

Brambles

GENERAL INFORMATION

The success of a bramble planting is highly dependent upon its location. The site should have full exposure to sunlight and good air circulation. It should also be somewhat protected, however, as brambles are quite susceptible to winter injury. Temperatures below $-20\frac{1}{2}$ F will injure most fruit buds above the snow line. Colder temperatures, especially if no snow cover is present, can kill canes to the ground, or damage roots, causing plants to die in the early summer when not enough water can be taken in to support them.

The soil should be well-drained; brambles will not tolerate "wet feet." Wet soils encourage the spread of *Phytophthora* root rot which will destroy brambles. Do not plant brambles where potatoes, tomatoes, or eggplant have recently been grown, because these crops carry *Verticillium*, another root rot fungus which can infect brambles. Avoid planting brambles near any wild brambles. Wild raspberries and blackberries harbor insects and virus diseases which will spread to cultivated plants. If possible, destroy all wild brambles within at least 600 feet of your planting.

Always obtain raspberry plants from a reputable nursery which certifies their plants to be virus-free. Raspberries are best planted in the early spring. Plant your rows at least 8 feet apart, preferably 10 to 12 feet apart to ensure adequate air circulation, as well as room for harvesting and pruning operations.

Raspberry plants are shallow-rooted and thus are poor competitors for water and nutrients if weeds are

present. A 3 to 6" layer of mulch will help to conserve soil moisture and inhibit weed growth. Coarse sawdust, wood chips or bark make good mulching materials. Straw, (free from weed seed), or pine needles work well, but need replenishing more frequently. Mulching of raspberry plantings is not without risk. The use of a permanent mulch may delay fruit ripening and plant hardening-off in the autumn, increasing the risk of winter damage.

Proper pruning is a crucial part of pest management for raspberries. Remove old second year canes in the fall and also thin out weak, spindly first year canes. In the early spring, thin out the remaining canes, leaving only those with good height, large cane diameters and no symptoms of winter injury, insect or disease damage. Everbearing varieties (e.g., Heritage) may be completely mowed down each year in early spring before growth starts as pruning practice.

Plant rows should be narrowed to a width of 2 feet or less. When finished, there should be no more than 4 or 5 canes per foot of row remaining. Canes which have been cut should be removed from the planting and destroyed. Pruning in this manner will greatly reduce the incidence of most raspberry cane diseases by increasing air circulation and reducing disease inoculum. Check with your Cooperative Extension office for details of proper varieties and cultural techniques for brambles, or see NRAES 35, Bramble Production Guide available through New England Extension Fruit Specialists. See source page at end of this guide for more information on ordering the Bramble Production Guide.

Table 32. Recommended optimal soil characteristics for growing brambles.

Soil Characteristic	Desirable Range*
pH	5.8-6.2
Organic matter	4 to 6 %
Phosphorus	20-30 ppm
Potassium	120- 180 ppm
	Base Saturation >3.0
Magnesium	100-150 ppm
	Base Saturation >5.0
Calcium	1000 - 1500 ppm
	Base Saturation >50.0

*Desirable range will vary with soil types (sand, silt, or clay), soil organic matter, and pH.

Table 33. Number of bramble plants per acre at different spacings.

Feet between plants in row	Spacing Between Rows		
	8 FEET	10 FEET	12 FEET
2	2,722	2,178	1,815
3	1,815	1,452	1,210
4	1,360	1,090	907
5	1,090	870	726
6	907	726	605
8	680	544	453
10	544	435	362

Table 34. Postplant nitrogen recommendations for brambles.

Year	IRRIGATED			NON-IRRIGATED		
	Sandy	Loamy	Clay	Sandy	Loamy	Clay
FALL-BEARING REDS (NO SUMMER CROPS)						
1	40	30	25	35	30	25
2	80	70	60	70	65	50
3+	120	100	90	90	80	70
SUMMER-BEARING REDS						
1	35	20	25	30	25	25
2	55	50	45	45	40	35
3+	80	70	60	60	50	40
SUMMER-BEARING BLACKS AND PURPLES						
1	30	25	25	25	20	20
2	45	40	35	35	30	25
3+	60	50	45	45	40	30

Note: Rates should be adjusted according to leaf tissue analysis
 Courtesy Cornell University.

Table 35. Critical nutrient values for bramble tissue analysis.

Element	Deficient	Below Normal	Normal	Above Normal	Excessive
N (%)	1.80	2.00	2.50	3.00	>3.00
P (%)	0.23	0.25	0.35	0.40	>0.40
K (%)	1.45	1.50	2.00	2.50	>2.50
Ca (%)	0.57	0.60	1.70	2.50	>2.50
Mg (%)	0.27	0.30	0.70	0.90	>0.90
Mn (ppm)	45	50	150	200	>200
Fe (ppm)	48	50	150	200	>200
Cu (ppm)	6	7	30	50	>50
B (ppm)	28	30	40	50	>50
Zn (ppm)	18	20	35	50	>50

Source: PennState University

DISEASES

Fruit and Foliage Diseases

Botrytis Fruit Rot; Gray Mold (*Botrytis cinerea*): Raspberries are very susceptible to fruit rots caused by fungi, especially during wet weather. To prevent fruit rots from becoming a major problem, encourage air circulation and rapid drying of the plants and fruit by maintaining narrow plant rows, and proper cane thinning. Harvest fruit regularly. Do not allow overripe or rotten fruit to remain on the plants.

Management: Infections can occur as early as bloom, so preventative fungicide sprays should be applied beginning at that time, and followed-up with additional sprays when wet weather is predicted. See pest management schedule for recommended materials and timing. To prevent molds from developing after harvest, cool the fruit as rapidly as possible after picking and maintain them at about 33½F until they are sold. Never place raspberries in containers more than 3 fruit deep, and avoid rough handling.

