



Chapter 2 Production

Nature of the Strawberry Plant

The strawberry plant is a perennial that produces leaves, stolons (runners), flowers, and roots in patterns determined by its genetic makeup (Figure 2-1). Each year leaves and roots arise at higher points on the crown. Thus, the plant tends to grow out of the ground and develops poor root-soil contact with age.

The root system is shallow, with 80 to 90 percent in the top 6 inches of clay and 50 percent in the top 6 inches of well-drained sandy loam soils (Figure 2-2). A primary root normally lives for

one year. The plant will initiate new roots at succeeding higher levels on the crown and, when exposed to cold or drought, may die while younger plants live.

Fertility, water supply, and aeration at soil depths greater than 6 inches are of major concern. Placing 1 inch of soil over the plant bed after harvest will enhance new root formation and make plants less vulnerable to cold and drought. The use of raised beds and renovation for Midwest conditions is discussed later in this publication.

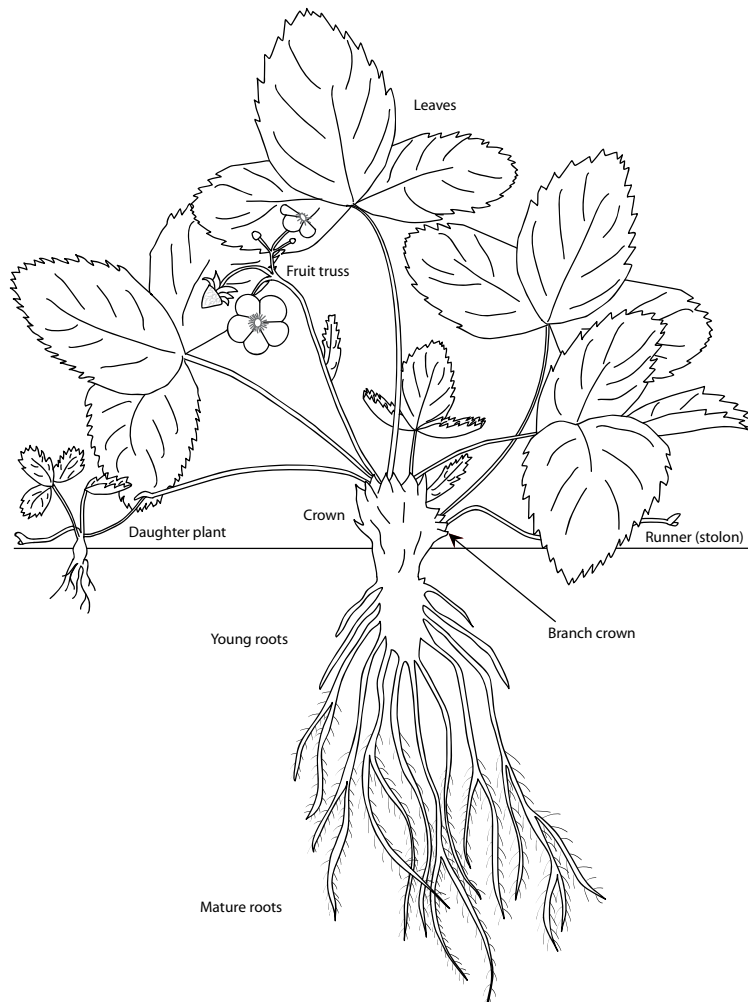


Figure 2-1. Mature strawberry plant at flowering with stolons. Courtesy of The Pennsylvania State University.

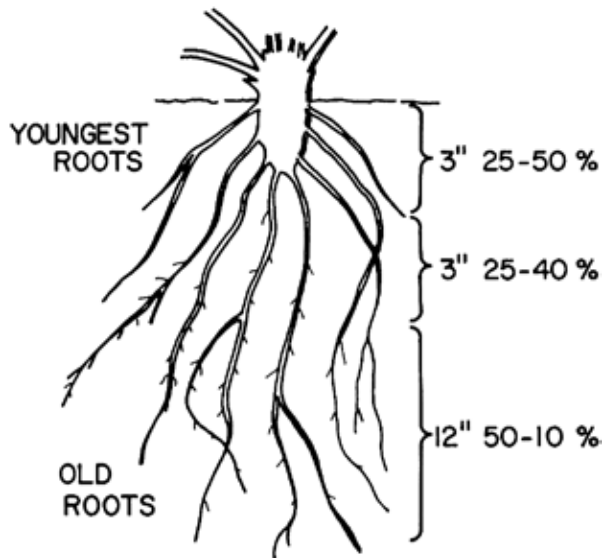


Figure 2-2. Root distribution of mature strawberry plant.

