

The raspberry belongs to a group of small-fruit crops called brambles. Brambles have perennial root systems and biennial canes. Canes produced during spring and summer (primocanes) will produce fruit on the same canes the following summer (floricanes). The canes will then die back to ground level during winter.

The raspberry is an aggregate fruit composed of 75 to 125 drupelets. The drupelets are held together by microscopic, interlacing hairs. The core of the raspberry fruit remains on the plant when picked. Raspberry fruit can be red, yellow, purple, or black.

### CLIMATIC ADAPTATION

The red raspberry is the hardiest or most cold tolerant of the bramble or cane berries. 'Latham' has been known to survive temperatures of -40°F. Black raspberries, or blackcaps, are adapted to more moderate winter climates. Both can be grown in Northern New Mexico, but must be protected from late spring freezes after plants break winter dormancy.

Most traditional or standard raspberries (biennial canes) have a chill unit requirement of about 800+ hours below 45°F. This chill unit requirement is normally met sometime in January or February in Northern New Mexico. Canes subjected to temperatures above 40°F after the chill unit requirement is met rapidly break dormancy. As a result, buds rapidly lose their cold hardiness.

Canes that have broken dormancy are susceptible to freeze damage. The amount of freeze damage depends on several factors, including the duration and intensity of the cold period and the levels of carbohydrates or food in the canes. Temperatures that fluctuate above and below freezing can cause the most damage. The damage is intensified during dry, windy weather.

New foliage on freeze-damaged canes may appear to be normal in the early spring. However, as temperatures warm up in June, increased water loss from leaves causes new foliage to be stunted and berries to shrivel. Hot, dry, windy weather will result in soft, seedy berries. Often, berries will turn white and leaves will be scorched.

Gardeners can often overcome these problems by using microclimates in the garden. Walls or trees can protect raspberries from spring winds. Raspberries planted on the north side of a house will break dormancy later in the spring, and berries will mature under cooler conditions. Commercial growers, however, can rarely take advantage of such microclimates.

### EVERBEARING RED RASPBERRIES

The New York Agricultural Experiment Station released an everbearing raspberry called 'Heritage' in 1969. Everbearing raspberries differ from standard raspberries in that they send up new canes during spring and summer and produce berries on the terminal ends of these canes during fall of the same year. Canes can be mowed down to ground level with a brush hog, sickle mower, or loppers during winter. New canes are produced the following spring that in turn produce berries in the late summer-fall. This eliminates the problem of freeze damage on overwintering canes that occurs with standard raspberries. This also solves the problem of selectively thinning canes that have fruited from those that haven't. Mowing also reduces insect and disease problems the following year. Labor needed to prune standard raspberries is also eliminated.

Everbearing raspberries also produce fruit of superior quality when grown as a fall crop. Cool weather seems to increase sweetness and red color of the berries. Fruit scalding and field heat are reduced, resulting in firmer berries with longer shelf life.

Everbearing raspberries left unmowed during winter will produce like standard raspberries the following summer. Canes that produced berries during the previous fall (terminal ends) will produce berries again on the lower portions of the canes the following summer. This, however, defeats the purpose of growing everbearing raspberries. Freeze damaged canes would still be a problem, generally resulting in a very small summer crop. The fall crop generally produces much higher yields. Yields in New Mexico will typically vary from 8,000 to 12,000 pounds per acre, or 12,000 to 15,000 half pints of berries per acre.

New canes are produced each year from basal cane buds and from suckers that grow from an extensive, spreading root system. Flower bud induction on these primocanes takes place during summer (under long days) and is correlated with the age of the terminal meristems. Flower bud initiation generally takes place when the canes have reached 35 to 45 nodes in height. Thus, the sooner vegetative growth starts in spring, the sooner flowering will take place. Early vegetative growth can, however, be injured by late spring frosts.

### SITE SELECTION

Everbearing red raspberries grow best during relatively cool, dry summers. Dry weather reduces the incidence of cane and foliar diseases. Hot, dry, windy weather will, however, retard

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cane growth. The harvest period during fall should be relatively free of rainfall. Rainy weather increases fungal infection of the berries.

