

GROWING RASPBERRIES IN WISCONSIN



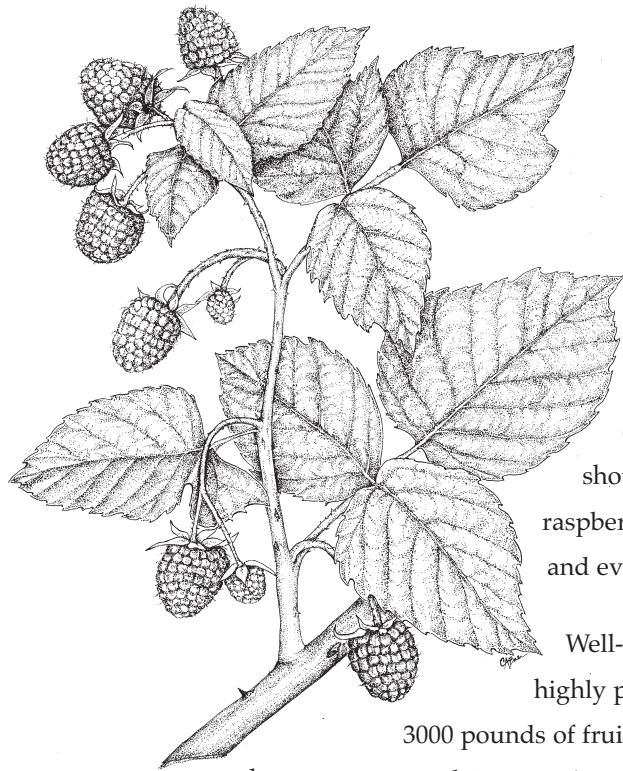
Rubus idaeus

BRIAN R. SMITH, DANIEL L. MAHR, PATRICIA S. MCMANUS, TERYL R. ROPER

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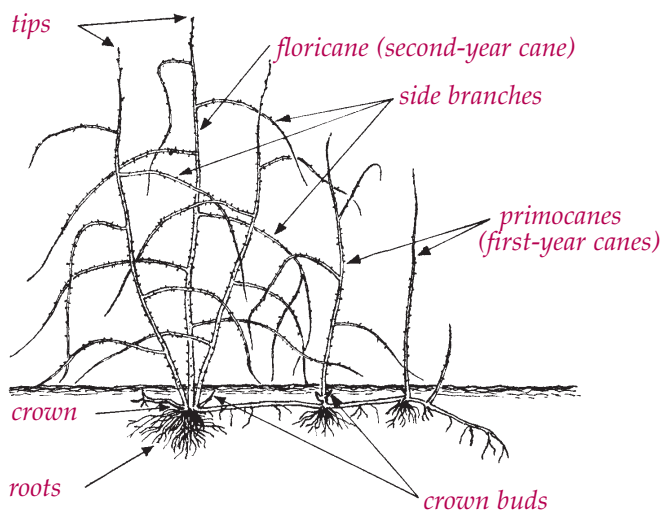




*T*art, juicy and flavorful, raspberries are a welcome addition to the home garden or commercial planting in Wisconsin. Red and yellow raspberry cultivars can be grown throughout the state. Purple raspberries should be grown only in the lower two-thirds of the state. Black raspberries should be planted only in the southern quarter of the state, and even then, only in good sites.

Well-established, vigorous, disease- and insect-free plantings are highly productive. Yields of 1 to 2 quarts per plant (2500 to 3000 pounds of fruit per acre) are common and provide a ready source of fruit for home use or supplementary income from direct on-farm or pick-your-own sales. Commercial production of raspberries should be limited to red and purple cultivars and should be developed on favorable sites near potential pick-your-own and pre-picked markets.

ANATOMY OF A RASPBERRY PLANT



THE RASPBERRY PLANT

Raspberries can be categorized as one of two fruiting types: summer-bearing or fall-bearing. Summer-bearing types produce one large crop between early July and early August. Many of the common red and most of the common black and purple cultivars are summer bearing. Fall-bearing raspberries, sometimes incorrectly called ever-bearing, produce a large crop in the fall and a smaller crop the next summer. Typically, however, fall-bearing raspberries are mowed annually, so they bear fruit only in the fall.

The difference between these two types is due to the fruiting cycle of the plants. Raspberries have perennial (long-lived) roots and crowns but above-ground canes that live for only two summers. In the first summer of growth, the new cane is called a primocane. On summer-bearing raspberries, the primocane produces vegetative (non-fruiting) growth only. Fall-bearing raspber-

ries bear fruit on the tips of the primocanes sometime after August 1. Fruit development continues inward and downward on the primocanes until the first killing frost.

In the second summer, the primocane that emerged the previous year is now called a florican. In summer-bearing cultivars, this florican will produce one large crop in late summer and then die. In fall-bearing raspberries, the cane that emerged and fruited the previous fall will fruit the rest of the way down the cane and then die.

Since primocanes emerge each year and grow concurrently with the floricanes, fruit production continues year after year for both fruiting types. The only difference is that any one cane on a summer-bearing raspberry has only one crop; on a fall-bearing cultivar it has two crops.

Raspberry flowers are self-fertile, which means pollen originating from one cultivar can cause fruit set on any plants from the same cultivar. Bees are attracted to the profuse amounts of nectar produced in raspberry flowers and are responsible for 90–95% of pollination.

Red raspberries and black raspberries are separate species, while purple raspberries are hybrids between the two. Most yellow raspberries are natural color variants of red raspberries and are identical to them in every other way.

Red and yellow raspberries produce numerous new canes from “crown buds” at the base of floricanes and from buds distributed randomly on the roots. Thus, the many emerging sucker shoots will produce a dense, ill-defined planting unless plants are confined to their allotted location by pruning and cultivation.

Black raspberries and most purple raspberries produce primocanes only from the crown buds at the base of floricanes. Because these plants do not sucker, the clumps or “hills” remain in the original planting location.

Raspberry canes are round with small thorns and sometimes numerous prickles. Many thornless raspberries are not suited to Wisconsin’s climate.

SITE AND SOIL SELECTION

Raspberries grow best in full sunlight on an airy site sheltered from direct winds. Poorly drained areas where water stands after a rain are not acceptable. To decrease disease and insect problems, isolate cultivated raspberries from wild raspberries or blackberries, and plant them in fields that have been free of wild raspberries whenever possible. Also, raspberries, strawberries, and solanaceous plants (tomatoes, potatoes, and eggplants) share many of the same diseases. To reduce the risk of diseases carrying over to new plantings, wait at least 3 years before planting on these sites.

Good air circulation and air drainage improve raspberry plantings. Air circulation around the plants helps them dry quickly after dew, rain, or irrigation. Ideally, raspberries should be planted on a slope or hillside so that the heavier cold air can drain and settle into lower areas. Spring frosts are less likely to damage a planting if cold air can drain away.

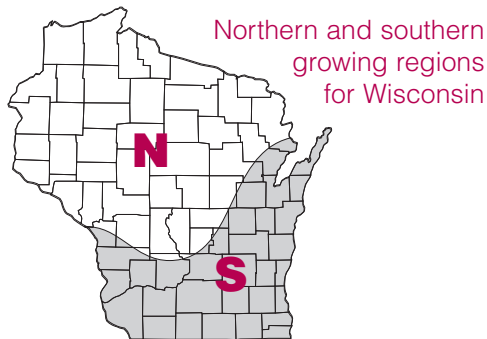
Raspberries perform well on most mineral soils that are moderately fertile, well drained and easily cultivated. A deep, sandy loam high in organic matter (5–7%) is ideal. Light sandy soils are also acceptable if irrigation is available. Raspberries do best in slightly acidic soils with a pH of 6.0 to 6.8. They will produce satisfactorily at a soil pH between 5.5 and 7.5, however.

Summer-bearing red raspberries tolerate winter temperatures of –30°F or lower when the plant is fully hardy or acclimated. This crop suffers injury most severely during winters with fluctuating temperatures. On warm winter days, the dark raspberry canes absorb heat from the sun and are warmed above the air temperature injuring tissues and buds, especially those growing on south slopes. To minimize this exposure, summer-bearing raspberries will perform best if planted on a north slope or on the north side of a windbreak.