Cultivars can be separated into three plant types based on their response to the hours of sunlight per day (photoperiod). These are June bearers, everbearers, and day-neutrals. The June-bearing strawberry is a popular type for commercial production in the Midwest and will produce one crop each year. Everbearers are long-day plants and initiate flowers when days exceed 12 hours of light; they produce two main crops. Day-neutral strawberries are insensitive to daylength and will produce fruit from spring through fall.

Selecting Site and Soil

Strawberry plants grow and produce satisfactorily in a wide range of soil types, from sandy to clay loams. They are not particularly sensitive to soil reaction (pH); however, they produce best on sandy-loam soils with a pH of 5.8 to 6.5. If soil reaction is unknown, the grower should submit a soil test. Best yields are obtained when strawberries are grown on deep, fertile soil that is well supplied with organic matter. Important factors to consider in site selection are internal soil water drainage and freedom from frost.

Good production cannot be expected without adequate soil drainage during the entire year. The strawberry cannot tolerate standing water. Tile drainage systems should be considered if land is poorly drained. Raised beds that are eight inches high and two to three feet wide have been recommended and should be maintained over the life of the planting. Because strawberries bloom very early in the spring, plantings should not be located in frost pockets. Where air drainage is

limited, the crop may be lost to late spring frosts, which can kill the flower. Frost control measures may need to be considered.

Strawberries require cultivation, so avoid planting on steep slopes. Plantings on 10 to 15 percent slopes are likely to erode, with some plants being buried and others washed out of the soil. If sloping sites must be used, run rows across the slope or on the contour and use a wide row width.

Avoid areas that have been used recently to grow tomatoes, potatoes, or sod. Such sites are likely to contain disease and insect pests that may attack plants. Likewise, sites that are heavily infested with sedge, nutgrass, quackgrass, Johnson grass, and thistles should be avoided or treated prior to planting to destroy these chronic weeds.

Ideally, the site should be selected the year before it is to be planted. Early site selection allows proper preparation of the soil, including weed control, fertility, and pH adjustments and elimination of other potential problems. Selection of a suitable site is the first step toward success with strawberries.

Cultivar Selection

Selection of the best possible cultivar is vital to the success of any strawberry enterprise, whether or not it is a large commercial planting. No cultural practice can overcome the handicap imposed by poor selection of cultivars. Cultivar performance is strongly influenced by local soil and climate conditions, and a cultivar that may be highly satisfactory in one area of the country may be of little value in another.

Most growers would be wise to test cultivars, even recommended ones, on a limited scale before making extensive plantings. In this way, the grower can determine, with minimal financial risk, how a cultivar performs under his/her own growing and marketing conditions. Commercially available strawberry cultivars are self-fruitful (do not require cross pollination) and will produce full crops when planted alone. Most growers, however, plant several cultivars in order to extend the harvest season.

Cultivars have been developed that are resistant to the most important root, leaf, and fruit diseases; however, each cultivar is different in fruit size, color, and firmness. The major decision as to

cultivar selection must deal with fruit quality and resistance to disease for maximum economic yield. Each cultivar will require different cultural methods in regard to pests, herbicide sensitivity, soil and weather conditions.

Cultivars can be separated into three plant types based on their response to the hours of sunlight per day (photoperiod). These are June bearers, everbearers, and day-neutrals. Tables 2-1, 2-2, 2-3, and 2-4 (see pages 14-18) list important characteristics of strawberry cultivars adapted to Midwest growing conditions.

The annual plasticulture system of strawberry production has gained much attention in the Midwest since 2000. Fruit ripening can be in early May and continue over several weeks. Growers should investigate promising methods, costs, and higher levels of management than current production systems. (See Chapter 10, *Plasticulture in the Midwest*.)

Many new cultivars are patented, which requires that the propagator own a license before growing patented cultivars. Growers need to be aware of the legal aspects of patented cultivars.

