

BACKYARD CANE FRUIT PRODUCTION AT ELEVATIONS 4,000 TO 6,000 FEET

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Figure 1. Blackberry fruit, *Rubus fruticosus*. University of New Haven, Deena Chadi, Bugwood.org

Introduction

Arizona's mid-elevations, 4,000 to 6,000 feet, offer some of the best growing areas for temperate zone fruits. Climatic conditions in the southeastern and northeastern parts of the state with elevations above 4,000 feet as well as parts of central Arizona with elevations from 5,000 to 6,000 feet are excellent for the production of small fruit species. Small fruit refers to size of the plant, not the fruit size. These include the following cane fruits; blackberry, blueberry, current, gooseberry, kiwifruit and red raspberry. Note: Growing cane fruit at elevations higher than 6,000 feet in Arizona is possible but fruit production will be limited due to frost damage and cooler nighttime temperatures. At elevations below 4,000 ft day temperatures can severely effect growth and development.

Small fruits are desirable because they can be very productive on good sites and require less management than fruit trees. One drawback is they are generally more perishable than tree fruit. In general, small fruit require more frequent watering than fruit trees but use less amounts over the course of a growing season. An exception is red raspberry which may require more water.

Backyard grape and strawberry production in Arizona at mid-elevations are presented in other Extension publications. They are listed in the Further Reading section at the end of this publication.

Site Selection

Microclimates occur all around; the front yard may be warmer than the backyard, close to the house is going to be warmer than near the street, the north side of the house will be cooler than the south. Cold air travels downhill and flows much like water, settling in the lowest area. It can accumulate behind houses, fences and rows of trees making these spots colder at night than those with good air drainage. Rock outcroppings and bare ground retain heat and radiate it back during the night. Site selection is the single most important factor in fruit production and can make a pronounced difference on how well and abundantly fruit will grow.

Planting location can have a significant effect on potential production. Sloping sites provide the best protection against frost. North sloping land is best because it warms up less quickly in the spring and will delay flowering, thus avoiding late spring frosts. An exception to this rule would be fall fruiting red raspberry, which flower in late summer. These plants perform better on south facing slopes.

Protecting plants from frost during flowering and fruit development can help prevent damage. Cloudless nights, which are common in Arizona, are normally colder than nights with cloud cover, which will reflect radiated heat back to the earth. Frost protection for plants include: cover plants during freezing temperatures with tarps, floating row covers, sheets, etc.; adding heat to the air around the plants with electric lights or smudge pots; continuously spray plants with water during freezing temperatures producing ice encasement, thus insulating plant tissue, (water must be applied until the freeze event is over); irrigating the soil under plants during the day allowing the soil to hold more heat and re-radiate heat at night; and if temperature inversions are occurring, fans can be used to mix cold air near the ground with warmer air aloft. The rule of thumb is mixing warmer inversion air and cooler ground air will increase the ground temperature two-thirds of the difference between the two. For more information on preventing frost refer to the University of Arizona AZ1002 "Frost Protection".

Fruit development is highly dependent upon sufficient light. Small fruits require a minimum of six hours of sunlight per day, so plant accordingly.

Site Preparation

Small fruit crops do best in well drained soils with 5-10% or higher organic matter. Soils high in clay content (greater than 40%) should be avoided. Sandy soil will require frequent

watering and fertilizing. All but blueberries will grow in the common range of soil pH's (6.7 to 7.3) found at the higher elevations of Arizona. Blueberries require a soil pH of 4.3 to 5.0. Soils with a pH above 7.5 have high buffering capacity and it is difficult to maintain sufficiently low pH and would not be suited for blueberry production. Conduct a soil pH test for sites to be used for growing blueberries.

Fertilizing

Small fruit plantings benefit from good soil conditions. High levels of organic matter can insure good production. Regular additions of organic matter and fertilizer throughout the life of the plantings are helpful. Mulching plants with 2-4 inches of organic materials is very beneficial and highly recommended.

