

Strawberries

Keys for Success

Choose a site with full sun, good drainage, and a pH between 5.5 and 7.0. Begin improving the soil the year before planting, especially if the pH needs adjusting.

Plant in early spring in soil where no strawberries, brambles, or crops in the tomato family (including potatoes, peppers, and eggplants) have been grown for several years.

Strawberries are shallow rooted. Keep plants well watered, especially just after planting.

Do a good job of early weed control during the establishment year to prevent problems later.

If using the matted-row system, pluck flowers the first year to encourage runners to fill out a 12- to 15-inch-wide strip, but don't let plants get too crowded.

Because they bear early and are relatively easy to grow, strawberries are a great crop for you to start with in your home fruit planting. Strawberries are the most widely grown fruit crop in the world. They can flourish from tropical highlands to subarctic regions. The plants are hardy throughout New York State (if managed and mulched correctly) and can tolerate a wide range of soil types. Strawberries provide more vitamin C than oranges and have fewer calories than most other fruits (see Table 1, page 1).

Day-neutral cultivars, which bear fruit from June through October in the Northeast, are now available (see the section “Day-Neutral Strawberries” starting on page 62). The section below discusses traditional “June-bearing” cultivars that fruit in June and July.

Choosing Cultivars

You can find June-bearing cultivars adapted to northern climates in many nursery catalogs. Some cultivars perform better than others, but it is difficult to predict which will grow best in a particular garden.

Cultivars differ in flavor, disease resistance, cold tolerance, when they ripen, and suitability for frozen storage. Perhaps the best way to decide which cultivars to grow is to find out what works well for your neighbors or local commercial growers. Then try several promising cultivars before planting a large area.

June-bearing strawberry cultivars are reliably winter hardy throughout New York (as cold as USDA Hardiness Zone 3), provided they are properly managed and mulched. Some cultivars that perform well include:

- **Earliglow**—perhaps the best-flavored cultivar, it is among the earliest to ripen.
- **Northeast**—ripens about the same time as Earliglow. It is resistant to red stele and does well on heavier clay soils. The berries are large and have a hint of grape flavor, which some people love and others dislike.
- **Sable**—has excellent flavor and also ripens early.
- **Allstar**—a reliable producer with large light red to orange, sweet-flavored berries.
- **Honeoye, Cavendish, Kent, Raritan, Redchief, and Scott**—good midseason strawberries.

- **Jewel**—the most widely grown variety in the Northeast, it has excellent flavor. It is productive and maintains a large fruit size throughout the season.
- **Lateglow**—a reliable late-season cultivar.

All these cultivars are cold hardy, yield well, and produce firm fruit with good freezing quality. Allstar, Cavendish, and Jewel produce exceptionally large fruits.

Buying Plants

Purchase dormant, virus-indexed plants from a reliable nursery. (For an updated list of nurseries, see www.hort.cornell.edu/nursery.) Nurseries usually sell plants in bundles of 25. Ask that they be shipped in late April or early May.

When plants arrive, check them for signs of winter injury, mold, and root rot. Plants showing signs of winter injury—a brown- or orange-colored internal crown—are likely to die if the weather quickly turns hot and dry after planting. A heavy mold on roots and crowns indicates that they weren't stored properly. If plants are moldy, discard them. Store healthy plants in a refrigerator until you are ready to plant.

Site Selection

Strawberries grow best in a sunny location with deep, well-drained sandy loam soil with a pH of approximately 6.2. The plants do not tolerate extremes in pH, either below 5.5 or above 7.0. Determine pH by testing the soil, and follow recommendations to adjust the pH accordingly a year before planting. (Contact your county's Cornell Cooperative Extension office for more soil test information. See www.cce.cornell.edu/local_offices.cfm.) Lime and other soil amendments that are used to adjust pH require at least two months of warm weather to work, so don't wait until the fall before planting to apply them.

Plants can be productive over a broad range of soil types, but avoid extremes. Heavy clay soils retain moisture but are often poorly drained, while sandy soils drain well but require irrigation. Add organic matter to sandy or clay soils to reduce those shortcomings.

Adequate drainage is essential for healthy strawberries. If your site is poorly drained, plant on ridges or in raised beds. Strawberry plants are shallow rooted and benefit from irrigation. Consider using irrigation to prevent yield reductions caused by drought, particularly on raised beds, which can dry out quickly. Drip irrigation works well for home gardens.