June-Bearing Cultivars

The June-bearing strawberry is the most popular type for commercial production in the Midwest and will produce one crop each year. These strawberries are typically planted in the spring (April 15 to May 15). Newly set plants are deblossomed to encourage more growth and stolon (runner) production for the popular matted-row system of culture.

Stolons are produced under the long sunny days of June and July. At the same time and at the second node, a daughter plant begins and sets roots. Dry soil conditions, recently applied herbicides, or high winds retard daughter plant establishment. Poor establishment of daughter plants will result in reduced fruit yield the following year.

Growers can increase fruit potential for high yields by timely planting, irrigation, and proper fertilization to increase leaf area early in the season. Flower buds are initiated when daylength shortens in the autumn (less than 10 hours light per day). In addition to triggering flower bud formation, short daylength and cool autumn

temperatures induce the production of branch crowns and trigger the onset of dormancy.

In the Midwest, fruit ripens from late May to early July, depending on the cultivar. Many of the newer June-bearing cultivars are resistant to red stele root rot, a fungus disease. (See Chapters 5 and 6 on disease and insect problems for detailed information on red stele.) Red-stele-resistant cultivars can be grown successfully on soils in which the disease-causing fungus is present. Non-resistant cultivars should not be planted in soil suspected of having the red stele fungus. Resistant cultivars often have sufficient merit to warrant planting, even though red stele is not a problem.

Day-Neutral Cultivars

Day-neutral strawberries produce fruit from spring through fall, with several peaks throughout the season because they are insensitive to daylength and will flower and runner continuously if temperatures remain above 35° and below 80°F. A temperature above approximately 70°F will not allow flower bud formation. This may account for some field observations that day-neutrals have poor flower production from mid-summer to early fall. Daughter plants flower the first season, often without rooting.

Fruit size is correlated with soil temperature and can be increased by cooling the soil in the root area with mulches, shading, or irrigation, such as trickle irrigation. Fruit size tends to be 7 to 11 grams per berry, compared to “Guardian” (June bearer), which is 10 to 13 grams per berry. However, in mid-summer, berry size is very small (4 to 5 grams) if plants are subjected to hot, dry conditions.

Day-neutral cultivars do not runner as profusely as June-bearers; therefore, they require a completely different cultural system. Plants can be set out in mid April to early May. All flowers should be removed until mid July of the planting year so the plant can put energy into vegetative growth.

Weed control is a problem with day-neutral strawberries. Since they are more sensitive to herbicides than June-bearers, and since herbicides vary in their preharvest interval (PHI), chemical control is virtually eliminated. Weeds will need to be cultivated by hand.

Tristar and Tribute, two older red-stele-resistant day-neutral cultivars have been available since 1982. Fruit size has been medium, and flavor has been good. These cultivars bear fruit three times per season, nearly four to six weeks apart, or June 1 to 10, July 10 to 15, and August 15 to 20 in Ohio. They may bear an additional crop before frost. For high yields, they should be spaced 10 inches or closer in the row.

- Tristar bears an early crop and is smaller than Tribute. It is resistant to Verticillium wilt.
- Tribute is slightly later in cropping than Tristar, but berry size is larger. It is similar in cropping pattern to Tristar but only tolerant, not resistant, to Verticillium wilt.

Renovation techniques and cultural practices for day neutrals have not been fully explored in all climatic conditions. However, the use of close spacing (plants 8 to 10 inches apart), raised beds, drip irrigation, and black and white plastic mulch (black on the bottom side, white on the top side) appear to be valuable cultural techniques. See Chapter 10, *Plasticulture in the Midwest*.

Everbearer Cultivars

Everbearers are long-day plants, which initiate flowers when days exceed 12 hours of light. They produce two main crops, but yields are less than a single crop from a June-bearer. They produce few runners and tend to form multiple crowns.

Table 2-1. Listing of Red Stele-Resistant, June-Bearing Strawberry Cultivars Currently Grown or for Trial in the Midwest, USA, 2005.

Earliglow [MD 2350 (Fairland x Midland) x MD 2713] is an early-blooming and early-ripening cultivar with excellent flavor and color. Berry size is small (10 gm), and yields can be low.

Annapolis [(Micmac x Raritan) x Earliglow] is a major cultivar in Canada, the Midwest, and the northeastern United States; it has firm berries of good size (12 gm) and good flavor. It runners freely.