Established Plantings

Nitrogen

Nitrogen (N) will be the most commonly used fertilizer. Nitrogen is mobile and will not be held for long periods of time in the soil. It is easily leached below the root zones with irrigation water or used by other soil organisms. Nitrogen can also be lost to the atmosphere when it is on the soil surface. Apply the recommended amount of nitrogen in Table 1 in two to three applications rather than one to reduce losses. The first application should be at bud swell and subsequent applications four to six weeks apart. Irrigation or light incorporation should immediately follow nitrogen applications to place the nitrogen in the root zones.

Table 1. Percentage* of nitrogen fertilizers, in pounds, to apply per 100 square feet for established canefruits.

Crop	46%	21%	15%	11%	10%	4%	2.4%	0.7%
Blackberry	0.26	0.55	0.75	1.00	1.15	2.87	4.78	16.4
Blueberry	0.46	1.00	1.40	1.80	2.00	5.00	8.40	28.6
Current	0.31	0.65	0.85	2.25	1.15	3.15	5.25	18.0
Gooseberry	0.31	0.65	0.85	2.25	1.15	3.15	5.25	18.0
Kiwifruit	0.59	1.25	1.70	2.25	2.50	6.25	10.5	35.8
Raspberry- fall	0.46	1.00	1.40	1.80	2.00	5.00	8.40	28.6
Raspberry- summer	0.36	0.75	1.00	1.40	1.50	3.75	6.30	21.5

*Nitrogen is the first number on fertilizer containers, i.e. nitrogen-phosphorous-potassium (N-P-K).

Table 2. Nutrient and water content of fresh manures.

Manure type	% Water Content	Nitrogen*	Phosphorous	Potassium
Beef	82	0.65	0.43	0.53
Dairy	87	0.50	0.16	0.44
Hog	84	0.45	0.27	0.40
Horse	60	0.70	0.25	0.60
Poultry	73	1.30	1.02	0.50
Rabbit	70	2.40	1.40	0.60
Sheep	73	1.00	0.36	1.00

* About 25 percent of the nitrogen is available the first year.

From: Caneberries. J. Hart et al. Oregon State University Extension Service. EM 8903-E January 2006.

(Manure nutrient content may vary greatly depending on animal's diet, and water content and age of the manure.)

Phosphorous

– If fertilizers containing phosphorous are used they need to be tilled in or injected into the soil. Since phosphorous is non-mobile in the soil it needs to be placed close to the root zone.

Sulfur

Blueberries require acidic soil. Soil pH level should be between 4.3 and 5.5. Blueberries need lower soil pH so more nutrients are available. Blueberries are members of the heath or heather (Ericaceae) plant family, as are azaleas, cranberry and rhododendrons. It will be necessary to acidify the soil to produce blueberries in most areas in Arizona. For recommendations on how much sulfur is needed to lower the soil pH, refer to Table 4. It should be noted that it is very difficult to lower soil pH in Arizona because of soil's great buffering capacity. To see the desired effects of additions of soil acidifying materials takes months. Soil microbes and weathering must break these materials down for chemical reactions to occur to lower soil pH.

Aluminum sulfate or aluminum hydrate may also be used to acidify soils. Follow label directions when using these products to acidify soils. Excessive amounts of aluminum may cause toxicity and can inhibit root development, thus limiting crop growth.

Sulfur should be finely ground or soluble in water and worked into the top 6-8 inches of soil. Sawdust and/or pine needles incorporated into the soil will also help lower pH. Add 0.6 pounds of actual nitrogen (3 pounds of ammonium sulfate (21-0-0) or equivalent) for every 100 pounds of uncomposted sawdust applied. Nitrogen fertilizers containing sulfur, such

as ammonium sulfate, will also lower soil pH over time. It is recommended soil pH be checked yearly when growing blueberries in Arizona. Due to the soil pH requirements of blueberries it may be easier to grow them in large containers.

New Plantings

When preparing the soil for a new planting, till in 2-6 inches of compost, well-rotted manure, peat moss, etc. Use higher amounts for sandy soils. Fertilizer should be added as well.

Use half the recommended nitrogen amount during the establishment year (new plantings).