Powdery Mildew (*Sphaerotheca macularis*): Powdery mildew affects susceptible cultivars of red, black, and purple raspberries. Blackberries and their hybrids are usually not affected. The disease can be severe (varying from year to year) on highly susceptible cultivars, and these plants may be stunted and less productive. The infection of flower buds reduces fruit quantity, and infected fruit may be lower in quality or unmarketable as a result of the unsightly covering of mycelial growth.

Infected leaves develop light green blotches on the upper surface. Generally, the lower surface of the leaf directly beneath these spots becomes covered by white, mycelial growth of the powdery mildew fungus. The leaf spots may appear water-soaked. Infected leaves are often mottled, and if surface growth of the fungus is sparse, they often appear to be infected by a mosaic virus. Infected shoot tips may also become covered with mycelial growth. When severely infected, the shoots become long and spindly (rat-tailed), with dwarfed leaves that are often curled upward at the margins. Infected fruit may also become covered with a white mycelial mat. When the disease is severe, the entire plant may be stunted.

Management: The easiest way to control powdery mildew is to avoid planting susceptible cultivars. If susceptible cultivars are planted, cultural methods to

promote good air circulation around canes will reduce disease severity. Removal of late-formed mildewed suckers in the fall may also delay the start of the disease build-up in the spring. Most fungicides currently registered for use on raspberries are not effective against powdery mildew, nor is chemical control usually warranted.

Cane Diseases

Anthracnose (*Gloeosporium venetum*): Anthracnose is a fungus disease which first appears as purple spots on the young canes. As the disease develops, the spots enlarge and become sunken. Small, white spots may appear on the leaves, and the fruit may develop brown, scabby areas. Individual drupelets become infected, sunken, and light tan in color; fruit has a bitter flavor. On older canes, the lesions will turn gray and cause the bark to split. Although this disease tends to be worse on black and purple raspberries, heavy infestations can cause serious yield losses in red raspberries. Anthracnose spores spread under wet conditions, so it is important to promote drying by ensuring good air circulation. This can be accomplished through careful pruning each year and removing all infected canes.

Management: This disease can be greatly inhibited by encouraging good air circulation, through maintaining narrow plant rows and good pruning and thinning practices. Early spring sprays of lime sulfur on the canes will help prevent early infections. Lime sulfur should be applied before the emerging buds are 1/2" long, or plant damage will result. See pest management schedule for recommended materials and timing.

Spur Blight (*Didymella applanata*): Spur blight is a fungus disease which causes brown or purple blotches to appear on the canes, usually centered around a leaf stem. Symptoms appear on new canes in mid to late summer. On second-year canes, the blotches become gray areas on the bark with tiny black spots on them, which are the fruiting structures of the fungus. Leaves on infected canes may show yellow or brown areas which begin at the mid-vein and spread out to the leaf tip. Infected canes are weakened, and produce fewer fruiting branches than healthy canes.

Management: Similar to anthracnose, this disease can be greatly inhibited by encouraging good air circulation through maintaining narrow plant rows

and good pruning and thinning practices. Applications of lime sulfur to the canes in the early spring before the new buds are 1/2" long will prevent early infection. See pest management schedule for recommended materials and timing.

Cane Blight (*Leptosphaeria coniothyrium*):

Cane blight is caused by a fungus and is characterized by large brown and purple lesions which form on the canes. Unlike spur blight, these lesions are not typically located at a leaf stem and may involve whole stems. Fruiting laterals exhibit weak growth and may wilt and turn brown. This disease is most common on black raspberries.

Management: Control of cane blight is the same as for anthracnose or spur blight.

Root and Crown Diseases

Verticillium Wilt (*Verticillium albo-atrum*):

Verticillium is a root rot fungus which causes the leaves on raspberry canes to yellow, wilt and fall off, progressing from the bottom of the cane to the top. These symptoms may only appear on one side of the plant and are most frequently observed during hot, dry periods. Young canes may show a purple discoloration starting near the soil line and extending upward. Canes eventually die.

Management: Verticillium attacks a wide range of plants, including potatoes, tomatoes, peppers, squash and strawberries. Do not plant raspberries following any of these crops. Non-host crops such as corn or wheat can help eliminate the fungus if grown for at least 2 years before planting raspberries. Many weed species, including pigweed and lamb's-quarters also carry the disease, so good weed control in the raspberry planting is essential. Preplant soil fumigation can help eliminate this fungus, but is quite costly. This disease is most serious on black raspberries.

Phytophthora Root Rot (*Phytophthora fragariae*): The Phytophthora fungus invades the roots of raspberries and disrupts the vascular system, causing infected plants to produce weak, stunted canes, with small, off-color leaves. When dug up, the roots of these plants may look dead. Symptoms are most obvious in the spring, frequently causing this disease to be misdiagnosed as winter injury. In order to spread throughout a planting, the fungus requires flooded soils.

Management: Good soil drainage is critical for preventing this disease. The varieties Latham and Newburgh seem to have some resistance to Phytophthora, while Titan and Hilton are very susceptible. Soil drenches with Ridomil in the spring and fall will provide control of Phytophthora, but should not be considered a substitute for good soil drainage and appropriate variety selection. This is only an emergency measure and it is better to move the planting to a more suitable location. Planting on raised beds helps with this problem and wet feet in general. Mulching new plantings with straw has been observed to increase the likelihood of Phytophthora infection the following spring.

Crown Gall (*Agrobacterium tumefaciens*):

Crown gall is a widespread disease of all brambles caused by a bacterium *Agrobacterium tumefaciens*. The bacteria induce galls or tumors on the roots, crowns, or canes of infected plants. Galls interfere with water and nutrient flow in the plants. Seriously infected plants may become weakened, stunted, and unproductive.

