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Strawberries in South Dakota

by Anne Fennell, assistant professor,
and David F. Graper, Extension horticulture specialist
SDSU Department of Horticulture, Forestry, Landscape, and Parks

The strawberry is a popular small fruit that is adapted to a wide range of soil and climatic conditions and may be grown in most parts of South Dakota. Strawberries are very productive plants for the space they occupy. The fruit is high in vitamin C and contains ellagic acid, an anticarcinogen. A planting of 50 Junebearing strawberries will fill a 100 foot matted row and should produce 50-60 quarts of fruit. Everbearing plants grown in a raised bed can produce one half to one quart of berries per plant.

Types of Strawberries

There are three basic types of strawberries, and each can be grown in South Dakota:

- Junebearing
- Everbearing
- Day-neutral

Junebearing strawberries are the most common type grown in South Dakota. These strawberries initiate runners to form new plants during midsummer under long daylengths, and they initiate flower buds in the fall under short daylengths. They produce one crop of fruit in the early summer between June and mid-July, depending on the variety. Honeoye and Jewel are examples of typical Junebearing strawberries.

Everbearing strawberries also are fairly popular in South Dakota. They tend to produce most heavily in the spring and less in the fall. Everbearing strawberries do not produce as many runners as Junebearers. Fort Laramie and Ogallala are two popular Everbearing strawberry varieties.

Day-neutral strawberries are a newer type of everbearers that will fruit from June through the first frost and will seldom form runners. The day-neutrals produce fruit more uniformly throughout the season, whereas the everbearing strawberries generally have two peak periods of production. However, day-neutral strawberries do not form flower buds at temperatures above 85F. They are recommended only where mulching, shading, or sprinkler irrigation can be used to provide a cool midsummer environment to promote continuous flowering. Tribute and Tristar are two examples of day-neutral strawberries.

The alpine strawberry (*Fragaria vesca*) is a small white or red-fruited form of everbearing strawberry. The plants are low yielding and do not runner heavily. They produce small, soft fruit that has a unique flavor. Alpine strawberries are used most frequently as an ornamental or novelty item, often grown in hanging baskets or gardens since they tolerate light shade.

Variety Selection

New varieties are introduced every year, however, not all are suited to this region. Always plant new varieties on a small scale to test their performance before establishing a large planting. Harvest season, disease resistance, size, color, firmness, flavor, and freezing/ processing characteristics vary with cultivar and should be considered when selecting cultivars. Table 1 lists characteristics of some commonly grown strawberries for this region.

Site Selection

Strawberries require a site that is fully exposed to the sun. They can be grown on a variety of soil types, provided the soil is well drained and properly prepared. A well-drained sandy loam with pH 5 - 7 is optimal. Strawberries are sensitive to high salt content in the

Table 1. Plant and fruit characteristics.

Cultivar	Yield	Hardiness	Vigor	Fruit Size	Fruit Firmness	Process/ Freezing	Disease*
June bearing							
<u>early season</u>							
Annapolis	mod	good	med	large	v. good	good	
Crimson King	mod-high	good	high	large	soft	v. good	susc vert
Earliglow	mod	fair	med	med	v. good	v. good	res vert
Settler	mod	good	med	large	v. good		
Veestar	mod-high	good	high	med	good	good	
<u>midseason</u>							
Honeoye	high	v. good	high	med-large	v. good	good	susc vert
Jewel	high	good	med	large	good		
Kent	high	v. good	fair	large	good		
Redcoat	high	v. good	high	med	good	good	
Settler	high	fair	med	large	v. good		res vert
<u>late season</u>							
Bounty	mod-high	v. good	med	large	soft		
Glooscap	high	v. good	high	med-large	v. good	v. good	
Seneca	high	good	high	large	v. good		
Sparkle	high	v. good	high	med	good	good	susc vert
Trumpeter	mod-high	v. good	high	med	fair	v. good	
Everbearing							
Ogallala	mod-high	excel	high	small	poor	good	
Ft. Laram	high	excel	high	large	poor	very	susc PM
Ozark Beauty	high	medium	med	med	med	good	
Day-neutral							
Selva	mod-high	fair	high	large	good	good	
Tribute	high	v. good	med	med-large	v. good	good	
Tristar	mod	v. good	med	med	v. good	good	res vert

* res vert = resistant to verticillium wilt, susc vert = susceptible to verticillium wilt, susc PM = susceptible to Powdery Mildew

soil; it should not exceed 2.5 mmho/cm. Soil salt content and pH can be determined easily through a soil test (contact your county Extension office for more information on soil testing).