Manures

Using manure to supply plant nutrients requires handling more material compared to commercial fertilizers. Manures add organic matter and micronutrients to the soil, but may serve as a source of weeds and pests. Consider an application of 70 lbs. N/acre. For this N rate, 152 lbs. of urea, (70 lbs. N ÷ 46% N in urea), per acre would be required. The same amount of N from manure, assuming 1 percent N, requires 7,000 lbs/acre, (70 lbs. N ÷ 1% N in manure). Also, additional manure (5,000 to 7,000 lbs/acre) would be required for the first year because not the entire N is initially available. The conversion of unavailable N to the available form occurs throughout the growing season by soil microbes. If plant demands exceed the rate of conversion, a deficiency occurs. Conversely, if conversion to available forms is high late in the season, unwanted late-season growth may result. Losses of nitrogen exceeding 50 percent can occur during manure storage or after application to the surface of the soil. Nitrogen loss is least when fresh manure is spread and worked into the soil immediately. Unless livestock have been fed on weed-free feed, use aged manure that has been composted at temperatures high enough to kill weed seeds and other pests. Aged and composted manures contain lower nitrogen concentrations than fresh manures.

Phosphorous

The table below shows amounts of phosphorous fertilizers needed to provide sufficient levels at planting. Phosphorous should be tilled or worked into the soil before planting because it is non-mobile in the soil and needs to be placed in the root zone.

Varieties

Variety selection can be one of the most important decisions in growing fruit. Many varieties have been selected to withstand cold winter temperatures, for disease resistance, or for their

superior flavor. However, when selecting varieties for mid-elevations consider those that are resistant to sunburn and can tolerate higher than neutral pH (particularly with blueberry and somewhat with kiwifruit). Since disease problems are not common in Arizona disease resistance is not a major factor when choosing varieties. Resistance to sunburn is unknown for the varieties listed. Consult the local Cooperative Extension Office for recommended varieties.

Blackberry (*Rubus fruticosus*) No pollinator required.

Blackberries are suitable for home production but fruit have a very short shelf life of only a few days. They will fruit the year after planting. Above-ground shoots, hereafter referred to as canes, have a two-year life cycle, but roots are perennial. Many years of productive growth and fruiting should be anticipated. Blackberries are adapted to all parts of Arizona, although some winter damage can be expected in the most northerly and coldest areas. Spring frosts are usually not a consideration if planted on sites with good air drainage. Blackberries may be planted in a wide array of soil types, although heavy, poorly drained soils should be avoided. There are two classes of blackberries - erect and trailing. Erect cultivars do not need to be trellised, but trailing cultivars do.

Blackberries are nutritious. One serving of blackberries (one cup or 140 gm) provides 50 percent of the vitamin C, 10 percent of the foliate, and 22 percent of the fiber required daily. Blackberries are also a good source of potassium, calcium, and iron. In addition, the compound ellagic acid, identified as an anti-carcinogen, is found in blackberries.

Erect thornless types

‘Apache’ - Produces higher yields and larger fruit (up to 10 grams), than the other thornless cultivars.

‘Arapaho’ - Good fruit quality. Medium berry (about 5 grams). Ripens before other cultivars.

‘Natchez’ - Good flavor. Large, averages 8-9 g/berry. Yields twice as much as ‘Arapaho’.

‘Navaho’ - Produces a 5 gram firm berry, which is the smallest of the thornless cultivars. Later and prolonged ripening period.

Trailing thornless types

‘Chester’ - High yield. Berry size is medium (about 5 grams), and flavor is mild.

Table 3. Phosphorous Fertilizers, Formulations and Application Amount

Fertilizer	Formulation (N-P-K)	Pounds per 100 square feet
Rock Phosphate	0-15-0	2.0
Bone Meal	0-30-0	1.0
Ammonium Phosphate	16-20-0	1.5
Monoammonium Phosphate	11-48-0	0.67
Diammonium Phosphate	21-48-0	0.67
Triple Superphosphate	0-45-0	0.67



Figure 2. To grow healthy blueberry plants in Arizona the soil will need to be acidified using sulfur based fertilizers. University of Maine, Caleb Slemmons, Bugwood.org

‘Dirksen’ – Excellent quality. Medium to large berry with high sugar content. Resistant to anthracnose.

