tank-mixed with certain preemergence herbicides (see label). **Do not apply within one year of harvest**.

WEED CONTROL IN GRAPES

HERBICIDE	RATE PER ACRE (Broadcast) Active Ingredient (lbs.)	Formulation	DIRECTIONS AND PRECAUTIONS
Fluazifop - FUSILADE DX-2EC	0.25 - 0.375	16 - 24 fl. oz.	For postemergence control of annual and perennial grasses. Use low rate for annual grasses before they exceed 4 inches tall. Use high rate for perennial grasses. Repeat application may be required for re-growth of perennial grasses. For bermudagrass, make first application when runners are 4 to 8 inches long, and repeat when 4 inches of regrowth occurs. Add either crop oil concentrate at 1% volume/volume (or 2 pts. in 25 gallons of water carrier) or non-ionic surfactant (containing 75% active ingredient) at 0.5% volume/volume (or 1 pt. in 25 gallons of water carrier). Can be tank-mixed with certain preemergence herbicides (see label). Do not apply a total of more than 72 fluid ounces of Fusilade DX per acre per season. **Do not apply within one year of harvest**.
Sethoxydim - POAST 1.5EC	0.188 - 0.469	16 - 40 fl. oz.	For postemergence control of annual and perennial grasses. For annual grasses, use low rate before 4 inches in height is reached. For perennial grasses, use high rate and conduct at least one timely retreatment based on regrowth. Do not apply more than 40 fl. oz. (or 2.5 pts.) acre in a single application and not more than 5 pts. product in a single year. Add crop oil concentrate at 1% volume/volume (or 2 pts. per 25 gallons of water carrier.). Can be tank-mixed with certain premergence herbicides (see label). Do not apply more than 80 fluid ounces of Poast per acre per year. **Do not apply within 50 days of harvest.**
Postemergence Control: Grass and Broadleaf Weeds			
Paraquat - BOA 2.5SL - GRAMOXONE EXTRA 2.5SL - GRAMOXONE MAX 3 SL **Restricted-Use Pesticide**	 0.5 - 1.0 0.5 - 0.94 0.56 - 1.01	 1.6 - 3.2 pts. 1.6 - 3.0 pts. 1.5 - 2.7 pts.	Provides non-selective, contact control (non-systemic) of annual grass and broadleaf weeds and suppression of perennial weeds. Apply as a post-directed or shielded spray [low pressure with coarse droplet size (minimum of 10 gallons of water carrier per acre)] to avoid contact with foliage or bark less than one year old. Repeat application is dependent on regrowth. Can be mixed with certain preemergence herbicides for residual control (see label). Treat when sucker growth is less than 8 inches in length. Late season applications to weeds should be made to avoid contact with desirable foliage. Requires the addition of either non-ionic surfactant at 0.25% volume/volume (or 2 pts. per 25 gallons of water carrier) or crop oil concentrate at 1.0% volume/volume (or 2 pts. per 25 gallons of water carrier).

WEED CONTROL IN GRAPES

HERBICIDE	RATE PER ACRE (Broadcast) Active Ingredient (lbs.)	Formulation	DIRECTIONS AND PRECAUTIONS
Glufosinate - RELY 1SL	0.75 - 1.5	3 - 6 qts.	Provides control of most annuals (grass and broadleaf weeds) and some perennials with suppression of other perennial weeds. Apply as a post-directed or shielded spray to avoid contact with foliage or bark less than one year old. Repeat application is dependent on re-growth. Can be mixed with certain preeemergence herbicides for residual control (see label). No surfactant or crop oil concentrate needed. For spot application, use 1.5 to 4 fl. oz. per gallon of water - spray to wetness but before runoff. For sucker control (less than 12 in. length), apply a split application of approximately 4 wks apart at 4 qts. per acre. Do not apply more than 4.5 gallons (or 18 quarts) per acre in a single season. **Do not apply within 14 days of harvest.**
Glyphosate - ROUNDUP ULTRA 4SL - ROUNDUP ULTRA MAX 5SL - ROUNDUP WEATHER MAX 5.5SL - TOUCHDOWN 3SL *	 1 - 5 1.25 - 5 1.37 - 5 1 - 5	 1 - 5 qts. 1 - 4 qts. 1 - 3.3 qts. 1 - 5 qts.	Provides non-selective, systemic control of annual and perennial grass and broadleaf weeds. Has systemic activity, thus, do not allow spray to contact foliage, green bark or any new growth. Post-directed or shielded application only to the base of the vines. Do not apply in late summer or fall. Use should be limited to a application in late fall, winter or spring prior to bloom. Can be mixed with certain preeemergence herbicides for residual control (see label). * TOUCHDOWN requires the addition of non-ionic surfactant at 0.25% volume/volume (or 0.5 pts. per 25 gallons of water carrier).
Preemergence (Residual) Control:			
Dichlobenil - CASORON 4G	4 - 6	100 - 150 lbs.	Provides preemergence and limited postemergence activity towards annual and perennial grass and broadleaf weeds. Product is applied as a granular not as a liquid. Use high rate for activity towards existing perennial weeds. Apply in winter or early spring (pre-bud break). Soil temperature needs to be 55°F or less to limit decomposition and volatilization losses. **Can be used during establishment** or in established vineyards. In new plantings, do not apply sooner than 4 wks after transplanting.
Napropamide - DEVRINOL 50WDG - DEVRINOL 10G	 4	 8 lbs. 40 lbs.	Provides preemergence control of certain grasses and small seeded broadleaf weeds. Shallow incorporation or irrigation (wet soil 2-4" deep) should be performed if rainfall is not received within 5 to 14 days after application. Ideally, make application in fall through to early spring. Apply to weed free soil or can be tank-mixed with glufosinate, glyphosate or paraquat. In establishment year, spray formulation can be tank-mixed with pendimethalin or oryzalin for improve residual control spectrum. **Can be used during establishment** or in established vineyards. **Do not apply within 35 days of harvest.**

WEED CONTROL IN GRAPES

HERBICIDE	RATE PER ACRE (Broadcast) Active Ingredient (lbs.)	Formulation	DIRECTIONS AND PRECAUTIONS
Diuron	Soil Type	Soil Type	Provides preemergence and limited early postemergence (with addition of surfactant) control of certain annual grass and broadleaf weeds. Can be tank-mixed with certain additional preemergence herbicides including norflurazon or oryzalin for improved residual control. Can be tank-mixed with glufosinate, glyphosate or paraquat. Apply as a directed spray from late winter to early spring (prior to bud break). **Vines must be established for at least three years.**
	Low in clay or organic matter (1 - 2%)	Low in clay or organic matter (1 - 2%)	
- KARMEX 80WDG	1.6 - 4.8	2 - 3 lbs.	
- DIREX 80WDG		2 - 3 lbs.	
- DIREX 4L		1.6 - 2.4 qts.	
	High in clay or organic matter (3% or greater)	High in clay or organic matter (3% or greater)	
- KARMEX 80WDG	4.8 - 9.6	3 - 6 lbs.	
- DIREX 80WDG		3 - 6 lbs.	
- DIREX 4L		2.4 - 4.8 qts.	
Norflurazon	Soil Texture	Soil Texture	Provides preemergence control of predominantly annual grasses and certain broadleaf weeds. Can be tank-mixed with certain herbicides including diuron or simazine for more complete residual control. Can be tank-mixed with glufosinate, glyphosate or paraquat**.** Apply as a directed spray from fall to early spring (prior to bud break). Loss of pigment (whitening) in leaf veins may occur on grapes grown on coarse textured soils when applied within 3 months after bud-break. Do not apply to vine nurseries. **Vines must be established for at least two years prior to application. Do not apply within 60 days of harvest.**
- SOLICAM 80WDG	Course	Course	
	2	2.5 lbs.	
	Medium	Medium	
	3	3.75 lbs.	
	Fine	Fine	
	4	5 lbs.	
Oryzalin			Provides preemergence control of predominantly annual grasses and certain broadleaf weeds. Use high rate for long-term weed control (6 to 8 months) and low rate for short-term control (2 to 4 months). Can be tank-mixed with certain herbicides including either simazine or diuron for more complete residual control. Can be tank-mixed with glufosinate, glyphosate or paraquat. Maximum application is 12 qts. per acre per year with a minimum of 2 ½ months between applications. **Can be applied to first year plantings.**
- SURFLAN 4AS	2 - 6	2 - 6 qts.	
Oxyfluorfen			Provides preemergence control of grass and broadleaf weeds and early postemergence control of certain grass and broadleaf weeds. For post-emergence control of certain weeds less than 4 inches tall add non-ionic surfactant (at 0.25% volume/volume). Use rate dependent on weed size (see label). May be tank-mixed with certain herbicides including napropamide, oryzalin, pendimethalin, pronamide or simazine. Apply as a directed- or shielded- spray. Do not apply more than 2.0 lbs. a.i. /A. in a single year. **Do not apply to vines less than three years old, unless vines are on the trellis wire a minimum of 3 ft above the soil surface. Caution:** Plants must be dormant (prior to bud break).
- GALIGAN 2E	0.5 - 2	2 - 8 pts.	
- GOAL 1.6EC		2.5 - 10 pts.	
- GOAL 2XL		2 - 8 pts.	

