How to Grow

STRAWBERRIES

From your friends at

NOURSE FARMS

BEFORE YOU START

It is essential that, as you plan where you'll be planting your strawberries, you avoid soils where previous crops have included strawberries, brambles, potatoes, tomatoes, eggplants, or peppers. These crops may harbor soil pathogens, which will affect the health and performance of your new plants. Soil that has previously grown these crops should be crop-rotated for five to eight years with a non-Verticillium-susceptible crop, such as oat or wheat. We do not recommend growing strawberries for more than 5 years in the same field without crop rotation. Allow for at least 3 years of crop rotation before planting strawberries at the same site.

pH:
6.5–6.8

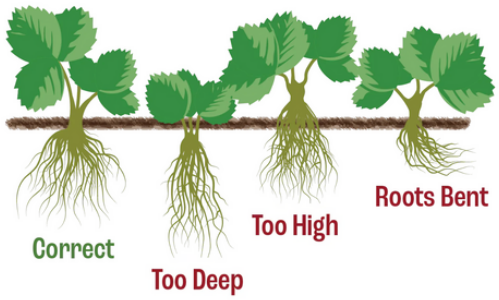
Spacing:
Plasticulture: 12–18 inches in the row, 3–4 feet between rows
Matted Row: 18–24 inches in the row, 3–4 feet between rows

SITE SELECTION

For optimal production, select a site with full sun exposure and access to an ample water supply. Your site must have good water drainage; strawberries do not tolerate standing water, and many strawberry diseases thrive in wet conditions.

Strawberries are generally adaptable to a wide variety of soil types and conditions. Planting strawberries on a moderate slope (3–5%) reduces the risk of frost injury. Avoid planting on west-facing slopes, as they are exposed to winter winds, posing the most significant risk for winter injury. Avoid planting where cold air accumulates in a frost pocket, as strawberry crowns may suffer injury when their temperature nears 20˚F. Open flowers become damaged at 28–30˚F.

IDEAL DEPTH OF PLANTING



PRODUCTION SYSTEMS

Matted Row

The matted row is the most commonly used system in the northern United States and Canada.

Pros:

- Long-established, successful, and profitable system that is widely planted throughout the northern U.S.
- Low initial investment costs. At a recommended spacing within the row of 18 inches and 40 inches between rows, plant density would be 8,800 plants per acre. There is no need for plastic, and there is flexibility in irrigation systems.
- Pick-Your-Own operations have historically employed the matted row system, which has resulted in strong customer acceptance.
- Proven adaptation to colder climates versus plasticulture.
- With proper weed management, your planting could produce for up to five years.

Cons:

- Weed control can be challenging, particularly during the establishment year, due to the limited availability of effective herbicides.
- Picking efficiency is lower due to the fruit being less accessible compared to the plasticulture system.
- Yields can vary dramatically, ranging from 3,000 to 20,000 pounds per acre, depending on management practices.

Plasticulture

Pros:

- Increased picking efficiency of at least 20%, which lowers costs in the long term.
- Weed control is relatively simple and is primarily limited to areas between the rows.
- Bigger berries with longer shelf life, particularly with the use of straw mulch.
- Higher consistent yields in the range of 16,000+ per acre.
- Controlled timing of fruiting.
- Vegetable growers with experience growing on plastic and using drip irrigation find the system easier to work with compared to matted rows.

Cons:

- Higher upfront costs. In addition to plastic and drip irrigation, a higher plant density of 18,000 plants per acre increases costs.
- Planting by hand is the only option for bare roots plants. Machine planting has not been successful for growers. Although machine planting is an option with plug plants.
- A trickier establishment due to planting in the heat of summer.
- Late planting dates in June and July coincide with the harvest times of strawberries and other crops. Planting dates for plugs are 4–6 weeks later than for bare root plants.
- One to three fruiting years versus up to five years with a matted row.
- The risk of winter injury may be higher due to the height at which the plants are situated. Using straw mulch for winter protection is essential in northern areas.