Young galls are rough, spongy, and wart-like. Galls can be formed each season and vary in size from a pinhead to several inches in diameter. They develop near the soil line or underground in the spring. Cane galls occur almost exclusively on fruiting canes and usually appear in late spring or early summer. Both crown and cane galls become hard, brown to black, woody knots as they age. Some disintegrate with time and other may remain for the life of the plant. The tops of infected plants may show no symptoms, but plants with numerous galls may be stunted, produce dry, poorly-developed berries, break easily and fall over, or show various deficiency symptoms due to impaired uptake and transport of nutrients and water.

Management: Control procedures include: (1) planting only nursery stock which is free of any obvious galls on crowns or roots; (2) not planting into a field where crown gall has occurred previously, unless a non-host crop, such as strawberries or most vegetables, is grown for two or more years before replanting; and (3) minimizing injury to root and crown systems during farm operations such as cultivation.

In addition to the above procedures, a nonpathogenic bacterium, *Agrobacterium radiobacter*, strain K-84, is commercially available for biological control of crown gall. The biocontrol agent may be applied to roots of healthy plants when they are first set out. After planting, the control becomes established in the soil around the root zone and prevents crown gall bacte-

rium from entering this region. However, the biocontrol agent will not cure plants which are already infected before its application.

VIRUSES

Several types of viruses infect raspberry plants causing a variety of symptoms, including mosaic yellow patterning of the leaves, leaf curl and/or crinkle, cane dwarfing and crumbly berries. Once a plant becomes infected with a virus, it cannot be cured. All infected plants, including the roots, should be removed from the planting and destroyed. Viruses are typically spread by aphids, but in some cases (e.g., crumbly

berry) nematodes may be responsible. When these creatures feed on infected plants they can take in the virus and then spread it to other plants. In order to prevent the spread of viruses, start with certified, virus-free planting stock. Plant your raspberries away from any wild brambles which may be harboring viruses that could be spread to your plants. A distance of at least 600 feet between cultivated raspberries and any wild brambles is recommended. Controlling the insects which spread these disease is usually not a practical method of preventing infection. However, some raspberry varieties are resistant to aphid feeding and are thus somewhat protected. These varieties include Canby and Titan.

Table 36. Relative hardiness and disease resistance for red raspberry varieties recommended for New England.

Variety	HD	SB	AN	VR	PH	Comments
Algonquin	F	R	U	R	F	Spineless canes, upright growth; med. size fruit, good quality.
Autumn Bliss	F	U	U	F	F	Everbearing; vigorous plants; med. to large fruit, good quality.
Autumn Britain	G	U	U	U	G	Everbearing, vigorous plants, med. to large fruit, good quality.
Boyne	E	F	S	U	F	Early ripening; small dark fruit, good quality; most reliably hardy.
Festival	G	R	U	R	U	Midseason; short plants; med. size fruit, good quality; very susceptible to leaf rust.
Heritage	F	U	U	S	S	Everbearing; second crop late; vigorous plants; med. to large fruit, good quality.
K81-6	G	R	R	S	S	Tall, vigorous canes; late season, large fruit, good quality.
Killarney	E	F	S	U	F	Early ripening; med. size fruit, good quality and yield.
Latham	G	S	S	F	U	Midseason; med. size fruit, crumbly, fair quality.
Lauren	F	U	U	F	U	Large fruit, productive, early season.
Newburgh	G	F	F	U	F	Midseason; med. size fruit, yields and quality fair.
Nova	G	R	R	R	U	Midseason; vigorous plants; med. size fruit, good quality.
NY 7	G	U	U	U	F	Spineless canes, vigorous; large, firm fruit, extended harvest season.
NY 1009	G	U	U	U	U	Everbearing, but use for very early summer crop. Large, firm fruit.
Reveille	U	U	U	U	U	Early to midseason; med. to large fruit, good flavor but soft.
Taylor	F	S	S	S	S	Mid to late season; vigorous plants, med. to large fruit, excellent quality.

HD: Hardiness; SB: Spur blight; AN: Anthracnose; VR: Viruses; PH: Phytophthora

E= excellent G= good F= fair R=resistant S= susceptible U= unknown

INSECTS

Fruit and Foliage Insect Pests

Raspberry Fruitworm (*Byturus rubi*): The raspberry fruitworm is a small (1/4") brown beetle which feeds on the flower buds and leaves of raspberry plants during the spring and early summer. Female beetles lay eggs on the flowers and green fruit. The grubs that emerge are yellowish white, and feed on the fruit, attaining about 3/8" in length. Many of the flowers and fruit can be destroyed by this insect, and the larvae may end up in the harvested fruit, greatly reducing customer appeal.

Management: There is some evidence suggesting that this insect is more of a problem in weedy plantings. If early damage is noted, (e.g., small holes chewed in flower buds and skeletonizing of leaves), cover sprays should be applied prior to bloom. Adults (beetles) tend to be most active and noticeable on plants in the early evening hours. See pest management schedule for recommended materials and timing.

Tarnished Plant Bug (*Lygus lineolaris*): The tarnished plant bug (TPB) is a small (1/4") bronze-colored insect with a triangular marking on its back. The immature stage, or nymph, is smaller and bright green, resembling an aphid, but much more active. Both adults and nymphs feed on the developing flowers and fruit, sucking out plant juices with straw-like mouthparts. This results in deformed fruit, with a few to many drupelets not enlarging, depending on the severity of the damage. Such fruit tend to crumble easily, and are generally unmarketable.