‘Triple Crown’ - Very productive. Large, sweet berries. Late ripening. Berries are firm with a good sugar/acid balance.

Blueberry (*Vaccinium corymbosum* & *V. corymbosum x angustifolium*) Blueberries generally will not produce reliable crops without cross-pollination. At least two varieties need to be planted.

There has been very little experience growing blueberries in Arizona. However, the varieties listed should be suited to mid-elevations. As a general rule soil pH needs to be lowered to 4.3 to 5.0 prior to planting. After planting, closely monitor pH levels and apply acidifying materials, like sulfur, as needed. For sulfur requirements to lower pH refer to Table 4. Highbush, (5-7 feet tall), or half-high, (2-4 feet tall), varieties grow upright as shrubs.

Table 4. Soil pH modification.

Current soil pH	Soil Type		
	Sand	Loam	Clay
4.5	0*	0	0
5.0	0.4	1.2	1.8
5.5	0.8	2.4	3.6
6.0	1.2	3.5	5.0
6.5	1.5	4.6	6.9
7.0	1.9	5.8	8.8
7.5	2.3	6.9	10.0

*Pounds of sulfur needed to lower 100 square feet of soil to a pH of 4.5 for various soil types.

Adapted from: Danny L. Barney. 1990. Highbush blueberry crop recommendations. University of Idaho Cooperative Extension System.

Highbush

‘Bluecrop’ – Medium to large fruit, approximately 65 per cup; bright blue, flavor is considered good and tart. Bears mid-season. Moderately drought resistant and can withstand late spring frosts. This is the most widely adapted blueberry in the United States.

‘Bluegold’ – Medium size fruit, approximately 70 per cup; light blue. Bears late season.

‘Blueray’ – Large size fruit, approximately 60 per cup; bright blue. Makes an excellent ornamental plant. Cold hardy. Bears early mid-season.

‘Duke’ – Medium size fruit; medium blue color, approximately 65 berries per cup, Blooms late but bears early.

‘Patriot’ – Large size fruit, approximately 55 per cup; medium blue; excellent flavor. Cold hardy. Bears early mid-season.

‘Toro’ – Medium size fruit, approximately 75 per cup; light blue. Bears mid-season.

Half-highbush

‘Northblue’ – Medium fruit size, sky blue color, the most popular half-high in Michigan. Very cold hardy. Bears early mid-season.

‘Northland’ – Small size fruit, approximately 136 per cup; medium blue; fair flavor. Cold hardy. Smaller in size than others listed here. Bears early mid-season.

Currant and Gooseberry (*Ribes* species)

Currant and gooseberry are classified by several species in the genus *Ribes*.

Fruit production in the United States is very limited whereas in Europe these berries are grown widely for commercial purposes. These will grow well in poorer soils and in low light, for example on a building’s north side .

Plants in the genus *Ribes* in the Western United States. are the alternate host for white or pinyon pine blister rust disease. Due to the severity of this disease some regions of the country have prohibited *Ribes* from being planted. However, Arizona is



Figure 3. Golden currant fruit, *Ribes aureum*. USDA Forest Service, Dave Powell, Bugwood.org

considered a low risk area for white pine blister rust and there are no such restrictions for growing these plants. Various native species of *Ribes* are found throughout the forests and woodlands of Arizona.

Currant – No pollinator required.

‘Consort’ – Medium size fruit; black; borne in medium-length clusters. Musky sweet flavor. Bears mid-late season. This variety is resistant to white pine blister rust.

‘Golden’ – Medium size fruit which are red to black in color. Very popular 3 to 6 foot tall shrub grown throughout the highest elevation communities of Arizona. Known to be a host for pinyon pine blister rust, but not white pine blister rust.

‘Perfection’ – Medium fruit; red; borne in long, loose clusters. Very productive. Fruits are mildly tart and juicy. Bears mid-season.

