

Bulletin No. 39

Revised April 2006

Growing Blackberries in Missouri



State Fruit Experiment Station
Department of Agriculture
Missouri State University™
Mountain Grove Campus

GROWING BLACKBERRIES IN MISSOURI

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Growing Blackberries in Missouri

Blackberries of one type or another are native to much of North America, and were part of the diets of wildlife, native Americans, and the early settlers. The first serious attempt at cultivation in North America was in 1850. By 1900 blackberries were an important commercial fruit crop in Missouri. Since then plant breeders have developed improved varieties, engineers have developed mechanical harvesters, and more people have developed a taste for this luscious fruit.

The relative ease of producing blackberries makes them attractive to growers. High yields can be expected (at least 6,000 lbs./acre) if properly managed. Possible direct marketing can make growing blackberries a promising commercial enterprise as well. At the present time blackberry production in Missouri is primarily a small scale or "cottage" industry.

The Blackberry Plant

The blackberry plant has a perennial root system with biennial canes or shoots. New canes, called primocanes, grow the first season. Primocanes remain over winter and are called floricanes the second year. Floricanes flower, bear fruit, and then die after fruiting.

The blackberries commercially grown in Missouri can be grouped into three classes. Erect thorny blackberries bear fruit on thorny, self supporting canes. Erect thornless blackberries are similar except for the lack of thorns. Both of these classes spread by root suckers and eventually form a continuous hedgerow. Trailing thornless blackberries produce long, vigorous canes that require a trellis for support. This class of blackberry does not produce suckers and plants are maintained as clumps with new canes arising from a single crown.

Blackberries can suffer damage from cold temperatures in Missouri. This damage can occur in the fall (from sudden temperature drops before plants are hardened off), during the winter, and from spring frosts. Buds may be damaged, reducing the crop. Canes may also suffer damage. As a group the trailing thornless blackberries are less hardy than the erect types, though erect thorny and thornless blackberries can also suffer damage from extreme cold.

At the present time, the risk of crop loss and the expenses associated with trellising may reduce the potential for profit from a trailing thornless blackberry planting to the point that commercial production is not warranted in Missouri. Trailing thornless blackberries are harvested later in the season than upright blackberries. This harvest at a "non traditional" season when the temperature is warm can complicate marketing. Upright thorny and thornless blackberries offer greater opportunities for commercial production. This situation may change as hardier trailing thornless cultivars are developed and different cultural systems are investigated.

Site Selection

The considerations in selecting a site for blackberry production are both general and individual. Climate, especially minimum temperature, is the factor that most limits blackberry production in Missouri. Individual testing at a proposed site is the best way to determine if blackberries are adapted to a given site.

Individual site considerations include the following: soil characteristics, air drainage, water availability, the previous use of the site, labor availability, and market considerations.

While blackberries are adapted to a wide range of soils, the best blackberry soils are well drained and of sufficient depth (about 2 feet). Soil testing is critical in evaluating a site for blackberries. Information on soil testing is available at University Extension offices, and soil samples can be submitted to these offices for analysis. Collect enough samples to represent the proposed site, and sample to a depth of 12 to 18 inches (most of a blackberry's root system is confined to the upper 18 inches of soil). Soil test results should indicate a slightly acid pH (5.5 to 6.5) and moderate fertility (phosphorus at 50 lb./acre and potassium at 200 to 300 lb./acre). While blackberries are tolerant of the low soil organic matter levels commonly found in Missouri, adequate amounts of soil organic matter (2 to 3 %) are beneficial.

Good soil water drainage is critical for blackberries. Blackberry root systems are very sensitive to excess soil water and soil-borne diseases are more severe under waterlogged conditions. Drainage should be evaluated at all proposed planting sites using test drainage holes. In spring or fall dig several holes to a depth of 2 feet. Fill the holes with water, and observe the time

required for the water to drain. The hole should drain within 24 hours. Drainage problems can be corrected to some extent by planting on raised beds, but the best approach is to avoid sites with poor soil water drainage.

A good blackberry site should be elevated above surrounding land and on a slight slope. Cold air is heavier than warm air and flows away from elevated areas. Avoid planting in "frost pockets", low lying areas where cold air settles and frosts are likely. Good air drainage also reduces humidity around plants and promotes rapid drying of foliage, reducing disease problems. Blackberry canes can be damaged by strong winds, so a protected site is desirable. The importance of good air drainage, however, may overrule the benefits of a protected site.

Potential sources of irrigation water are also an important site consideration. Sites near towns or cities may have access to municipal water supplies, a reliable (though likely expensive) source. Other potential water sources include wells and surface water (lakes, ponds, streams). Both water quantity and quality should be considered when evaluating a potential water source.

A new blackberry planting should be as far away from wild brambles or existing bramble plantings as possible. Destroy wild brambles within at least 1000 feet if possible to reduce the spread of diseases and insect pests into the new planting. Trees, shrubs, and perennial weeds present at a proposed site will make site preparation more expensive. Avoid planting blackberries in an area where strawberries, tomatoes, potatoes, peppers, eggplants, or other brambles have been grown during the previous 4 to 5 years. These crops are susceptible to verticillium wilt, a soil-borne disease that can destroy a blackberry planting.

Blackberries are a labor intensive crop, and sufficient labor must be available during critical times of the season, especially at harvest. Pick your-own marketing may partially address a labor shortage. However, a reliable labor source is important if marketing strategies change and for cultural practices, such as pruning and tipping, during other times of the year. Potential growers should not over-estimate the energy or time available from themselves and family members.