Management: Controlling weeds in and around the planting may reduce populations of this insect, but insecticide sprays may be necessary, applied prebloom and repeated after petal fall. If mowing around fields, do so after insecticides have been applied (to control migrating insects). Avoid planting alfalfa (which attracts high populations of TPB) near raspberries. White sticky traps are available for monitoring tarnished plant bug adults. These traps are used as an indication of when plant bugs begin their activity in the spring and a relative indication of their abundance, not as an indication of when to control this insect. Immature TPB (nymphs) are sampled by shaking flower trusses over a flat white surface. Thirty flower clusters should be sampled evenly from across the field (typically 6 clusters at 5 locations or 5 clusters at 6

locations). If 4 or more flower clusters are infested with nymphs (regardless of how many) a spray is recommended. A follow-up spray application may be made after bloom if TPB are still present in high numbers (check harvest interval before selecting material). See pest management schedule for recommended materials and timing. Do not apply insecticides during bloom.

Strawberry Bud Weevil (*Anthonomus signatus*): The strawberry bud weevil or "clipper" is an important pest of strawberries, but will also attack raspberries. This insect is a very small beetle (1/8") with a copper-colored body and a black head with a long snout. The female weevil chews a small hole in unopened flower buds and lays an egg in the hole. She then girdles the stem just below the bud. The flower bud dries and dangles from the stem, eventually falling to the ground. The immature weevils, or grubs, develop in the girdled buds, emerging as adults in the early summer, and the migrating to wooded areas. These insects are not always present and may only cause minimal damage in raspberries.

Management: Examine the plants before bloom, and look for dead or clipped-off buds. Insecticides which are applied prebloom for control of raspberry fruitworm may also control this insect. See pest management schedule for recommended materials and timing.

Two-Spotted Spider Mites (*Tetranychus urticae*): Spider mites are very small (1/50"), insect-like creatures that feed on raspberry foliage, sucking out plant juices and causing a white stippling or bronzing of the leaves. Under heavy infestations, leaves will turn brown and be covered in a fine webbing. Adults may also move onto the fruit, reducing consumer appeal by their presence. There is currently little available for chemical control of this pest. Foliar sprays of diazinon may suppress populations of spider mites, but this chemical may also reduce populations of natural predators which feed on the spider mites.

Management: There have been some reports that soaking sprays of water applied at relatively high pressure may temporarily suppress mite populations. Several companies now commercially produce predatory mites which feed on spider mites. These predators can be released in raspberry plantings and may provide some control of spider mites, but research is needed to determine appropriate release rates and timing. It is important, however to encourage natural enemies of

spider mites by reducing the use of pesticides which harm natural enemies, such as benomyl. See source list at end of this guide for predatory mites.

Aphids: Aphids are small, pear-shaped, soft bodied insects which feed on plant sap with straw-like sucking mouthparts. Several species of aphids ranging from 1/16" to 1/8" in size, and dull yellow to bright green in color feed on raspberries. Most are wingless and slow moving. These insects tend to congregate on the underside of leaves, where their feeding causes the leaves to curl downward and be deformed. The most damaging aspect of aphid feeding is the spread of viruses. Aphids will take in a virus from infected plants, and later inject it into healthy plants. The virus then spreads throughout the plant, resulting in symptoms such as mosaic, leaf curl or stunting.

Management: To reduce the incidence of aphids and viruses, start with certified virus-free plants; eliminate all wild brambles from within 600 feet of the planting; apply insecticides when aphids are first noted in a planting; and rogue out all plants which exhibit virus symptoms. See pest management schedule for recommended materials and timing. The varieties Canby and Titan are resistant to aphid feeding.

Japanese Beetles (*Popillia japonica*): Japanese beetles are about 1/2" long and copper-colored, with metallic green markings. They feed on raspberry foliage, skeletonizing the leaves during the mid and late summer. The larvae, or grubs, live in the soil, feeding on roots of grasses.

Management: The beetles can be controlled with sprays of carbaryl or malathion. Traps are also available which use a sex and/or feeding attractant to capture the bugs in a can or plastic bag, but such traps may not provide adequate control. Place traps near, but not in the planting. Traps placed within a planting may cause localized damage from beetles which are attracted to, but don't fall into the trap.

Yellowjackets: Yellowjackets, sometimes called hornets or wasps, are large, up to one inch or more, black and yellow stinging insects. Their closely related cousins are black and white and are known as whitejackets and bald-faced hornets. Both groups of these insects are very aggressive and will sting with little provocation.

There are several species of this group of wasps found in the Northeast. Depending on the species, the yellow jacket builds its nest underground or in hollow/

rotten logs or builds a large paper nest in trees or on houses. The workers scavenge food, often meat such as insects or pieces of flesh from dead animals. However, yellowjackets also have a great fondness for ripe or injured fruit. These insects can be found on pears, apples, raspberries, etc., using these fruit for sugar and moisture which, like the meat, is taken back to the nest to feed the larvae.

This fondness for fruit makes this insect a severe nuisance pest in raspberries. They are a danger and annoyance to pickers. Pickers frequently refuse to harvest when yellowjackets are present, thus allowing the crop to get overripe and attracting more wasps. To help discourage the yellowjacket from feeding on raspberries, be sure to harvest berries as soon as they begin to ripen, even though there may be only a few early berries. Once the yellowjackets have discovered the berries, it is almost impossible to discourage them.

Management: Insecticide sprays for control of yellowjackets are not effective or recommended unless you know where a nest is and can eradicate it with a household hornet spray. This is best done in the evening when most of the members of the colony are in the nest. Yellowjackets can be discouraged by sanitation, which is regular and thorough, picking of all berries as soon as they begin to ripen, and frequent removal of overripe fruit and fruit debris.