Note: Strawberries are incredibly productive in soilless controlled environment systems. Methods include:

High Tunnel Production

This system utilizes plastic-covered hoops to improve growing conditions and reduce pest and disease pressure. It can be soil-based or soilless production. Raised beds, mulch, and drip irrigation are typically used, allowing for precise irrigation control and minimum temperature control.
Example growing methods: raised bed, table-top

Greenhouse Production

This soilless system enables varied levels of climate control, including temperature, light, relative humidity, and CO2 levels, dependent upon the specific greenhouse.
Example growing methods: hanging-gutter, hydroponic

Vertical Farm Production

This soilless system enables complete climate control, encompassing temperature, lighting, relative humidity, and CO2 levels. Requires a high level of monitoring and control.
Example growing method: multi-tiered

PLANTING BARE ROOT STRAWBERRIES IN A MATTED ROW SYSTEM

We suggest soaking your strawberry plants for up to one to two (1-2) hours before planting, keeping the plants in the pail of water as you plant. Agri-gel and OxiDate can be added to the water. Do not soak plants for more than two (2) hours. The use of a product such as Agri-gel will help support the plants during short dry spells.

Plant as soon as possible in the spring, after the soil has reached 50°F. Planting later than June 1 typically results in poorly filled beds. If later planting must occur, we recommend reducing row spacing to compensate for fewer viable runners.

Planting at the correct depth is very important. Dig a hole deeply enough that you can lower the plant into the ground without bending the roots. Set plants in the ground with the roots straight down. Make certain the plants are set, with the middle of the crown level with the top of the soil. We advise against cutting any of the roots off your plants. Planting too shallowly results in poorly anchored plants that will dry out.
Take care that the soil is pressed firmly, but not hard-packed, around the plant roots. Be sure not to cover the crown. Strawberry leaves, roots, runners, and fruit all develop from the crown, and burying the crown can slow or stop development. Check the soil level within a week or so, as the soil will likely settle, exposing the roots.

PLANTING YEAR SUMMARY SCHEDULE FOR MATTED ROW SYSTEM (depending on location)

March or April: Fertilize
April or May: Plant dormant crowns
May: Weed control
June or July: Remove flowers
June: Fertilize
July through September: Position runners
August: Weed control
September: Fertilize
November: Weed control
Late-November: Mulch

PLANTING STRAWBERRIES IN A PLASTICULTURE SYSTEM

For annual plasticulture systems, plants are set at high density on raised beds and then covered with black or white plastic mulch. Plasticulture beds should be raised 6–10 inches high, and 24–42 inches wide, with row spacing being 60–72 inches apart. Drip irrigation is crucial for this system. We recommend ensuring the bed is smooth and firm before laying the plastic to promote good mulch-to-soil contact. Lay the plastic mulch firmly and ensure the ends are positioned under the soil. We encourage you to mark the plant spacing on the plastic mulch before planting to ensure proper spacing.

Both bare-root and plug strawberry plants perform well in plasticulture systems.

If using bare-root plants, we suggest soaking your strawberry plants for up to one to two (1-2) hours before planting, keeping the plants in the pail of water as you plant. Agri-gel and BioSafe Disease Control can be added to the water. Do not soak plants for more than two (2) hours. The use of a product such as Agri-gel will help support the plants during short dry spells. When you're ready to plant, planting with Nourse Farms' Strawberry Planting Tool ensures good soil contact and straight roots. With the end of the roots overlapping the planting hole by about ½", gently push the half-moon-shaped end of the planting tool downward until the middle of the crown reaches soil level.

If using plug plants, create a hole in the mulch large enough to incorporate the plug. You can also utilize a mechanical transplanter for planting plugs.

Both bare-root and plug plants require immediate irrigation after planting and for several days after to ensure good establishment. We recommend using overhead irrigation during this time to improve rooting for better establishment.

IRRIGATION

Water thoroughly after planting and maintain good soil moisture throughout the season.

Strawberries perform poorly under drought conditions and thrive best when they receive one to two inches of rain or equivalent irrigation each week, depending on the soil type. We strongly encourage the use of drip irrigation, as it is the most efficient irrigation method and is the healthiest option for the plants.