WEED CONTROL IN GRAPES

HERBICIDE	RATE PER ACRE (Broadcast) Active Ingredient (lbs.)	Formulation	DIRECTIONS AND PRECAUTIONS
Pendimethalin - PROWL 3.3EC - PENDIMAX 3.3	2 - 4	 2.4 - 4.8 qts. 2.4 - 4.8 qts.	Provides preemergence control of predominantly annual grasses and certain broadleaf weeds. **Can be applied to first year plantings and non-bearing years.** To new plantings with dormant plants, apply after the soil has settled (do not apply to non-dormant plants). To established plantings, apply when dormant (before buds begin to swell). For older vines, do not apply in bearing years. Use high rate for long-term weed control (6 to 8 months) and low rate for short-term control (2 to 4 months). Can be tank-mixed with napropamide or oxyfluorfen for broadspectrum residual control. Can be tank-mixed with glufosinate, glyphosate or paraquat.
Propamide - KERB 50WP	1 - 4	2 - 8 lbs.	Provides preemergence and early postemergence control of certain winter annual grass and broadleaf weeds. Apply as a directed spray in late fall (after harvest) or winter prior to soil freeze up (but, air temperature should not exceed 55°F). Make only one application a year and do not exceed 8.0 pound of Kerb per acre per year. Can be tank-mixed with certain herbicides including simazine for improved residual control spectrum. **Do not apply to fall transplanted vines less than one year old and spring transplanted vines less than 6 months old.**
Simazine - PRINCEP 4L - PRINCEP 90WDG - SIMAZINE 4L - SIMAZINE 90DF - SIMAZINE 90WDG	2 - 4	 2 - 4 qts. 2.2 - 4.4 lbs. 2 - 4 qts. 2.2 - 4.4 lbs. 2.2 - 4.4 lbs.	Provides preemergence control of many annual grass and broadleaf weeds. Apply either the full rate in the spring or a split application of ½ rate in the spring (before bud break) and then again in the fall (after harvest). Can be tank-mixed with certain herbicides including oryzalin or norflurazon for more complete residual control spectrum. Can be tank-mixed with glufosinate, glyphosate or paraquat. **Do not apply to vines less than 3 years old.**

WEED CONTROL IN GRAPES

Summary of Possible Pre-emergence Treatments: The following lists provides a summary of possible preemergence (or residual) herbicide combinations for improved residual control spectrum listed based on the vineyard age. Please refer to the weed susceptibility tables to aid in decision making and the above discussion for use directions and precautions. Note, the addition of a post-emergence herbicide to pre-emergence treatment may be needed for application of preemergence or residual herbicides that do not also provide control of existing vegetation.

Establishment Year	One Year Old	Two Year Old	Three Years Old or More
1. CASORON (wait 4 wks after transplanting)	1. CASORON	1. CASORON	1. CASORON
2. DEVRINOL plus - SURFLAN or - PROWL	2. DEVRINOL plus - SURFLAN or - PROWL	2. DEVRINOL plus - SURFLAN	2. DEVRINOL plus - SURFLAN
	3. GOAL	3. GOAL	3. GOAL
	4. KERB	4. KERB	4. KERB
	5. KERB plus GOAL	5. KERB plus GOAL	5. KERB plus GOAL
	6. GOAL plus - SURFLAN or - PROWL	6. GOAL plus - SURFLAN	6. GOAL plus - SURFLAN
			7. PRINCEP plus - SURFLAN or - SOLICAM
			8. KARMEX plus - SURFLAN or - SOLICAM

STRAWBERRY SPRAY SCHEDULE

Name/Time	Pest	Material and Rate Per Acre	Notes
		SETTING YEAR (MATTED ROW)	
Before setting -- During soil preparation	White grubs, strawberry rootworms, ants, wireworms, strawberry leaf beetle	Methyl bromide plus chloropicrin (various formulations, rate depends on formulation)	8
After setting -- Begin at first warm period, three applications	Strawberry crown borer	2 - 4 lb Sevin 50WP, or 2.5 lb Sevin 80S, or 1 - 2 qt Sevin 4F	5
Spring applications -- Apply at 10-14 day intervals until insects are controlled	Strawberry crown borer, strawberry leafroller	2 - 4 lb Sevin 50WP, or 2.5 lb Sevin 80S, or 1 - 2 qt Sevin 4F	4,5
	Strawberry rootworm	No insecticides are labeled for this pest.	3
	Strawberry leafroller	1.5 - 3 pt malathion 57%EC, or 1 lb Guthion 50WP, or 6.4 - 32 oz Brigade 10WSB	
		HARVEST YEARS (MATTED ROW OR PLASTICULTURE)	
Pre-bloom -- In March during first warm period	Strawberry crown borer, strawberry weevil (clipper), strawberry leafroller	2 - 4 lb Sevin 50WP, or 2.5 lb Sevin 80S, or 1 - 2 qt Sevin 4F	4,5
	Strawberry weevil (clipper)	1 qt Lorsban 4E, or 6.4 - 32 oz Brigade 10WSB	4
	Strawberry leafroller	1.5 - 3 pt malathion 57%EC, or 1 lb Guthion 50WP, or 6.4 - 32 oz Brigade 10WSB	
	Strawberry rootworm (adult beetles)	No insecticides are labeled for this pest.	3
	Catfacing insects (plant bugs, stink bugs)	1.5 - 3 pt malathion 57%EC, or 1.33 qt Thiodan 3 EC, or 10.7 fl oz Danitol 2.4EC, or 6.4 - 32 oz Brigade 10WSB	10
	Leaf spots (if needed)	See Bloom Spray	7

Strawberry (continued)

Name/Time	Pest	Material and Rate Per Acre	Notes
Bloom Every 7-10 days (except where noted) from 5-10% bloom until most petals fallen	Insects	Save the bees! Do not apply insecticides during bloom.	3,4,5
	Botrytis	1.5 lb Elevate 50WG Can be applied at 1.0 lb as a tank mix (See "Botrytis, anthracnose, leaf spots," below, for tank mixes.)	For help with fungicide selection, see Notes 7 & 12 & Table 8.
	Botrytis, anthracnose, leaf spots	6 lb Captan 50WP or 3.4 - 4.4 lb Thiram 75WG or 11-14 oz Switch 62.5WG or a tank mix containing a product from each of the following 2 groups: (1) 3 lb Captan 50WP or 3 lb Thiram 75WG (2) 1.0 lb Elevate 50WG, 1 lb Topsin-M 70WP, 6.2-15.4 fl oz Quadris 2F, or 12-14 oz Cabrio 20EG (limited efficacy data available for Cabrio)	Switch is not for leaf spots.
	Powdery mildew, leaf spots (if needed)	2.5 - 5.0 oz Nova 40W every 14 - 21 days	
	Leather rot, red stele (if needed)	See Notes section for timing of applications.	11
Post-Bloom through Harvest Insecticides: Apply as needed. Follow all harvest restrictions.	Spittlebugs	10.7 fl oz Danitol 2.4EC, or 1.33 qt Thiodan 3EC, or 1.5 - 3 pt malathion 57%EC, or 1 lb Guthion 50WP, or 6.4 - 32 oz Brigade 10WSB	
	Aphids	1.33 qt Thiodan 3EC, or 1.5 - 3 pt malathion 57%EC	
	Two-spotted spider mites	16 - 21.33 fl oz Danitol 2.4EC, or 1 - 2 lb Kelthane 50WSP, or 16 fl oz Agri-Mek 0.15EC, or 16 - 32 oz Brigade 10WSB, or 6 oz Savey 50-WP, or 6 oz Savey 50 DF, or 1.5 - 2 lb Vendex 50 WP, or 0.75 - 1 lb Acramite-50 WS	9
	Cyclamen mites	3 - 4 lb Kelthane 50WSP	
	Slugs	10 lb Sevin 5% Bait, or 5 lb metaldehyde 5% bait	
	Sap beetles	2 - 4 lb Sevin 50WP, or 6.4 - 32 oz Brigade 10WSB, or 16 - 21.33 fl oz Danitol 2.4EC, Keep fruit picked to avoid attracting sap beetles	
	Whiteflies, leafrollers	1.5 - 3 pt malathion 57%EC, or 1 lb Guthion 50WP	

continued

Strawberry (continued)