If soil pH is too high, you can lower it by incorporating elemental sulfur into the bed to a depth of 6 to 8 inches prior to planting. An application of 5-10 lbs elemental sulfur per 100 square feet will lower the pH from 7.5 to 6.5. If your soil pH is higher than 7.5, additional sulfur will be needed to neutralize the "free lime" that is in the soil before the pH can be reduced.

Plant strawberries near a source of good quality water for irrigation. Do not use water with a high sodium or salt content. High salinity and high pH are problems in many parts of South Dakota that can cause failure of a strawberry planting. Do not use artesian water or any other water source unless you know it is of good quality with less than 700-900 ppm salts.
The site should be elevated, with a 2-3% slope to provide good cold air drainage. Avoid low-lying sites since cold air will move to these sites creating a potential for frost damage. Avoid areas where water stands or drains very slowly. Waterlogged soils can kill the roots through oxygen deprivation and by promoting root rot diseases.

Avoid sites that have had potatoes, tomatoes, eggplants, peppers, or strawberries and raspberries growing on them within the last 3 years. These plants may have had verticillium wilt which can readily spread to the strawberries. The risk of disease can be reduced by rotating with crops that are not susceptible to verticillium wilt.

Site Preparation

Good soil preparation is the key to developing a long-term, high-yielding strawberry planting. White grubs and perennial weeds are frequently a problem on sites that have been in sod or pasture. Begin site

preparation at least one year before planting. It is easier to control weeds before planting. Clean cultivation, planting a green manure crop, or planting a crop in which weeds can be controlled by using chemical herbicides or by cultivating can help control weeds before planting. Consult herbicide labels to avoid potential carry-over problems in the new strawberry planting. Test soil pH and fertility levels and incorporate phosphorus and potassium, if needed, before planting. Incorporating a green-manure crop or well-rotted manure will improve soil texture and add nitrogen (manure 20 tons/acre, 4 bushel/100 square feet). If manure is not available, apply nitrogen at or before planting (20-40 lb. N/acre or 3/4 lb. 10-10-10 per 100 ft², Table 2).

Planting

Order plants early (midwinter) from a reputable nursery to get high-quality, virus-free plants. Have plants delivered between April 15 and May 1 for spring planting in South Dakota. The number of plants needed depends on the planting design (see spacing recommendations in the section on establishing strawberries). Obtaining plants from old beds or neighbor's gardens is not recommended since a number of diseases may be brought with these plants into the new bed.

Early spring is the best time to plant strawberries. Set the plants as soon as possible after they arrive. If wet soil or low temperatures prevent immediate planting, store the plants in a cool, moist place, preferably at, but not below, 33F. You can use the crisper compartment of your refrigerator for short-term storage of strawberry plants if the roots are kept barely moist. Bare root plants, shipped from nurseries, will not tolerate planting temperatures of 22F or below in the field. However, don't wait too long to plant, as the earlier the plants are planted the more quickly they will become established and become productive.

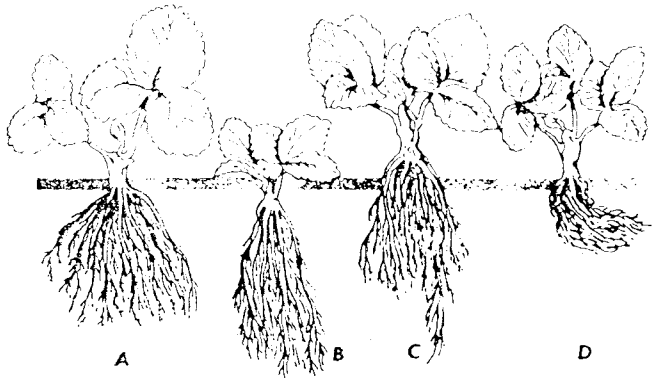


Figure 1. Proper planting depth is important for quick establishment. In this illustration, plant A is at the proper depth. Plant B is too deep (plant will be smothered). Plant C is too shallow (roots are exposed). The roots of plant D have been bent and remain near the soil surface.

It is critical that plants are put in the ground at the right depth (Figure 1). Setting the plants too high will expose roots to drying. Setting plants too deeply will

Table 2. Fertilizer recommendations for strawberries.