‘Red Lake’ – Medium size fruit; light red; high quality berries borne in loose clusters. Very productive and winter hardy. Considered by many as the best red currant. Recently considered resistant to white pine blister rust. Bears mid-season.

Gooseberry – No pollinator required.

‘Captivator’ – Medium to large fruit; dull red; good quality, moderately sweet. Almost thornless, easy to harvest. Bears mid-season. Resistant to mildew and leaf spot.

‘Oregon Champion’ – Medium to large fruit; light green to yellow. Thornless and vigorous. Resistant to mildew and some resistance to *Armillaria* root disease.

‘Pixwell’ – Medium fruit; pink to red; borne in clusters with long pedicels; fair to good quality. Has few thorns. Winter hardy. Resistant to mildew and drought.

Kiwifruit – (*Actinidia arguta*) (also known as Chinese gooseberry) Pollinator required.

Kiwifruit are dioecious, meaning female and male flowers are on different plants. One male plant is needed for each eight

females. These are hardy kiwifruits and should not be confused with the frost sensitive large, fuzzy kiwifruit (*Actinidia deliciosa*) sold in produce markets. Growth is similar to grapes, with clusters of fruit and requires a trellis. Fruit skin is edible, not fuzzy.

‘74-55’ – Vigorous vine, medium to large smooth-skinned fruits. Use ‘74-46’ male to pollinate.

‘Anna’ (also known as ‘Ananasnaja’) – Average to above average size fruit. Known for its pineapple aroma and taste.

‘Issai’ – Bears long, sweet fruit (1¾” in diameter). May bear fruit after only one year. Use ‘1971’ male to pollinate.

‘Geneva HH I’ – A vigorous vine that is very winter hardy. Delicious, smooth-skinned, medium size fruit. Use ‘1971’ male as a pollinator.

‘Geneva HH II’ – A vigorous vine that is very winter hardy. Use ‘1971’ male as a pollinator.

Red Raspberry (*Rubus idaeus*) No pollinator required.

There are two types of red raspberry, summer and fall bearing. Varieties that produce fruit in a biennial manner (flowers on the over-wintered cane) are referred to as summer bearing or floricanes fruiting. Varieties that produce flowers the first year, when cane elongation ceases, are fall bearing types, referred to as primocane fruiting, fall fruiting or everbearing. Refer to the section below on pruning for information on raspberry life cycle.

Summer Bearing Red Raspberry

‘Boyne’ – Medium sized, deep red, juicy, tender fruit. Medium sweet flavor, good for processing and freezing. Late-early bearing. Very hardy canes.

‘Nova’ – Medium-sized bright red firm fruit. Hardy canes.

‘Nordic’ – Medium sized light red fruit has superior flavor and firmness, and resists tearing. Very hardy canes.

‘Kilarney’ – Medium-large deep red sweet fruit with good firmness and generally excellent overall quality. Medium-sized hardy canes.

Fall Bearing Red Raspberry

Low winter temperatures are not a significant factor since the canes are pruned to the ground in the winter.

‘Autumn Bliss’ – Large dark red fruit, medium firm, mild flavor. Good fresh or processed. High yielding. Bears early.

‘Caroline’ – Excellent variety with large sized berries, intense raspberry flavor. Resistant to root rot.

‘Heritage’ – Medium to large fruit, firm and good quality. Vigorous canes that sucker well and stand erect. Latest ripening of the fall varieties. Best choice for warmer sites. #1 fall variety in the U.S.

‘Polana’ – Early ripening, medium-sized, good quality fruit. Vigorous plants. Harvest 3 weeks before ‘Heritage’. Good choice for colder areas. Needs extra nitrogen fertilizer in May.

‘Redwing’ – Medium to large size fruit, firm, good flavor and excellent quality. Bears early.



Figure 4. Raspberry plants set 24-30 inches apart in the row.

‘Summit’ – Small to medium fruit, medium red color, firm. High yielding. Bears early.

Planting

Most small fruit plants are sold as bare-root stock. Plant as soon as the ground can be worked and while the plants are still dormant. Plants purchased in containers can be planted at any time once the ground is workable.