Traps may be put up around the perimeter of the planting before the berries begin to ripen. There are many yellowjacket traps on the market, and various baits (fish, meat, jam, honey, beer, yeast, etc.) have been used with some success. Our (eastern) species of yellowjackets do not respond to trapping as well as western species. Different baits and traps may have to be tried to determine if any traps/baits will work in a particular raspberry planting. Some plantings may be infested with species of yellowjackets that do not respond to any of the commercially available traps. Fish traps, made with a fish suspended over a tub of soapy water, can be effective against all species. If traps are to be used, the key to success is to get the traps out early. Once yellowjackets have found the ripened fruit, the traps will probably not be of much help.

Cane Insect Pests

Cane Borers: Raspberries are attacked by two types of cane borers. The raspberry cane borer is a 1/2" long, slender black beetle with an orange band just below the head and has long antennae. The female

beetles girdle the tips of young raspberry canes by chewing two rings, about a half inch apart, around the stems about 3 to 6" below the top. An egg is inserted into the cane between the two girdled rings. When the larvae, or grubs, emerge, they feed inside the cane, tunneling downward, and eventually destroying the cane. Soon after the cane tips are girdled, they wilt, blacken, and may fall off.

Management: As soon as the wilted tips are noticed, they should be cut off, several inches below the lowest girdle mark. Remove the infested tips from the field and destroy them. Also eliminate any wild brambles near the field which may be harboring this pest.

The red necked cane borer is 1/4" long, slender, black with a "coppery" neck. Unlike the raspberry cane borer, it has short antennae. The red necked cane borer also causes a different sort of damage. The females insert an egg into young canes, usually within 10" of the base of the cane. They do not girdle the cane, but the presence of the egg, and later the grub, causes a swelling in the cane which can vary in length from 1/2" to nearly 3". These canes become weakened and

may break off.

Root and Crown Insect Pests

Raspberry Crown Borer (*Bembica marginata*): The adult phase of raspberry crown borer is an attractive clear-winged moth which resembles a wasp. These moths lay eggs on the underside of raspberry leaves in late July and August. When the eggs hatch, the young larvae crawl down the cane and into the soil to overwinter. The following spring, they bore into the base of the raspberry canes and feed on the plant tissue. This feeding interrupts the flow of water and nutrients to the cane, causing them to wilt and become weak and spindly. Early symptoms may include browning of the leaf margins on new canes. Eventually, the entire crown may die.

Management: If this insect is noticed in the field, it can be controlled by drenching around the base of the plants with diazinon in the spring before bud break, or with Sniper™ before harvest. Elimination of all wild brambles in the area can also reduce local populations of this pest.

Table 37. Bramble pest management schedule†.

Early spring, prior to bud swell			
Pest	Spray Material, Rate/A (pre-harvest interval)	Cultural Practices and Scouting Notes	Comments
Phytophthora root rot	Ridomil Gold EC, 1/4 pt/1000 linear ft. (45)	Plant only in well-drained soils.	Apply Ridomil in 3 ft wide band over the row in early fall; repeat in early spring before growth begins.
	Ridomil Gold GR, 5 lb/1000 linear ft. (45)	Planting on raised beds also significantly reduces Phytophthora incidence.	Apply Aliette in sufficient water to thoroughly wet the foliage.
	Aliette WDG, 5 lb (60)	Cultivars Latham and Newburgh appear to be somewhat resistant.	Begin foliar sprays in the spring after bud break and continue spraying on a 45-60 day schedule up to a maximum of 4 sprays during the growing season.
Crown borers	Diazinon AG500, 2 qt (7) °Sniper 2E, 4 - 8 (14)t		Apply Diazinon as heavy drench to base of canes before bud break.
			Apply Sniper as heavy drench before harvest.
Early spring to bud swell			
Anthracnose	Lime sulfur, 10-20 gal (0) or	Prune out all canes which have fruited, thin remaining canes to only 3 to 4 per foot of row.	DO NOT apply after buds are 1/2 inch long or plant damage will result.
Spur blight	Copper hydroxide 50WP, 4 lb (0)	Plant rows should be no wider than 2 feet. Remove and destroy all prunings and diseased canes.	
Cane blight	Check registration in your state		

Table 37 continued. Bramble pest management schedule[†].

New cane emergence			
Pest	Spray Material, Rate/A (pre-harvest interval)	Cultural Practices and Scouting Notes	Comments
Anthracnose	Benlate 50WP, 12 oz (3)		Apply when new canes are 6-8 inches tall, repeat when canes are 12-15 inches tall.
Spur blight			Benlate: The current Benlate label specifically states that Benlate is "not for use in home plantings nor once any commercial crop is turned into U-pick, Pick Your Own, or similar operation." Consult with your state's pesticide office for the relevant interpretation of this restriction.
Pre-bloom to initiation of bloom			
Raspberry fruit worm	Diazinon AG500, 1qt (7) Pyrellin EC, 1 – 2 pt (0)	Keep planting free of weeds.	Apply to foliage when blossom buds separate and again when blossoms just begin to open. Do not spray insecticides during bloom.
Tarnished plant bug	Sevin 50W, 3-4 lb (7) Pyrenone Crop Spray 0.5EC, 2-12 oz (0)	Keep planting free of weeds. See description of sampling procedures in the description of TPB in the text. Adults migrate to fruit when adjacent fields are mowed.	Apply pre-bloom if adults found in planting, but avoid insecticide sprays during bloom. Apply sprays in evening.
Strawberry bud weevil	Methoxychlor 2E 2-3 qt (14) Pyrenone Crop Spray 0.5EC, 2-12 oz (0)	Scout planting for live adult weevils or clipped buds, especially at edges near woods and hedgerows.	Spraying late in the day may be more effective than morning sprays.
Cane borers	Methoxychlor 2E , 2-3 qt (14)*	Cut off infested tips below girdle marks, remove canes showing swellings.	*Cultural practices are the most important control measures. If an outbreak occurs, direct insecticide spray at lower foliage of canes. Keep insecticide off blooms and fruiting shoots.
Japanese beetle	Sevin XLR Plus, 1-2 pt (7) Cythion 8E, 2 pt (1) Malathion 57EC, 1.5 pt (1) Pyrenone Crop Spray 0.5EC, 2-12 oz (0)	Traps may reduce populations. Place traps at least 50 feet away from planting.	Apply spray only if beetles are present. Check labels for specific restrictions.
Aphids	Cythion 8E, 2 pt (1) Guthion Solupak, 5/8 - 1 lb (14) Malathion 57EC, 3 pt (1) °Sniper 2E, 1 1/4 - 2 pt (14) Pyrenone Crop Spray 0.5EC, 2-12 oz (0)	Lady bird beetles can devour great numbers of aphids. These beneficial insects should be conserved by using insecticides only when necessary and by using recommended rates. Contact your local Extension Specialist or call (916) 324-4100 for a copy of Suppliers of Beneficial Organisms in North America, an excellent sourcebook for natural enemies such as predatory mites. Also available via the Internet at http://www.cdpr.ca.gov/docs/ipminov/bensuppl.htm	
		Guthion has 48 hr REI for mowing, irrigating, and scouting; and 4 day REI for all other activities.	