In Wisconsin, plant fall-bearing red raspberries on a south slope or protected location to promote rapid growth of primocanes and early fall fruiting.

CULTIVAR SELECTION

Selecting winterhardy, productive raspberry cultivars is an important ingredient for success. Hardiness refers to a plant's ability to withstand winter conditions—both low and fluctuating temperatures and desiccating winds. Select cultivars adapted to Wisconsin's rigorous and unpredictable winter climate. The cultivars described below are listed in order of ripening within each section. The preferred growing regions are listed in parentheses after each cultivar name.



Summer-bearing red raspberries

Red raspberries are most common in Wisconsin, with many adapted cultivars available.

Boyne (N&S) The tender, medium-sized fruit is glossy and dark red with good flavor. Good for processing and fresh use. Moderately vigorous canes are sturdy, winterhardy, and very productive. Boyne is best suited for trellis training systems where fruiting canes are tied to wires on the outside of rows. Above-average yields.

Nova (N&S) Medium-large, bright red, fruit of good quality, somewhat acid. Good for fresh use and freezing. Good winter hardiness, few prickles. Above-average yields.

Festival (N&S) Glossy, bright red fruit is medium sized and very attractive. Very good for fresh use, fair for freezing. Short but vigorous, nearly spineless plants have good winter hardi-

ness. Immune to mosaic virus, tolerant of spur blight, and susceptible to late leaf rust. High yielding.

Killarney (N&S) Medium-large, bright red fruit with good flavor. Good for freezing. Fruit tends to soften in hot weather. Canes are spiny and sucker readily. Susceptible to mildew and anthracnose. Very high yields.

Reveille (S) Large soft fruit has very good flavor for fresh use, but is only fair for freezing. Vigorous canes tolerate fluctuating winter temperatures. Average yields.

K81-6 (S, trial) Very large, firm fruit has very good flavor. Resistant to powdery mildew and late yellow rust. Tolerant to crown gall, but susceptible to fruit rots, fire blight, and *Phytophthora* root rot. Medium-tall canes with few spines at base.

Latham (N) Medium-large fruit is an attractive, bright red color. It is very good for canning and freezing, but somewhat crumbly for fresh eating. Fruit ripens over a long period. Vigorous plants are productive and have excellent winter hardiness. Requires trellis. Tolerant to several viruses.

Haida (S, for trial N) Dark red fruit are larger, firmer, and sweeter than Boyne. Very good fresh or processed. Vigorous plants sucker prolifically and have very few spines. High yield potential.

Fall-bearing red raspberries

Fall-bearing raspberries are recommended for the southern two-thirds of the state where the growing season is longer. Early fall-bearing cultivars can be planted in the northernmost areas, but frost may ruin the crop before the total potential harvest is complete.

Summit (N) Small to medium-sized fruit is bright red, firm, and glossy with very good flavor. Excellent for processing. Ripens in early August, making Summit a good choice for northern Wisconsin. Vigorous canes require a trellis.

Autumn Britten (N&S, trial) This new cultivar has uniform medium to dark red fruit. Higher yields and better flavor than Autumn Bliss. Vigorous plants have sparse spines.

Autumn Bliss (N&S) Considered the standard for fall-bearing raspberries in Wisconsin. These large, dark red fruit have a pleasant, mild flavor, but are soft and somewhat crumbly. Canes are vigorous and spiny and typically produce higher yields than Heritage. Ripens mid-August.

Ruby (S, for trial N) The largest fruit of the fall-bearing red raspberries for Wisconsin. The berries are dark red, moderately firm, and slightly tart. Vigorous, productive canes produce numerous suckers and sparse spines. Yields are equal to or better than Heritage. Requires a well-drained soil.

Caroline (N&S, trial) Large red berries have excellent flavor and shelf life. Good vigor, moderate suckering, and higher yields than Heritage. Better tolerance to yellow rust and root rots than Heritage. Long fruiting season.

Heritage (S) The fruit is firm and medium-sized with good quality. Ripens late August in southern Wisconsin. Typically lower yielding than Autumn Bliss and Summit. The canes are sturdy, vigorous, and hardy. Performs best in warm, sheltered locations.

Black raspberries

Black raspberries are marginally hardy in southern and eastern Wisconsin and thrive only in favorable locations. Black raspberries originated from the American black raspberry. They are not as hardy as red raspberries but, if properly managed, they will produce acceptably. The berries have a distinctive flavor with prominent, hard seeds.

Blackhawk (S) Vigorous plants with medium-sized, good quality black berries. Productivity varies according to winter injury. Fairly resistant to anthracnose.

Bristol (S) Suggested for trial. Produces medium-large, firm, glossy black fruit. Widely planted but not hardy in Wisconsin except on favored sites.

Purple raspberries

Purple raspberries are hybrids of red and black cultivars. They grow similarly to blacks but are more vigorous and significantly hardier. The berries are large and of good quality, though usually less attractive than red cultivars. They are good fresh and excellent for freezing. With proper cultural practices, purple raspberries will produce substantial amounts of fruit.

Amethyst (S) Fruit is shiny and moderately large, but tends to be soft. Highly productive and vigorous. Adapted for home use or on-farm sales.

Brandywine (S, for trial N) Reddish-purple fruit is large, firm, and very tart. Fair for fresh use, excellent for jams, jellies, and freezing. Brandywine is not fully hardy even in southern Wisconsin.

Royalty (S, for trial N) Produces large, attractive purple fruit which may be harvested in the red ripe stage. Berries are sweet with better flavor than Brandywine. Excellent for processing or freezing. Needs protection from winter injury; it is not fully hardy even in southern Wisconsin. Resists aphids, a primary carrier of virus diseases.

Yellow raspberries

Yellow-fruited cultivars are rarely as productive as red-fruited types. May be difficult to obtain.

Honeyqueen (N&S, trial) A high-quality summer-bearing raspberry with large yellow fruit. Medium height canes sucker freely.

Anne (N&S, trial) Fall-bearing raspberry with large, light yellow fruit. Excellent flavor and good firmness. Good vegetative vigor and sparse suckering. Relatively low yields.

Plant source

Avoid the temptation to start new plantings from an existing planting. These plants may harbor diseases and insects that are not readily apparent. Purchase plants from a reliable nursery to be sure they are true to name, vigorous, healthy, and disease free. Such plants grow better, produce more fruit, and live longer. But remember, although these plants start out disease free, they are not immune to diseases. You will still need to take precautions to avoid infecting the planting with viruses and other diseases that will weaken the plants.

Nurseries propagate stock using one of two methods: by digging suckers from the original parent plants to sell as bare root stock and through tissue culture. Tissue-cultured stock is grown from a small piece of the desired cultivar and grown in a sterile environment. Tissue-cultured plantings typically bear fruit earlier, produce more fruit, and live longer than bare root cane stock plantings.

If you choose to propagate your own stock, be aware of plant patent restrictions. It is illegal to propagate cultivars that are still protected under 17-year plant patents (even for home use) unless you are licensed to do so.

PLANTING

Select the planting site 1 to 2 years before planting. Check for adequate internal soil moisture drainage and install drainage tile if necessary. Add large amounts of organic matter such as manure or green vegetation. If persistent triazine herbicides such as atrazine or simazine have been used, wait a year before planting. Control perennial weeds with nonresidual systemic herbicide applications or frequent cultivation. Get a soil test from the site. Before planting, incorporate any recommended nutrients—especially phosphorus, potassium, and lime. Soil phosphorus should be 25 ppm (parts per million); soil potassium should be 100 ppm. Plow or rototill the planting site the fall before planting. To prevent erosion, you can plant the site to rye.

Plant bare-root cane stock as early as possible in the spring, but after danger of temperatures dropping below 20°F has passed. Tissue-cultured stock is particularly tender, so wait until all risk of frost is past before planting (normally when one would transplant tomatoes into the garden).

For both types of stock, prevent root exposure when the soil settles by setting the plants in a hole or furrow slightly deeper than they were grown. Pack the soil firmly around the roots and water them well. Tissue-cultured plants require frequent shallow irrigation throughout the first growing season.