A blackberry grower must carefully plan a marketing strategy and evaluate the potential of a site for this strategy. Good sites for pick-your own or on-farm sales should be located in an area with sufficient population or traffic to support the planting. Good access is important, as are surrounding attractions that bring people to an area. Growers contemplating off-farm sales should be located as

close to potential markets as possible, Blackberry fruit are perishable, and do not store or ship well.

Cultivars

Blackberry growers have available a wide range of cultivars adapted to Missouri. Cultivar choices are rapidly evolving, and growers are advised to contact the SMSU Fruit Experiment Station for the latest information on established and new cultivars.

Blackberries are divided into erect and semi-erect types. Erect cultivars, which include both thorny and thornless types, are self supporting and require minimal trellising. Semi-erect cultivars, which are thornless, should be trellised.

While winter hardiness is an issue for all Missouri blackberry growers, many cultivars are sufficiently hardy for profitable production. In general, the semi-erect cultivars are more sensitive to cold winter temperatures than erect cultivars. All blackberries can suffer winter damage during particularly harsh winters. Commercial blackberry production is primarily located in central and southern Missouri, where winter temperatures are more moderate.

The following cultivars have been tested at the SMSU Fruit Experiment Station at Mountain Grove and are suggested for commercial production:

Erect Thorny

'Shawnee'- Vigorous, productive plants. Season late June-July. Even distribution of yield over a 3-4 week period. Consistent producer of med-large, glossy berries of good quality. Berry too soft for long term storage. 'Chickasaw'-

Vigorous, productive plants. Season late June-July. Among the highest yields in trials. Consistent producer of large berries of good quality. Berry firmer than 'Shawnee', but still too soft for long term storage

'Kiowa'- Vigorous, productive plants, but less productive than 'Shawnee' or 'Chickasaw'. Produces largest berry of erect blackberry cultivars. May suffer damage in moderate to severe winters.

'Darrow' and 'Illini'- Two hardy cultivars that are recommended only where winter temperatures are too extreme for other blackberry cultivars. Productive, erect bushes. Long fruiting period. Fruit small to medium size, glossy, and mildly tart. Fruit quality is only fair.

'Cheyenne', 'Cherokee'- These cultivars, while still planted in Missouri, are of less importance now and are not recommended for commercial production.

Erect Thornless

'**Navaho**' - Thornless, erect, self-supporting plant. Season July-early August, one week after 'Shawnee'. Firm, medium size fruit; medium size seeds. Fruit quality good, comparable in quality to thorny erect cultivars. Firm berry offers potential for short term storage and shipping. Susceptible to orange rust in Missouri.

'**Apache**' - Thornless erect cultivar. Season July-early August, just after Navaho. Fruit size large, moderately firm. Fruit quality good. Among the hardiest of the erect thornless cultivars; hardiness equal to thorny blackberries. Among the most productive of the erect thornless cultivars.

'**Ouchita**' - Recently introduced thornless erect cultivar. Earlier than 'Navaho' or 'Apache'. Fruit size similar to 'Navaho', with similar fruit firmness. Hardiness untested in Missouri at publication. For trial planting only.

'**Arapaho**' - Thornless erect cultivar. Season late June-July. Earliest of the erect thornless cultivars. Fruit size medium, fruit quality good. Less productive than 'Navaho' or 'Apache'. Less winter hardy than 'Navaho' or 'Apache'. For trial planting only.

Semi-Erect Thornless

'**Chester**'- Vigorous and productive. Season mid-July - August. Resistant to cane blight. High quality fruit, medium fruit size. Observed to be more winter hardy than other semi-erect thornless blackberry cultivars in Missouri. Trellising recommended.

'**Triple Crown**'- Vigorous and productive. Season mid July - August. Earlier than Chester. High quality fruit, medium fruit size. Observed to be similar in hardiness to 'Chester'. Trellising recommended.

'**Black Satin**', '**Dirksen**', '**Hull**' - While still planted in Missouri, these semi-erect thornless cultivars are not recommended for commercial production.

Site Preparation

Site preparation should begin at least a year before planting. Three main factors are included in site preparation: adjusting soil fertility and pH, building up soil organic matter, and eliminating perennial weeds.

The first step in site preparation is to layout the planting. Erect thorny and erect thornless cultivars are commonly planted in rows 8 to 10 feet apart, while trailing thornless cultivars should be planted in rows 10 to 12 feet apart. Actual row spacing is also determined by the width of equipment. In many situations only a strip centered on the planting row need be prepared. The row middles can be planted in grass, or left as is if perennial weeds are not a problem. This approach is especially recommended on sloping sites where erosion potential is present.

Any perennial weeds such as johnsongrass, bermudagrass, multiflora rose, or wild brambles present on the site should be eradicated with herbicides prior to planting. The herbicides effective against these perennial weeds are not registered for use on cultivated blackberries after planting. The postemergent herbicide glyphosate works well against these perennial weeds. In many cases only a three foot strip centered on the planting row need be sprayed. In some cases, when the weeds present at the site are tough perennials, the entire area should be sprayed with glyphosate. This should be done in the late spring or early summer while the weeds are rapidly growing. After the weeds have died, either till the strips or plow and disc the entire site (if treated). A suitable cover crop should be planted to reduce erosion in all worked areas. Bluegrass, orchard grass, or perennial ryegrass work well as permanent row middles. Sudan grass can be used as a warm season green manure in the planting strips, while annual grasses (wheat, oats, or annual ryegrass) can provide cover in the fall, winter, and spring.