Name/Time	Pest	Material and Rate Per Acre	Notes
Post-Bloom through Harvest *continued*	Leafrollers	6.4 - 32 oz Brigade 10WSB	
	Flea beetles	2 -4 lb Sevin 50 WP	
	Strawberry rootworm (adult beetles)	No insecticides are labeled for this pest.	3
Fungicides: Apply every 7-10 days, except where noted. Follow all harvest restrictions	Botrytis, anthracnose, leaf spots	Same as Bloom Sprays, or strobilurins may be applied alone.	7,12
	Leather rot, red stele (if needed)	See Notes section for timing of applications.	
	Powdery mildew, leaf spots (if needed)	2.5 - 5.0 oz Nova 40W every 14 - 21 days	11
Post-Harvest (matted row) -- Every 10-14 days, as needed	Root weevils	1.5 - 3 pt malathion 57%EC, or 8 - 32 oz Brigade 10WSB	2
	Leafrollers, strawberry crown borers	1.5 - 3 pt malathion 57%EC, or 2 - 4 lb Sevin 50WP, or 1 lb Guthion 50WP,	
	Strawberry rootworm (adult beetles)	No insecticides are labeled for this pest.	
	Leafrollers	6.4 - 32 oz Brigade 10WSB	
	Leaf spots, anthracnose	3 lb Captan 50WP **PLUS** 0.5 lb Topsin-M 70WP	
	Powdery mildew, leaf spots (if needed)	2.5 - 5.0 oz Nova 40W every 14 - 21 days	

NOTES

PESTS

1. **Spider Mites:** Applications should be made when tiny mites, webbing or bronzing is first noticed. Repeat as needed. Two-spotted mite populations build up on host plants in borders in April and May, then migrate to the planting.

2. **Root Weevils**: In June the black weevils emerge, feed on foliage at night, and in a couple weeks begin depositing eggs near the crowns of the plants. The larvae that enter the soil to feed on roots are white, c-shaped, legless grubs with brown heads. Insecticide treatments should be targeted toward adult weevils soon after emergence to prevent egg laying and migration by their crawling to other plantings.

3. **Strawberry rootworm:** This pest builds up in perennially grown strawberries, not those replanted yearly and grown on plastic mulch. The presence of many small, roundish holes in leaves indicates rootworm adults (small brown beetles with four darker areas on the wing covers). The larvae of the rootworm (small grubs) destroy and tunnel the root system. If a heavy infestation of adults exists, this usually means that the roots are also infested. Preplant soil treatments can prevent buildup. If a heavy infestation exists it is possible to control by continuously controlling adults. Insecticides used for control of other strawberry pests are likely to control this pest as well. Do not apply insecticides during bloom.

4. **Strawberry Weevil (Clipper):** If this pest was a problem last year, make the first insecticide application when buds emerge and a second spray just before bloom. If previous damage from this pest didn't occur, apply insecticides at first sign of damage to

flower buds (buds clipped). Weevils are a sporadic pest usually found around field margins. Do not apply insecticides during bloom. Lorsban 4E pre-bloom only. Do not make more than two applications per season or apply within 21 days before harvest. Phytotoxicity may occur when applied to strawberries experiencing high temperature and drought stress.

5. **Strawberry Crown Borer:** Begin treatments in the spring (April) when adults or numerous holes appear in the leaves. Make two applications at weekly intervals starting when buds first appear. Do not treat during bloom. Lorsban 4E pre-bloom sprays as for strawberry weevil will aid in controlling strawberry crown borer. Make two to three applications of Sevin, Malathion or Guthion at two-week intervals in post-harvest period if there is tunneling damage to the crown by the white, legless, grublike larvae (1/5 inch long) which can stunt or even kill plants. Carbaryl (Sevin) may injure Earlidawn and Sunrise varieties.

6. Slugs: Scatter baits along beds at dusk. Do not contaminate fruit.

7. Diseases

Botrytis gray mold -- Botrytis is present in all plantings. The critical period for control with fungicides is during bloom, but additional applications may be needed during the harvest period. If Botrytis pressure is considered to be low after the bloom period, fungicide selection can shift from products with high Botrytis efficacy to those with good anthracnose efficacy.

Anthracnose -- The fruit rot phase can be very destructive if the weather is warm and rainy during harvest. An intensive spray schedule that includes Switch, captan, thiram, Cabrio, or Quadris is needed during harvest in anthracnose fields. Control of the runner rot phase during the summer in matted row plantings is not very effective.

Angular leaf spot -- Some fields, mostly plasticulture, have experienced this bacterial disease, which causes marketability problems. Fixed copper sprays provide some control if begun early, but their benefit may be offset by the phytotoxicity they can cause.

Phytophthora crown rot -- Also known as vascular collapse, this soil-borne disease has begun appearing in some plasticulture fields. For known infested plantings, apply Ridomil as for red stele (see Note 11).

SPRAY MATERIALS

8. Methyl bromide: Inject 6 to 8 inches below the soil surface, when the soil temperature is 55 F, all plant residue is fully decayed and the soil is at a good workable moisture.

9. **Agri-Mek:** Make two applications seven to 10 days apart when mites first appear. Do not repeat treatment within 21 days of second application. Do not exceed 64 fl oz per acre in a growing season. Three-day pre-harvest interval.

10. Thiodan: When using Thiodan for catfacing insects, do not reapply within 15 days or more than twice within a 35-day period when fruit are present.

11. **Ridomil and Aliette:** Ridomil Gold EC is labeled for control of red stele and leather rot at 1 pt per treated acre. Apply in sufficient water to move the fungicide into the root zone of the plants, or incorporate with 1/2 inch irrigation. Up to 2 applications may be made in the spring. Make the first application after the ground thaws but before bloom. For improved leather rot control, an additional application may be made during fruit set or harvest, but only if an earlier application has been made. For red stele control, apply again in the fall.

    Aliette is applied at 2.5-5 lb per acre as a foliar spray. For red stele control, apply in the spring when plants start active growth. If disease conditions persist or reoccur, make additional applications on 30-60 day intervals. For leather rot control, begin applications between 10% bloom and early fruit set and continue on 7-14 day intervals as long as conditions are favorable for disease development.

12. **Fungicide resistance management**: In planning a fungicide spray schedule, consider that Topsin-M, Elevate, Cabrio, and Quadris can lose their effectiveness against Botrytis due to resistance if they are used too often. Use these materials in a resistance management program: Do not apply Topsin-M alone; always tank-mix with captan or thiram. Elevate can be used alone, but never for more than 2 consecutive applications before alternating to another Botrytis fungicide (Table 8) for 2 applications. The

strobilurins, Cabrio and Quadris, should be followed with a non-strobilurin fungicide after 2 consecutive applications. For more information on this subject, see the section on Pesticide Classification for Resistance Management, in this publication.

Table 7. Restrictions for strawberry pesticides.