The favored planting system in Wisconsin is the “narrow hedgerow.” Set red raspberries every 2 to 3 feet in rows at least 6 feet apart. Set black and purple raspberries every 2 to 3 and 2 to 4 feet, respectively, in rows that are at least 8 feet apart. Allow new red raspberry shoots to spread along the row but do not let them spread wider than 12 to 15 inches at the row base. Wider rows are hard to weed and prune and invite diseases that thrive in damp, slow-drying conditions. Maintain a 2- to 3-foot weed-free strip on either side of the raspberry row and permanent sod in the remaining space between rows.

Red raspberries can be grown in the “hill” system. “Hill” refers to the cluster of canes that develops around a single plant. It does not mean setting the plant in a mound of soil. Set the plants in holes 4 to 5 feet apart in each direction and allow new shoots to spread to a diameter of about 1 foot.

With proper care and normal weather conditions, a raspberry planting can remain productive for 12 to 15 years. When the planting begins to decline (small, crumbly fruits; stunted plants; low yields; weedy areas), plow it up and replant in a new location, if possible. If not, wait a year or two before replanting in the same site.

SOIL FERTILITY PROGRAM

Well-fertilized, healthy plants have tall, thick, new canes, dark green leaves, and high quality fruit. To make the soil more fertile, plow under a cover crop, such as clover or soybeans, or 1000 to 1500 pounds of stable manure or compost per 1000 square feet. Fall plowing to a depth of 8 to 10 inches is preferred. Early in the spring, cultivate the soil until it is in good planting condition.

If you did not plow down manure or a cover crop, and if the soil is not already fertile, work a complete fertilizer thoroughly into the soil before planting.

Preplant fertilizer applications should be based on soil test results. Information on how to take a proper sample and submit samples for testing is available at your county Extension office.

Extension publication *Sampling Lawn and Garden Soils* (A2166) outlines these procedures.

On new plantings, after plants are well established, broadcast 2 to 4 pounds ammonium sulfate (21-0-0) or 1½ to 2 pounds urea (46-0-0) per 100 feet of row or scatter ¼ cup in a band 18 inches wide around each plant.

Established plantings on well-prepared sites should require only nitrogen fertilizer. Apply 1 lb ammonium sulfate or ½ lb urea per 100 feet of row before growth begins. Repeat 3–4 weeks later. In hill plantings, apply ½ cup complete fertilizer around each plant group.

To encourage maximum growth early in the season, apply all fertilizer in very early spring before growth starts. Avoid fertilizing after August 1 as the nutrients will encourage succulent new growth late in the season, making them more susceptible to winter damage. For more specific fertilizer recommendations, refer to *Fertilizing Small Fruits in the Home Garden* (A2307), available through county Extension offices.

MULCHING

In Wisconsin, a mulch is desirable in the establishment year on most soils. It helps retain soil moisture, suppresses weeds and reduces soil heaving in winter. Avoid mulching poorly drained heavy clay soils as the mulch will keep the roots too wet.

If mulch is expensive or scarce, use it only in the rows around the hills, and cultivate the area between the rows. Where water is readily available for irrigation, sod can be allowed to develop between rows. Use an approved herbicide to maintain bare soil around plants if growing sod between rows.

Chopped hay, straw, and stable manure are good mulches, but they are likely to be full of weed seeds. Instead use old silage, leaves and lawn clippings, wood chips, sawdust, wood shavings, or rye or sudangrass straw, which are usually free of weed seeds.

Stable manure used as a mulch also adds nutrients, so avoid applications after June 15 that may keep the plants growing too late in the fall. Apply other mulches whenever they are available, but avoid smothering young suckers in the spring. Mix ¼ to ½ cup ammonium sulfate or urea fertilizer per bushel of sawdust or wood shavings to speed mulch decomposition and to protect against plant nitrogen deficiency.

Mulch should be spread no thicker than 2 inches deep to discourage rodents from nesting in it.

IRRIGATION

Raspberries produce better quality and higher quantities of fruit. They are also typically less susceptible to disease and insect infestations if given adequate water throughout the growing season.

Raspberries obtain most of their water from the top foot of soil. Frequent, shallow irrigations are better than occasional, deep watering. From bloom until harvest, raspberries growing in loamy soils need about 1 to 1½ inches of water

every 7 to 10 days either from rain or irrigation. Raspberries growing on sandy soils should receive $\frac{1}{3}$ to $\frac{1}{2}$ inch of water every 3 to 5 days. Fall-fruiting cultivars need adequate moisture throughout the summer to help them form primocanes and fruit. Low winter soil moisture is a major cause of damage and plant loss, so irrigate thoroughly before the soil freezes if late fall rainfall is inadequate and the soil is dry.

You can irrigate raspberries with overhead sprinkler irrigation or with drip or trickle irrigation. Overhead sprinkler irrigation also can provide frost control to extend the harvest season of fall-bearing raspberries. Use tall risers to get sprinklers above the plants. Overhead irrigation may aggravate some disease problems.

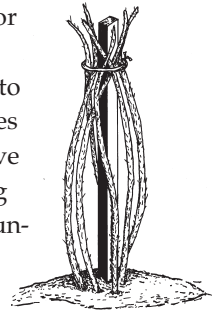
Although drip irrigation has not been used extensively in raspberry production, it can enhance growth and productivity in Wisconsin. Drip irrigation typically uses plastic pipe or tape with emitters or nozzles at regular intervals. The amount of water applied is regulated by the type and number of emitters and the duration of the application. Drip irrigation requires a clean, filtered water supply to prevent clogging. Drip or trickle systems apply water more evenly and more efficiently than does overhead irrigation.

Added benefits include fewer disease problems because foliage remains dry and fewer weed problems because between-row areas are not watered. Drip systems cost less initially than do sprinkler systems, but they cannot be used for frost control.

TRAINING

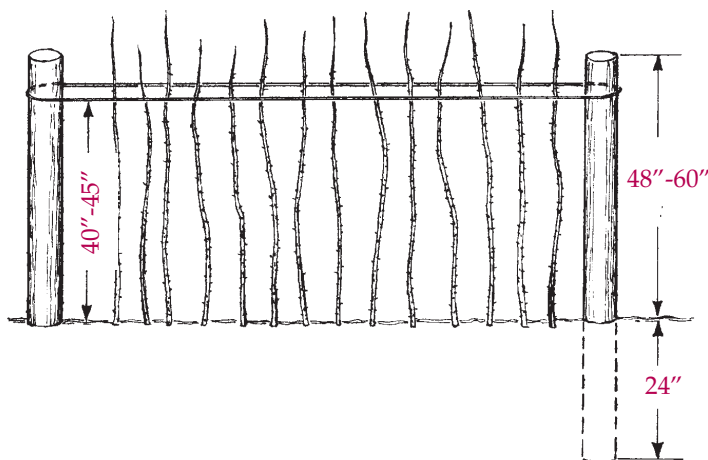
Training raspberries provides a number of advantages compared to untrained hedgerow plantings. Training makes picking easier, supports fruiting canes to keep berries off the soil, improves pest management and most importantly, enhances light interception for maximum production of large, high quality berries. Before choosing a trellis system, carefully evaluate costs of material and labor.

Hill system. With this system set a permanent stake—metal or treated wood—in the center of each hill. Tie the canes loosely to the stakes at the top of the canes with heavy twine after you have pruned them. Wait to tie young shoots or suckers until after pruning in late fall or winter.



Narrow-hedgerow system. With the narrow-hedgerow training system, a trellis is used to hold canes upright. The simplest system uses single or double wires. Stretch heavy-gauge galvanized or aluminum wire between permanent posts set 20 to 30 feet apart in the row. You may use either one wire, two wires at different heights, or two wires at the same height. Place the canes between the wires to eliminate tying (figure 1). If the wires spread, hold them together with a hook of wire. Fasten one end of the hook loosely, but permanently to one wire and bend the other end to hook over the remaining wire. You can move these hooks easily along the wire where they are most needed. If you use a single wire or one wire above the other, tie the canes loosely to the wires after pruning.