Soil testing is critical for proper site preparation. Soil samples should be taken from the plowed planting strips, and the soil should be sampled to a depth of 12 to 18 inches.

University Extension will send the grower written recommendations on bringing the soil up to the proper pH and fertility. The pH should be corrected to 5.5 to 6.5. The phosphorus level should be at least 50 lb./acre, and potassium at least 200 to 300 Lb./acre. Fertilizer materials such as phosphorus, potassium, calcium, and magnesium should be applied 6-12 months before planting. Low pH soils can be modified with lime, while high pH can be lowered with sulfur. Contact the SMSU Fruit Experiment Station for more information in these areas. Keep in mind that materials will be applied only to the planting strip. Thus, with planting rows 3 feet wide and rows 10 feet apart, only 30% of a

given area is treated. A fertilizer recommendation of 200 Lb./acre will actually require 30% x 200 lb., or 60 lb., of fertilizer spread over the planting rows in that acre.

Blackberries benefit from adequate amounts of soil organic matter. Building up the soil organic matter is especially important in areas where soil humus is low, as is the case in many parts of Missouri. It is difficult to augment the organic matter directly under the plants once they are established, and increasing the organic matter content prior to establishment will benefit the blackberries for the life of the planting. Planting and turning under cover crops is an excellent way to build organic matter, as is applying manure. If manure is used, 8-10 tons/acre of barnyard manure or 23 tons/acre of chicken litter is recommended. Manures should be applied the fall prior to planting to allow for decomposition and to avoid nitrogen burn to plants. Other organic materials, such as grass clippings, straw, chopped leaves, decomposed sawdust, and rotted bark chips, can also be used. Fresh organic materials should be applied at least 6 months and weathered organic materials at least 2 months before planting. About 15 pounds of actual nitrogen should be applied for each ton of organic matter other than manure to aid in decomposition.

Planting

The growth, longevity, production, and ultimate profitability of a blackberry planting depends upon starting with healthy, disease free planting stock. Purchase planting stock from a reputable nursery that propagates plants from "certified" virus and disease free stock. Plants transplanted from an existing planting may be infected with viruses or diseases that can greatly shorten the productive life of a planting.

Blackberry planting stock is available in three forms, root cuttings, conventionally propagated plants, and tissue culture (TC) propagated plants. Root cuttings are generally of pencil diameter or slightly larger and 4-6 inches long. Conventionally propagated plants include rooted suckers (erect thorny blackberries) and rooted tip layers (trailing thornless blackberries). Both root cuttings and conventionally propagated plants are available as dormant stock in the fall or early spring. Tissue culture plants are produced by micropropagation techniques under sterile laboratory conditions, and are available as dormant or actively growing plants. While more expensive than other planting stock, TC

plants offer the blackberry grower several advantages. The propagation conditions for TC plants insure that they are as disease-free as possible. Tissue culture plants grow more rapidly and produce more uniform growth. Yields in the early years of a TC planting are generally greater. Some types of blackberries, such as the erect thornless cultivar '**Navaho**', do not propagate easily from root cuttings or conventional methods. Whenever possible TC plants should be considered when establishing a blackberry planting.

The final plowing before planting should be deep-six to nine inches. A final disking will facilitate the planting operation. Some provision for irrigation should also be in place.

Plant spacing within the row varies with the type of blackberry and the type of propagation material. Erect thorny and erect thornless plants should be spaced four feet apart and trailing thornless plants six or eight feet apart. If using root cuttings, space them only two feet apart since they take slightly longer to fill in a solid hedgerow. Table 1 gives the number of plants or root cuttings necessary to plant an acre at various spacings.

Table 1. Number of blackberry plants or root cuttings needed to plant an acre.

Space between rows	Space between plants			
	2 feet	4 feet	6 feet	8 feet
8 feet	2723	1362	908	681
10 feet	2178	1089	726	545
12 feet	1815	908	695	454

Dormant blackberry planting stock is best planted in early spring. Actively growing TC plants are planted in spring after the last frost. Upon arrival, inspect the plants immediately. Root cuttings and the roots of conventionally propagated plants should moist and brown, not black, soggy, or moldy. Tissue culture plants should not be dried out. Report any problems to the nursery at once.

Do not allow planting stock to dry out. If planting cannot be undertaken immediately upon receiving the stock, keep the roots moist (not wet)

and cold (not freezing). It is beneficial to allow the roots to soak for several hours immediately before planting. While planting, the stock that has not yet been set can be kept moist by leaving them in polyethylene bags or moistened burlap. If kept in poly bags, do not place in direct sunlight. Actively growing TC plants cannot be stored for any length of time and should be planted at once. Root cuttings are an economical way to establish a blackberry planting. Set cuttings two feet apart in a furrow three to four inches deep and cover immediately. Cuttings should lie horizontally in the furrow. No part of the cutting should extend above the soil.

Before planting, cut the tops of conventionally propagated plants back to about six inches. The six inch top is useful as a handle and will mark the location of plants. Plants should be set at the same depth as they were in the nursery.