Timing	Application Rate Pounds N/100 ft row	Application Rate Pounds N/Acre
Junebearing Strawberries - Establishment Year		
Prior to Planting	.5*	20 to 40
August during runner production	.5	20 to 40
Junebearing Strawberries - Bearing Year		
Immediately after renovation (August)	1.0	40 to 80
Day-neutral/Everbearing Strawberries		
Every 3 to 4 weeks	.2 to .4	15 to 40
Second year - follow same fertilization regime as first year		

*equivalent to 5 lbs. of 10-10-10 or 2.5 pounds of 25-5-10 per 100 foot row

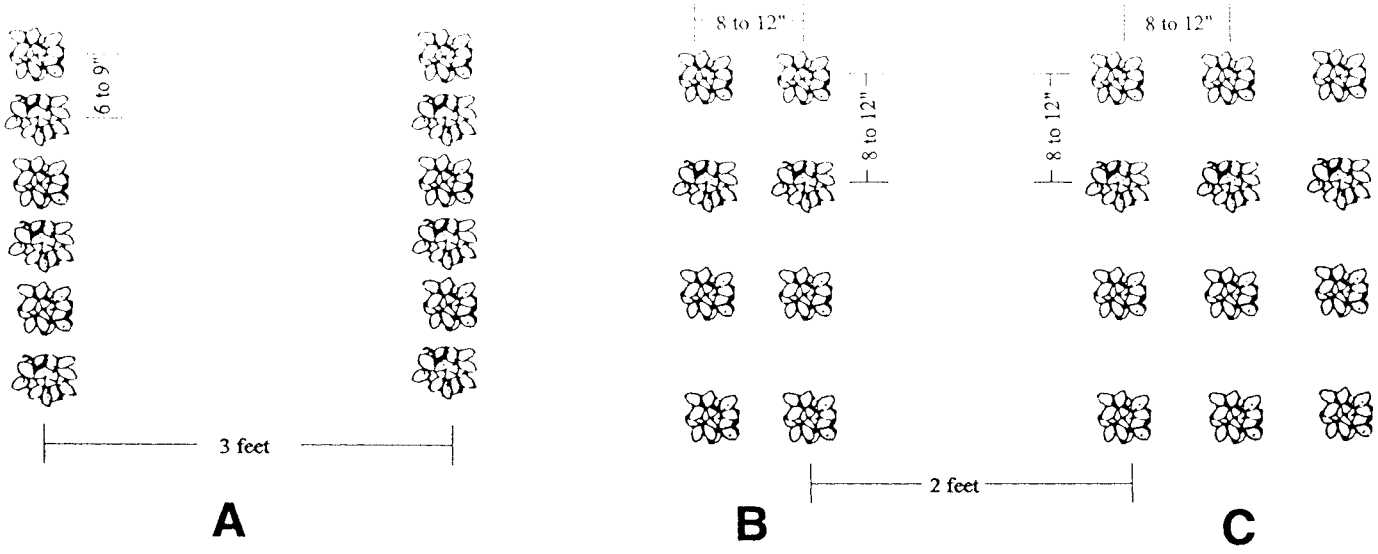
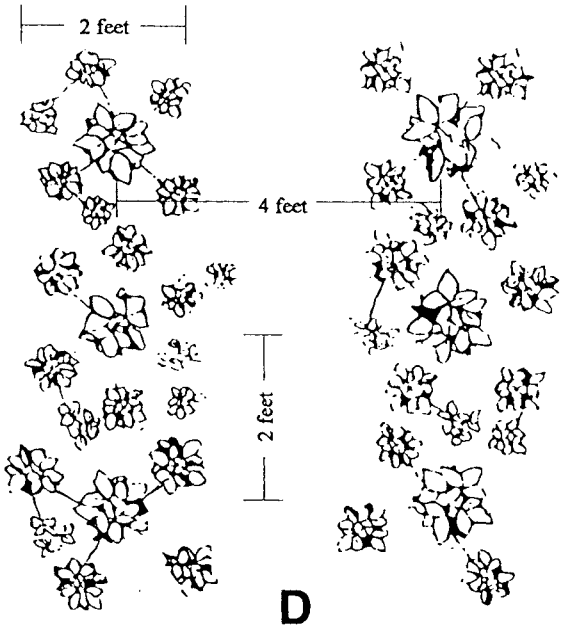


Figure 2. Spaced and matted row configurations that can be used for strawberry plantings.

