

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 circula-

tion. 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 bacterium 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