Tissue culture plants have shallow root systems that are sensitive to dry soil conditions and frost damage. Plant after danger of frost. Cover the top of the root ball with 3/4 inch of soil and firm. Water each plant individually as soon as possible.

The entire new planting should be watered as soon as possible after planting. Irrigate as needed during the establishment period. Weed control is also important in a new planting.

Pruning and Training

Erect thorny and erect thornless

A single wire trellis (Fig. 2) is usually not necessary for training erect thorny or erect thornless blackberries, but may be helpful in some circumstances. If cane growth is excessively vigorous, tying the canes to a wire about 3-5 feet high can keep drooping canes from invading the row middles. In windy areas, a single wire trellis can keep canes from being broken off at the crown.

Pruning of erect blackberries, both thorny and thornless, is relatively simple. Primocanes should be tipped in early summer to encourage the growth of lateral branches. Cut the primocanes to a height of 36 to 48 inches. This tipping can be done with hand tools (machetes or pruners), or with machines that have been developed to mechanically tip the primocanes. Tipping may have to be repeated several times. During the summer it is also important to pull out

(not cut) suckers that develop outside of the row. If the row is allowed to get too wide, harvest is difficult and inside plants cannot get the care or sunlight necessary to produce high quality fruit.

In early spring, laterals should be pruned back to 12-14 inches to promote larger fruit and facilitate picking (Fig. 1). Remove any diseased or damaged wood. Floricanes die soon after fruiting, and should be removed as soon as possible after harvest. All prunings should be removed from the planting and destroyed.

Trailing Thornless

The trailing thornless varieties should be trellised. A one-wire system such as the one described above is satisfactory, but most growers prefer a two-wire system (Fig. 3) for ease of picking and to keep the vigorous cane growth under control. The lower wire should be about 3 feet from the ground, and the top wire 5 1/2 to 6 feet from the ground.

There are basically two systems of pruning and training trailing thornless cultivars. The choice of systems depends on cultivars, chance of winter damage, and grower preference.

The trailing thornless cultivars adapted to Missouri are trained similar to erect cultivars. In this system primocanes should be tipped when they are six inches above the top wire to induce the development of lateral branches. In the winter or early spring, select eight to ten of the strongest canes and tie them to the trellis. Remove additional canes as well as any diseased wood. Prune the remaining laterals to 18-24 inches in length. Remove floricanes after fruiting. This system is most practical for mature plantings where the canes are thick and upright.

The other system can be used for young plantings, where cold damage is likely (due to either cultivars or site), or for cultivars that never develop thick and upright growth. In this system, the floricanes (two-year-old canes) are trained to the wires as in Fig. 3. Canes do not have to be tipped until they reach 8-10 feet in length and are intruding on neighboring plants. The primocanes may be allowed to run along the ground where they can be mulched in the winter for cold protection. Remove the mulch in the spring, select the eight to ten strongest canes per hill, and tie these canes (now two-year-old floricanes) to the trellis. The newly emerging primocanes can again be allowed to run on the ground.

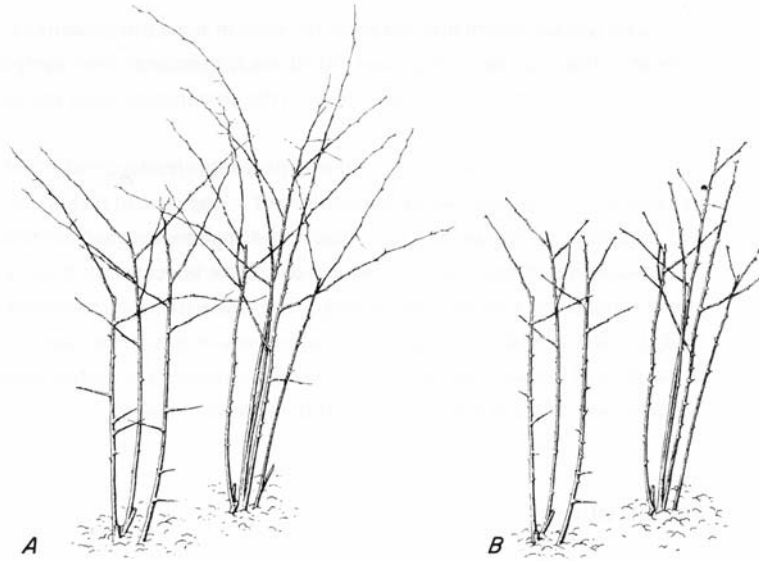


Fig. 1. Before (A) and after (B) pruning (Courtesy USDA).

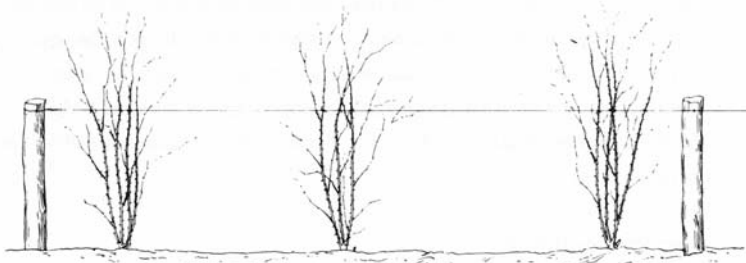


Fig. 2. 1-wire training (Courtesy USDA).