Material	Re-entry Interval	Preharvest Interval (days)	Remarks (Refer to product label for details)
FUNGICIDES			
Aliette	12 hours	0	Do not apply more than 30 lb per acre per year. Do not mix with copper. If Aliette is to be applied to foliage with copper residues, raise the spray pH to 6.0 or above with an alkaline buffer.
Benlate	24 hours	1	Do not apply more than 5 lb per acre per year. Use only as a tank mix or in alternation with a labeled non-benzimidazole fungicide, e.g. not with Topsin M. Benlate cannot be used once the crop is turned into a U-Pick operation.
Cabrio	12 hours	0	Do not make more than 5 applications of Cabrio or other strobilurin fungicides per crop. Do not make more than 2 consecutive applications before alternating to fungicides with a different mode of action (see Table 9).
captan	24 hours	0	Do not apply more than 24 lb a.i., e.g. 48 lb of Captan 50WP, per acre per year.
copper, fixed	48 hours	0	Can cause a burn of leaves and a discoloration of berries, especially if applied to ripening berries.
Elevate	4 hours	0	Do not apply more than 6 lb per acre per season. Do not make more than 2 consecutive applications. Use an alternative Botrytis material for 2 consecutive applications before reapplying Elevate.
Nova	24 hours	0	Do not apply more than 30 oz per acre per year. 30-day plant-back interval between last application and planting non-labeled crops.
Quadris	4 hours	0	Do not make more than 4 applications per crop. Do not make more than 2 consecutive applications before alternating to fungicides with a different mode of action (see Table 9). Avoid spray drift to apple trees, and do not use spray equipment that has been previously used to apply Quadris to spray apple trees.
Procure	12 hours	1	Do not apply more than 32 oz per acre per season. 1-year plant-back interval between last application and planting non-labeled crops. Exceptions: Leafy vegetables may be planted after 30 days; root vegetables after 60 days.
Ridomil Gold EC	12 hours	0	Do not apply more than 1.5 qt per acre per year.
Rovral	24 hours	*	* Do not apply after first flower, no more than 1 application per season.
Switch	12 hours	0	Do not exceed 56 oz of product per acre per year. Do not plant rotational crops other than strawberries or onions for 12 months following the last application of Switch.
Thiram	24 hours	3	Has rabbit and deer repellence.
Topsin M	12 hours	1	Do not apply more than 5 lb per acre per year. Use only in as a tank-mix or in alternation with a labeled non-benzimidazole fungicide, e.g. not with Benlate.
sulfur	24 hours	0	Do not use on sulfur-sensitive varieties.
INSECTICIDES AND MITICIDES			
Acramite	12 hours	1	Make no more than one application per harvested crop per year.
Agri-Mek	12 hours	3	Do not repeat treatment within 21 days of second application.
Brigade	12 hours	0	Do not apply more than 80 oz per acre per season.
Danitol	24 hours	2	Apply as pests appear before mite counts exceed 20 per leaflet (eggs + motiles). A second application can be made with a retreatment interval of no less than 30 days. Do not make more than two applications totaling 2.67 pints of Danitol per acre to the same planting in 12 consecutive months.

Material	Re-entry Interval	Preharvest Interval (days)	Remarks (Refer to product label for details)
Guthion	48 hours/ 4 days	5	REI is 48 hours for mowing, irrigating or scouting only; 4 days for all other purposes. Limit of four applications per crop per season. Allow at least five days between applications. Application by backpack or hand wand sprayers is prohibited.
Kelthane	48 hours	3	Do not make more than 2 applications per season.
Lannate	48 hours	3 (fresh) 10 (processing)	Do not apply more than 4.5 lb a.i. per acre per crop. Do not make more than 10 applications per crop.
Lorsban	24 hours	21	For pre-bloom use only. Limit of two applications per season.
Malathion	12 hours	3	Do not combine emulsifiable liquids with wettable powders in the same spray tank unless previous use of the materials being combined has proven them to be physically compatible.
Savey	12 hours	3	Do not make more than one application per year.
Vendex	48 hours	1	Make no more than two applications per season. Apply when mites first appear.
Sevin	12 hours	7	May injure Earlidawn and Sunrise varieties. Apply up to a total of five times but not more often than once every seven days.
Thiodan	24 hours	4	At lower rate, do not repeat application within 15 days or more than twice during a 35 day period when fruit are present. At higher rate, do not apply at intervals less than 35 days when fruit are present. Do not make more than three applications per year.
Vendex	48 hours	1	Apply when mites first appear. Make no more than two applications per season and no more than 4 lb per acre per season.

Table 8. Effectiveness of Fungicides for Control of Strawberry Diseases

Product	Angular Leaf Spot	Anthracnose		Botrytis Gray Mold	Leaf Blight (Phomopsis)	Leaf Spot (Common)	Leather Rot	Phytoph-thora Crown Rot	Powdery Mildew
		Coll. acut.[a]	Coll. gloeo.[a]						
Aliette	0	0	0	0	0	0	+++	?	0
Captan	0	+	+	++	+	++	+	0	0
copper	+	0	0	0	0	+	+	0	0
Elevate	0	0	0	+++[b]	0	0	0	0	0
Nova	0	0	0	0	+++	+++	0	0	++
Quadris	0	++	++	+[b]	++	+++	++	?	++
Procure	0	0	0	0	?	?	0	0	+++
Ridomil	0	0	0	0	0	0	+++	++	0
Switch	0	+++	?	+++	?	0	0	0	0
Thiram	0	+	+	++	+	++	+	0	0
Topsin-M	0	0	+	+++[b]	++	++	0	0	+

+++ = highly effective; ++ = moderately effective; + = somewhat effective; 0 = not effective

[a] *Colletotrichum acutatum* and *Colletotrichum gloeosporioides* (fungal species that cause anthracnose). *C. acutatum* can infect any part of the plant, including the crown. *C. gloeosporioides* primarily infects the crown.

[b] If these fungicides are not used properly, Botrytis can develop resistance to them, reducing their control effectiveness. Refer to Note 12 for information on how to avoid resistance development.

All of these ratings apply to the use of these materials on a regular, preventive schedule begun before the onset of disease.

WEED CONTROL IN STRAWBERRIES

Weed Management in Strawberries: Weed management strategies, including herbicide options, are dependent on the production system. In Tennessee, two production systems are common; one is the traditional system referred to as perennial (or matted-row) production in which the planting is maintained for several years; the second system is referred to as the annual (or plastic-mulched or plasticulture) system in which the planting is established in the fall and fruit is harvested the following spring/early summer after which the planting is terminated. These two production systems are very different in many aspects, and as a result herbicide options are dependent on production system.

Selecting Herbicides: The following table provides discussion on registered herbicide options available for use in strawberry production. The table groups options dependent on production system (either perennial or annual production).

Herbicide Application: To ensure successful herbicide application refer to the SUMMARY OF REQUIREMENTS FOR HERBICIDE APPLICATION table at the back of this publication. This table assists you with a quick reference or check list of all the requirements for successful herbicide application and optimum herbicide performance.

Perennial Production Options

Weed management in the perennial system of production is complicated by the fact that the crop is carried over for several years favoring the development of perennial weeds and the limited herbicide options available. Historically, several herbicide options were registered for use in perennial strawberry production. However, with the decline of perennial production or increasing trend towards switching to the annual system of production, herbicide options for perennial production have become limited. As a result, weed management in perennial production is best achieved by timely treatment with available cultural and herbicide options.

HERBICIDE	RATE PER ACRE (Broadcast) Active Ingredient (lbs.)	Formulation	DIRECTIONS AND PRECAUTIONS
Preplant Options - Preplant Soil Fumigation			
Methyl Bromide/Chloropicrin - MB/C 67/33	Various	Various	In terms of weed control, especially during the establishment phase, preplant soil fumigation with a fumigant product that provides activity towards weeds in addition to other soil borne pests can be very beneficial. Traditionally, the standard has been preplant fumigation with a soil fumigation product that contains both methyl bromide and chloropicrin. Use of methyl bromide is currently being phased out so alternative treatments are currently being considered. Soil fumigation is a specialized procedure requiring further study on choice of products and application procedures which are product dependent. As a result, consult with individuals experienced in their performance and application.
Metam Sodium - VAPAM - VAPAM HL	Various	Various	
1,3-D plus chloropicrin - TELONE C-35 - TRIFORM 35 - TELONE C-17	Various	Various	
Preemergence			
Napropamide - DEVRINOL 50WDG - DEVRINOL 10G - DEVRINOL 2-E	4	8 lbs. 40 lbs. 2 gal.	Provides preemergence control of several annual grass and small-seeded broadleaf weeds. Apply to established plantings after weed removal or before weed emergence. Can be applied essentially anytime except; the interval between bloom and harvest. During renovation, it is best to wait until the fall and apply after sufficent daughter plants have established (as application during daughter plant establishment can delay pegging). Can be applied broadcast over the crop and the row middles. Requires ½ inch rainfall or irrigation within 7 days of application.