Northeaster (MDUS 4380 x Holiday) is a medium-sized berry (12 gm) that is firm and has good flavor and aroma. Adapted to heavy soils. Does not have favorable grower or customer acceptance.

Sable K90-1 (Veestar x Cavendish) is larger and more productive than Veestar; berries are bright, attractive, and have a very good flavor. Less firm than Annapolis. Plant runners freely. Lacks size and firmness. Flowers open early.

Cavendish (Glooscop x Annapolis) is a medium-sized berry (14 gm) with good flavor and firmness. Plants are productive, but susceptible to leaf spot. May ripen unevenly in warm seasons. Not recommended in Missouri. Patented.

Brunswick K90-12 (Cavendish x Honeoye) ripens with Honeoye and produces attractive, medium-sized, firm berries that can be larger than Honeoye but smaller than Cavendish. May have good winter hardiness. Performance best in colder north climates. Flavor is less tart than Honeoye. Plants are vigorous; leaflets tend to be cupped but are more dense than Cavendish. For trial. Patented.

Mira K84-5 (Scott x Honeoye) produces high yield in matted rows with bright orange-red color and has a tendency for tart fruit but is similar to Kent. Post-harvest quality is good. Good winter hardiness and produces well in northern climates. Can be more productive than Jewel and Kent but ripens five days later than Kent. Cavendish is larger and more flavorful than Mira. For trial.

Table 2-1 (continued). Listing of Red Stele-Resistant, June-Bearing Strawberry Cultivars Currently Grown or for Trial in the Midwest, USA, 2005.

L'Amour NY1829 (NYUS 256 x Cavendish) is productive; plant is vigorous; has large red fruit with good eating quality and flavor. Can be larger than Cabot. Later and more firm than Honeoye. Berry size can average over 20 gm in plasticulture. Under wet conditions, culls can be over 15%. Cold hardy. For trial. Not tested for red stele, but parents are red stele-resistant. Patent pending.

Eros (Allstar x Elsanta) has darker fruit color than Allstar. Large, firm fruit with good flavor. Very productive. For trial. May do well in plasticulture. Patented.

Allstar [MDUS 4419 (Redstar x Surecrop) x MDUS 3184 (NC-1768 x Surecrop)] is a high-yielding berry with large fruit (15 gm) with good flavor. Resistant to fungal leaf diseases. Firm. A standard cultivar in Ohio. Fruit color improves with cultural practices and maturity. Good for annual or multiyear plasticulture systems in warmer areas.

Cabot K92-17 [(Elsanta x K79-5) x (Arking x K79-4)] ripens at the same time as Mira with very large fruit averaging 20 to 25 gm over the season and 50 gm berries with primary flowers. Fruit are red and glossy with medium-firm flesh. Plants are vigorous but may produce few runners. Patented.

Mesabi (Glooscop x MNUS 99) has large red fruit with good flavor under cool conditions. In Pennsylvania, it has lost flavor and turned dark in color under hot conditions. High yielding. Winter hardy; does not store well. Patented.

Winona MNUS 210 [Earliglow x (Lateglow x MDUSS 4616)] has produced large, firm berries with bright red-orange color. Yields may be low and of marginal quality in warm climates. Similar to Annapolis and Cavendish for winter injury. Plants are vigorous, winter hardy, and late blooming. Patented.

Clancy NYUS 304B (MDUS 4774 x MDUS 5199) fruit has a deep dark red color, is firm, and has very good flavor, good texture, and eating quality. Berry size can average over 25 gm over the season in plasticulture. Can be larger than Cabot. May have fewer culls than L'Amour. Fruit held off ground. Larger and two days later than Jewel. Cold hardy. Not tested for red stele but parents are red-stele resistant. Has been reported to be highly susceptible to leaf scorch. For trial. Patented.

Ovation B440N (Lateglow x Etna) has large (15 gm), firm berries with good flavor and high antioxidants, and ripens in late June in Ohio. Plants are tall, vigorous, and should be spaced at 18 inches if soil is fertile and high in organic matter. Yields are comparable to Allstar and greater or equal to Chandler. Good for eastern plasticulture production. For trial.