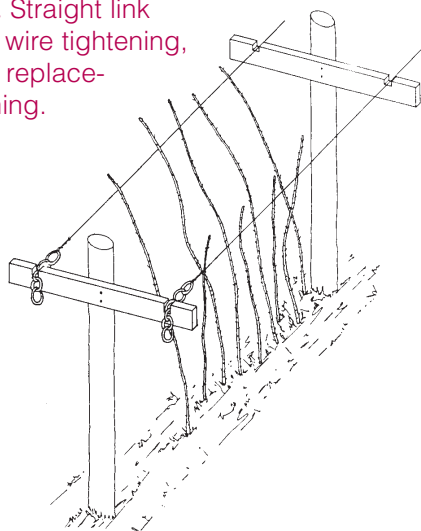
FIGURE 1. A permanent trellis. Cedar posts (4 to 6 inches in diameter) are placed about 20 feet apart. Set posts at least 24 inches into the ground.



Trellis crossarm or “T” trellises allow maximum light penetration and greatest productivity. Tying fruiting canes to wires on a “T” or crossarm trellis keeps fruit to the outside of both sides of the row, making picking easier. Primocanes are directed towards the middle while floricanes are anchored to the wires on either side to make harvesting easier. Maximum light in the row center helps develop strong, vigorous fruiting canes for the following season, and doesn’t interfere with the current season’s harvest. Permanent metal or treated wood fence posts should be set 20 to 30 feet apart in the row. Make crossarms 24 to 32 inches long out of scrap oak at least 1-inch thick, pipe or angle iron. Treated 2 x 4 inch lumber is also satisfactory for crossarms but may be more expensive than other materials suggested. Attach crossarms to posts 48 to 60 inches from the soil. You will need to alter crossarm height on posts to conform to cane vigor and height of canes.

A simple method for maintaining trellis wire tension uses simple straight link chains to adjust wire tension (figure 2). Attach a heavy-duty spring, available from farm supply stores, between each chain and wire to maintain constant tension and avoid frequent wire tightening.

FIGURE 2. Straight link chain allows wire tightening, removal and replacement at pruning.

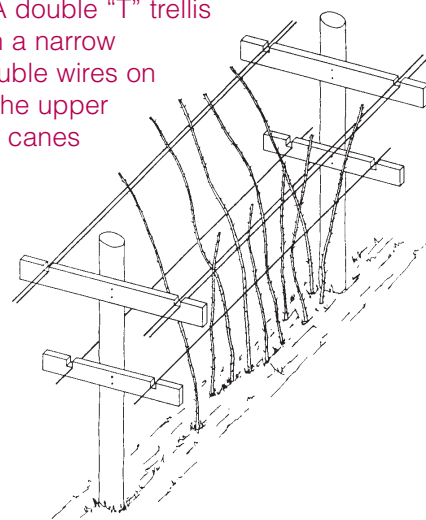


Chain link tighteners make it easy to remove wires, which is helpful for pruning. To simplify removing old fruiting canes or thinning canes in dormant pruning, lift wires from the trellis arms. After pruning or thinning, replace the wires on the trellis arms, then tie selected fruiting canes to wires at spacings of 4 to 6 inches along the wires.

For vigorous cultivars or narrow row spacing of plantings, double “T” trellises provide added support for fruiting canes (figure 3). Use upper arms the same length as for the single “T” trellis. Lower arms generally are shorter (12 to 15 inches) and are attached to posts at approximately 24 inches above the soil. Lower arms help contain new growth in the center of the row and between upper wires. Lower crossarms also reduce cane sagging, improving ease of cultural operations such as weed control or mowing along the plant hedgerow.

To hold canes upright, spiral a piece of string or light twine along the length of a single trellis wire, placing canes in the spiral. You will need to cut the string before removing floricanes after harvest. Double wires on each side of the upper crossarms will also hold canes upright. After

FIGURE 3. A double “T” trellis holds canes in a narrow hedgerow. Double wires on either side of the upper crossarm hold canes without tying.



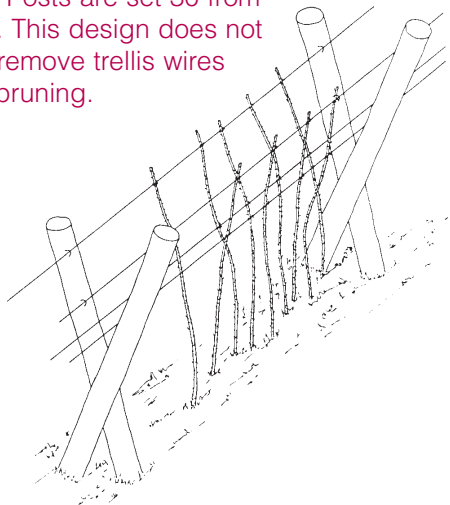
pruning, place dormant canes between the two wires. Sufficient tension on both wires should hold canes with adequate force to prevent wind whipping or sliding along the wires. Double wires on each side of the trellis arms may be used on any of these training systems and will largely eliminate the need to tie canes to wires.

The “V” trellis system (figure 4) provides the same advantages of increased productivity, ease of harvest and improved pest control as the “T” trellis systems. Additional costs for posts may be offset by eliminating the need for crossarms. Metal T-posts are also suitable for this system.

For most raspberry trellis systems, 12-gauge galvanized wire is strong and durable enough for long-term use. High tensile steel wire, available from specialty fencing suppliers, permits extra tensioning of wires with superior support strength. For short rows of 20 feet or less, heavy plastic twine will also do.

In all cases, trellis end posts should be larger than line posts and adequately braced to support wire tightening and crop loads. To ease harvesting and cultural operations, trellis rows should be no longer than 300 feet to permit cross traffic and equipment turning.

FIGURE 4. A simple “V” trellis design. Posts are set 30 from vertical. This design does not let you remove trellis wires during pruning.



PRUNING

Pruning summer-bearing red raspberries

Summer pruning. Immediately after the last harvest, cut out at ground level and remove all canes from the planting that have just borne fruit. These floricanes will die soon anyway, and removing them eliminates a disease source and gives new shoots more room to grow. Thin new shoots at this time, leaving three or four of the sturdiest canes per foot of row (or six to eight canes per hill in the hill system). Do not cut back the cane tips until the following spring when you can determine die-back and winter damage.

Dormant pruning. Make this pruning in the spring after danger of winter injury passes but before new growth begins. If you haven’t already pruned the old canes and thinned the new shoots as described for summer pruning, do so at this time.

Cut back slightly any side branches on the remaining fruiting canes. Also cut back the tips of the fruiting canes slightly. This is called “heading back” and prevents the canes from becoming top heavy. Severe heading back greatly reduces the crop, therefore never cut off more than one-fourth of the cane. At this time cut off any tips that died back in winter.

Biennial bearing. This pruning system is the easiest and least time consuming way to maintain summer-bearing raspberries, though yields are lower. Each year during the dormant season, cut off half of the planting. Choose a contiguous section or cut alternate rows throughout the planting. Yields are typically reduced by only 30% rather than the expected 50% since the primocanes are able to grow unimpeded by the floricanes. Wait until the end of the second growing season before mowing plantings.

Pruning fall-bearing red raspberries

Fall-bearing raspberries produce the fall crop on primocanes—the current season’s growth. For maximum yield, cut or mow off all canes at the soil surface in late fall when plants are dormant or in early spring, before growth resumes. Use sharp tools or a heavy-duty mower with sharp blades to avoid damaging plant crowns.

The following spring, primocanes will begin growing. These canes will produce fruit in early fall of the same season. Fruit will continue to ripen until frost. In southern Wisconsin, you can often extend the fall harvest into early November using sprinkler irrigation systems to protect the fruit against frost damage.

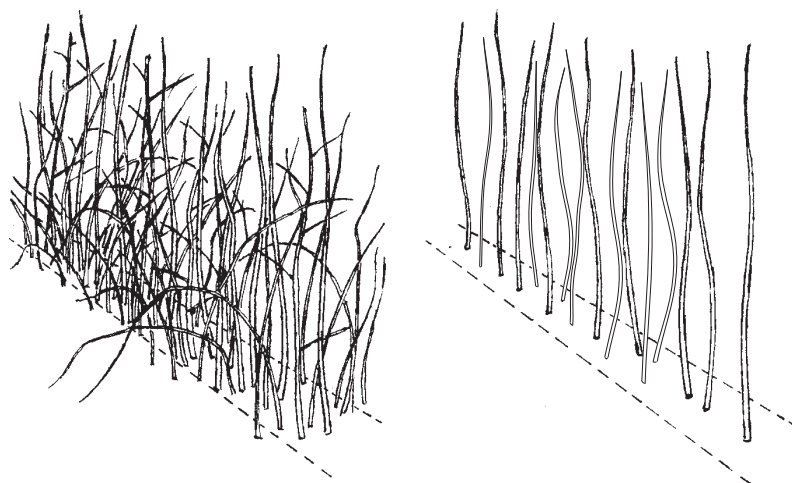
This pruning technique offers many advantages over other pruning practices. It’s less time consuming to mow than to prune and it avoids problems with some common raspberry insects and diseases. Additionally, damage from rabbits feeding on canes in winter and winter injury are not a concern.