Keys for Success

Cover plants with mulch when nighttime temperatures approach 20 degrees F. In early spring, rake mulch off the plants into the space between the rows.

To get good production and a long-lived planting, renovate the planting by mowing it after harvest.

When the planting starts to decline, generally after about the third year of fruiting, start a new planting with virus-indexed plants purchased from a reliable nursery.

Do not plant strawberries in an area where they were recently grown. Also avoid planting them where crops in the tomato family (Solanaceae, including eggplants, potatoes, and peppers) have been grown.

Before planting, find out about the soil and its history. It may harbor troublesome pests, particularly perennial weeds or weed seeds, insects, soilborne diseases, or nematodes. Control insects that reduce strawberry yields, such as white grubs, strawberry root weevils, and European chafers, by growing a crop other than strawberries for a year before planting.

In soils where the fungi causing red stele and verticillium wilt are known to be present, plant only resistant cultivars. Northeaster, Allstar, Cavendish, Redchief, Scott, and Lateglow are resistant to both red stele and verticillium wilt. Honeoye, Kent, Raritan, and Jewel are susceptible to these two diseases.

Growing Methods

Keep topsoil covered with plants, but avoid overcrowding.

There are several different systems that you can use to grow strawberries. You should decide which is best for you before ordering plants.

The **matted-row system** is the easiest to maintain. Set plants 12 to 24 inches apart in rows that are 48 inches apart. Pluck off the flowers the first season to encourage vegetative growth. The plants will produce side stems with daughter plants called runners. Ideally, you want about six to eight runners per plant. Your goal is for the runners to fill out a strip about 12 to 15 inches wide (18 inches at the most). If you set the plants closer than 12 inches at planting, you'll have too many runners and the planting will be too crowded. You'll have to either spend more time thinning the plants or settle for lower yields from the overcrowded plants and possibly more risk of disease.

Harvest fruit from these 12- to 15-inch-wide rows in subsequent years. The planting will be most productive on the edges. Rows any wider are harder to weed and harvest, and the plants are at greater risk of disease.

Use a rototiller or hoe to remove plants that stray into the area between the rows. Within the rows, you want to keep the soil covered with plants, but you don't want them to be too crowded—no less than about 6 inches apart. Clip off runners to keep the plants from getting too crowded. Clipping runners is hard work, but it increases fruit size, decreases rotting, and makes harvest easier.

With most plantings, you can expect about three years of harvests before the stand declines seriously. As the planting ages, weeds will become more difficult to control, and diseases often become more of a problem. At some point, you'll want to start over at a new location. You may be tempted to use runners from your existing planting. But it's usually best to purchase new, disease-free planting stock. Otherwise, you will just move any disease problems right into your new planting.

The **ribbon-row system** is more labor intensive and requires purchasing more plants, but it produces fruit the first year. Space the plants just 4 inches apart in rows 36 inches apart. Do not remove flowers, and clip all runners. Plants managed this way are very productive and produce large berries. Continue harvesting berries for about three years or until productivity declines.

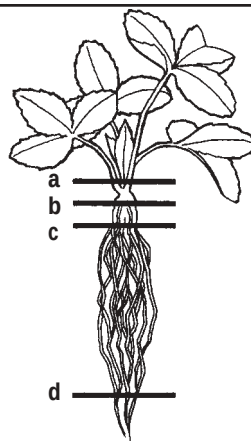
Planting and Early Care

No matter which planting system you use, plant strawberries as soon as possible in the spring (fall planting is not recommended in the Northeast). Prepare soil the season before planting to speed soil warming and minimize the need to work the ground before planting. If the soil is still frozen when your plants arrive, refrigerate them until the ground has thawed.

Avoid exposing the plants to sun and wind. Cool, cloudy weather is ideal for planting. Dig a hole large enough so that the roots can extend vertically, then cover the plants with soil to just below the crown (see Figure 18). Do not bury the crowns. You may need to cut the roots back to 4 inches before planting to avoid J-shaped root systems. During the first few weeks after planting, make sure the plants have adequate water.

Plant strawberries in early spring.

Figure 18. When setting out strawberry plants, do not bury the crown (a) or leave roots exposed (c). The correct planting depth is indicated (b). You may need to trim roots back to about 4 inches (d).