FERTILIZATION/SOIL PREPARATION

Avoid fertilizer burn. Applying fertilizer close to the planting date can cause the burning of plant leaves and roots. Being too generous with fertilizer will also be detrimental. You may mix one-half pound (½ lb.) of 10-10-10 per 100 square feet into the soil, at least two to three (2–3) weeks prior to planting. Otherwise, do not fertilize until your plants are established (about six [6] weeks after planting). Fertilize June-bearing varieties with one-half pound (½ lb.) 10-10-10 per 100 square feet again in July and in August. Day-neutral varieties should be fertilized weekly or bi-weekly once established to maintain growth and fruit production.

WEED CONTROL/MULCHING

Prepare your site before planting. Remove weeds throughout the growing season. After planting, weekly cultivation removes weeds when they are small, so they do not have a chance to compete with your plants. A scuffle hoe works well for this type of work. Avoid covering crowns with soil when hoeing, weeding, and cultivating throughout the season, as strawberry roots are shallow.

Mulch is a protective layer of material applied to the top of the soil. Proper mulching aids in weed control, keeps fruit clean, conserves moisture, and adds humus to the soil. Mulch with a loose, acid-free, and weed-free material such as straw or salt marsh hay. Leaves or grass clippings are not recommended, as they can mat, smother plants, and harbor pests.

CARING FOR STRAWBERRY PLANTS

JUNE-BEARING STRAWBERRIES (Such as Jewel or Honeoye)

ESTABLISHING YEAR

A few weeks after planting, flowers emerge from the crowns. Remove all the flower trusses by pinching them off in the first year of growth. This reduces stress and allows plants to focus their energy on becoming established, which in turn yields a larger crop in the first bearing year. It will also encourage runner production and support winter survival. We recommend removing flower trusses three or four times over a two to three-week span.

Daughters or runners emerge from the crowns in early summer. In matted row production, your rows fill in by allowing two to four daughters (runners) to take root per mother plant. Evenly space the plants in the bed, leaving five to eight inches (5–8") between, lightly pressing them into the soil to make sure there is good soil contact around the roots. This allows you to establish desired plant density for the following year. Cut off any additional runners that form during the season. Overcrowded beds will produce small berries and can cause more disease problems. Do not allow your rows to exceed 18 inches in width; remove all runners that fall outside of your planting row width.

SUCCEEDING YEARS AND RENOVATION

Generally, strawberry plantings will produce their largest yield in their first fruiting year. A process called renovation is performed on June-bearing strawberry beds IMMEDIATELY AFTER HARVEST. This thinning process promotes healthy new growth. Do not renovate in the establishment year. Prompt renovation promotes more runners with larger crowns and more flower buds, improves weed management, and can reduce pest and foliar disease problems.

As soon as all the berries have been harvested, mow off the leaves or clip them to about three inches tall. You may use a bush hog or flail mower to remove leaves. Collect the clippings or rake them off to help reduce disease. Take care not to cut or injure the crowns.

In matted row systems, reduce crowding in the bed by cultivating the edges of the bed to narrow the bed width to twelve to eighteen inches (12–18"). Allow new daughter plants to root on the edges of the bed to refill the row. We recommend applying one to one-and-one-half pounds (1 lb.–1 ½ lbs.) of 10-10-10 per 100 sq. ft. at renovation. For the most efficient use of fertilizer, apply about two-thirds (2/3) of the rate at renovation and one-third (1/3) in September.

Inspect your soil to check for soil compaction. If your soil is compacted, use a subsoil blade between rows to break up compacted layers, improving water infiltration and soil aeration. Strawberry plants need well-draining soil for good root development.

Adequate watering during the renovation process is essential to ensure that new growth gets off to a good start. Continue to maintain soil moisture throughout the remainder of the growing season.

EVERBEARING/DAY-NEUTRAL STRAWBERRIES (Such as Evie-2 and Seascape)

PLANTING YEAR

Day-neutral varieties can be planted in a single row with twelve inches (12") between plants. We suggest one-half to one pound (½ –1 lb.) of 10-10-10 fertilizer per 100 sq. ft. be worked into your soil at least two to three (2–3) weeks before planting.