Other red-stele-resistant cultivars not mentioned are Guardian, Redchief, Lester, Delmarvel, Lateglow, and Primetime. These cultivars have performed well in Ohio or other areas but may no longer be of value to most growers in the Midwest.

Table 2-2. Listing of Non-Red-Stele-Resistant, June-Bearing Strawberry Cultivars Grown or for Trial in the Midwest, USA, 2005.

Evangeline K93-1 [(Honeoye x Veestar) x NY 119] is a cultivar ripening before Annapolis with medium yields of medium to large, firm conic berries. Flowers earlier than Annapolis and subject to frost. Fruit is darker in color than Annapolis. Partial resistance to red stele, but may be insufficient for the Midwest. Patented.

Honeoye NY 1409 (Vibrant x Holiday) is a large-sized berry. Has performed well in cool harvest seasons and has good winter hardiness. Excellent frozen.

Darselect (Parker x Elsanta) is a large-sized, attractive berry with good flavor but tends to be soft. Plant is vigorous. Yields can be low. Patented.

Jewel NY 132Y [(Senga Sengana x NYE-58) x Holiday] is productive, but fruit can be soft in hot weather. Does not runner well. Some growers only harvest for two seasons but continues to be a favorite in its season. Patented.

Seneca NY 1529 [NY 1261 (Redcoat x NY 844) x Holiday] fruit is round, large, and among the most firm of any cultivar. The plant is vigorous with high yield and is winter hardy. Flavor is mediocre. Potential for plasticulture. Does not runner heavily. Patented.

Canoga NY 1362 [NY 1123 (Senga Sengana x Midland x Holiday)] has large, firm, and tough-skinned fruit with good keeping quality. Flesh is dark red throughout, and seeds are yellow. Low fruit disease incidence. Good frozen. Suggested for plasticulture and organic systems.

Table 2-3. Suggested Strawberry Cultivars for Different Systems of Culture. In this list, only Everest and Seascape are day-neutrals.

Plasticulture System (See Chapter 10, Plasticulture in the Midwest.)

Sweet Charlie FL 85-4925 (FL 80-456 x Pajaro) is an early-ripening strawberry adapted to the mid-Atlantic and southern United States; has large orange-red fruit color and is moderately firm. Easy to harvest. Good flavor. Flowers early. Tolerant to anthracnose. Patented.

Chandler Cal 77.32-103 and C24 (Douglas x Cal 72.361.105). Standard for the system. Plant is vigorous. Berries are firm and large with good flavor. Do not over fertilize with N. Glossy attractive fruit. Susceptible to anthracnose.

Camarosa Cal 88.24-603 (Douglas x Cal 85.218-605). Fruit is larger and more firm than Chandler; color similar to Chandler; earlier, higher yielding, more vigorous than Chandler in warm climates. Cool fall can affect flower bud initiation. Susceptible to leaf spot. Patented.

***Allstar** — see Table 2-1.

***Ovation** — see Table 2-1.

Everest (Evita x Irvine). Harvest from June to October. Day-neutral; not a good plant maker; set plants at 6 to 8 inches. May overwinter. Fruit is large, bright, with good flavor. Fruit can be soft. For trial.

Seascape CN 49 (Cal 83.49-1). Day-neutral. Superior to Selva in flavor but less productive; erect habit; susceptible to leaf spot and two-spotted spider mite. Patented. Does not overwinter. For trial.

Canoga — see Table 2-2.

Seneca — See Table 2-2.

* Red-stele resistant. Other day-neutral cultivars not mentioned that are red-stele resistant are Tristar and Tribute.

Table 2-4. Strawberry Cultivars for the Midwest with General Characteristics for Production and Marketing.

Plasticulture	Large Berry Size	High Yield	Shipping	Shelf Life**
Eros	Clancy	Eros	Eros	L'Amour
Cabot	L'Amour	Allstar	L'Amour	Allstar
Honeoye*	Allstar	Cabot	Allstar	Lester
Jewel*	Cabot	Honeoye*	Lester	Kent*
Kent*	Jewel*	Kent*	Kent*	Earliglow
Seneca*	Honeoye*	Lester	Seneca*	
Allstar	Seneca*		Latestar	
Ovation				

* Not red-stele resistant; some new cultivars should be grown as a trial before adoption in your area.

** Tends to maintain good quality under refrigeration and if chilled within one hour after being picked.