

Strawberries in South Dakota

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Strawberries can be grown in most areas of South Dakota as they are adapted to a wide range of soil and climatic conditions. The fruit is tasty and nutritious, being particularly high in vitamin C and several antioxidants. Strawberries are very productive plants for the space they occupy. A planting of 25 June-bearing strawberries will fill a 50 foot matted row and should produce 25-30 quarts of fruit. Everbearing plants grown in a raised bed can produce one-half to one quart of berries per plant.



David Hansen, University of Minnesota

Types of Strawberries

There are three basic types of strawberries: Junebearing, Everbearing, and Day-neutral strawberries; all are types of *Fragaria x ananassa*.

Junebearing strawberries are the most common type of strawberry grown in South Dakota. These strawberries initiate runners to form new plants during the long days of midsummer, and initiate flower buds only under the short days of fall. The flower buds then go dormant until the following year. As the name suggests, Junebearing strawberries produce one crop of fruit in the early summer between June

and mid-July, depending on the variety. They should not be allowed to fruit the year of planting, so that their energy is put into building the plant for future production. 'Honeoye,' 'Sparkle,' and 'Jewel' are popular Junebearing strawberry varieties grown in South Dakota

Everbearing strawberries are also grown 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 Junebearing strawberries. 'Fort Laramie' and 'Ogallala' are two popular everbearing strawberry varieties. These are not usually used in commercial production.

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 but produce small soft fruit with intense flavor. Alpine strawberries are most frequently used as an ornamental or novelty item, often grown in hanging baskets or gardens since they tolerate light shade.

Day-neutral strawberries are a newer type of everbearing strawberry that fruit from June through the first frost; they also seldom form runners, and are often grown as annuals as they can be harvested the year of planting. The day-neutrals form flower buds and fruit continuously, whereas the everbearing strawberries generally have two peak periods of production. However, day-neutral strawberries do not form flower buds at temperatures above 85°F. 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.

Variety Selection

New varieties are introduced every year, but not all are suited to this region. Plant new varieties on a small scale to test their performance before establishing a large planting. Consider harvest season, disease resistance, size, color, firmness, flavor and freezing/processing characteristics when selecting cultivars (see Table 1).

Order plants early (midwinter), from a reputable nursery to get high-quality, virus-free plants of the desired quality. Have orders 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).

To avoid disease problems, always obtain healthy, virus-free plants from a reliable nursery rather than transplanting from an established bed.

Growing Site

Strawberries require a site that has full sun at least 8 to 10 hrs per day. They can be grown on a variety of soil types, provided the soil is well drained and properly prepared. Avoid areas where water stands or drains very slowly; waterlogged soils can kill the roots through oxygen deprivation and root rot diseases. To avoid problems in heavy soils, use raised beds (at least 6- to 8-inches high) or plant on a 2-3% slope. Even on well-drained soils, avoid low-lying sites because cold air will move to these sites, creating a potential for frost damage.

A well-drained sandy loam with pH 5.0 – 7.0 is optimal. Strawberries are sensitive to high salt content in the soil; it should not exceed 2.5 mmho/cm. Soil salt content and pH can be easily determined through a soil test (contact your regional extension office for more information on soil testing).

If necessary, soil pH may be lowered by incorporating elemental sulfur 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. On some soils with high carbonate levels, sulfur will not be effective; check with

your soil testing laboratory.

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. Irrigation water can be tested for salinity; contact your regional SDSU Extension office for water sample collecting and testing information.

Avoid sites that have had potatoes, tomatoes, eggplants, peppers, raspberries or strawberries growing on them within the last 3 years. These plants can host *Verticillium* wilt, which can readily spread to the strawberries.

Before Planting: Site Preparation

Good site preparation is the key to developing a long-term, high-yielding strawberry planting. If possible, begin preparing the site a year before planting. White grubs and perennial weeds are frequently a problem on sites that have been in sod or pasture; it is easier to control them before planting. Clean cultivation, or planting a crop in which weeds can be controlled using chemical herbicides or by cultivation, can help decrease weeds before planting strawberries. Be sure to consult herbicide labels before any application to avoid potential carry-over problems in the new strawberry planting.