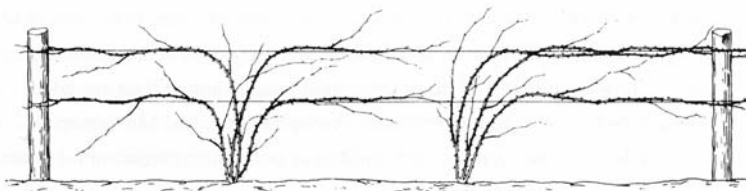


Fig. 3. 2-wire training (Courtesy USDA).

This second system may not work for some of the trailing thornless cultivars as the planting matures and growth tends to become more upright. Trying to force some of these canes to lie on the ground may result in cane breakage at the crown.

A variation of the second system may be used to propagate plants by tip layering. To tip layer plants, bend the tip of a long cane to the ground in late summer or early fall. The tip is placed in a shallow hole and covered. The tip cannot continue to grow in length, and a root system and vigorous young vertical shoot should soon develop. The newly rooted plant should be ready to dig and replant during the dormant season, or the parent cane can be cut off and the new plant allowed to develop in place. The last technique is a good way to fill in empty spaces left in the row.

Fertilization

The soil nutrients most needed by blackberries are nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg). In most instances, nitrogen is the only nutrient that must be applied on an annual basis. The application of other nutrients should be based upon the results of soil and foliar tests, which should be submitted every two years after planting, and the health and vigor of the plants. Check with the SMSU Fruit Experiment Station or University Extension for recommended soil and foliar nutrient levels.

Preplant nutrition.

Submit a soil sample for testing at least a year before planting. The results of the soil test should contain recommendations for application of P, K, Ca, and Mg. In general, at least 50 lb. per acre of P and 200-300 lb. per acre of K should be present in the soil. Any nutrient corrections should be made at least 6 months prior to planting. Superphosphate is a good source of P, while potassium sulfate or potassium magnesium sulfate are good sources of K. Calcium may be added through liming, and Mg through dolomitic limestone, magnesium sulfate, or potassium magnesium sulfate.

New planting nutrition.

Proper preplant site preparation should eliminate the need for all nutrients except N the first year. Do not apply N at planting time. A light application of N

application of N may be made 4 to 8 weeks after planting. Ammonium nitrate is the N fertilizer of choice. Do not apply more than 10 lb. per acre of actual N at this time.

Established planting nutrition.

Table 2 lists estimated amounts of N required for one year old and older blackberry plantings. Use plant response to modify these rates if needed. Nitrogen applications may be split. Apply half of the recommended rate in early spring (before growth starts) and the other half in May. In general, a grower gets the most efficient use of fertilizer by banding the fertilizer along the rows rather than broadcasting the material throughout the planting. Ammonium nitrate is the N source of choice. Apply other nutrients as indicated by soil and foliar tests.

Table 2. Estimates of the nitrogen requirements (lb./ A) for blackberries.

Blackberry type	Year	Irrigated			Nonirrigated		
		Sandy	Loamy	Clayey	Sandy	Loamy	Clayey
Upright thorny and thornless	1	30	25	25	25	XI	XI
	2	45	40	35	35	30	25
	3	ill	50	45	45	40	30
Trailing thornless	1	35	30	25	30	25	25
	2	55	50	45	45	40	35
	3	80	70	ill	ill	50	40

(Reprinted, with permission, from Bramble Production Guide, by M. Pritts and D. Handley. Copyright 1989 by the Northeast Agricultural Engineering Service.)

Manures and other organic materials are good sources of nutrients such as N and K. The nutritional value of organic fertilizers is highly variable and usually unbalanced in respect to N, P, and K. The analysis of manure, for example, can vary greatly depending on age of the material, how the material was stored, and what the animals were fed. Considering these properties, a specific application rate is impossible to recommend. In general, however, manure or compost could be applied at the rate of 5 to 15 lb. per 10 feet row,

depending on the general fertility of the soil. Being high in nitrogen, heavy application of poultry manures may result in "nitrogen burn" to plants. It is better to underestimate the application rate of poultry manure rather than risk damage to plants. Manures should be applied in late fall. When fertilizing with organic fertilizers, the grower will find that any material not finely textured will be difficult to spread within an established hedgerow. Large clumps of organic matter could also impede primocane emergence. Coarse textured compost or manure can be more easily applied if it is sieved or broken up with spading forks or shovels. Cottonseed meal is more predictable as to nutrient content than manures, and the texture makes it easy to apply to blackberries. About 7.5 lb. of cottonseed meal per 10 feet of row should supply the necessary nutrients for good plant growth. Apply in the mid to late winter.

Water Management

Missouri commonly experiences periods when moisture is limiting to blackberry growth. In most years some form of irrigation is required to supplement naturally occurring rainfall for maximum production of high quality fruit. In some years irrigation is necessary for plant survival. Adequate soil moisture is important during the establishment period of a new planting. Adequate soil moisture is also important in established plantings during the fruit development period and to promote cane growth.

Excess soil moisture, on the other hand, can be devastating. Blackberry plants are sensitive to the lack of root oxygen caused by water logged conditions. Plants are weakened, and are more susceptible to disease attack. Avoid sites with poor drainage. If drainage problems are suspected on a potential site, some benefit can be obtained by planting blackberries on raised beds or berms.

Blackberry growers contemplating commercial production must have a reliable source of irrigation water. As a rough guide, blackberries require 1 to 1 1/2 inches of water per week from rain or irrigation from bloom time to harvest. After harvest, adequate soil moisture is still necessary to promote good cane growth, but in most years post-harvest supplemental irrigation may be necessary only during prolonged drought.