If you prefer to harvest two crops per year, follow the pruning techniques described for summer-bearing cultivars. Be aware, though, that many of the better fall-fruited cultivars are not winter-hardy, so the second crop will be lost if the canes die back over winter.

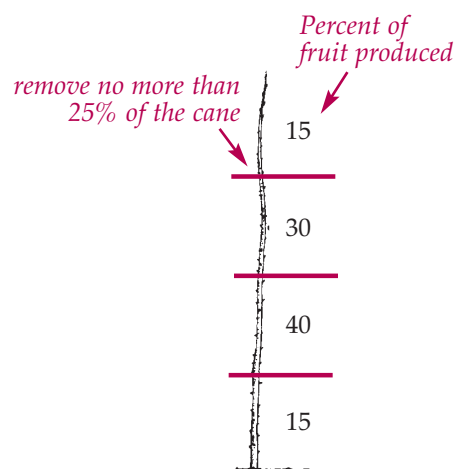
HARVESTING CROPS EARLIER

You can harvest fall-bearing raspberries 5 to 15 days earlier than normal if you place floating row covers over mowed plantings in early spring. Loosely drape the cloth over the row. To hold heat in, use soil or u-shaped pins to seal the cloth edges around the base of the planting. Remove the covers when temperatures reach 80°F or when primocanes are 12 to 18 inches tall.

PRUNING SUMMER-BEARING RED RASPBERRIES



Summer pruning. Immediately after the last harvest, remove all but three or four of the sturdiest new canes per foot of row.



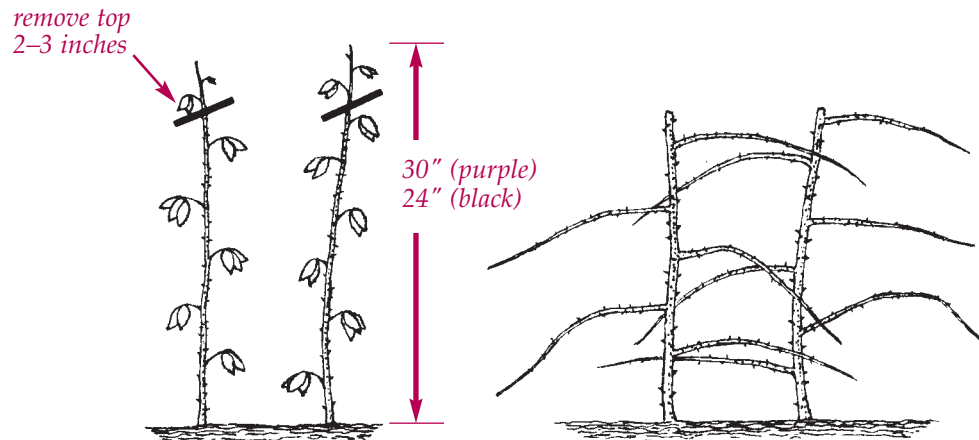
Dormant pruning. Head back cane tips in early spring to keep canes from becoming top heavy.

Pruning black and purple raspberries

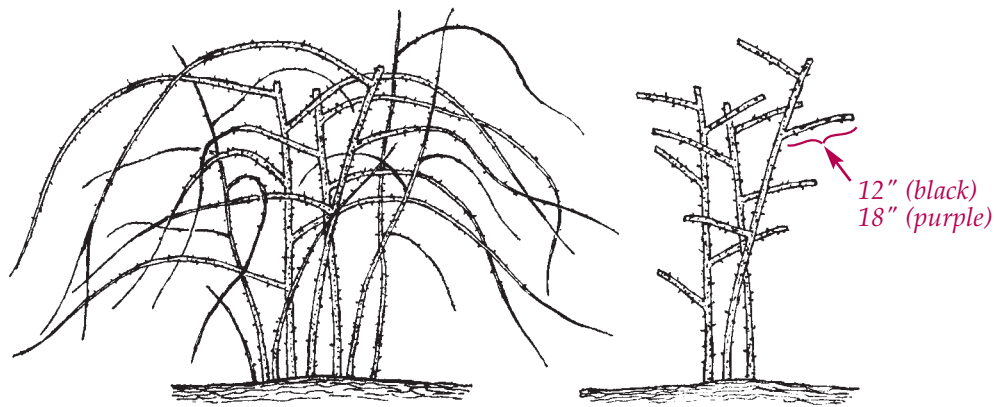
Summer pruning. Pinch out the tip of each shoot when primocanes of black raspberries are 24 inches high and when the canes of purple raspberries are 30 inches tall. Each cane then will produce several side branches. This makes the fruit easier to pick and increases production. Immediately after harvest, cut out at ground level and burn all the canes that bore fruit.

Dormant pruning. Before growth starts in the spring, select four or five sturdy canes per plant and remove and burn all others. Cut back the remaining side branches of black raspberries to 12 inches and the side branches of purple raspberries to 18 inches. Secure the canes to a trellis or stake. Remove old fruiting canes at this time if you did not do so the previous summer.

PRUNING BLACK & PURPLE RASPBERRIES



Summer pruning. Remove the top 2 to 3 inches when black raspberries are 24 inches tall and purple raspberries reach 30 inches.



Dormant pruning. Remove all but four or five of the sturdiest new canes. Cut back remaining side branches.

INSECT MANAGEMENT

Good cultural practices will usually reduce insect problems, as healthy canes recover more rapidly from insect attack. Some pests occasionally become too abundant, despite cultural practices. Temporary chemical control measures will be needed. Certain insect pests will always be troublesome if there are many wild host plants near the patch.

For additional management guidelines, home gardeners should consult Extension publication *Raspberry Pest Management for Home Gardeners* (A2128). Commercial growers should refer to Extension publication *Strawberry and Raspberry Pest Management for Wisconsin* (A1934).

Raspberry cane maggot

This insect causes the cane tips to wilt or break off in late spring or early summer. The base of the wilted portion turns purple and the broken-off ends look like they were cut with a knife. The adult cane maggot is a small, grayish fly about two-thirds as large as a house fly. Flies appear shortly after spring growth begins and lay their eggs in new buds or in the tips of new shoots. The maggots or worms feed around the inside of the stem and completely girdle it. Maggots work downward in the stem below the break point and remain there all winter.

To control, carefully examine the planting in May and June. If you see drooping cane tips, cut them off several inches below the girdle point and burn. In late fall or winter remove injured canes missed in the early season examination.



You probably will not need chemical control as these insects rarely attack more than a few shoots in a planting.

Red-necked cane borer

The adult red-necked cane borer is a bluish-black beetle about ¼-inch long. It appears on the canes in late May or June. The beetle's "neck" is a distinctive coppery-red color. It lays its eggs in the cane bark and the larvae bore beneath the bark. The boring causes the stem to swell ½ to 1½ inches in diameter, several inches along the cane. By late fall, the swellings contain creamy white-colored grubs up to ½-inch long.

To control, cut out and burn all canes with abnormal swellings during the fall and winter. If the problem persists, you may need to apply a pre-bloom insecticide to the canes.

Raspberry crown borer

This insect causes the leaves to turn red prematurely and the cane to wilt in late summer. The borer is about 1-inch long with a white body and brown head. It feeds in the larger roots, in the crown, or at the base of canes. The adult moth looks like a yellow jacket wasp and appears late summer or early fall. It lays eggs on the foliage, and the larvae crawl to the crown. They overwinter under the bark just below the soil surface. In the spring, the larvae attack new cane buds and finally move downward toward the crown. It takes them 2 years to develop completely.



To control, dig and remove infested plants completely, when possible. There are no insecticides registered for use against this pest in home plantings. For commercial plantings, an insecticide may be used in problem patches. Apply as a drench around the base of each plant in early May. Repeat the treatment for at least 2 years.