Organic matter should be worked into the soil four to six weeks prior to planting. Adding 2-6" of compost or rotten manure will greatly improve soil structure. Using organic matter high in carbon, such as sawdust or wood chips may render nitrogen unavailable in the soil. Additional nitrogen may be added to counteract the increased carbon:nitrogen ratio caused by the addition of large amounts of organic matter.

Planting holes should be dug to accommodate plant roots. The soil should be loosened five times as wide and only as deep as the root ball. Removing soil deeper than the root ball is not necessary. Deeper soil preparation may enhance deep root growth, but settling may also occur, causing plants to sink and buried stems to rot with time. Be sure that soil in the bottom of the hole is well settled before planting.

Spacing

Blackberry and Raspberry

Plant erect blackberries and raspberries 24-30 inches apart in the row, with rows 8-10 feet apart. Plant trailing blackberries 6-8 feet apart in the row, with rows also 8-10 feet apart.

Blueberry/Currant/Gooseberry

Highbush blueberries, currant, and gooseberries require 4 feet between plants and 6-8 feet between rows if grown as a hedge-row. As a landscape plant allow approximately 20 square feet per plant.

Kiwifruit

Plant 15-20 feet apart in the row with rows 10-12 feet apart. Each plant will require 150-200 square feet of space. One male plant will pollinate up to eight female plants.

Irrigation

Irrigation is essential for new plantings and mature bearing plants. Begin irrigating in March or April and reduce watering in September to slow new growth and allow hardening of canes. Infrequent winter irrigations may be needed during drought years. Raspberries need additional water between bloom and harvest. A thorough soaking to 20 inches deep is preferred to more frequent, shallow sprinkling. Canefruits grow well when watered using drip irrigation or soaker hoses.

Weed Control

To control weed growth apply a mulch of straw, grass clippings, sawdust, or wood chips. A depth of 4 to 6 inches is sufficient. Add some mulch each season to maintain the proper depth. Rodents may infest areas that are mulched, so apply new mulch in spring to minimize rodent populations over winter.

Hand pulling or lightly hoeing weeds is recommended. Systemic herbicides, like glyphosate, may be used with great care.

Pruning & Training

Blackberry – fruit is produced on one year old canes.

The stems, referred to as canes, will live for two years. Canes grow the first year, flowers and fruit are produced the second year, and then die. First-year canes are referred to as primocanes; second-year canes are called floricanes.

Erect types

Don't be alarmed if during the first growing season many of the canes of erect types will have a trailing habit. Growth of the canes in the second and subsequent years will be erect. Proper training of erect types entails allowing primocanes to develop in a row approximately 12 inches wide during the growing season.

In the second season after planting when the new shoots of erect blackberries reach a height of 30 to 36 inches, cut off the tips. Tipping of primocanes monthly the first two or three months of the growing season will increase lateral branching and thus fruit buds, resulting in greater yields the following year. This can be done with loppers or hand shears. This hedging stimulates the canes to branch. The tipped canes will grow stout and will be better able to support a heavy fruit crop the following year. If time and labor permit, thin new shoots at the same time to reduce crowding in the row, thus allowing laterals more room to grow.



Figure 5. If raspberry and trailing blackberry are not put on a trellis system they will grow onto the ground where the fruit can lay on the ground and rot, as indicated in circle.

After fruiting, remove dead floricanes and thin out weak primocanes, as time permits. In late winter prune lateral shoots to 12 - 14 inches long. This will make harvesting more convenient and result in larger berries. At the same time remove the remaining dead and weak wood. Leave only five to eight of the largest diameter, healthy, vigorous canes per linear foot of row..

Trailing types

During the first growing season, trailing blackberry primocanes do not need to be trained to a trellis. However, after the first season, trailing blackberries must be trained on trellises to assure clean, disease-free fruit and ease of picking. Trellis posts should be driven into the ground 8-16 feet apart, with a wire secured between them at 5-6 feet off the ground. Another wire may be placed 2½- 3 feet off the ground. A drip irrigation tube may be hung from the lower wire. Using high tensile strength wire is recommended. Electric fence wire is made from this type of wire. If common #9 or baling wire is used it will continue to stretch and sag over time. Several styles of wire tensioning devices are available. At the end of each trellis row wires should be attached to dead-man posts.