Everbearing and day-neutral strawberries may be planted as single plants in single rows (A). Or, they may be spaced more closely in beds with either double (B) or triple (C) rows.

Junebearing strawberries typically are planted in a matted row configuration (D).



reduce their vigor. The soil level should be at the center of the crown after the soil is firmed around the roots. Be sure that the hole is deep enough so that the roots are not bent and horizontal. Water plants within six hours of planting, preferably right after planting, to settle the soil around the roots. Water the plants even if the soil seems moist.

Establishing Junebearing Strawberries

Junebearing strawberries are best grown in a matted row (Figure 2). Set plants 1.5 to 2.5 feet apart in rows spaced 3 to 4 feet apart. Each plant will produce several runner plants. Let the runners develop until a 1 to 1.5 foot wide matted row forms. Keeping the rows narrow will minimize fruit rot and allow for easier harvest and weed control. Wider rows are not as productive as narrow rows because the plants in a wide row are shaded by each other, reducing their productivity.

After planting, remove flower blossoms from the Junebearing strawberries during the first year to promote plant establishment and improve yields in future years. Remove flower buds only during the establishment year. Irrigate immediately after planting and during dry periods so the plants will receive a minimum of one inch of water per week in August during runner development (Table 2).

Good weed control is critical during establishment and in successive years. Early weed control will reduce future problems and improve fruit yields. Few herbicides are labeled for use in strawberry plantings, so preplant control, mulching, and early weed removal are the best ways to increase planting longevity.

Establishing Day-neutral and Everbearing Strawberries

Day-neutral/everbearing cultivars can be planted in matted rows like Junebearers on a 6- to 8-inch raised bed (Figure 2). The raised bed will provide better drainage and allow faster establishment in the spring due to higher soil temperatures. Place plants 6 to 9 inches apart in single rows three feet apart. Alternatively, place the plants 8 to 12 inches apart within double or triple rows that are spaced 8 to 12 inches apart within the bed. Leave 1.5 to 2 feet between each series of double or triple rows for cultivating and harvesting.

Mulch the beds with 1 to 2 inches of clean straw to conserve moisture, keep the soil cool, control weeds, and keep the fruit clean. Plastic mulch also can be used with day-neutral and everbearing varieties. Black plastic will help warm the soils and encourage better growth. However, white plastic may be more suitable for areas with high summer temperatures, since day-neutral strawberries stop forming flower buds when temperatures exceed 85F.

Remove flower blossoms from day-neutral/everbearing plants for 4 to 6 weeks after planting to promote plant establishment. Allow the plants to flower when they have 5 to 6 fully expanded leaves (about July 1). Remove flower buds only during the establishment period of the first year.

Runner removal also may be necessary for some day-neutral cultivars during the first 6 to 8 weeks after planting to encourage establishment and greater productivity. This is not necessary on all day-neutrals as many day-neutral cultivars do not runner readily.

Day-neutral strawberries are most productive the first year. They can be wintered over like the Junebearers, but their major advantage is that they produce a crop the first year. Day-neutral cultivars provide the option of growing strawberries as an annual.

Fertilizing

Fertilization requirements for Junebearing and day-neutral strawberries differ. Base preplant applications on soil test recommendations. After the establishment year, apply nitrogen to Junebearing strawberries during renovation to promote the development and establishment of new runners. Never apply nitrogen fertilizers to Junebearing strawberries in the spring of bearing years as this can promote dense foliage, softer fruit, and disease problems.

Day-neutral/everbearing strawberries have a high demand for nutrients and can be fertilized every 3 to 4 weeks to maintain fruit production throughout the season. This usually results in 4 to 6 applications during the season. Apply fertilizer in the second year just like in the first year and include a spring application.

Soils with medium to high organic matter will require lower levels of nitrogen. You can use a soil test or foliar analysis to help find out whether micronutrients need to be applied.

Mulching

The flower buds of Junebearing strawberries form in early September and are injured by temperatures below 15F. To provide winter protection, apply 3 to 5 inches of a mulch material when temperatures fall to about 20F but before the temperature drops below 15F. This is usually in late October to early November, after several freezes. Any mulch, such as straw, Sudan grass or a similar material that is free of weed seeds can be used for winter protection. Do not use leaves or grass clippings for mulch as these materials pack down and smother rather than protect the plants.