WEED CONTROL IN STRAWBERRIES

HERBICIDE	RATE PER ACRE (Broadcast) Active Ingredient (lbs.)	Formulation	DIRECTIONS AND PRECAUTIONS
Terbacil - SINBAR 80WP	0.1 - 0.3	2 - 6 oz.	Provides preemergence control of several grass and broadleaf weeds and provides extended residual control. Can be applied broadcast over the crop and the row middles. Make an initial application no earlier than 6 months after planting, or after postharvest renovation before new growth begins. Application can also be made in late fall for additional control of winter annual weeds. For best control of emerged weeds, weeds should be 1 inch in height or diameter when treated. Do not apply more than 8 oz. per acre per growing season. **Planting must be established for at least 6 months.** Has the potential to cause some level of injury. Do not apply to soils with less than 2% organic matter.
Postemergence - Selective for Established Broadleaf Weeds			
2,4-D Amine - AMINE 4L	1.0 - 1.5	2 - 3 pts.	Provides postemergence control of certain established broadleaf weeds. Apply to well established plantings after harvest or at renovation before mowing or can be applied when the crop is dormant. Timing is critical to avoid damage (do not apply during bud, flower or fruiting stages).
Postemergence- Selective for Established Grass Weeds			
Clethodim - SELECT 2EC	0.09 - 0.12	6 - 8 fl. oz.	For postemergence control of annual and perennial grasses. Use low rate for annual grasses up to 6 inches tall. Use high rate for perennial grasses including rhizome johnsongrass and bermudagrass. Repeat application may be required for re-growth of perennial grasses. For repeat applications, make on a minimum of a 14 day interval. For bermudagrass, make first application (high rate) when runners are less than 6 inches and repeat before 6 inches of regrowth occurs. Add crop oil concentrate (containing 80% oils and 15% emulsifier) at 1% volume per volume (or 2 pts. per 25 gallons of water carrier). **Do not apply within 4 days of harvest.**
Fluazifop - FUSILADE DX-2EC	0.25 - 0.375	16 - 24 fl. oz.	For postemergence control of annual and perennial grasses. Use low rate for annual grasses before they exceed 4 inches tall. Use high rate for perennial grasses. Repeat application may be required for re-growth of perennial grasses. For bermudagrass, make first application when runners are 4 to 8 inches long, and repeat when 4 inches of regrowth occurs. Add either crop oil concentrate at 1% volume/volume (or 2 pts. in 25 gallons of water carrier) or non-ionic surfactant (containing 75% active ingredient) at 0.5% volume/volume (or 1 pt. in 25 gallons of water carrier). Do not apply a total of more than 72 fluid ounces of Fusilade DX per acre per season. **Do not apply within 1 year of the first harvest.**

WEED CONTROL IN STRAWBERRIES

HERBICIDE	RATE PER ACRE (Broadcast) Active Ingredient (lbs.)	Formulation	DIRECTIONS AND PRECAUTIONS
Sethoxydim - POAST 1.5E	0.188 - 0.469	16 - 40 fl. oz.	For postemergence control of annual and perennial grasses. For annual grasses, use low rate before 4 inches in height is reached. For perennial grasses, use high rate and conduct at least one timely retreatment based on regrowth. Add crop oil concentrate at 1% volume/volume (or 2 pts. per 25 gallons of water carrier.). Do not apply more than 40 fl. oz. (or 2.5 pts./acre) in a single application or within a single growing season. **Do not apply within 7 days of harvest.**
Postemergence in Row Middles - Non-selective Control of Grass and Broadleaf Weeds			
Paraquat - BOA 2.5 SL - GRAMOXONE EXTRA 2.5SL - GRAMOXONE MAX 3 SL **Restricted-Use Pesticide**	 0.5 0.47 0.56	 1.6 pts. 1.5 pts. 1.5 pts.	For use only in row middles only. Provides non-selective, contact control (non-systemic) of annual grass and broadleaf weeds and suppression of perennial weeds. To row middles, apply as a post-directed or shielded spray [low pressure with coarse droplet size (in minimum of 20 gallons of water carrier per acre)] to avoid contract with crop (or injury will result). Requires the addition of either non-ionic surfactant (16 to 32 fl. oz. per 100 gallons water carrier) or crop oil concentrate (1 gallon per 100 gallons water carrier). Repeat application is dependent on regrowth. Limited to three applications in a single growing season. Do not graze livestock in treated areas. **Do not apply within 21 days of harvest.**

Summary of Options in Perennial Production: Except for control of established grass weeds, herbicide options in perennial production are limited. As a result, weed management relies on timely treatment with available options. The following provides a summary of the potential herbicide options and application timings.

Renovation	Fall	Winter
- Application of 2,4-D amine immediately after harvest - Around the first week of July, mow plants and cultivate middles (to reduce the width of the row to 15 to 18" inches). Prior to the last cultivation, apply terbacil and cultivate lightly.	In the fall, after sufficent daughter plants have been established, napropamide can be applied.	In the winter when the plants are dormant and before they begin to grow, terbacil can be applied (the plants must be dormant). Napropamide can be applied in the winter to dormant or non-dormant plantings.

WEED CONTROL IN STRAWBERRIES

Annual Production Options

In terms of weed control, the annual production system can be divided into two areas; in the crop row and the row middles. In the crop row, weed control is achieved by controlling problem perennial weeds prior to planting; preplant soil fumigation and the weed suppression provided by the plastic-mulch row cover. Between the rows, weeds can be suppressed with a managed cover crop and the use of preemergence and postemergence herbicides.

HERBICIDE	RATE PER ACRE (Broadcast) Active Ingredient (lbs.)	Formulation	DIRECTIONS AND PRECAUTIONS
Preplant Options - Preplant Soil Fumigation			
Methyl bromide/ chloropicrin - MB/C 67/33	Various	Various	For annual strawberry production, preplant soil fumigation is considered a standard practice. Traditionally, the standard products used contained methyl bromide and chloropicrin which provided weed control in addition to control of other soil borne pests. However, use of methyl bromide is currently being phased out, so alternative treatments are currently being considered. Soil fumigation is a specialized procedure requiring further study on choice of products and application procedures which are product dependent. As a result, consult with individuals experienced in their performance and application.
Metam Sodium - VAPAM - VAPAM HL	Various	Various	
1,3-D plus chloropicrin - TELONE C-35 - TRIFORM C-35 - TELONE C-17	Various	Various	
Preemergence - For Row Middles			
Napropamide - DEVRINOL 50DF - DEVRINOL 10G - DEVRINOL 2-E	2 - 4	4 - 8 lbs. 40 lbs. 2 gal.	Can be applied to the row middles for weed suppression. Provides preemergence control of several annual grass and small-seeded broadleaf weeds. Requires ½ inch rainfall or irrigation within 7 days of application.
Postemergence (non-selective) - For Row Middles			
Paraquat - BOA 2.5SL - GRAMOXONE EXTRA 2.5SL - GRAMOXONE MAX 3 SL **Restricted-Use Pesticide**	 0.5 0.47 0.56	 1.6 pts. 1.5 pts. 1.5 pts.	For use in row middles only. Provides non-selective, contact control (non-systemic) of annual grass and broadleaf weeds and suppression of perennial weeds. To row middles, apply as a post-directed or shielded spray [low pressure with coarse droplet size (in minimum of 20 gallons of water carrier per acre)] to avoid contract with crop (or injury will result). Requires the addition of either non-ionic surfactant (16 to 32 fl. oz. per 100 gallons water carrier) or crop oil concentrate (1 gallon per 100 gallons water carrier). Repeat application is dependent on regrowth. Limited to three applications in a single growing season. Do not graze livestock in treated areas. **Do not apply within 21 days of harvest.**

WEED CONTROL IN STRAWBERRIES

HERBICIDE	RATE PER ACRE (Broadcast) Active Ingredient (lbs.)	Formulation	DIRECTIONS AND PRECAUTIONS
Postemergence - Selective for Grass Weeds			
Clethodim - SELECT 2EC	0.094- 0.125	6 - 8 fl. oz.	For postemergence control of annual and perennial grasses. Use low rate for annual grasses up to 6 inches tall. Use high rate for perennial grasses including rhizome johnsongrass and bermudagrass. Repeat application may be required for re-growth of perennial grasses. For repeat applications, make on a minimum of a 14 day interval. For bermudagrass, make first application (high rate) when runners are less than 6 inches and repeat before 6 inches of regrowth occurs. Add crop oil concentrate (containing 80% oils and 15% emulsifier) at 1% volume per volume (or 2 pts. per 25 gallons of water carrier). **Do not apply within 4 days of harvest.**
Sethoxydim - POAST 1.5E	0.188 - 0.469	16 - 40 fl. oz.	For postemergence control of annual and perennial grasses. For annual grasses, use low rate before 4 inches in height is reached. For perennial grasses, use high rate and conduct at least one timely retreatment based on regrowth. Add crop oil concentrate at 1% volume/volume (or 2 pts. per 25 gallons of water carrier.). Do not apply more than 40 fl. oz. (or 2.5 pts./acre) in a single application or within a single growing season. **Do not apply within 7 days of harvest.**

VERTEBRATE MANAGEMENT

White-tailed deer (*Odocoileus virginianus*)

Deer are attracted to nearly all species of fruit. They are "selective browsers or grazers" and move slowly through the planting feeding on leaves, twigs and fruits or on ground covers. They are frequently seen browsing in early summer, late summer and fall when food is most scarce. The most common damage comes from eating emerging leaves and shoots in spring and summer. In late summer to early winter, fruits and nuts make up a large part of their diet. Deer have no upper incisor teeth. They pinch their food with their lower incisors against a tough pad in their upper jaw and leave ragged edges at the point of detachment. This type of damage is most devastating in young plantings.