Another option is a green manure crop such as sudangrass, oats, or rye, which can help increase the soil organic matter to the higher levels preferred by strawberries. Incorporation of green-manure crops or of well-rotted manure will also improve soil texture and add nitrogen. Manure may be used (20 tons/acre, or 4 bushels/100 square feet), or fertilizer (Table 2). Test soil pH and fertility levels and incorporate phosphorus and potassium, if needed, before planting.

Planting

Early spring is the best time to plant strawberries. Plant sets 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, 33°F. The crisper compartment of

Table 1. Characteristics of some commonly grown strawberries for this region. Diseases: Vert = *Verticillium*, Phytoph = *Phytophthora* crown/ root rots, RedStele = Red Stele Crown Rot, Foliar = includes leaf spot, leaf blotch, leaf scorch. VS = Very susceptible. S = Susceptible, T= Tolerant, R=Resistant

| Cultivar | Hardiness | Season | Fruit size | Texture | Flavor | Disease | Comments |
|--------------------------------|-----------|--------------|--------------|-----------|--------------|--|---|
| Early Junebearing | | | | | | | |
| Annapolis | Good | Early | Med-L | Firm | Good | Vert-S; RedStele-T/R; Foliar-S | Maintains fruit size; Light red skin and flesh |
| Earliglow | Fair | Early | Med-Small | Firm | Excellent | Vert-R RedStele-R Foliar-R | Fruit size decreases over season |
| Honeoye | Excellent | Early to Mid | Med | Medium | Good | Vert-S; RedStele-S; Phytoph_S | High yield; Not for heavy soils |
| Itasca | Very good | Early | Med-L | Mod soft | Good | Foliar-R; RedStele-R | Orange-red |
| Wendy | Good | Early | Med | Mod firm | Very good | Vert-S | Sweet; w/o acid |
| Mid-Season Junebearing | | | | | | | |
| Allstar | Fair | Mid | Med | Firm | Very good | Vert-M/R; RedStele-R Foliar-T | Orange-red; irregular; delicate skin |
| Brunswick | Good | Mid | Med-large | Firm | Very good | RedStele-R; Foliar- R; Phytoph-S | High yield; Dark red skin, med red flesh |
| Cabot | Fair | Mid-late | Very Large | Very Firm | Fair to good | Very suscept. to mites | Lower yields; few runners; |
| Cavendish | Very good | Mid | Large | Firm | Very good | Vert-M RedStele-R Foliar-R | High yield but high temps can cause uneven ripening |
| Glooscap | Excellent | Mid | Med | Mod Firm | Good | Vert-M; RedStele-S | Good for freezing |
| Jewel | Fair | Mid-late | Large | Very firm | Excellent | RedStele-S; Vert-S; Foliar-M | High yield if no winter damage |
| Kent | Very good | Mid | Med | Mod firm | Good | RedStele-S Foliar-VS | High yield in cooler temps |
| L'Amour | Good | Mid | Med-large | Firm | Very good | Foliar-S | Consistent; high quality |
| Mesabi | Excellent | Mid | Med-large | Mod Firm | Excellent | RedStele-R; Foliar-R | High yield; juicy, doesn't store well |
| Seneca | Good | Mid | Med | Very Firm | Good | Vert-S | High yield; Tart |
| Surecrop | Good | Mid | Large | Firm | Very Good | Vert-R; RedStele-R | Vigorous |
| Late Season Junebearing | | | | | | | |
| Sparkle | Very Good | Late | Med | Fair | Excellent | RedStele-T; Foliar-S; Vert-S | Berries lose size over season |
| Winona | Very good | Late | Large | Fair | Good | RedStele-R; Foliar-T | Orange-red berries |
| Everbearing/Day Neutral | | | | | | | |
| Ft. Laramie | Excellent | Ever | Med | Fair | Fair | Vert-Mod | Dark-red soft fruit |
| Ogallala | Excellent | Ever | Med to Large | Soft | Very good | Foliar-R | Older variety; yields well |
| Quinalt | Good | Ever | Med | Soft | Fair | Foliar-R | Very sweet |
| Tribute | Very Good | Neutral | Med | Firm | Good | Vert-R; RedStele-R | Low yield; lighter-colored fruit |
| Tristar | Very Good | Neutral | Small-Med | Firm | Very good | Vert-R; RedStele-R | Low yield; Intense color |
| Seascape | Fair?? | Neutral | Large | Firm | Very Good | Vert-S RedStele-R Foliar-mixed | Plant closely- does not runner; dark red berries |