Raspberry cane borer

When this insect lays its eggs, it makes a double row of punctures around the stem tip, causing the cane tips to wilt. The adult female is a slender, black and yellow-striped beetle about ½-inch

long with very long antennae. Grubs bore down the cane a few inches and hibernate for the winter. The following season, grubs bore downward within the cane, killing it.

To control, remove wilted cane tips 5 to 6 inches below the punctured area. Burn the prunings to destroy the insects inside.

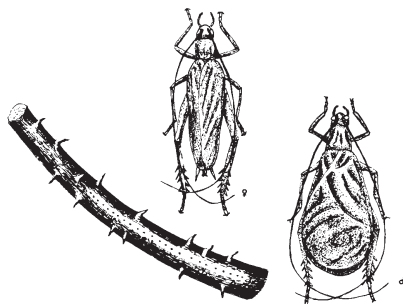
Tree crickets

These insects are not pests because of their feeding habits. Although some species will occasionally feed on leaves or ripe fruit, they also feed on other insects, fungi, and pollen. Indeed, they are often considered beneficial because they prey on certain types of slow-moving pests, such as aphids.

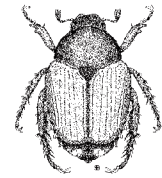
Tree crickets injure canes when adult females lay eggs in the fall. They bore a series of tiny holes in the cane and lay an egg in each hole. These holes are usually in a single row, spaced about 25 holes to the inch, and may extend 2 to 3 inches. The cane often dies above the series of holes.

The insects pass the winter in the egg stage within the canes or in the twigs of other plants. In spring, the eggs hatch into slender, pale-green crickets that grow slowly until they reach the adult stage in late summer. The adults are soft-bodied, pale-green insects, about 1-inch in length with long slender legs and very long antennae. They are active primarily at night.

If these insects seriously injured canes in the past, examine canes in late fall to early spring for the egg-laying punctures. Prune out and burn punctured canes to destroy the overwintering eggs.



Japanese beetle



The Japanese beetle is a relatively recent invader of Wisconsin. It is most serious in the southern part of the state, but extends into central Wisconsin, and will likely continue to be an increasing problem. The 1/3-inch beetles are reddish brown and metallic green, with a series of white tufts of hair around the edge of the wing covers. They feed on many types of trees and shrubs, especially from late June to early August. All members of the rose family, including raspberry and blackberry, are favorite food plants of Japanese beetle. Populations can build to very large numbers, resulting in substantial damage to fruit and foliage. They are strong fliers and can invade from considerable distances from outside the immediate garden area. Plants can tolerate modest defoliation (10 to 15%) but higher levels of damage may reduce crop yield. On cane fruits, feeding damage can be to both leaves and fruit.

Many insecticides registered for use in raspberry plantings will kill Japanese beetle adults, but others may soon fly in from adjacent untreated areas. Japanese beetle traps are available and can catch thousands of beetles, but, because they can attract more beetles than they catch, research has shown that the use of traps can actually increase damage to small gardens. If you use traps, they should be placed at least 50 feet away from plants you wish to protect. If your planting is relatively small, you may find success using the woven fabric "floating row covers" that are available to protect garden plants from flying insects.

Raspberry sawfly

This insect is probably Wisconsin's most common raspberry foliage pest. The spiny, pale worms attack first when leaves are about three-fourths grown. They feed along the leaf edge, eating irregular holes until only the leaf veins remain. Characteristically, the worms raise their head and tail when disturbed. The adult is a black wasp with yellow and reddish markings.

To control, apply an insecticide just before the first blossoms open.

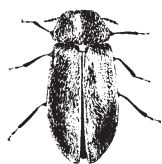
Spider mites

Occasionally, spider mites become troublesome, particularly during prolonged hot, dry weather. The minute creatures feed on the undersurface of leaves causing the foliage to become spotted with white or brownish flecks. If mites are too abundant, leaves will begin to fall and fruit will dry up.

If mites persist, use a dormant spray for control. During the growing season, use a recommended miticide.

Raspberry fruitworm

The grub is slender, whitish and about ¼-inch long. It feeds inside buds or in developing fruit, usually causing the fruit to drop or decay before harvest. Full-grown larvae drop to the ground, pupate, and emerge as beetles the following season. Beetles are light brown, hairy, and about ⅛-inch long. They feed on the tender foliage. Adult beetles will partially skeletonize the leaves. They lay their eggs on or near buds and green fruit.



To control, cultivate soil thoroughly in late summer to break up the pupal cases. If chemical control is necessary, treat just before the first blossoms open and again after the blossom period.

Picnic beetles

Also called sap beetles, these small, black insects with reddish-yellow spots on their backs become a severe nuisance soon after berries begin to ripen. The beetles are attracted to all types of overripe fruit. They may become abundant if excessive food sources are available outside the raspberry planting.



To control, remove as much damaged or overripe fruit from the planting as possible. Frequent picking will help reduce the amount of overripe fruit and decrease the area's attractiveness to the beetles. If they become extremely abundant, you may need an insecticide treatment to salvage the fruit. Insecticides are available to use during harvest, interrupting it briefly.

DISEASE MANAGEMENT

Anthracnose, spur blight, cane blight, Verticillium wilt, and gray mold are the more important fungal diseases that affect raspberries in Wisconsin. Powdery mildew occurs sporadically and is not a serious problem in most years. Phytophthora root rot has been diagnosed in several locations in the state, and fire blight, caused by a bacterium, has been confirmed. Virus diseases are widespread in Wisconsin and may be the limiting factor for raspberry production in some areas.

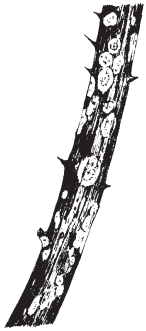
Accurate diagnosis of the problem is the first step towards effective disease management. Consistent disease management is essential for long-term raspberry production. It is best achieved by an integrated approach, which should include planting resistant cultivars (when known and available) and using both chemical and cultural control practices.

Cultural practices. Cultural practices that can be effective in disease management are:

- Plant only certified, pathogen-free plants obtained from reliable nurseries. Be aware, however, that only a few pathogens are screened at nurseries.
- Destroy wild or abandoned brambles near commercial and garden plantings; these are likely to be reservoirs for pathogens, especially viruses.
- After harvest, remove and destroy canes that have fruited or are weak and diseased; much of the inoculum for the following season is produced on canes infected during the current season.
- Improve air circulation by proper thinning and pruning and by controlling weeds. This will reduce moisture levels and promote drying in the plant canopy; most of the diseases caused by fungi need extended periods of wetness on the plant surface for infection to occur.

Chemical control. In addition to cultural practices, chemical controls often are helpful to maintain a high-quality raspberry planting. Only a limited number of fungicides are registered to control the fungal diseases that affect raspberries. For specific information on fungicides and application schedules, consult Extension publications *Strawberry and Raspberry Pest Management in Wisconsin* (A1934) or *Raspberry Pest Management for Home Gardeners* (A2128). Before establishing a new commercial raspberry planting, consider using a preplant soil fumigant.

Anthracnose



This fungal disease can attack all raspberries, but black and purple cultivars are more susceptible than most red cultivars. Small, purplish spots appear on the young canes and spurs. The spots enlarge and become oval-shaped and slightly sunken with buff-colored centers and purple borders. As heavily diseased canes mature, they dry out and crack lengthwise. With late-season infections, the lesions are generally larger, more buff or gray than purple, and so numerous that they join together and produce a condition known as “gray bark.” Diseased canes are prone to winter injury. Dark-colored fruiting bodies develop in a circular pattern on diseased canes. On leaves, lesions are small, approximately 1/16 to 1/8 inch in diameter, irregularly shaped, and whitish-gray in color with purple borders. Eventually the centers may drop out of the lesions creating a “shot hole” appearance on the leaf. Although the fungus may attack the fruit, rarely is this of any economic importance.

To manage, follow the cultural controls and fungicide applications recommended above.