Missouri blackberry growers commonly use trickle systems to supply irrigation. Overhead sprinklers are also used. Trickle irrigation systems offer the advantages of requiring much less water to irrigate a given area, as only the blackberry plants are watered. Some trickle systems can also be used to apply soluble fertilizers. Irrigation specialists and vendors can supply up-to-date information on irrigation systems for blackberries.

Disease and Insect Management

The proper identification of blackberry diseases and insect pests is necessary for effective control. The grower must be aware of the cost effectiveness of any control measure used in relationship to the damage done by the pest. Money is wasted when a pest is misidentified and the grower applies ineffective pesticides, sprays after it will do any good, uses a pesticide too frequently or too seldom, or uses an improper rate. In all cases, the grower is legally required to follow the pesticide label recommendations. Current information on blackberry pest management, including pesticide recommendations, is included in the annually revised **Missouri Small Fruit Pest Management Guide** (see reference list).

Blackberry diseases in Missouri

Anthracnose is a common disease of blackberries in Missouri. Anthracnose can infect the canes, leaves, and fruits. The symptoms of cane infections are small, purplish spots that enlarge to elliptical, sunken, tan to gray lesions. The leaf symptoms first appear as small, yellowish spots that develop a reddish-purple margin. The enlarged leaf spots can eventually drop out creating a "shot-hole" effect. Infected plants often produce berries with scattered reddish-brown drupelets among the other apparently ripe black drupelets. These berries may have an "off" flavor. Infected fruit are also reduced in size and eventually become dehydrated. Anthracnose control consists of the removal of dead canes in combination with fungicide applications.

Septoria cane and leaf spot is another common disease of blackberries. The symptoms first appear as small tannish spots on the leaves and canes.

As the disease progresses, the spots enlarge and become white in the center and brown or purple around the margins. The fungus overwinters on infected leaves and canes. Septoria control consists of removal of diseased tissue and fungicide applications.

Orange rust is a systemic disease. Once the host blackberry has been infected, the fungus remains within the tissue throughout the life of the plant. The symptoms on young shoots are small, thin stems with pale green to yellow leaves. In the spring the fungus sporulates and the undersides of the leaves are covered by bright orange powdery pustules. Soon after sporulation the leaves wither and die. The plants appear to recover in summer, but the fungus has simply gone dormant until the next spring. Fungicides can protect non-infected plants and reduce sporulation of infected plants. If the initial symptoms are noted early enough, infected plant parts should be pruned out. Once the infection is systemic, however, the best remedy is to remove and destroy (burn or bury) infected plants to kill the fungus.

Spur blight is a raspberry disease that has recently been found on blackberries. The symptoms appear as dark brown or purplish bands around the cane, immediately below the junction of a leaf petiole and the cane. The lesions enlarge until the cane is entirely girdled, and in late summer the lesions crack and split open. Symptoms on infected leaves appear as chocolate-brown, angular leaf spots that enlarge and cause the leaves to wither and drop prematurely. The fungus overwinters on dead canes and diseased plant parts. Removal of this tissue will aid in limiting the spread of this disease. Fungicides are also available for control of spur blight.

Botrytis blossom and fruit rot is probably the most common fruit rot of blackberries. Infected fruit rapidly decay and become covered with a dusty mass of gray spores. Eventually the rotted fruit become dry, shriveled mummies. The fungus can survive winter cold or summer drought in these mummies. Flowers can also become infected, with the petals turning brown and falling from the calyx. Infected petals may touch the leaves and cause leaf tissue to rot. Warm, wet weather favors this disease. Botrytis may infect a large number of host species and is capable of surviving on dead plant material. Removal of dead and dying plant tissue does little to limit the spread of the

disease. Maintaining good air drainage in the planting through proper pruning may reduce the severity of the disease. Fungicides are available for control of botrytis. Another fruit rot, **penicillium fruit rot**, is more common on harvested fruit. Fungicides are also available for control of this rot. In general, harvested fruit should be refrigerated and marketed without delay to reduce fruit loss to rots.

Crown gall is a bacterial disease that can weaken or kill infected plants. The bacteria enter the crown or root system at the site of a wound. The bacteria then cause the surrounding tissue to grow at an abnormally fast rate, forming a gall. This tumorous tissue may eventually disrupt the flow of water and nutrients in the plant, causing wilting and death. The best way to control the disease is to plant disease free plants in soil that is not infested with the bacteria. A void injuring the plant roots and the crown and thus providing entry points for the bacteria. Once galls are noted, however, the only remedy is to dig up and destroy the infected plant.

Sterility is a condition related to a transmissible biotic factor, possible a virus. Symptoms include a failure of fruit set in spite of heavy flowering. The berries that do arise are limited to a few large drupelets and the number of fruit buds for the next season is extremely reduced. The young primocanes are overly vigorous with round, glossy leaflets. Infected plants never recover. The only method of control is to remove and destroy (burn or bury) infected plants. Wild raspberries or blackberries may serve as a reservoir of infection, and should be destroyed in the vicinity of blackberry plantings. The cultivar 'Darrow' is most often associated with sterility in Missouri.

Other blackberry diseases that have been reported in Missouri include cane blight, powdery mildew, verticillium wilt, and phytophthora root rot.