If you are carrying day-neutral/everbearing plants over for a second year of production, mulch at the same time as Junebearing strawberries.

Remove mulch late in the spring (mid-April to early May) before the developing leaves under the mulch start to turn yellow. Leave some mulch on the ground within the row to keep the fruit clean. Pile the remaining mulch in the picking aisles to help control weeds and provide a clean walkway.

Renovation

Immediately after final harvest, renovate the rows to maintain plant vigor and production. If the planting becomes too dense, berry size and yield are reduced and disease can become a problem. Junebearing strawberries grown in a matted row can be kept for 3-5 seasons if good weed control is maintained. If the beds have become too weedy, consider removing them and establishing a new planting.

After harvest and before August 1, begin renovation by controlling weeds. A broadleaf herbicide such as 2,4-D amine may be applied; however, this herbicide should not be used if strawberry beds are located near other plants that are susceptible to this herbicide. Do not use

a herbicide unless it is labeled for strawberries and be sure to follow all label instructions.

Mow off the leaves one inch above the crown, within one week after last harvest. Delaying mowing may result in damage to the new leaves. An old rotary lawn mower may be used to mow the berries if it is raised to the appropriate height. If beds are weed- and disease-free, mowing may not be necessary.

Cultivate the rows, reducing the row width to 12-18 inches. This will provide space for runners to form and to become established for the next year. Apply nitrogen to promote runner development and establishment. Maintain weed control into the fall.

Irrigation, Frost Protection, and Cooling

Strawberries are very shallow rooted and require a constant supply of moisture to produce good quality fruit. They require about 1 inch of water per week. In most areas of South Dakota, strawberries require supplemental irrigation. High temperatures and windy sites will require more water than areas sheltered from wind.

Day-neutral strawberries require more careful water management than Junebearing strawberries to keep production up throughout the summer. Trickle irrigation under the mulch is the most effective irrigation method. Overhead irrigation can be used with organic mulches. When watering overhead, apply water early enough in the day to allow leaves to dry before evening.

Water should have less than 700-900 ppm salts. Irrigation water can be tested for salinity by the SDSU Water Quality Testing Laboratory, Room 204 Agricultural Engineering Building, SDSU, Brookings, SD 57007. Contact your county Extension office for water sample collecting and testing information.

Late-spring frosts can severely damage flower buds, blossoms, and fruit. Sprinkler irrigation can be used to prevent frost damage. Begin sprinkling (0.1 inch/hr) as soon as the temperature has dropped to 32F at the level of the leaves in the lowest part of the field. Continue to sprinkle until the ice has melted from the leaves and temperatures are above freezing.

Overhead irrigation also can be used during hot weather to cool day-neutral plantings and to improve flowering and fruiting when temperatures exceed 85F. However, the water must be turned off early enough in the day to allow the foliage and fruit to dry out before nightfall to avoid disease problems.

Insects and Diseases

Selection of resistant varieties, proper sanitation, and good cultural practices are the first defense in disease and insect control in strawberry plantings.

Many fruit mold and rot infections occur during flowering or early in fruit development. Scout your planting on a regular basis. Pick fruit when it is ripe and remove all soft and spoiled berries from the patch. Always pick all ripe fruit, even the small berries, to reduce the chance of fruit rots developing in the patch. Maintain good weed control and renovate plantings yearly to prevent dense, crowded conditions conducive to disease problems. Be sure to identify the disease problem and check re-entry time and harvest limitations before applying pesticides that are labeled for strawberries.

Failure to follow pesticide labels can result in illegal and harmful pesticide residues on the fruit. For further information on diseases, consult your county Extension office. An excellent reference book, *A Compendium of Strawberry Diseases*, also is available for purchase from the American Phytopathological Society, 3340 Pilot Knob Rd, St. Paul, MN 55121.

Insects can sometimes be a problem in strawberry plantings. Those most likely to be found include flea beetles, leafhoppers, leafrollers, tarnished plant bugs, cutworms, and white grubs. Proper soil preparation and weed control can help limit many insect problems before and after planting. For further information on insects and control, consult your county Extension office. An excellent reference book for the commercial grower, *Strawberry IPM Scouting Procedures*, is available for purchase from the New York State Integrated Pest Management Program Number 203A, Cornell Cooperative Extension, 119 Plant Sciences Building, Ithaca, NY 14853.

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