Several weeks after planting, the plants will begin to flower from buds formed within the crown the preceding fall. If you are using the matted-row system, remove these flowers to prevent fruiting and encourage runners. Berries on first-year plants rob the plants of energy necessary for growth, runner production, and winter survival. Although some strawberry cultivars produce only one flower cluster per plant, others produce several sets, so you may need to check the planting and remove flowers several times.

About six weeks after planting, apply 2 pounds of 10-10-10 fertilizer per 100 linear feet of row. Apply another 2 pounds in early September before flower

buds form. Sprinkle the fertilizer evenly over the row area, and try to avoid contact with the foliage. Don't work the fertilizer into the soil, or you may damage the shallow roots.

Managing Your Planting

Watering. Because of their shallow root systems, keeping strawberries well watered is extremely important. There is a tendency to overfertilize strawberries when actually a lack of water is holding back yields.

**Don't
overfertilize or
underwater your
strawberries.**

Strawberry plants need about 1 inch of water each week, either by rainfall or irrigation. Avoid watering in the very early morning or late evening so the plants are not wet for long periods.

When overnight frost threatens blooming plants, cover them with row covers or use sprinklers to deliver a fine mist over the planting. Ice that forms on the plants actually prevents the flowers from freezing. Apply the mist continually from the time the temperature falls below 34 degrees F until the ice melts in the morning.

Weed control. Remove weeds by cultivation, hand hoeing, or pulling. The most important time to keep the strawberry planting weed-free is the first few months after planting while the plants are sending out runners and new plants are getting established. Do a good job of soil preparation and weeding early and you will have fewer weed problems later. Few herbicide options are available to home gardeners. Consult your local Cornell Cooperative Extension office for specific recommendations.

Mulching. In the fall cover your strawberry plants with mulch to prevent injury from low temperatures. Mulching is particularly important on clay soils or those that remain wet for much of the year. Clean straw is traditionally the mulch of choice (avoid mulches that might contain weed seeds, such as hay). Apply mulch when nighttime temperatures approach 20 degrees F, covering the plants 2 inches deep.

Remove the mulch in early spring—around the end of March to mid-April, after the threat of severely cold weather has passed. Strawberries are evergreen. The plants that have overwintered will have green leaves, and they will begin photosynthesizing when you remove the mulch and expose them to the sun. Place the mulch between the rows to help smother weeds and to keep mud from splashing onto the fruit.

If you remove mulch early, you can cover plants with a floating row cover to provide additional protection and encourage early growth. Plants will flower and set fruit earlier. But use caution in areas prone to late spring frosts that could kill the flower buds. (If you lose the first flowers to frost, fruits from later flowers usually compensate.) Remove row covers before flowers appear so that insects can pollinate them. This also reduces the chance of *Botrytis* fungus causing fruit rot.

In the Northeast strawberries typically flower in May and produce fruit in early June through early July (depending on the cultivar and weather). Watch the flowers for signs of insect damage, particularly by tarnished plant bugs. Fruits ripen about 30 days after the flowers open.

Renovation and fertilization. Renovate your strawberries immediately after harvesting to help reduce disease, stimulate vigorous new growth, and prolong the life of your planting. Mow or clip the plants to a height of 3 inches. If you can, collect your clippings in the mower bag or rake them off and remove them to the compost pile to help reduce disease.

After harvest, mow or clip plants to 3 inches tall.

Rototill the area between the rows to incorporate the mulch. While you are tilling, reduce the width of matted rows to about 12 inches. Rake or hoe soil from the alleyways to cover the plants left in the row to about 1 inch deep.

While renovating, fertilize at a rate of 5 pounds of 10-10-10 fertilizer per 100 feet of row. Never fertilize with nitrogen before harvest because this increases fruit mold. (The one exception is fertilizing at planting, but you remove flowers during the planting season when you use the matted-row system so there is no harvest that year.) For more efficient fertilizer use, apply about two-thirds of that rate at renovation and one-third in September.

Diseases and Pests

Many insects feed on unripened fruit and young vegetative growth, and several diseases render the berries inedible or attack the roots. Whenever possible, select disease-resistant cultivars and virus-free plants. For assistance in diagnosing problems with strawberries and other berry crops, see www.hort.cornell.edu/diagnostic.