Blackberry Insect and Mite Pests in Missouri

Few insect problems have been observed on a regular basis in commercial blackberry plantings in Missouri. No regular insecticide spray schedule for blackberries is presently recommended. Growers should make insecticide

applications for specific problems only if and when they appear. Insect identification services are available at the SMSU Fruit Experiment Station and at University Extension offices.

Three **insect borers** attack blackberries in Missouri. The life cycles and the timing and nature of damage are different in each case. However, since all spend much of their life cycle sequestered within the plant, chemical control is difficult and cultural controls based on close observation are necessary.

The **red-neck cane borer** is a small metallic blue-black beetle about 1/3 inches in length. The area behind the head is a coppery red color, hence the name red necked cane borer. Adults begin emerging in early May, and can be observed on the leaves of the plant. Eggs are deposited on the cane bark, usually near the base of a leaf. When the eggs hatch, the larva bores into canes and causes gall-like swellings from 1-3 inches in length. Infested canes can be recognized by these swellings near the ground. Larvae then bore into the pith and move upward for several inches, where they overwinter and emerge the next spring as adult beetles. Infested canes are weakened or killed by the girdling. The best method of control is to cut out and burn all affected canes during the dormant pruning. Destroying nearby wild brambles will also aid in controlling this pest. If the infestation is severe, insecticides are available for control.

The **raspberry crown borer** has a two year life cycle, most of which is spent as a larva living and feeding in the crown. The adult is a large, clear winged moth that resembles a yellow jacket hornet. Adults may be found flying about or resting on the foliage of blackberries during the latter half of September. Eggs are deposited on the leaves. The larvae hatch in the following spring and burrow into the crown and roots. Larvae feed for two years until the adult moths emerge in September to complete the cycle. Infested canes usually exhibit poor growth and often wilt during the summer, especially during periods of water stress. Examine blackberry plantings in September for the adult moths, which rest on the upper surface of the leaves. If crown damage is noted or adults are observed, the planting should be treated to control the pest. Since raspberry crown borer has a two year life cycle, insecticide treatments should be applied for two consecutive years. Insecticides will probably not be needed again for a

few years, but growers should examine plantings each year for evidence of the pest. Removal and burning of isolated wilted plants in June and July will aid in control.

The **raspberry cane borer** is probably the least common of the three borers in our area. It also has a two year life cycle. From June to August the adult beetles, after laying an egg in the cane, girdle the cane just above and below the egg puncture, causing the tip of the shoot to wilt and die. After hatching, the larvae tunnel down a short distance past the point of girdling and then overwinter. The following season the larvae continue boring to the crown. If pruning is done within a few days after the characteristic wilted tips appear, only the wilted tip and a few inches below it need be removed.

The **strawberry weevil**, also known as the strawberry clipper, is a small-nosed beetle that lays its eggs in the unopened flower bud. It then girdles the stem beneath the bud, causing the bud to fall over or off. Like most other blackberry insect pests, it is an intermittent pest. It may be totally absent or of no consequence some years and then suddenly become a problem another year. It is a good idea to closely inspect the developing flower buds every spring.

Aphids and psyllids commonly cause a symptomatic distortion and downward curling of blackberry leaves. The plant can tolerate some amount of damage, and sprays may not be necessary unless the damage becomes severe or widespread. **White grubs** can be a problem when the planting site has been in sod for several years. Proper advance site preparation will eliminate most grubs (see Site Preparation). Other insects that are potential pests of blackberries in Missouri include stink bugs, tarnished plant bugs, and green June beetles. Spider mites may also become a problem.

Weed Management

Weed management in a blackberry planting begins during preplant site preparation. All perennial weeds should be removed from the site, either through the use of herbicides or through tillage. Cover cropping the site for at

least a year before planting will reduce the number of annual weeds after planting.

The planting design of most blackberry plantings creates two distinct areas of weed management, the planting row and the area between rows (row middles). Trailing thornless blackberries are maintained as separate plants within the row. Hoeing, mechanical cultivation, mulching, and herbicides are effective weed controls with this situation. Upright thorny and thornless blackberries form a continuous hedgerow. The density of the hedgerow canopy suppresses weed growth, but also makes cultivation and hand weeding difficult. Herbicides banded along the row provide good control of most weed species. Mulching along the edge of the hedgerow will also eliminate many weeds, but mulching is usually a supplement to some other form of weed control. Excessively heavy mulching within the hedgerow may interfere with primocane emergence and harbor harmful rodents. A strip of black plastic placed on the row perimeters will help prevent weed encroachment as well as unwanted sucker emergence. If cultivation is to be practiced, it should be shallow, especially near the blackberry root zone. Cut roots may proliferate into new plants in the row middles. Cutting the roots may also open the plant to crown gall infection.

The area between the rows is generally maintained with a permanent or semi-permanent cover crop. Bluegrass, orchard grass, or perennial ryegrass are suitable permanent cover crops. Weedy row middles should be mowed frequently to reduce production of weed seed.

The proper use of weeder geese (see University of Missouri Cooperative Extension Report 8922) can eliminate most grasses and many tender broadleaved weeds from the planting. The geese will eat the ripe fruit and possibly some of the newly emerging primocanes, so their use should be timed accordingly. Further information on blackberry weed management, including herbicide recommendations and the sensitivity of TC blackberries to specific herbicides, is included in the Missouri Small Fruit Pest Management Guide (see reference list).