Deer are creatures of habit and won't return to a predominantly forest diet once more nutritious plants have been found. While damage from deer browsing is most severe on young plants, significant economic losses can occur on mature ones. The severity of damage varies from slight to extreme depending on population, weather, alternate food sources and tree size. Damage generally varies season to season and year to year.

Their home range tends to be quite limited - often as little as one square mile. Heavy hunting pressure, dogs and seasonal changes in food supply can cause deer to shift their use areas within their home range. Bucks increase their movements slightly in the fall mating season.

Management

Effective management begins by anticipating the extent of possible damage and then responding with appropriate control measures. Consider the severity of deer damage during the previous year and reports of deer density in your area as indicators of potential problems. Compare the cost of control versus the cost of damage. In new plantings, browsing damage may set back the development and subsequent fruiting for several years. In extreme situations, damage may prevent a planting from ever reaching its potential.

Several methods for limiting deer damage might be considered. Each of them, or combinations of them, may prove to be effective. They include:

1) habitat modification. Deer prefer early successional forests that are in the shrub-tree sapling stage. They are also abundant in agricultural areas where field crops and orchards are interspersed with forest habitat. Converting forest areas adjacent to plantings to cropland or pastures may somewhat limit movement of deer into them.

2) hunting. Encourage hunting on your farm. Non-hunted areas may serve as refuges during hunting season. Hunters should be encouraged to harvest doe deer to keep the population in check.

3) shooting. Check with wildlife officers in your area regarding permission to shoot deer out-of-season if they become a problem. Lethal control methods often are temporary in nature.

4) repellents. Repellents vary in their effectiveness. They are affected by population, feeding habits and environmental conditions. They may be effective if damage is light to moderate, if small acreages are involved and if few applications will be needed for adequate control. **Repellents will not work satisfactorily in high-pressure situations.**

Two different types of repellents are available. The first type is an area repellent and includes things such as tankage (putrified meat scraps), ammonium soaps, bone tar oil, blood meal, human hair and bar soap. These repellents should be applied close to or on the plants needing protection. In some cases, putting them on the side of the planting from which the deer enter is effective in keeping deer out. However, it may be necessary to disperse repellents throughout the planting . The other general type is a contact repellent. It works by taste and should be applied directly to plants during the dormant season and on dry days when temperatures are above freezing. Expect some feeding damage when taste repellents are used. Repellents in this category include putrescent egg solids, thiram, and hot pepper sauce. Reapplication is frequently necessary as rainfall will wash the repellents off. When using commercial repellents, always follow label directions.

COMMERCIAL DEER REPELLENTS USED IN FRUIT CROPS

Common Name	Product Name	EPA Registration Number
13.8% Ammonium Soap	Hinder	4-152
	(Application to apples under hot, humid conditions may result in fruit-finish problems such as spray burn ring)	
37% Egg Solids	Rockland Deer Guard	4866-10
20% Thiram	Chew-Not	358-105
11% Thiram, 11% Acrylic Polymers	Bonide Rabbit-Deer Repellent	4-136
2.5% Capsaicin	Hot Sauce Animal Repellent	72-574

NON-COMMERCIAL DEER REPELLENTS

Soap Bars	Drill a 1/4 inch hole through the center of small soap bars. Leave the wrapper on to prevent excessive weathering. Hang the bars away from the trunk on a wire or string and about 30 inches aboveground. Bar soap has no EPA registration. The cost of materials plus the substantial amount of labor involved in putting the soap bars on trees may render this treatment economically impractical.

5) fencing. In areas having a high deer population, fencing may well be the only viable control method. Electric fences offer an effective, less expensive option when compared to conventional fences.

A single strand of high-tensile wire at 30 inches aboveground can be quite effective if it is visible so the deer will "investigate." Treat the wire with a 50/50 mixture of peanut butter and vegetable oil or drape aluminum foil strips with peanut butter on them over the wire to attract deer. Decorating the wire with flagging will further increase effectiveness. Highly visible fences having very conspicuous wire (wire impregnated tape) are visible to deer and are effective without an attractant. Once deer get shocked from the fence, they tend to avoid the area unless they are being chased.

In extreme pressure situations, the Pennsylvania five-wire fence might be justified. It is constructed with five high-tensile strength wires stretched to 250 pounds tension and is charged using a high voltage/low impedance "New Zealand type" energizer. Wires are charged so as to shock deer from wire to wire. Put the lowest wire 10 inches aboveground and space the others 12 inches apart. Baiting the middle wire with peanut butter may increase the effectiveness of the fence. Control weeds along fences to avoid shorting them out.

Individual young trees may be protected from bucks rubbing their antlers against the trunk by setting three fence posts placed one to two feet apart in an equilateral triangle around each tree.

Unelectrified fences for deer exclusion need to be at least eight feet high to be effective. They are much more costly than electric fences.

CALIBRATING HERBICIDE SPRAYERS FOR FRUIT CROPS

Three factors must be known or determined to properly calibrate a sprayer for spraying most fruit crops. These factors are: the width of the band being sprayed, speed of travel and rate of spray delivery.

Width of the band being sprayed is one-half of the total strip to be treated since only one side of the row is being sprayed at a time. Band width may vary from three to four feet on young plants up to six or eight feet or more for large trees.

Speed of travel must remain constant to insure uniform spray application. Tractor speed should be checked with a stop watch or a watch with a sweep second hand to determine exactly how long it takes to travel a given distance. Speedometers or tachometers on tractors should not be relied upon to supply this information. Check tractor speed over terrain similar to where the spraying will actually be done. The relationship between miles per hour and feet per minute is as follows: (1 mph = 88 ft/min).

Speed (mph)	ft/min
2.00	176
2.25	198
2.50	220
2.75	242
3.00	264
3.25	286
3.50	308

Rate of spray delivery is determined by nozzle size, pressure at the nozzle and several other factors. Consult manufacturer's specifications to determine nozzle size and pressure required to obtain the desired spray rate per acre. Actual rate of delivery should be checked by measuring output from the nozzle(s) in a given period of time. With the sprayer running at a constant pressure, check the time needed to collect a gallon of water. The delivery rate (gal./min.) may be calculated by dividing one by the number of minutes necessary to catch a gallon of water. Times required to collect one gallon of water at various delivery rates are as follows:

Delivery Rate (gal/min)	Time to Collect 1 gal
0.40	2 min, 30 sec
0.50	2 min
0.60	1 min, 40 sec
0.70	1 min, 26 sec
0.80	1 min, 15 sec
1.00	1 min
1.20	50 sec
1.60	38 sec
200	30 sec

Decide upon the conditions under which you want to apply the herbicides and then equip and operate the sprayer to meet these conditions. The following example will illustrate this procedure:

Desired rate of application . . . . . 30 gallons per acre
Band width to be sprayed . . . . . 3 feet
Travel speed . . . . . 3 mph (264 ft/min)

Nozzle discharge rate required to meet these conditions is determined below.

1. Determine area sprayed per minute: band width (3 feet) x speed = 792 square feet sprayed per minute.

2. Determine time required to spray one acre of area: 43,560 square feet/acre ÷ area sprayed per minute = 55 minutes to spray one acre.

3. Determine gallons per minute required: gal/acre (30) ÷ minutes/acre (55) = .54 gal/min.

4. Consult manufacturer's guide for nozzle and pressure required (assume that the nozzle wanted is rated to deliver 0.5 gal/min. at 30 psi).