The raspberry site should have good air circulation, preferably on a hillside, to prevent an accumulation of cold air. Sloping sites will also provide good surface water drainage during periods of excessive rainfall. South-facing slopes warm earlier in spring, resulting in earlier cane growth.

Raspberries grow best in New Mexico in loam or sandy loam soils with a pH of 6.5 to 7.5. Such soils should be 2 to 4 feet deep, well-drained, and relatively free of salt. Raspberries have little tolerance for soils high in either calcium or sodium salts. Soils should also be free of perennial noxious weeds and nematodes; these pests should be eliminated the year before raspberries are established.

Soil improvement programs should be started the year before raspberries are established. Green manure crops of winter wheat, barley, or rye should be planted in fall and turned under the following spring. Barnyard manures can be applied at a rate of 8 to 12 tons per acre during fall. Poultry manure can be applied at a rate of 5 to 6 tons per acre. All manures should be low in salts and free of weed seeds.

## PLANT ESTABLISHMENT

Most new plantings are established from dormant, bare-root plants or root cuttings. Certified, virus-free planting stock is recommended. This minimizes the chance of introducing new disease and insect pests into your field.

Establishing everbearing red raspberries is generally more difficult than establishing standard types. Wind and salt in either the soil, water, or both severely reduce the survival of everbearing raspberries. The use of high-quality irrigation water and windbreaks on the west and south sides of the planting greatly increases plant survival.

If possible, plants should be shipped by plane or truck directly from the nursery. They should be unpacked immediately and the roots soaked in water before being planted. Dipping the roots in a liquid gel treatment that attracts water and a root stimulator solution just before planting also improves survival. If plants arrive during bad weather, they can be stored in moist burlap at 32 to 38°F in the dark until the weather improves, or heeled in until you're ready to plant. Plants that will be heeled in should be laid out in a single layer of plants in a shaded, shallow trench deep enough to accommodate the roots. Roots should then be covered with soil, firmed for good soil contact, and watered. Plants can generally be held quite safely under these conditions for 1 to 2 weeks.

Dormant plants should be planted in early spring. Root development occurs faster at cooler soil temperatures (50°F). Planting sprouted plants later in the season generally results in a poor stand.

The soil should be thoroughly prepared before planting begins. Rows should be 8 to 10 feet apart. The distance between rows depends on cultivation equipment, but growers should take into account that the eventual hedgerow of raspberries will be 2 to 3 feet wide. Enough room should be left at the end of the rows to turn tractors around. Space should also be left for access roads.

Plants can be placed in a 3- to 4-inch plowed furrow with roots spread out in the bottom of the furrow and covered with 2 to 3 inches of soil. Place plants every 18 to 24 inches along the furrow. Root cuttings should be placed in the bottom of the furrow so that they are overlapping, and covered with not more than 3 inches of soil. Firm the soil after planting to remove any excess air pockets. Tops of the transplants are generally cut off 4 to 6 inches above ground level. All plants should be watered immediately.

Plants that do not survive the first year can be replaced with new bare-root plants the following spring. Blank spaces in the hedgerow can also be filled in by digging rooted suckers for transplants from the alleys between rows. This can be done during the early fall or early spring. In either case, a soil ball should accompany the roots to minimize shock to the sucker. Sucker tops should be cut back to balance the root and cane growth.

Raspberries can also be established from tissue-cultured plants. Tissue-cultured plants are generally actively growing green plants, 3 to 6 inches high, and growing in individual plugs or cells. These plants are vegetatively propagated in labs and/or greenhouses from cells of virus-indexed mother plants (certified to be free of viruses).

Tissue-cultured plants shipped to growers have well-developed roots and are hardened off outside before shipment. Plants should not be transplanted to the field until after all danger of frost has passed. They may be planted throughout the summer (except in very hot areas) up until one month before frost.