Botrytis fruit rot (gray mold). This disease is the most common and serious fungal disease of strawberry plants. It affects the flower petals, flower stalks, fruit caps, and fruit, and it is most prevalent during prolonged rainy and cloudy periods just before or during harvest. Blossoms are very susceptible and often turn brown and dry into their stems. Blossom infection leads to fruit infection, which begins as soft, light-brown areas that enlarge rapidly. In later stages, a gray dust of spores covers the fruit as it shrivels and mummifies. Handling diseased fruit while picking spreads the fungus to healthy berries. Under conditions favorable for disease development, healthy-looking fruit can rot within two days of picking.

To prevent botrytis fruit rot, practice good weed control and provide adequate nutrition. In particular, be sure that calcium and potassium are sufficient, and do not overfertilize with nitrogen. Fungicides are most effective when used during bloom.

Verticillium wilt. This fungal disease infects about 300 different host plants, including fruits, vegetables, woody ornamentals, flowers, and weeds. Once

established in the soil, it infects plantings for many years. In new strawberry plantings, the first symptoms often appear about the time runners form. With older plants, symptoms appear just before the berries ripen. Symptoms differ with cultivar susceptibility. Generally, the outer older leaves turn reddish or dark brown at the margins and between the veins. Then they wilt and drop. Few new leaves develop, and those that do emerge are stunted, wilted, and curled up along the midvein. Severe infections produce stunted and flattened plants with small yellowish leaves. Many plants wilt and die rapidly. With less severe cases, occasional or scattered plants wilt and die.

To minimize verticillium wilt, always start with healthy plants, and do not plant them in low-lying wet areas. Always clean garden tools before use, particularly if they are borrowed, to prevent the spread of infection. Avoid planting susceptible cultivars where other plants commonly infected by verticillium wilt (tomatoes, potatoes, eggplants, peppers, brambles, or other strawberries) have been grown in the past several years.

Red stele. This fungal disease is commonly found in low-lying, poorly drained areas of a strawberry planting. It can spread and become well distributed over an entire patch, especially during cool, wet springs. Infected plants are stunted, lose their shiny luster, and fail to send out runners. With the first hot, dry weather of the season, diseased plants quickly wilt and die. To identify the disease, dig up the plants and look at their roots. Infected plants show few new roots compared with healthy plants, whose roots are thick and bushy. Peel away the outer portion of the white roots and the central part (stele) appears pink to red or brownish red. Normally, the stele is yellowish white.

The best way to control red stele is to plant only resistant cultivars. Whenever possible, choose a well-drained site that has no history of red stele, and avoid planting in low-lying areas.

Leather rot. This disease infects primarily fruit at any stage of development, but it also can infect blossoms. It is common in poorly drained areas or where berries are in direct contact with the soil. Leather rot first appears as a darkened spot on the berry, but as the infection spreads, the entire berry becomes brown, leathery, and rough. Infected berries have a distinctively unpleasant smell and taste. To confirm the presence of leather rot, cut through several berries and look for a marked darkening. Unfortunately, mild infections that go unnoticed can ruin a batch of jam or jelly. To help prevent leather rot, mulch early in the season to prevent the fruit from contacting the soil and avoid planting in wet sites.

Leaf diseases. Leaf spot and leaf scorch generally appear in early to mid-spring. Severe infections cause premature death of the leaves and reduce fruit quality. The most obvious symptoms of leaf spot are small round purple

spots on the upper surface of the leaf. Leaf scorch is characterized by round to angular dark purple spots that enlarge to resemble small drops of tar. Strawberry leaf diseases are most prevalent on old weak plants. To minimize their occurrence, remove old and infected leaves from runner plants. Choose a site with full sun, well-drained soil, and good air circulation. Control weeds and fertilize to keep the plants in good condition.

Tarnished plant bugs. The brownish adults are about 1/4 inch long and marked with yellowish and black spots. The nymphs suck plant juices and inject toxic substances that kill the surrounding tissues in the bud. Injured berries remain small, have a woody texture, and fail to mature. “Button berry,” or seediness around the tip of the fruit, is a serious problem that occurs when the bug punctures young fruits before they fully develop. Tarnished plant bugs are more troublesome in fields bordered by woods and fencerows, where weeds are plentiful. They appear in the strawberry patch when plants start to bloom. To confirm their presence, hold a shallow white dish under the leaves and blossoms of a strawberry plant and tap the flower clusters over the dish. If several small green nymphs fall into the dish, consider using an insecticide to prevent the formation of nubby, inedible berries.