The second season, before bud swell, bring floricanes up to the trellis wires and tie them individually with soft string or plastic horticultural/ gardening tape designed for tying brambles and grapes. The lateral branches are pruned to 10 to 12 inches at the same time. Often, only a small crop is available for harvest the year after planting. For this reason, cut back canes to within several inches of the ground that would have otherwise fruited. This helps the plants become better established by preventing a severe drain on their productivity from fruiting. This practice favors the development of a strong root system and sturdier, more fruitful shoots in the subsequent year. In the second and succeeding years, new shoot growth is more vigorous. These

shoots should be tied to the trellis as soon as they have reached a height of 4 to 6 feet.

Fan the canes out from the ground and tie them where they cross each wire. Avoid tying canes in bundles. In summer, as soon as the last berries have been picked, cut out all the old canes to ground level, or this can be done during the dormant winter period. Do not remove new canes that have come up since spring except too thin to four - eight shoots per crown. The best shoots should be selected so wires are well covered with evenly spaced shoots. Broken shoots or those too short or too weak for training should be removed.

Ordinarily, no further summer pruning is performed on thornless trailing blackberry varieties. However, research indicates potential benefits from periodic summer topping to encourage more lateral branching and the development of shorter, more compact plants. Plants should be set closer than 6 feet in the row if this management plan is to be adopted.

Blueberry – fruit buds are on one year old stems.

Blueberry is a perennial plant that can live a very long time. Pruning is necessary to keep the plant vigorous and healthy. Blueberries have multiple stems arising from an above ground crown or below ground rhizome system. New stems are produced every year if the plant is vigorous. The ideal plant will have 10 stems of varying age. Removing five year old stems and the smallest new stems will insure a good balance. When removing stems cut them at the crown or ground level, depending on where they originated. Half-high varieties, if stems arise from rhizomes, will best be pruned by cutting the entire plant at ground level every 2 to 3 years. If the plant is cut to the ground it will not bear fruit the first summer following the pruning. Otherwise prune as you would a highbush plant.

Currant & Gooseberry – Fruit buds are on one year and older stems and spurs arising from these stems.

Currant and gooseberry are perennial plants. Pruning is necessary to keep the plant vigorous and healthy. These berry bushes have multiple stems arising from a below ground crown. New stems are produced every year if the plant is vigorous. As with blueberry, removing five year old stems and the smallest new stems will insure a good balance. When removing stems cut them at ground level.

Kiwifruit – fruit is produced on current season's growth.

Kiwifruit grow similar to grape and must be supported by a trellis system described under the training blackberry section. A trellis may consist of 6-foot high sturdy T-post or pressure treated wooden post supports with 3 to 5 parallel wires to support the trunk, cordon—arm off of main trunk, and one year-old fruiting arms. These also provide support for current year's growth that will bear fruit. Wires at each end of the trellis should be attached to a dead-man post for support. Drip irrigation tubing may be hung from the wire closest to the ground. Wire tensioners are required.

Pruning and training are done to manage shoots and for ease of harvesting. Fruit is produced near the base of the current season's growth. Newly established plants are managed similarly to



Figure 6. A fruiting raspberry cane showing how the fruit ripened first at the tip of the cane and is progressing downward. Leaves at the upper end of the cane have been removed to illustrate this principle.



Figure 7. Raspberry plants that were not trellised and are laying down in the row making harvest difficult. Disease problems are more common when raspberry and trailing blackberry plants are not trellised (see Figure 4).

grapes. The young plant is trained straight up to form a trunk. However, with kiwifruit the trunk needs to grow up as high as the six foot trellis.

Lee Reich, in his book *Uncommon Fruits Worthy of Attention*, describes pruning and training of a developed trunk. He recommends the following: "Cut the trunk to just below the height of the middle wire in opposite directions (these shoots will be the cordons).