Spur blight

This is one of the most troublesome fungal diseases attacking red raspberries. It also can occur on purple raspberries but usually is not a problem on black raspberries. Symptoms appear first on the green primocanes in late spring or early summer. Bluish-brown or purplish-brown cankers develop on the canes, usually where a

leaf is attached and usually on the lower portion of the cane. Occasionally leaves become infected. Lesions on leaves are large, brown, and wedge-shaped. Diseased leaves may fall off, leaving only the petioles attached to the cane. Cankers on canes enlarge but usually stop before reaching the next bud in either direction. When these diseased canes become fruiting canes the next season, the side branches growing from the cankered areas are weak and have yellowish leaves. The canes remain purplish to dark brown until late summer or fall, when they turn grayish. The bark splits lengthwise and small, pimple-like fruiting bodies producing spores appear in cankers.



By autumn, larger black pustules appear in the same areas. These are another type of fruiting body (which produces a different type of spore) and may resemble the fruiting bodies of the anthracnose fungus in its “gray-bark” stage. However, the fruiting bodies of the spur blight fungus are scattered rather than arranged in a circular pattern.

To manage, follow the cultural controls and fungicide applications recommended earlier.

Cane blight

With this fungal disease, cankers appear near wounds or at the base of the canes, and side branches may suddenly wilt—typically when berries are beginning to ripen. On the surface of older cankers, small black dots (fruiting bodies of the fungus) may appear. These dots are often surrounded by smoke-colored smudges of spores.

To manage this disease, both cultural controls and fungicide applications are recommended (see suggestions in Cultural Practices and Chemical Controls). Infection occurs through pruning and other types of wounds; therefore, avoid pruning and tipping during wet weather. Black raspberries appear to be more susceptible than red or purple raspberries.

Verticillium wilt

Verticillium wilt is caused by a soilborne fungus that attacks the roots and vascular system of raspberry and other plants. Symptoms are less severe on red raspberries than on black and purple raspberries. Initial symptoms usually appear between late spring and early summer. On infected plants, lower leaves on some of the primocanes will appear dull green rather than the typical bright green of healthy plants. As the disease progresses up the stem, the older leaves turn yellow and then drop off. The tip of the shoot will start to wilt, and eventually the entire cane may wither and die. Fruiting canes infected the previous season are more likely to die than are newly infected primocanes. Symptoms tend to be more severe when temperatures are high and the soil is dry.

A symptom called “blue stem” can occur on the canes of many cultivars. This dark blue discoloration appears as streaks or covers the entire surface. In advanced stages of disease, the plant’s vascular system is reddish in color and can be seen by cutting into an affected cane near its base. Often only one or two of the canes on a plant will show symptoms, and the remaining canes appear unaffected.

To manage this disease, begin by planting in a site that has never had Verticillium wilt and has not been used to grow one of the other susceptible hosts of this disease (e.g., tomato, potato, eggplant, strawberry, and others). Purchase and plant only pathogen-free plants. Remove and destroy symptomatic plants, including all the roots, as soon as they are recognized. If you must plant in a site where Verticillium wilt has occurred previously, there are two options to help reduce potential problems: grow a crop not susceptible to the disease (e.g., grain crops or corn) for 3 to 4 years before planting raspberries or consider using a preplant soil fumigant on commercial plantings (see suggestions in Chemical Controls). Fungicides will not control this disease.

Gray mold (Botrytis fruit rot)

Gray mold is one of the most common flower and fruit rots affecting raspberries. It is caused by a common fungus, and disease development is favored by wet conditions between bloom and harvest. Young flowers may blacken and die, similar to the symptoms of fire blight. Infected fruits develop areas of light brown cottony growth that later become powdery and gray as spores are produced. The disease may affect individual drupelets or the entire berry.

Proper site selection and thinning of canes to promote air circulation and drying conditions are important to manage gray mold. When environmental conditions favor disease, fungicides should be applied (see suggestions in Chemical Controls).

Powdery mildew

Powdery mildew is a potential problem in any given year; however, it is rarely of economic concern in Wisconsin. Unlike most fungal diseases, powdery mildew does not require free water—high relative humidity is enough. Symptoms first appear as light green blotches on the upper sides of leaves with corresponding white patches of spores on the undersides of leaves. Eventually, a whitish-gray powdery growth appears on, and may cover, both sides of the leaf. On severely affected shoots, leaves become twisted and shoots are stunted. This white, powdery growth also may cover the fruit.

To manage this disease, both cultural controls and fungicide applications are recommended (see suggestions in Cultural Practices and Chemical Controls).

Phytophthora root rot

This disease—caused by soilborne, water mold fungi—typically affects plants growing in soil with poor drainage that is wet for extended periods. Above ground, canes appear weak, stunted, and unhealthy, and leaves are small and off-color. Below ground, roots and the lower portion of the cane are rotted and typically reddish-brown.

Feeder and lateral roots may be missing entirely. Plants usually decline over time and, in most cases, eventually die. Occasionally, plants may collapse and die suddenly.

To avoid *Phytophthora* root rot, plant raspberries in well-drained soils. On soils with questionable drainage, improve soil drainage or plant on raised beds. Fungicides effective against these fungi are available, but they are not a substitute for good cultural practices.

Fire blight

Fire blight is a serious disease affecting apple, pear, and other plants in the rose family. Although the disease on raspberry is caused by the same bacterium that attacks apple and pear, the raspberry strains will not infect apple and pear, and the apple and pear strains will not infect raspberry. Symptoms of the disease include blackened shoot tips that wilt to form characteristic “shepherd’s crooks,” blighted flowers and blackened, immature fruits on dead stems.

Because of the relatively rare occurrence of fire blight on raspberry, no control strategies have been developed. Cultural practices aimed at disease management, especially removal of diseased canes, may be beneficial (see suggestions in Cultural Practices).

Crown and cane galls



These two similar diseases are caused by two different but closely related soil-borne bacteria. Cane gall occurs most often on black and purple raspberries and rarely on red raspberries. Crown gall occurs primarily on the lower stem or root crown of black raspberries, on the roots of red raspberries, and on both the root crown and roots of purple raspberries. This disease is particularly

a problem in nurseries; therefore, examine plants carefully before planting. Galls initially are spongy, rough, and wart-like; later they become hard and woody. Both bacteria infect plants primarily through wounds; consequently, galls tend to occur where plants have been wounded or injured.

Planting pathogen-free plants is the most important step in preventing these diseases. Avoid injuring roots and crowns. Chemical controls are not available.

Mosaic

Mosaic is one of the most commonly occurring and widespread virus diseases affecting raspberries. It is caused by several viruses, acting alone or in various combinations. All of these



viruses are transmitted by aphids. Leaves on affected plants can be mottled (light to dark green), blistered, or dwarfed. Infected foliage may turn yellow. Berries may be small and fall apart easily. Plants become progressively more stunted and unproductive over time. In hot weather, foliage symptoms often disappear.

This disease can best be managed by planting virus-free canes and controlling aphids. If fewer than 10% of the plants are affected, removing diseased plants (roguing) can be effective. If a greater proportion of the plants are affected, maintain the planting until fruit production is no longer profitable, then destroy it. Do not establish a new planting next to one with virus-infected plants or near wild bramble plants.

Tomato ringspot virus (crumbly berry)

Tomato ringspot virus may be the most widespread virus in raspberries in North America. It is especially important in red raspberries. The disease is also known as “crumbly berry” because affected plants produce small misshapened berries that fall apart when picked. Eventually these plants become stunted and unproductive. Leaves on fruiting canes may turn bronze in color. The virus is transmitted by dagger nematodes and has a wide host range, including many weeds.

Good cultural practices are essential for virus disease management. Before planting, have a representative soil sample analyzed for the presence of dagger nematodes. If necessary in commercial plantings, fumigate soil. To help prevent spreading the disease, avoid moving soil, which may contain virus-carrying nematodes, from areas with symptomatic plants to areas where plants show no symptoms.

Leaf curl

This virus disease is less common than mosaic or crumbly berry. Leaves curl downward and become dwarfed, and shoots appear stunted. Some shoot proliferation may develop. Aphids transmit the virus that causes leaf curl. To manage, follow the recommendations suggested for mosaic.

WEED MANAGEMENT

Weeds compete for water, nutrients, and light during critical periods of active growth and fruiting. They can also harbor diseases and insect pests, and can interfere with cultural practices and harvesting. To minimize weed problems, you’ll need to use a combination of timely cultivation, mulches, and appropriate herbicides.