Strawberry bud weevil. This insect typically cuts buds and partially severs stems, resulting in the loss of blossoms. Injury is most likely to occur in strawberry patches near woodlots or other protected sites where the weevils overwinter. The dark reddish brown weevils leave these hiding places in the spring when temperatures approach 60 degrees F and infest plants having early fruit buds. Injury is often noticed before bloom and during blossoming. Late cultivars usually suffer the most damage.

Spittlebugs. Named for the mass of frothy material that covers their bodies, nymphs of this insect appear in April or May and complete development in five to eight weeks. The adults have sharp beaks that they use to pierce the stems of plants and suck their juices. Spittlebugs also attack flower bud clusters, leaf stems, and new crown growth. Although heavy feeding by spittlebugs can stunt berry and plant growth, the problems are generally cosmetic. Infestations are usually not severe enough to warrant the use of an insecticide.

Spider mites. These pests often go unnoticed because of their small size, but their damage is easy to see. As spider mites feed and deposit eggs on the undersides of leaves, plants lose their healthy green luster and become a coppery bronze color. Severe infestations weaken strawberry plants and interfere with sugar production and other normal processes. Mite life cycles vary with the season and weather. They can reproduce continuously from early spring until late fall. In general, hot, dry weather (particularly in July and August) and high nitrogen fertilizer rates favor rapid population increases. Insecticides are not effective because technically the mite is not an insect. Avoid overfertilization and keep the plants watered. Natural enemies often keep mites in check.

Instead of producing a bumper crop in June, day-neutral strawberries can be harvested through fall.

Slugs. Few creatures evoke as much frustration for gardeners as the common slug. These mollusks (related to snails and shellfish) come in all sizes and leave slimy trails. As they feed at night or on dark, overcast days, they make small, moderately deep holes in ripening berries. Slugs overwinter in protected places beneath mulch. Various homemade traps, such as shallow pans of beer placed at ground level, and handpicking can reduce populations. Several control products and baits are available.

Day-Neutral Strawberries

Unlike the common June-bearing strawberries discussed above, day-neutral strawberries flower and produce fruit anytime temperatures are between 35 and 85 degrees F. Instead of a bumper crop in June and July, harvest is spread out through the summer to as late as October, and plants yield well during the planting year. Because they do not send out runners as profusely as June bearers, you need to manage them differently.

Cultivar selection. The most successful day-neutral cultivars for the Northeast are Tribute, Tristar, and Seascape. All three are far more productive than older “everbearing” types such as Ozark Beauty. They produce small-to medium-sized fruit, topping out at about 1 inch in diameter. But their flavor is excellent, particularly Tristar.

Tristar produces a large amount of fruit early in the planting year, but the larger-fruited Tribute surpasses its production by the middle of September. Seascape, from California, has the largest fruit—nearly as big as June-bearing cultivars—and is the most productive of the three.

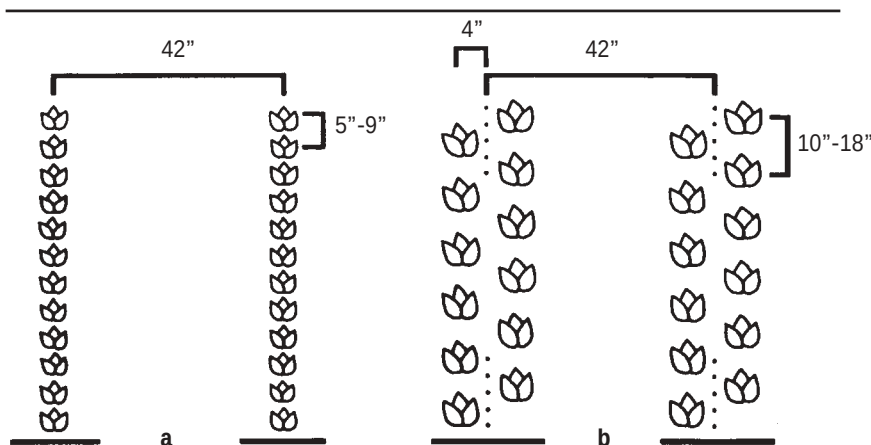


Figure 19. You can plant day-neutral strawberries in single rows (a), but staggered double rows (b) are more productive.