Bloom—do not apply insecticides during bloom

Pest	Spray Material, Rate/A (pre-harvest interval)	Cultural Practices and Scouting Notes	Comments
Botrytis fruit rot (gray mold)	Benlate 50WP, 12 oz (3) Rovral 50WP, 1-2 lb (0) Ronilan 50WP, 1-2 lb (9)	Space rows at least 8 feet apart, prune canes to a density of 3 to 4 canes per sq. ft. to improve air circulation.	Apply at 5% bloom and again at full bloom. Repeat application only if weather is wet. Overuse of these materials may result in the development of resistance in the fungus. Benomyl may be detrimental to predatory mite populations. Benlate: The current Benlate label specifically states that Benlate is “not for use in home plantings nor once any commercial crop is turned into U-pick, Pick Your Own, or similar operation.” Consult with your state’s pesticide office for the relevant interpretation of this restriction.
Fruiting			
Tarnished plant bug	Same as pre-bloom application	See above	See above
Sap beetles	Cythion 5E, 1.5 - 2 pt (1)* Malathion 57 EC, 1.5 - 2 pt, (1)* Pyrenone Crop Spray 0.5EC, 2-12 oz (0)	Keep planting clean of over-ripe fruit	*Labeled for raspberry only, not other bramble fruit.
Two-spotted spider mite	Diazinon 50WP, 2 lb (7) Cythion 8E, 2 pt (1) Malathion 57 EC, 1.5 pt, (1)	Predatory mites may help. Avoid use of pesticides such as Benomyl or Sevin which will kill natural enemies of mites.	Unfortunately no miticides, as such, are labeled for use in raspberries. Alternatives may prove as effective. Contact your local Extension Specialist or call (916) 324-4100 for a copy of Suppliers of Beneficial Organisms in North America, an excellent sourcebook for natural enemies such as predatory mites. Also available via the Internet at http://www.cdpr.ca.gov/docs/ipminov/bensuppl.htm
Botrytis fruit rot	Same as bloom application	See above	See above. Check labels for harvest restrictions.
Post harvest and thereafter			
Phytophthora root rot	Ridomil Gold EC, 1/4 pt/1000 linear ft. (45) Ridomil Gold GR, 5 lb/1000 linear ft. (45) Aliette WDG, 5 lb (60)	Plant only in well-drained soils. Planting on raised beds also significantly reduces Phytophthora incidence. Cultivars Latham and Newburgh appear to be somewhat resistant.	Apply Ridomil in 3 ft wide band over the row in early fall; repeat in early spring before growth begins. Apply Aliette in sufficient water to thoroughly wet the foliage. Begin foliar sprays in the spring after bud break and continue spraying on a 45-60 day schedule up to a maximum of 4 sprays during the growing season.

Table 37 continued. Bramble pest management schedule[†].

New cane emergence			
Pest	Spray Material, Rate/A (pre-harvest interval)	Cultural Practices and Scouting Notes	Comments
Powdery mildew	Benlate 50WP, 3/4 lb (3) Microthiol Special (sulfur), 6-15 lb (0) Kumulus DF (sulfur), 6 – 12 lb (0)		Apply spray at 2-4 week intervals when mildew first appears. Apply each week from first bloom to fruit-set. Repeat as weather requires. Benlate: The current Benlate label specifically states that Benlate is “not for use in home plantings nor once any commercial crop is turned into U-pick, Pick Your Own, or similar operation.” Consult with your state’s pesticide office for the relevant interpretation of this restriction.
Japanese beetle	Same as under pre-bloom above		
Two-spotted spider mites	Same as under fruiting above	Contact your local Extension Specialist or call (916) 324-4100 for a copy of Suppliers of Beneficial Organisms in North America, an excellent sourcebook for natural enemies such as predatory mites. Also available via the Internet at http://www.cdpr.ca.gov/docs/ipminov/bensuppl.htm	

[†]Where brand names for chemicals are used, it is for the reader’s information. No endorsement is implied, nor is discrimination intended against products with similar ingredients. Please consult pesticide product labels for rates, application instructions and safety precautions. Users of these products assume all associated risks.

[°]Restricted use pesticide.

Table 38. Fall bearing (primocane fruiting) bramble pest management schedule[†].