Transplanting should occur late in the day, early in the evening, or during cloudy weather to reduce transplant shock. Transplant into moist soil, planting plugs 1 inch below ground level and firming soil up around the plant. Be sure to keep the soil moist but not soaked.

Although the cost of using tissue-cultured plants is much higher than bare-root stock, tissue-cultured plants generally exhibit greater vigor, are more uniform in size, and have higher growth rates and field survival. Most tissue-cultured plants are also adapted for mechanical transplanting.

## FERTILIZATION

During the latter phases of land preparation, preplant phosphorous fertilizer should be broadcast and tilled or banded into the centers of potential hedgerows at a rate of 50 to 80 pounds of  $P_2O_5$  per acre. If a soil analysis indicates that phosphorous is required, it should be applied in spring. Potassium should be applied only if a soil analysis indicates there is a potassium deficiency.

As new plants start to develop the first year, nitrogen fertilizers should be applied at a rate of 10 to 20 pounds of elemental nitrogen per acre. Nitrogen fertilizers should only be applied after the plants have had sufficient time to establish themselves (4 to 6 weeks). Earlier or heavier applications of nitrogen may burn young developing roots. Nitrogen should be applied at a rate of 60 to 100 pounds per acre in following years. All nitrogen should be applied in split applications, half in late March or early April and half in late June if using pelleted nitrogen, but applied more often if using liquid nitrogen

injected into the drip system. If applying manures or composts, they should be applied after pruning in the winter.

Growers using furrow or sprinkler irrigation should band all fertilizers 2 to 4 inches away from the outside edges of the hedgerow, and 2 to 4 inches deep. Soluble formulations of nitrogen and phosphorous fertilizers can also be applied through surface or underground drip systems. Nitrogen fertilizers can also be broadcast across the hedgerow and watered in.

Plants that show symptoms of iron or zinc chlorosis should be treated with foliar applications of iron or zinc sulfates or chelates. Foliar applications of these materials should not be applied during flowering because flowers may be burned. Growers should follow the label rates for best results.

## IRRIGATION TECHNIQUES

Raspberries can be irrigated with furrow, sprinkler, or drip systems. Furrow irrigation is generally the cheapest way to irrigate, but is not appropriate for fields that are not level.

Sprinklers can be used on land that is not level, and can also be used for protection from freeze damage in the fall. Sprinklers, however, can be quite expensive. Growers may also find that foliar and fruit diseases increase. Both furrow and sprinkler irrigation increase weed populations within the alleys, in contrast to drip irrigation.

Although drip irrigation is somewhat expensive, it is the most efficient way to apply water in terms of water use. Because water is generally confined to the root area, weeds are not as prolific in the alleys. Drip irrigation systems apply water more uniformly and require less labor, but can be damaged by rodents and cultivation unless the drip hose is suspended on a wire 15 to 18 inches above ground level.

Raspberries should never be severely stressed for moisture. Plants should be irrigated any time the available moisture in the top 2 to 3 feet of soil drops below 50%. Irrigation is particularly critical during bloom and when the berries are sizing.

## TRAINING AND PEST CONTROL

Everbearing (primocane bearing) raspberries are generally more erect and sturdy than regular raspberries, but most will benefit from a simple support system that may consist of poles or posts placed every 20 to 25 feet with support wire or twine placed on each side of the plants to help keep the fruit off the ground. Most varieties sucker prolifically and will form a mature hedge in 2 to 3 years. Hedges should be maintained to be 2 to 3 feet wide through cultivation, mowing, discing, or tilling. Wider hedges yield smaller berries and are harder to pick.

Cultivation or mowing will control most weeds within the alleys. Because raspberries have relatively shallow roots, cultivate no deeper than 2 inches. Annual weeds within the hedgerow can be controlled with preemergent herbicides. Information on registered herbicides for use on raspberries can be obtained from your county Extension agent. Perennial weeds should be eliminated before the planting is established.

Few insect pests have been noted on raspberries in New Mexico. Growers should, however, keep a watchful eye on their plants. New insect infestations should be reported to your county Extension agent, who can help with insect control.