Early care. Day-neutral strawberries prefer the same soil and sites as their June-bearing cousins. Plant them in the early spring, at the same time as June-bearing strawberries. They also are ideal for growing as annuals in containers. Day-neutral cultivars do not produce runners profusely, so matted-row management is not practical. Instead, plant them closer together—about 5 to 9 inches apart—in rows about 42 inches apart. Remove runners for the entire first season. This will increase yield significantly without excessive plant costs.

Planting day-neutral strawberries in a staggered double row reduces competition between plants and increases yields (see Figure 19). Space plants 10 to 18 inches apart, alternating them in two narrow rows just 8 inches apart. Space these staggered double rows 42 inches apart on center.

Day-neutral strawberries perform best when mulched with straw immediately after planting. Mulch reduces drought stress and keeps fruit clean. Remove flowers for several weeks after planting so plants can become established without premature fruiting.

If the summer is hot and dry, little fruit will be produced in the fall because day-neutral strawberries are sensitive to extreme heat and have very shallow root systems.

Watering. Because of these shallow root systems, keeping day-neutral strawberries well-watered is even more important than it is with June-bearers. Make sure they get at least an inch of water per week from rain and/or irrigation.

Fertilizing. During their first year, apply 1 to 2 pounds of ammonium nitrate or 3 to 6 pounds of 10-10-10 per 100 feet of row at the beginning of each month from June through September. Thereafter, apply the same amount at the beginning of each month from May through September. Be very careful to sidedress the fertilizer and avoid contact with the leaves, especially when they are damp and the weather is hot. Instead of monthly applications, you can use annual applications of slow-release fertilizer that deliver the same amount of nitrogen.

Flowering and fruiting. Day-neutral plants produce flowers from the time of planting through frost in autumn. Fruits form from open flowers in about 30 days. Because the flowering season is so long, flowers are more susceptible to insect attack than those of June-bearing strawberries.

Many growers till under their day-neutral strawberries at the end of the first year and start over with a new batch of plants the following spring. If you decide to hold your plants over for another year, cover them with mulch, as you would June-bearing strawberries. The following spring, they will produce a crop in June, then another crop in August. They will not fruit as long into the fall as the first-year planting.

Because of their shallow root systems, day-neutral strawberries need more attention to watering than June-bearers.

**Control weeds
with frequent
hand weeding,
light cultivation,
and mulch.**

Weed control. Because they are always fruiting and there is no good time for renovation, controlling weeds can be a challenge with day-neutral strawberries. These cultivars are also more sensitive to herbicides than June-bearing plants. Planting through black plastic mulch aids in weed control and warms the soil early. But this can hurt Tristar and Tribute cultivars in the summer because they are sensitive to heat. The best approach for home gardeners is to stay ahead of the weed problem. This can be done with light, frequent hand pulling, with light cultivation that avoids damaging shallow roots, and by mulching with straw.

Diseases and insects. Tarnished plant bugs are a major insect pest of day-neutral strawberries. They can be an even greater problem than they are on June-bearing plants because their populations can soar during the summer months when day-neutral cultivars are struggling to cope with the heat. Gray mold also can be a severe problem with day-neutral cultivars, because the fungus accumulates during the growing season, especially if you do not harvest berries regularly. (For more information, see the section “Diseases and Pests” for June-bearing strawberries, page 59.)

Harvest

For maximum sweetness and flavor, pick June-bearing and day-neutral berries a day or two after they are fully red. Berries picked before they are completely red will eventually turn red, but they will not sweeten. Slightly unripe fruit can be used for making jam. Under favorable conditions, expect a total yield of about 1 quart of fruit per foot of matted row. Immediately remove berries that do not ripen because they harbor diseases and attract insects.

For long-term storage of fresh berries, select firm berries that are not yet fully ripe and cool them immediately after harvest. Store as close to 33 degrees F as possible, but be sure the berries do not freeze. Their quality should remain acceptable for several days. Freezing sliced strawberries with sugar and then eating them months later is a great way to recall spring during the cold winter.