When canes are approximately 18 inches tall			
Pest	Spray Material, Rate/A (pre-harvest interval)	Cultural Practices and Scouting Notes	Comments
Cane borers		Cut off infested tips below girdle marks, remove canes showing swellings	Scout for presence of adults. Adult cane borer activity can occur from early May through early August.
Japanese beetle	Sevin XLR Plus, 1-2 pt (7) Cythion 8E, 2 pt (1) Malathion 57EC, 1.5 pt (1) Pyrethrin Crop Spray 0.5EC, 2-12 oz (0)	Traps may reduce populations. Place traps at least 50 feet away from planting.	Apply spray only if beetles are present. Check labels for specific restrictions.
From petal-fall through the beginning of harvest			
Sap beetles	Cythion 5E, 1.5 - 2 pt (1)* Malathion 57 EC, 1.5 - 2 pt, (1)*	Keep planting clean of over-ripe fruit	*Labeled for raspberry only, not other bramble fruit.

From petal-fall through the beginning of harvest

Pest	Spray Material, Rate/A (pre-harvest interval)	Cultural Practices and Scouting Notes	Comments
Tarnished plant bug	Sevin 50W, 3-4 lb (7) Pyrenone Crop Spray 0.5EC, 2-12 oz (0)	Keep planting free of weeds. See description of sampling procedures in the description of TPB in the text. Action threshold for nymphs or adults is when 10-20% of canes are infested Adults migrate to fruit when adjacent fields are mowed.	Apply pre-bloom if adults found in planting, but avoid insecticide spays during bloom. Apply sprays in evening.
Botrytis fruit rot (gray mold)	Benlate 50WP, 12 oz (3) Rovral 50WP, 1-2 lb (0) Ronilan 50WP, 1-2 lb (9)	Space rows at least 8 feet apart, prune canes to a density of 3 to 4 canes per sq. ft. to improve air circulation.	Apply at 5% bloom and again at full bloom. Repeat application only if weather is wet. Overuse of these materials may result in the development of resistance in the fungus. Benomyl may be detrimental to predatory mite populations. Benlate: The current Benlate label specifically states that Benlate is “not for use in home plantings nor once any commercial crop is turned into U-pick, Pick Your Own, or similar operation.” Consult with your state’s pesticide office for the relevant interpretation of this restriction.
Fruit rot sprays or special sprays			
Two-Spotted spider mite	M-Pede 1-2% (0)	Predatory mites may help. Avoid use of pesticides which will kill natural enemies of mites such as Benomyl or Sevin.	Sulfur (80% WP) applied at 5-10 lb/100 gal for powdery mildew will provide some suppression. Do not use M-Pede within 3 days of a sulfur application.
Fruit rot sprays or special sprays			
Phytophthora root rot	Ridomil Gold EC, 1/4 pt/1000 linear ft. (45) Ridomil Gold GR, 5 lb/1000 linear ft. (45) Aliette WDG, 5 lb (60)	Plant only in well-drained soils. Planting on raised beds also significantly reduces Phytophthora incidence. Cultivars Latham and Newburgh appear to be somewhat resistant.	Apply Ridomil in 3 ft wide band over the row in early fall; repeat in early spring before growth begins. Apply Aliette in sufficient water to thoroughly wet the foliage. Begin foliar sprays in the spring after bud break and continue spraying on a 45-60 day schedule up to a maximum of 4 sprays during the growing season.
Botrytis fruit rot (gray mold)	same as petalfall above		

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WEED MANAGEMENT

The primary goal of weed management is to optimize yields by minimizing competition between the weeds and the crop. Weeds reduce yields by competing with the crop for water, light, and nutrients. Weeds also harbor insects and diseases and encourage vertebrate pests. Timely cultivation, wise use of herbicides, and never permitting weeds to go to seed are integral parts of a good weed management system. Many of the weeds found in these fields are difficult-to-control perennial weeds that are not common in annual crop culture. New plantings usually have fewer perennial weed problems than older plantings. Annual and biennial weeds can also exist in these fields. Fields should be scouted at least twice a year (spring and fall) to determine specific weed problems. The selection of a weed management tool should be based on specific weeds present in each field. Several herbicides are labeled for use in this crop. A list of herbicides and their recommended uses is presented in Table 39.

Herbicides can be broadcast or applied as a directed spray to the base of the crop. With a band treatment, only 1 to 2 feet on either side of the row is treated. The areas between the crop row is usually maintained with a mowed cover of sod, clover, weeds, or a combination of these. This cover is used primarily for erosion control and to improve trafficability in the field. With banding, less herbicide is needed in each acre. For example, a 3 foot band (1.5 feet on either side of the row) where rows are spaced 9 feet apart will require only one third the amount of herbicide normally required for a broadcast treatment.

Cultivation and mulching are sometimes used as weed management tools. All cultivations should be timely and shallow to minimize crop root injury, to minimize loss of soil moisture, and to avoid repositioning new weed seeds to the soil surface. Mulches that are free of weed seeds and placed thickly enough can be very effective at reducing or eliminating most annual weeds from the crop row. They are seldom effective on perennial weeds. If mulches are used in combination with herbicides, use the lowest recommended herbicide rate to avoid crop injury.

Table 39. Weed management in brambles[†].