Table 2. Fertilizer recommendations for strawberries

| Timing | Application Rate for Nitrogen | |
|--|-------------------------------|---------------|
| | Amt for 100 ft. row | Amt per acre |
| <i>Junebearing</i> | | |
| Prior to planting | ½ lb. * | 20 to 40 lbs |
| Aug. of planting year | ½ lb. | 20 to 40 lbs. |
| Subsequent years: | | |
| Immediately after renovation (Aug) | 1 lb. | 40 to 80 lbs. |
| <i>Day-neutral or Everbearing</i> | | |
| Every 3 to 4 wks (1st and subsequent years) | .2 to .4 lb. | 15 to 40 lbs. |
| *equivalent to 5 lbs of 10-10-10 or 2 lbs of 25-5-10 per 100 ft. row | | |

your refrigerator can be used for short-term storage of strawberry plants if the roots are kept barely moist, but don't place them next to apples, which can emit damaging ethylene. Bare root plants will not tolerate temperatures of 22°F 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.

Proper planting depth is important for quick establishment. It is critical that plants are put in the ground at the right depth (Fig. 1). Setting the plants too high will expose roots to drying; too deeply will reduce their vigor and invite crown rots. 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 or placed sideways rather than down. Remove any flowers or dead leaves. Don't allow the roots to dry out while planting (cover them with a damp cloth if needed) and water the plants right after planting to settle the soil around the roots. Adding straw mulch around the plants can help keep the roots moist as the plants become established.

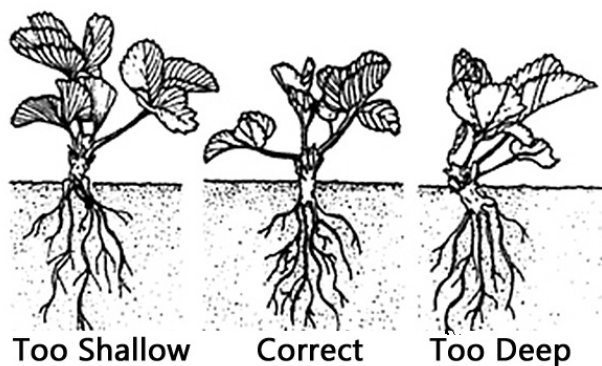


Fig. 1. Proper planting depth. University of Minnesota

Good weed control is critical during establishment as well as 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 timely weed removal are the best ways to increase planting longevity.

Establishing Junebearing Strawberries

Junebearing strawberries are most often grown in a matted row. Set plants 1.5 to 2.5 feet apart in rows spaced 3 to 4 feet apart (Fig. 2). 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

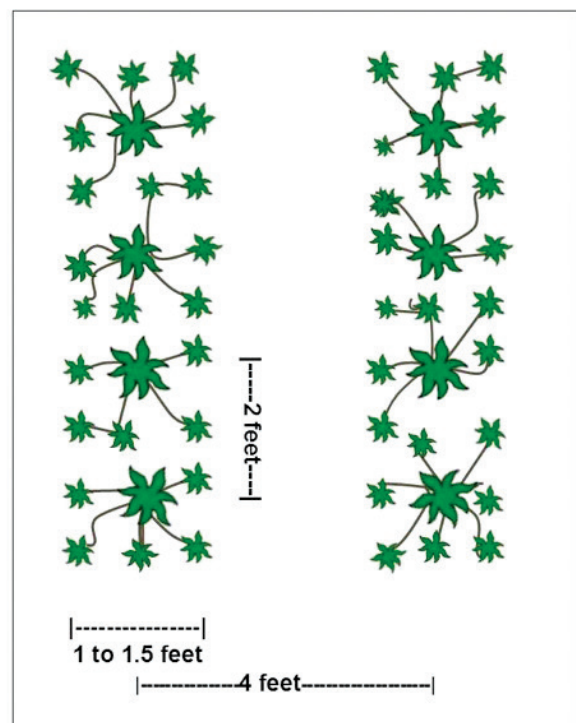


Fig. 2. Spacing for matted row plantings

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 Junebearing strawberries during the first year to promote plant establishment and increase yield in future years. Remove flower buds only during the establishment year. Irrigate during dry periods so the plants will receive a minimum of one inch of water/week in August during runner development.