Control severe infestations of perennial weeds, such as quackgrass or Canada thistle, before setting out new raspberry plants. Usually repeated

cultivation plus a selective, nonresidual herbicide will effectively control weeds in one full growing season before planting. Before using any herbicide in a preplant weed control program, check current Extension service information on herbicide persistence and potential toxicity to cultivated crops.

Cultivate raspberries frequently after planting to prevent weed growth and seeding. In established plantings, stop cultivating by mid-August or before harvest to avoid damaging ripening fruit and to allow plants to “harden off” early in fall. To reduce injury to raspberry plant roots, never cultivate deeper than 2 to 3 inches.

Plant a cover crop such as grass in the area between rows and keep it mowed. The cover crop will help keep weeds out of the planting. Non-spreading grasses such as perennial rye work best.

Suggestions for using herbicides in established raspberries are revised frequently. For current suggestions refer to Extension publication *Raspberry Pest Management for Home Gardeners* (A2128), or for commercial plantings consult *Strawberry and Raspberry Pest Management in Wisconsin* (A1934). These bulletins are available from your county Extension office.

PROBLEM SOLVING

Why raspberry plants fail to bear

There are many potential reasons why raspberries don’t bear fruit—cold winters, too much fertilizer, crowding, pests, or incorrect management. This section describes the most common problems and how to avoid them.

Cold injury. Raspberries are susceptible to winter cold injury. Fully acclimated red raspberries can tolerate temperatures to about -20°F , purple raspberries to -10°F , and black raspberries to -5°F . Below these temperatures injury and crop loss are certain, although injury may occur at warmer temperatures. Mulching helps keep the crown temperatures stable and will protect the crown,

particularly in sandy soils. In areas where snow is deep and reliable so that the canes are covered, winter injury should be minimal.

Overfertilization. Raspberries require moderate nitrogen fertilization. Bearing plantings should only receive two light applications of nitrogen fertilizer in the spring. Heavy nitrogen fertilization encourages vegetative growth at the expense of fruit growth. Young plantings should be well fertilized to encourage suckering.

Overcrowding. Because raspberries sucker profusely, plantings may become too dense. Overcrowding occurs when too many canes are allowed to grow in a section of row. The canes will compete with each other for light, water, and nutrients. When raspberry patches become a solid mat rather than a collection of rows, fruit quality declines, and harvest is difficult.

Pests. Weeds will compete with raspberries for water and nutrients. Grass weeds are most competitive. Weedy berry patches will produce few fruit of poor quality. Dense weeds also promote slow drying, make spray penetration difficult and impede harvest. Insects such as raspberry sawfly can reduce leaf area leading to canes having too little carbohydrates to produce flower buds.

Incorrect management. Summer-bearing and fall-bearing raspberries must be managed correctly to yield fruit. The canes of summer-bearing raspberries do not produce flowers and fruit until the second year. If summer-bearing raspberries are mowed off each dormant season (as is typically done for fall-bearing raspberries), no floricanes will be left to produce the crop.

Poor fruit quality

In some instances raspberry plantings produce fruit, but the fruit are small, crumbly, poorly colored and of low quality. This section describes several problems that lead to poor fruit quality.

Heat and light. In hot summers raspberries will sometimes become “crumbly” where the individual drupelets are not well connected. This may also be caused by viruses. When fruit are

exposed to direct sunlight the fruit can “scald” resulting in either a few white drupelets or fruit that are dried out on one side. Often these conditions are found in patches with weak cane and foliage growth such that leaves don’t shade the developing fruit. Keeping patches well pruned, irrigated and fertilized will help prevent these problems.

Age. As plantings age yields decline. Raspberry plantings are usually kept to bear fruit between 10 and 12 years. After that the planting should be removed and another crop rotated into that space for a year or two before replanting. Old plantings usually have more weed and insect pests than younger plantings.

Insufficient pruning. Plantings rapidly become overcrowded unless they’re pruned annually. When hedgerows or hills become too wide, little fruit of poor quality will be produced in the interior of the canopy. Remove floricanes after the fruit has been harvested. During the dormant season cut out all but four to six canes per foot of row.

Neglected plantings. Fruit quality suffers when plantings are not cared for. The plants need to receive proper cultivation, fertilization, and pest management as described in this bulletin. Reclaiming neglected plantings is usually not effective. It is better to remove the planting and start over with new nursery stock.

Poor growing conditions. Patches established in poor sites will produce poor fruit. Wet, shady, or droughty sites will result in poor plant growth and few small fruit. Raspberries must have at least a half day of full sun to be productive. The soil should also be prepared properly before planting.

Pests. The most common insect pest of raspberries is the picnic beetle. Picnic beetles feed on ripe fruit remaining on the canes. The beetles feed and crawl into the “thimble” interior and are not always visible until harvesting the berries. Harvesting fruit two to three times per week will help keep feeding to a minimum. In severe cases insecticides will be required to manage picnic beetles.

Inferior cultivars. Inferior cultivars will produce inferior fruit. For the best chance of success plant cultivars recommended in this bulletin, in *Home Fruit Cultivars for Northern Wisconsin* (A2488), or in *Home Fruit Cultivars for Southern Wisconsin* (A2582).

Why plantings fail

Plant death is usually caused by a number of interacting factors rather than by a single identifiable cause. One injury may provide sufficient stress to allow other problems to eventually kill the plants. Several reasons for plant death are described here.

Winter injury. Red raspberries are sufficiently hardy to survive and fruit in Wisconsin's harsh climate. However, purple and black raspberries are quite winter tender and will often sustain winter injury. Snow can be captured over raspberry plants during the winter by placing snow fencing to the windward side of the plants. Snow will insulate the canes and protect them from the coldest temperatures.

Too much water. Raspberry plants will not tolerate wet feet. Saturated soils do not allow air to reach the roots and they predispose the plants to root rot diseases. Plant raspberries only in well-drained soils. Heavy clay soils will remain wet longer than lighter sandy soils. Use irrigation prudently so soils don't remain wet.

Drought. Raspberry plants are shallow rooted and don't explore a large soil volume. When soils dry out the plants will wilt and die. Weeds will also compete with raspberry plants for moisture when water is in short supply. Light sandy soils are particularly prone to drought. Adding organic matter, controlling weeds, and irrigating will keep soils moist.

Mechanical injury. A myriad of factors can injure raspberry plants. Common sources of mechanical injury include lack of care while picking, running mowers too close to the canes, and animal feeding and browsing. If deer populations are high the planting may need to be fenced to deter the deer.

Insect and disease pests. Severe infestations of insects or diseases can weaken plants making them prone to winter injury or summer droughts. While these pests seldom kill plants outright, they are often contributing factors. If your planting becomes infected with viruses the only solution is to remove the planting and replace it with fresh plant material. Manage insect and disease pests using the practices described earlier in this publication.

RELATED PUBLICATIONS

For home gardeners

Fertilizing Small Fruits in the Home Garden (A2307)

Home Fruit Cultivars for Northern Wisconsin (A2488)

Home Fruit Cultivars for Southern Wisconsin (A2582)

Raspberry Pest Management for Home Gardeners (A2128)

Raspberry Disorders:

- Cane Blight and Spur Blight (A3236)
- Fire Blight (A3499)

Small Fruits: Insect and Disease Management for Backyard Fruit Growers in the Midwest (AIDEA2), Iowa State University, (515) 294-8802

For commercial growers

Strawberry and Raspberry Pest Management in Wisconsin (A1934)

Compendium of Raspberry and Blackberry Diseases and Insects, APS Press, (800) 328-7560.

Midwest Small Fruit Pest Management Handbook (Bulletin 861), The Ohio State University, (614) 292-1607.

Bramble Production Guide (NRAES 35), Cornell University, (607) 255-7654



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Authors: B.R. Smith is professor of horticulture, College of Agriculture, Food and Environmental Sciences, University of Wisconsin-River Falls and University of Wisconsin-Extension, Cooperative Extension. T.R. Roper is professor of horticulture, D.L. Mahr is professor of entomology, and P.S. McManus is professor of plant pathology, College of Agricultural and Life Sciences, University of Wisconsin-Madison and University of Wisconsin-Extension, Cooperative Extension. Produced by Cooperative Extension Publishing. Cover illustration by Catherine Baer, copyright 1998. Japanese beetle illustration by David Shetlar.

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