5. Install the nozzle and adjust the pressure to obtain a measured output of 0.5 gal/min.

6. Repeat this procedure for each nozzle of a different size. Collect water from each nozzle of the same size to check for wear and to insure uniform application rates.

7. Mix herbicides required for treating an acre of area in 30 gallons of water.

Before mixing herbicides, determine the amount of spray needed to treat the planting. To do this, calculate what part of the total floor is to be sprayed. If an 8-foot wide strip is to be treated (4 feet each side of the row) where rows are spaced 24 feet apart, then 8/24 (one-third) of the total orchard floor will be treated (one acre will be sprayed for each 3-acre section). If the desired application rate is 30 gallons per acre, then 1/3 X 30 = 10 gallons of spray solution will be needed for each acre. Mix only the amount of spray needed.

SPRAY SOLUTION pH

As a rule, most pesticides work best in a slightly acidic solution. Unfortunately, water used for sprays frequently will be alkaline. This may dramatically shorten the effective half-lives of many pesticides. Acidifying spray solutions may be worthwhile in this case.

Litmus paper may be used to determine the acidity or alkalinity of water or spray solutions. It is not accurate enough to give a true reading of pH. This may be determined with a pH meter. Portable units are available. Buffer solutions should be used to make sure the meter is giving accurate readings. It may also be possible to have samples tested at water treatment facilities.

Commercial products are available to acidify spray solutions. Follow label recommendations to obtain the desired results. Vinegar and granulated, food grade citric acid may also be used. It may be necessary to use a trial and error method to determine rates to be used. Start out using one quart of vinegar per 100 gallons of spray solution or two ounces of citric acid per 100 gallons. Check solution pH and modify the amount of acidifying agent necessary to achieve the desired response.

Do not attempt to acidify solutions containing Bordeaux, fixed copper or other copper compounds.

PESTICIDE CLASSIFICATION FOR RESISTANCE MANAGEMENT

All fruit growers should practice pesticide resistance management, which reduces the chances of pests becoming resistant to the pesticides used. If resistance develops in a pest population to one product of a class of pesticides, then the pest is also resistant to other products in that class. This development causes that group of pesticides to be less effective against that disease or insect.

An important element of resistance management is rotating pesticide classes, which are groups of pesticides that are related to each other. Rotating these classes means not using members of the same class in combination. Instead, members of different classes should be used in tank mixes or consecutive sprays.

Resistance is more of a threat to some types of pesticides than others. The fungicides in the table below are divided into moderate- to high-risk groups and low- to no-risk groups. Rotation of fungicide classes is not necessary for the low-risk types, but is needed for the high-risk types. Fungicides that are at-risk should be either tank-mixed or rotated with members of other classes of fungicides. Rotation is the preferred method for the strobilurin fungicides.

Table 9a. Classification of fruit fungicides.

Class	Products
At Risk for the Development of Resistance	
anilinopyrimidines	Vangard (cyprodinil)
benzimidazoles	Benlate (benomyl) Topsin M (thiophanate methyl)
demethylation inhibitors (DMI's), also known as sterol inhibitors (SI's)	Bayleton (triadimefon) Elite (tebuconazole) Indar (fenbuconazole) Nova (myclobutanil) Orbit, PropiMax (propiconazole) Procure (triflumizole) Rubigan (fenarimol)
dicarboximides	Ronilan (vinclozolin) Rovral (iprodione)
hydroxyanelides	Elevate (fenhexamid)
organophosphates	Aliette (fosetyl-Al)
phenylamides	Ridomil Gold (mefanoxam)
strobilurins	Abound, Quadris (azoxystrobin) Cabrio (pyraclostrobin) Flint (trifloxystrobin) Sovran (kresoxim-methyl)
Low Risk for the Development of Resistance*	
several classes	Captan (captan) Bravo, Equus (chlorothalonil) coppers (various brand names) Carbamate (ferbam) Dithane, Manzate (mancozeb) Maneb, Manex (maneb) Thiram (thiram) Ziram (ziram)

Table 9b. Classification of fruit insecticides and miticides.

Class	Products
biologically based	Agri-Mek (abamectin)
carbamates	Lannate (methomyl) Sevin (carbaryl)
organochlorines	Kelthane (dicofol) Methoxychlor (methoxychlor) Thiodan, Phaser (endosulfan)
oganophosphates	Diazinon (diazinon) Dyfonate (fonofos) Guthion (azinphos-methyl) Imidan (phosmet) Lorsban (chlorpyrifos) Malathion (malathion)
organotins	Vendex (hexakis)
synthetic pyrethroids	Brigade (bifenthrin) Danitol (fenpropathrin)

* These fungicides are multi-site inhibitors, which means that they affect the pathogen at several sites in its metabolic pathway. Because of this, there is little to no risk that a fungal pathogen will develop resistance to any of these products.

Spray Record. Crop _____

Date	Stage of Growth	Chemical Applied	Rate	Total Applied	Wind, Temperature, Rain, etc.

PREEMERGENCE HERBICIDES: WEED RESPONSE IN FRUIT CROPS

Directions: The following table is intended to assist you in selecting the most appropriate preemergence herbicide program based on knowing the site history or knowing what weeds can be anticipated. The following table provides weed response to the various herbicides labeled for use in small fruits. Select the herbicide or herbicide combination that will provide the needed spectrum of control based on site history. Keep in mind that herbicide options are crop dependent (review the section specific for the crop of interest in conjunction with review of this table).
Key to Weed Response Ratings: E = Excellent or 90% control or better; G = Good or 75 - 90% control; F = Fair or 50 - 75% control; P = Poor or control less than 50%; N = No activity; – = Lack of information. For a specific target weed(s), choose an appropriate herbicide or herbicide combination that provides excellent (E) to good control (G). Fair (F) to poor (P) control of additional weeds should be considered as added benefits to control of specific weeds. Ratings are based on application of labeled rates of each herbicide, applied at the optimum timing for each weed.

	Herbicide									
Weed Type and Species	**CASORON**	**DEVRINOL**	**GOAL**	**KARMEX**	**KERB**	**PRINCEP**	**PROWL**	**SINBAR**	**SOLICAM**	**SURFLAN**
Annual grasses										
barnyardgrass	G	G	E	G	G	E	E	G	E	G
crabgrasses	G	E	E	G	G	G	E	G	E	E
fall panicum	G	G	F	F	G	G	E	E	E	G
foxtails	G	E	F	G	G	G	E	G	E	E
goosegrass	G	E	E	G	G	G	E	G	E	E
johnsongrass (seedling)	—	P	F	P	F	P	E	G	G	G
signalgrass, broadleaf	—	G	F	P	F	P	E	G	E	F
Perennial Grasses										
bermudagrass (from seed)	—	P	P	P	P	P	P	F	N	N
dallisgrass (from seed)	—	F	P	P	F	F	P	—	F	—
fescue, tall (from seed)	G	F	P	P	G	F	P	—	F	P
johnsongrass (rhizome)	—	P	P	P	P	P	P	P	N	P
Sedges										
nutsedge, yellow	G	P	P	P	P	P	N	F	F	N
nutsedge, purple	F	P	P	P	P	P	N	P	P	N
Annual Broadleaf Weeds										
nightshades	G	P	E	G	G	G	P	G	G	P
chickweed, common	G	E	E	G	G	E	G	G	G	F
cocklebur	P	P	—	F	P	F	N	—	P	P
galinsoga	P	G	G	G	P	E	P	—	G	P

Weed Type and Species	Herbicide									
	CASORON	DEVRINOL	GOAL	KARMEX	KERB	PRINCEP	PROWL	SINBAR	SOLICAM	SURFLAN
horseweed	G	F	F	—	P	G	P	—	G	G
jimsonweed	P	P	—	G	P	E	P	—	P	P
lambsquarters	G	G	E	E	G	E	G	E	E	G
morninglories (annual)	F	P	P	F	G	F	P	—	P	P
pigweeds	G	G	E	E	P	E	G	G	G	G
prickly sida (teaweed)	—	P	E	F	—	G	N	G	E	P
primrose, evening	G	G	G	G	—	E	F	—	G	P
smartweed	G	G	E	F	G	E	P	G	F	F
ragweed, common	G	G	E	G	—	E	P	G	G	F
wild mustards/radishes	G	F	G	—	G	G	—	P	F	F
Perennial Broadleaf Weeds										
dogfennel	G	—	G	F	—	G	P	G	G	P
garlic, wild (wild onions)	—	N	P	P	—	P	N	G	G	N
horsenettle	—	N	G	F	—	P	N	G	N	N
musk thistle	—	F	P	G	—	E	N	P	G	G
plantains	G	P	P	N	—	G	P	P	G	P

POSTEMERGENCE HERBICIDES: WEED RESPONSE IN FRUIT CROPS

Directions: The following table is intended to assist you in selecting the most appropriate postemergence herbicide best suited to gain control of existing weeds. Keep in mind that herbicide options are crop dependent (review the section specific for the crop of interest in conjunction with review of this table).