Establishing Day-neutral and Everbearing Strawberries

Day-neutral/everbearing cultivars can be planted in rows on a 6 to 8 inch raised bed (Fig 3). The raised bed will provide better drainage and allow faster establishment in the spring due to higher soil temperatures. Because these strawberries do not produce many runners, 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. After planting, 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 can also 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



Fig 3

David Hansen, Univ. of Minn.

85F. Drip irrigation will be necessary for strawberries planted on plastic mulch.

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). It is not necessary to remove blossoms after the first year.

Runner removal 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. Although they can be wintered over like Junebearing types, 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. Preplant applications should be based on soil test recommendations. After the establishment year, apply nitrogen to Junebearing strawberries during renovation to promote the development and establishment of new runners (Table 2). 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. Fertilizer applications in the second year should be similar to that of the first year and should include a spring application.

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

Mulching

The flower buds of Junebearing strawberries are formed in early September. The flower buds are injured by

temperatures below 15°F. To provide winter protection, apply 3 to 5 inches of a mulch material before the air temperature drops below 15°F. Once soil temperatures remain below 40°F, the plants are dormant and may be mulched. 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.

Day-neutral/Everbearing plants that will be carried over for a second year of production should be mulched 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. Sometimes it is necessary to replace the mulch temporarily during a sudden spring cold spell. During the growing season, 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 for the pickers. However, if you have observed leaf diseases the previous year, replace the mulch in the fall or early spring with fresh straw to remove any disease propagules that may be clinging to the old mulch.

Junebearing strawberry 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 with new plants.

After harvest and before August 1st, begin renovation by controlling weeds. A broadleaf herbicide such as 2,4-D amine may be applied at that time, however, this herbicide should not be used if strawberry beds are located near other plants that are susceptible to this herbicide. Sethoxydim (Poast is one of the formulations) is a grass herbicide that is currently labelled in South Dakota for use as a spot treatment in strawberry beds, although not within 7 days of harvest. Never use an

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

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 can be raised to the appropriate height. If beds are weed- and disease-free, mowing may not be necessary. Cultivate between the rows, reducing the row widths to 12 to 18 inches. This will provide space for runners to form and 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.

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 32°F at the level of the leaves in the lowest part of the field, and continue to sprinkle until the ice has melted from the leaves and temperatures are above freezing.

Sprinklers can also be used during hot weather to cool day-neutral plantings, to improve flowering and fruiting when temperatures exceed 85°F. However, allow the foliage and fruit to dry out before nightfall to avoid disease problems.

Insects and Diseases

Selection of resistant varieties, starting with new disease-free plants placed into well-drained soil, proper sanitation and good cultural practices are the first

defense in disease and insect control. Use drip irrigation to avoid prolonged leaf wetting. Maintain good weed control and renovate plantings yearly to prevent dense, crowded conditions conducive to diseases. Do not apply nitrogen in the spring, as this encourages growth that is particularly susceptible to diseases.

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.

Most of the strawberry leaf spots or blotch diseases can be greatly reduced by good sanitation as they overwinter on live or dead leaves. Leaf spot (Fig 4), caused by the fungus *Mycosphaerella* is spread mechanically by equipment, people, or even birds and insects.



Fig 4

Before applying pesticides, make sure strawberries are on the label, and be sure to identify the disease problem and check reentry time and harvest limitations. Failure to follow pesticide labels can result in illegal and harmful pesticide residues on the fruit.

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. A new pest that can be a problem especially on late summer to fall fruit is the spotted wing drosophila fruit fly. A scouting and

management guide, "Integrated Pest Management Manual for Minnesota Strawberry Fields" can be downloaded at no cost from the Minnesota Department of Agriculture (www.mda.state.mn.us).

Deer can also be a significant problem as they like to eat the leaves from plants, dramatically reducing production.

For further information on pests or diseases, consult your SDSU Extension office. In addition, an excellent reference book entitled: "A Compendium of Strawberry Diseases" is also available for purchase from the American Phytopathological Society, 3340 Pilot Knob Rd, St. Paul, MN 55121.