TRANSPLANT YEAR			
Weed Problem	Herbicide	Rate/Acre	Comments and Limitations
PREEMERGENCE WEED CONTROL			
Annual grasses and small seeded broadleaf weeds	(napropamide) Devrinol 50WP	8 lb	Apply after transplanting to weed-free soil. Devrinol must be activated within 24 hrs by cultivation or enough water by irrigation or rainfall to wet the soil to a depth of 2 to 4 inches. The full rate may not be necessary at transplanting.
	Devrinol 50 DF	8 lb	
	(oryzalin) Surflan 4AS	2 to 4 qt	Do not apply until soil has settled around the plants and no cracks are present. Irrigation or 1 inch of rain is needed within 21 days of application. Shallow cultivation will improve control. May injure newly planted tissue culture plants.
Broadleaf weeds and some grasses	(simazine) Princep 80WP	1.25 to 2/5 lb	Use to improve the broadleaf weed activity of Devrinol or Surflan. Consider applying half the maximum rate after planting and half in the fall before winter annuals emerge. Do not use on newly transplanted tissue culture plants.
	Princept 4I	1 to 2 qt	
	Caliber 90	1.1 to 2.2 lb	
	Princep 4G	25 to 50 lb	
POSTEMERGENCE WEED CONTROL			
Emerged annual and most perennial grasses	(fluazifop) Fusilade DX	16 to 24 oz	See label for best times to treat specific weeds. Will not control broadleaf weeds or sedges. Do not apply to crops to be harvested within 1 year of application. Do not apply if rainfall is expected within 1 hour or if grasses are under drought stress. Must be used with a crop oil concentrate or non-ionic surfactant.
	(sethoxydim) Poast	1 to 2.5 pt	
Emerged annual weeds and suppression of perennial weeds.	(pelargonic acid) Scythe	3-10% solution	Contact material for burn down only. See Scythe comments on page in Strawberry section. See label for complete instructions.
Emerged annual and perennial weeds	(sulfosate) Touchdown	1 to 5 pt	NON-BEARING USE ONLY. Apply to actively growing weeds during site preparation prior to planting and no later than 1 year before harvest. Apply with a wiper or a shielded/directed spray. Do not allow the spray, spray drift, or mist to contact green foliage, suckers, open wound, or other green parts of the plant. Consult the label for rates for specific weeds and other precautions. Use with a surfactant or wetting agent.
ESTABLISHED PLANTINGS			
PREEMERGENCE WEED CONTROL			
Annual grasses and small seeded broadleaf weeds	(napropamide) Devrinol 50WP	8 lb	Apply in the early spring before seedling weeds emerge. Devrinol must be activated within 24 hours by shallow cultivation or with enough rainfall or irrigation to wet the soil to a depth of 2 to 4 inches.
	Devrinol 50 DF	8 lb	

Table 39 continued. Weed management in brambles†.

ESTABLISHED PLANTINGS			
Weed Problem	Herbicide	Rate/Acre	Comments and Limitations
PREEMERGENCE WEED CONTROL			
	(oryzalin) Surflan 4AS	2 to 4 qt	Apply to weed-free soil in the spring. Irrigation or 1 inch of rainfall is needed within 21 days of application.
	(norflurazon) Solicam 80DF	2.5 to 5 lb	Apply in early spring when crop is dormant to clean and weed-free soil. May result in temporary bleaching or chlorosis of leaves from which the plant will recover. Do not use on nursery stock.
NOTE: For broad spectrum preemergence weed control, consider applying one of the above three “grass” herbicides (napropamide, oryzalin, or norflurazon) in addition to one of the following “broadleaf” herbicides (simazine, terbacil, or dichlobenil).			
Broadleaf weeds, some grasses, and suppression or some perennial weeds	(simazine) Princep 80WP	2.5 to 5 lb	Apply in the spring before bud break and before weeds emerge, or in the fall. Do not apply when fruit is present. For improved control as well as quackgrass suppression apply half in the spring and half after harvest. May injure ‘Royalty’ raspberries.
	Princep 4L	2 to 4 qt	
	Caliber 90 Princep 4G	2.2 to 4.4 lb 50 to 100 lb	
	(terbacil) Sinbar 80WP	0.5 to 2 lb	Apply in the early spring or in the fall as a directed spray to the base of the plants. Will also control small emerged weeds. Do not contact new shoots and avoid contact with bramble foliage. Spring application must be made before fruit set. Avoid application on plantings low in vigor. Planting must be at least 1 year old before application. Do not apply within 70 days before harvest.
	(dichlobenil) Casoron 50 WP Casoron 4G	100 lb 8 lb	Apply at temperatures below 40½F preferably just before rain or snow. Soil must be settled around established plants. Uniform application is essential. Do not apply during new shoot emergence. The 4G formulation is effective on many perennial weed species. May reduce/delay new shoot emergence in plantings that are young or lacking vigor.
POSTEMERGENCE WEED CONTROL			
Emerged annual grasses and broadleaf weeds. Suppression of emerged perennial weeds	(paraquat) °Gramoxone Extra	2 to 3 pt	Contact herbicide. Use with a non-ionic surfactant. Apply as a coarse directed spray to wet the weeds. Apply before emergence of new canes or shoots to avoid injury. Use of a shield is highly recommended.
Emerged annual and most perennial grasses	(sethoxydim) Poast	1 to 2.5 pt	See label for best times to treat specific weeds. Will not control broadleaf weeds or sedges. Do not apply to grasses under stress (e.g., drought). Crop oil concentrate must be added to the spray tank. Do not cultivate 5 days before or 7 days after application. Do not apply within 45 days before harvest in brambles. Do not apply more than 5 pints per acre per season.
Emerged annual weeds and suppression of perennial weeds.	(pelargonic acid) Scythe	3-10% solution	Contact material for burn down only. See Scythe comments in Strawberry section. See label for complete instructions.
Emerged annual and perennial weeds	(glyphosate) Roundup Ultra	1 to 5 qt	Apply to actively growing weeds. Apply with a wiper or a shielded/directed spray to the base of the plants. Do not permit herbicide solution to contact desirable vegetation, including green shoots, canes, or foliage. Do not cultivate within 7 days after application.

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°Restricted use pesticide.