Key to Weed Response Ratings: E = Excellent or 90% control or better; G = Good or 75 - 90% control; F = Fair or 50 - 75% control; P = Poor or control less than 50%; N = No activity; – = Lack of information. For a specific target weed(s), choose an appropriate herbicide that provides excellent (E) to good control (G). Fair (F) to poor (P) control of additional minor weeds should be considered as added benefits to control of specific weeds. Ratings are based on application of labeled rates of each herbicide, applied at the optimum timing for each weed.

	Herbicides									
	Non-residual							Residual		
	Grasses Only			Grasses and Broadleaf weeds			Broad-leaf weeds	Certain Grasses and Broadleaf Weeds		
	Systemic			Non-systemic		Systemic		Systemic		
Weed Type and Species	**FUSILADE**	**POAST**	**SELECT**	**BOA GRAMOXONE**	**RELY**	**ROUNDUP TOUCHDOWN**	**2,4-D AMINE**	**CASORON**	**GOAL**	**KERB**
Annual grasses										
barnyardgrass	G	G	G	G	G	G	N	G	E	G
crabgrasses	E	E	E	G	G	G	N	G	E	G
fall panicum	E	E	E	G	E	G	N	G	F	G
foxtails	G	E	E	G	G	G	N	G	F	G
goosegrass	G	E	E	G	G	G	N	G	E	G
johnsongrass (seedling)	E	E	E	G	E	G	N	—	F	—
signalgrass, broadleaf	G	G	G	G	E	G	N	—	F	—
Perennial Grasses										
bermudagrass	G	F	G	P	P	G	N	—	P	—
dallisgrass	G	G	G	P	G	G	N	—	P	—
fescue, tall	E	G	E	P	G	G	N	—	P	G
johnsongrass (rhizome)	F	G	E	P	F	G	N	—	P	—
Sedges										
nutsedge, yellow	N	N	N	F	G	F	F	G	P	N
nutsedge, purple	N	N	N	F	F	F	G	F	P	N
Annual Broadleaf Weeds										
nightshades	N	N	N	G	E	G	E	G	E	—

Weed Type and Species	FUSILADE	POAST	SELECT	BOA GRAMOXONE	RELY	ROUNDUP TOUCHDOWN	2,4-D AMINE	CASORON	GOAL	KERB
chickweed, common	N	N	N	E	E	E	G	G	E	G
cocklebur	N	N	N	E	E	E	G	P	P	N
galinsoga	N	N	N	G	E	E	G	P	G	P
horseweed	N	N	N	G	F	G	G	G	F	—
jimsonweed	N	N	N	G	G	G	E	P	—	N
lambsquarters	N	N	N	E	G	G	E	G	E	G
morninglories (annual)	N	N	N	G	G	F	E	F	P	—
pigweeds	N	N	N	E	F	E	E	G	E	G
prickly sida (teaweed)	N	N	N	G	G	G	E	—	E	—
primrose, evening	N	N	N	F	G	F	G	G	G	—
smartweed	N	N	N	G	E	G	F	G	E	—
ragweed, common	N	N	N	G	E	E	E	G	E	P
wild mustards/radishes	N	N	N	G	E	G	E	G	G	—
Perennial Broadleaf Weeds										
dogfennel	N	N	N	P	—	E	F	G	G	—
garlic, wild (wild onions)	N	N	N	N	G	P	F	—	P	—
horsenettle	N	N	N	P	P	F	P	—	G	—
musk thistle	N	N	N	P	G	E	E	—	P	—
plantains	N	N	N	P	—	E	G	G	P	—

Summary of Requirements for Herbicide Application

Table Directions: This table provides a summary of information for optimum herbicide application and performance. Herbicides are listed in the left hand column, and divided based on preemergence or postemergence option and then listed alphabetically within each group. Across the top, columns list the application requirements for each herbicide.

Key to Codes:

Application Requirements: **GPA** = Gallons of water carrier needed for optimum application; **Additive** = Spray additive needed such as crop oil concentrate or non-ionic surfactant or no spray additive needed; **RF** = Rain-fast (in hrs.); **Stability** = Time herbicide will remain stable prior to rainfall or need for irrigation (in hrs. or days); **Water for Activation** = Amount of rainfall or irrigation needed to activate or stabilize the herbicide in soil; **RET** = residual control or retreatment interval (a range may be given as residual control is rate dependent from lowest to highest use rate); **REI** = Re-entry interval needed for safety; **PHI** = Preharvest interval or minimum time between last possible application and intended harvest time [a range may be given as intervals vary dependent on crop (refer to actual product label for specific interval)].

Codes within Table: NA = Not appropriate; NIS = non-ionic surfactant; COC = crop oil concentrate; N = no spray additive; RGD = Retreatment may be regrowth dependent (refer to use directions and precautions for retreatment crop tolerance and application instructions);
CD = Retreatment is crop dependent (refer to use directions and precautions for specific crops in actual product label) - - = not available.

Herbicide	**GPA** (gallons/acre)	**Additive** (N, COC or NIS)	**RF** (hrs.)	**Stability** (hrs. or days)	**Water for Activation** (inches)	**RET** (days)	**REI** (hrs.)	**PHI** (days)
Preemergence								
CASORON	NA	NA	NA	– –	½ - 1	none given	12	– –
DEVRINOL	20 - 100	NA	NA	24 hrs.	½ - 1 min. or wet soil to 2 - 4 inches	NA or none given	12	none - blueberries 35 - grapes prebloom - strawberries
GOAL	40 - 100	NA	NA	21 - 28 days	1/4 plus	NA or none given	24	none or prior to bud swell
KARMEX	10 plus	NA	NA	14 days	½ - 1	NA or one application per year	12	– –
KERB	20 - 50 (blueberries) 40 - 50 (grapes)	NA	NA	– –	required but no rate given	NA or one application per year	24	– –
PRINCEP	20 plus (grapes) 40 plus (blueberries and brambles)	NA	NA	– –	1/4 - 1	None or single or split application	12	– –
PROWL	10 plus	NA	NA	21 days	1/4 - 1	Single application	24	– –
SINBAR	20 plus (brambles) 25 plus (blueberries) – – (Strawberries)	NA	NA	– –	– –	– –	12	none - blueberries 70 - brambles none - strawberries

Herbicide	**GPA** (gallons/acre)	**Additive** (N, COC or NIS)	**RF** (hrs.)	**Stability** (hrs. or days)	**Water for Activation** (inches)	**RET** (days)	**REI** (hrs.)	**PHI** (days)
SOLICAM	20 plus	NA	NA	28 days	– –	none or single application	12	60
SURFLAN	20 - 40	NA	NA	21 days	½ - 1	2.5 months minimum	24	– –
Postemergence								
FUSILADE	5 - 40	COC or NIS	1	NA	NA	RGD	12	– – or non-bearing
POAST	5 - 20	COC	1	NA	NA	RGD	12	7 - strawberries 30 - brambles 45 - blueberries 50 - grapes
SELECT	5 - 40	COC	1	NA	NA	RGD	24	4 - strawberries or non-bearing all others
BOA GRAMOXONE	50 plus (blueberries and brambles) 10 plus (grapes) 20 plus (strawberries)	COC or NIS	1/2	NA	NA	RGD	12	– – 21 - strawberries
RELY	20 plus	NA	4	NA	NA	RGD	12	14
ROUNDUP	3 - 40	NA	2 - 6	NA	NA	RGD	4	14
TOUCHDOWN	3 - 40	NIS	2 - 6	NA	NA	RGD	4	14
2,4-D AMINE	25 - 50	NA	– –	NA	NA	none or single application	48	– –
CASORON	NA	NA	NA	NA	½ - 1	none or single application	12	NA
GOAL	40 - 100 plus	NIS	– –	21 - 28 days	1/4 plus	CD	24	none or prior to bud swell
KERB	20 - 50 (blueberries) 40 - 50 (grapes)	– –	– –	– –	required but no rate given	none or single application	24	– –