The first dormant season after the cordons have been formed, cut off all excess growth along the trunk and shorten the cordons to about 2 feet. Shorten the cordons each dormant season, leaving 2 feet of the previous season's growth, until they reach their allotted length of about seven feet in each direction along the wire. After that, cut back the cordons each dormant season to a length of 7 feet.

Fruiting arms will grow out perpendicular to, and draped over, the wires. The arms should be spaced a foot apart on opposite sides of the cordon; prune away any excess canes during the dormant season. Tie the fruiting arms to the side wires to keep them from blowing around, unless the arms are too stiff to be brought to the wire. The first crop will form on shoots directly from these arms; future crops will form on shoots from laterals growing from these arms.

Training is now complete and annual pruning will consist, first, in shortening the ends of the cordons each winter as described above and then in maintaining a supply of fruiting arms. The fruiting arms give rise to fruit laterals at their base and require cutting back to eight buds during each dormant season." Source of kiwi photos: <<http://www.clematis.com.pl/wms/wmsg.php/65114.html>> <<http://cru.cahe.wsu.edu/>

<<http://uconnladybug.wordpress.com/2010/04/>><<http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/20677/pnw507.pdf>>

Red Raspberry – fruit is produced on one year old canes.

Red raspberry is a perennial plant with roots that live for many years. The stems, referred to as canes, live for two years. Canes grow vegetatively the first year, producing flowers and fruit the second year, then die. First-year canes are referred to as primocanes; second-year canes are floricanes. Some red raspberry varieties produce flowers the first year when cane elongation ceases in mid to late summer. These types are referred to as primocane fruiting, fall fruiting, fall bearing or everbearing.

The degree to which a red raspberry variety flowers in the fall determines the potential flowering in the second year. Once a node (location where a leaf petiole is attached to the stem) on the primocane has produced flowers it will not produce at the same node next year. Every node on the raspberry cane has the potential to produce flowers, if not in the first year, then in the second year. A true "everbearing" variety would produce a harvestable fall crop on the primocane and a harvestable summer crop on the overwintered floricanes. Generally, strong fall fruiting varieties do not make good summer bearers. Fruiting on the raspberry starts at the tips of the cane and progresses down the cane as the season continues. Therefore pruning off too much of the growing tip will reduce fruit production.

Fall bearing varieties are selected to bear fruit on the current year's growth. The best fall bearers will flower on a high percentage of nodes. If the cane is overwintered, there is very

little potential for a spring crop. Since that cane does not have a desirable crop potential, it is best to remove it to make room for new primocanes. Cut primocanes at ground level following harvest in the fall or winter. Cutting can be done with hand pruners or with a sharp rotary lawn mower with wheels raised to the highest position. The width of the row should be maintained at 8 inches wide in the spring with shallow roto-tilling– 2-3 inches deep.

Summer bearing blackberry and red raspberry varieties are selected to produce crops on the floricanes only. The floricanes are cut at ground level following harvest or during the dormant season. During this time it is best to thin the strongest primocanes 5 to 8 per linear foot of row. Reserve the strongest, straightest primocanes to become the floricanes for next year's crop. The row should be reduced to 16 inches wide in the spring with shallow roto-tilling– 2-3 inches deep.

The red raspberry varieties 'Nova' and 'Nordic' are often selected for their summer bearing ability, but they also exhibit some fall bearing. If a fall crop occurs on the primocanes, then cut (tip) during the dormant season just below where fruiting occurred. After the following summer crop is produced on the floricanes, cut the floricanes at ground level during the following dormant season. Primocanes are thinned to 5 to 8 per linear foot of row as with other varieties.

Training or trellising of red raspberry is essential when growing summer bearing or tall fall bearing varieties. As canes grow the fruit weight may cause the canes to bend and break. A standard T-bar trellis, 3 to 4 feet high, can be installed and fitted with a 16 inch wide cross arm. Cross arms are fitted with two wires, one attached on or through each end of the cross arms and placed on a dead-man at the end of each row. Any other suitable post that can be driven into the ground 12" deep may be employed.

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