Raspberries are susceptible to numerous virus diseases. Once infected, plants cannot be cured. Viruses are commonly spread by aphids, nematodes, or infected pollen. The most effective way to control viruses is to plant virus-free planting stock. Wild raspberries in the area should also be destroyed. Diseased plants in the field should be removed and destroyed. Aphids should also be controlled.

Verticillium wilt is a soil-borne fungus that can be a problem in some areas of New Mexico. Leaves on infected plants turn yellow and eventually die. Canes often turn blue as the disease proceeds up the canes. Vascular tissues generally exhibit red discolorations.

Planting certified, disease-free plants in a Verticillium wilt-free soil is the best method of control. Raspberries should not be planted in soils that have been planted to potatoes, tomatoes, peppers, eggplant, strawberries, or other cane berries that have been infected with wilt in previous years. Infected plants should be removed from the field and burned.

All fields should be tested for nematode problems before planting. Typically, nematodes are a greater problem on sandy soils than on heavier soils. The root lesion (*Pratylenchus* spp.) and dagger (*Xiphinema americanum*) nematodes will cause weak cane growth, small leaves, and will reduce fruit size. The foliage may also turn yellow and drop in hot weather. Soil fumigation in the summer is the most effective means of control.

## POLLINATION

The raspberry is self-fruitful. Pollen transfer generally takes place within the same flowers via wind and insects. Honeybees are responsible for 90 to 95% of pollination. There should be at least two hives per acre. On cold, windy days, pollination is normally done by bumblebees and wild bees.

Lack of bee activity may result in a condition known as crumbly berry. Normally, raspberry flowers have 100 to 125 pistils from which 75 to 85 drupelets will typically develop. When pollination is incomplete and fewer drupelets develop, the berry will often crumble when it's picked. Crumbly berries can also be caused by drought, low soil fertility, viruses, winter damage, variations in male and female sterility, deep cultivation, and nematode infestations.

## HARVESTING

All pickers should be trained before harvesting begins. Mature fruit should be gently removed from the plant with the thumb and two fingers and a slight twist of the wrist, rather than a pull-and-jerk technique. Berries should not be squeezed, and only a few should be held in the palm at one time before being transferred to the picking container. Small picking containers can be fastened to the waist or hung around the neck. Care should be used in transferring berries from the picking containers to bulk trays. All moldy or insect-damaged berries should be discarded in the field.

At no time should berries or bulk trays be allowed to come in contact with the soil. All containers should be kept as clean as possible.

Picking should always be done in the morning to reduce the amount of field heat in the berries. The berries are also

firmer and easier to pick at this time. Bulk trays should be shaded at all times. Trays should be transferred to walk-in coolers as soon as possible.

Fruit should be graded as soon as possible. Only firm, blemish-free, mature fruit should be selected. Fruits are generally packed two to three berries deep in shallow, half-pint baskets and covered with perforated cellophane. Berries should be transported to market as soon as possible. Graded berries can, if necessary, be held at 31 to 32°F and 90 to 95% humidity for 1 to 2 days.

### **EVERBEARING VARIETIES**

**'Caroline'**—most productive everbearer at the Alcalde Agricultural Science Center variety trials; large berry with a rich and intense flavor; fruit ripens 10 to 14 days earlier than 'Heritage' and is widely adapted.

**'Polana'**—earliest everbearing variety, ripening three weeks earlier than 'Heritage'; highly productive with large, glossy, good flavored berries; recommended for colder (high elevation) areas of New Mexico.

**'Heritage'**—canes very vigorous, hardy, erect, sturdy, and sucker prolifically; medium-sized berry with conic shape, firm flesh, good flavor, and excellent quality; fairly late maturing and thus not recommended for colder (high elevation) areas of New Mexico.

**'Anne'**—largest, best tasting yellow raspberry; very productive, but not firm enough for shipping.

Other varieties that warrant trial are **'Joan J'** (smooth stem), **'Polka'**, **'Himbo-top'**, and **'Josephine'**.

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