Harvest and Postharvest Handling

Blackberries are highly perishable and will only last a few days once harvested, even with refrigeration. Blackberries are primarily harvested by hand

in Missouri, either by pickers, pick-your-own customers, or a combination of the two. Mechanical harvesters are available, but berries harvested mechanically are only suitable for processing. The lack of commercial processing facilities is a limiting factor in Missouri. Blackberries ripen quickly and must be picked frequently, as often as every two days. Blackberries are ready to harvest when sweet, fully colored, but still firm. Harvest during the cooler parts of the day. Fruit is best picked directly into the sale container to minimize handling. To reduce postharvest fruit rots do not place overripe or diseased fruit into the pack. Harvested berries should immediately be placed in the shade and refrigerated as soon as possible. Market the fruit without delay. Quick processing is recommended for those berries that are not consumed fresh.

Fresh blackberries can not be stored for extended periods of time. If properly handled, research has shown that fruit can be stored up to 7 days. Fruit that is to be stored should be firm and of top quality. For longest storage, cooling should take place in two stages. As soon as possible after harvest, precool the fruit. Precooling should remove the field heat of the fruit within one hour of harvest for longest storage. Cold air (thirty-five degrees Fahrenheit) should be pulled through the flats of berries. Plans are available for small scale forced air coolers (see reference list). Once fruit is precooled, store fruit at 30 - 32 degrees Fahrenheit and maintain humidity at 90-95%. Fruit should be marketed as soon as possible.

Marketing

Marketing is a major consideration when planning a commercial blackberry operation. Without commercial processing facilities (none are available in Missouri at the time of publication), blackberry marketing is restricted to local retailing or pick-your-own operations. Local retailing includes sales at the farm, roadside markets, and farmer's markets. Other retail outlets include grocery stores, restaurants and gourmet shops, and local fruit processors. A grower should make an effort to assess potential markets before planning a planting. For instance, approximately 300 U-pick customers are needed per acre for thorned blackberries and around 450 are needed for thornless. As many as 15-20 pickers may be required per acre during peak harvest.

Blackberry Planning Calendar

Before Planting

- | | |
|-------------------|---|
| January-March | <ol style="list-style-type: none">1) Discuss plans with advisors at the SMSU Fruit Experiment Station or University Extension.2) Site selection.3) Write for irrigation information.4) Attend informational meetings.5) Develop marketing strategy. |
| April | <ol style="list-style-type: none">1) Layout planting.2) Collect soil samples.3) Begin collecting irrigation information. |
| May | <ol style="list-style-type: none">1) Apply Roundup to actively growing weeds in 3 foot strips. (Roundup is most effective when June temperatures exceed 70° F.)2) Plow strips two weeks after Roundup application3 Incorporate lime, phosphorus, and potassium at the rates indicated by soil tests. Incorporate any additional organic matter you may have, and/or4) Sow summer cover crop (sudex, millet, soybeans, etc.). |
| July-August | <ol style="list-style-type: none">1) Shallow cultivation of the strips every few weeks unless strips are sown to cover crops.2) Mow row middles as needed. |
| September-October | <ol style="list-style-type: none">1) Order plants or cuttings for spring delivery.2) Plow under cover crops.3) Apply manures.4) Plant winter cover crops (rye, wheat, Austrian winter peas, etc.). |

- November-February
- 1) Make sure plants or cuttings will be available for spring.
 - 2) Plan irrigation system.
 - 3) Get material for trellises if desired.
- March
- 1) Final soil preparation: plowing under cover crops, if necessary, and disking.
 - 2) Plow a shallow furrow down the row center for planting plants or root cuttings.
 - 3) Establish trellises if necessary.
 - 4) Plant and water plants.
 - 5) Plant extra plants or cuttings in pots for use as replacements.

After Planting- First Season

- April
- 1) Install irrigation as weather permits.
 - 2) Apply designated pre emergent herbicides according to label directions (do not apply to cuttings before they have emerged).
- May-June
- 1) Replace dead plants.
 - 2) Mulch if desired.
 - 3) Weed as necessary.
 - 4) Mow row middles.
 - 5) Cultivate row edges shallowly if desired.
- July-September
- 1) Use irrigation to supplement natural precipitation.
 - 2) Mow row middles.
 - 3) Tie semi-erect types to trellises.

- October-February
- 1) Apply organic fertilizers in winter.
 - 2) Drain irrigation systems, and store components that may be damaged if left outside.
 - 3) Plan marketing techniques and strategies: call Farmer's markets, attend meetings, make signs, obtain containers, prepare parking site, etc.

Second and Following Seasons

- March
- 1) Apply chemical fertilizers, dormant fungicides, and pre emergent herbicides.
 - 2) Test irrigation system.
- April-June
- 1) Weed as necessary.
 - 2) Apply fungicides and insecticides on an "as needed" basis.
 - 3) Water as needed.
 - 4) Pull suckers that emerge in row middles.
 - 5) Mow middles.
 - 6) Tip primocanes.
- July
- 1) Harvest.
 - 2) After harvest remove dying floricanes (if possible).
 - 3) Irrigate in drought conditions.
 - 4) Apply fungicides and insecticides on an "as needed" basis.
 - 5) Mow as needed.
- Winter
- 1) Prune laterals back to 12-14 inches.
 - 2) Remove dead floricanes (from previous season) if not done after harvest.
 - 3) Apply organic fertilizers.

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