Pinch off the first flush of flowers four to six (4–6) weeks after setting out your plants. You can let plants develop fruit from midsummer through October.

Four weeks after planting, side-dress with one-and-one-half pounds (1 lb.—1 ½ lbs.) of 10-10-10 fertilizer per 100 sq. ft. After eight (8) weeks, begin weekly or bi-weekly application of a soluble fertilizer to maintain growth and fruit production.

We recommend that you remove all the runners during the lifetime of the planting. This will allow the plants to become well-established.

Hot weather will impact strawberry production. With day neutrals, the impact can be tempered with good watering practices. The cooler temperatures of autumn will bring a return of berry size and yield.

SUCCEEDING YEARS

DO NOT RENOVATE DAY-NEUTRAL OR EVERBEARING STRAWBERRIES.
Commercial day-neutral plantings are typically grown as annuals, removed after harvest in the fall, and replanted in the spring. If allowed to overwinter, day-neutrals will flower and fruit similarly to a June-bearing bed the following spring. In the second year, fruit yield and overall quality depend upon variety and plant health. After new growth starts, begin applying soluble fertilizer weekly or biweekly, just as during the planting year. Day-neutral plants will produce more runners in their second year; we recommend removing all runners.

PREPARING FOR WINTER

Although strawberry plants enter dormancy in the winter, they require protection from extreme cold to prevent injury or death. Quick freezing and thawing can cause serious crown damage, which may not only affect yield but also plant survival. An adequate layer of mulch mitigates fluctuating temperatures.

Apply 4–6 inches of straw or salt marsh hay in the late fall, after plants have gone dormant, or after 6–10 hard frosts. Depending on the location, this is typically between mid-November and early December. Do not apply mulch on plants that have not yet entered dormancy, as adding mulch too early may stress plants and reduce fruit yield and quality the following spring.

Remove mulch in early spring before new growth starts. We recommend raking the mulch into the aisles to reduce weed germination, prevent mud from splashing onto the fruit, and provide a dry medium for fruit development.

Cover the plants with straw again if cold temperatures are forecasted. A frost blanket or row cover can also provide some degree of protection in the spring. They must be removed by the time plants begin to bloom.

COMMON STRAWBERRY DISEASES

A pathogen is an organism that causes disease in its host. Bacteria, viruses, nematodes, and fungi are pathogens that can cause plant diseases. Pathogens enter their host and seize the plant's energy for their use. Pathogens can enter a plant in various ways, including through wounds or natural openings, penetration of plant tissue, mechanical damage, or insect transmission.

A disease cycle is a series of events involved in disease development. In most disease cycles, the basic steps are inoculum production, the spread of inoculum to a susceptible host, penetration of inoculum into a host, infection, secondary cycles, and pathogen survival between host plants.

Identifying pathogens is the first step in controlling plant diseases and producing quality crops. Proper identification is necessary to implement effective management strategies.

Neopestalotiopsis Leaf, Fruit, and Crown Rot (Neo-P)

The fungus Neopestalotiopsis causes Neopestalotiopsis leaf, fruit, and crown rot.

Symptoms:
The earliest visible symptom of Neopestalotiopsis is often leaf spots, occurring in the fall and winter as plants are getting established. Leaf symptoms commonly resemble other leaf diseases, so examination of spores is necessary for accurate diagnosis. As the disease progresses, it can infect crowns, leading to wilting, stunting, and plant death. Wilting is most severe when plants are producing fruit. Crown symptoms, such as reddened older leaves and stunted new growth, are easily mistaken for other crown rots and also require lab confirmation. Fruit infections present as sunken tan lesions with distinctive black spore masses.

Disease Cycle:
Infected plants are often asymptomatic and appear healthy at planting, and initial leaf symptoms occur days to weeks after planting. Neopestalotiopsis thrives between 60–78°F, with increased severity in prolonged wet conditions. The severity of the disease is directly related to the environmental conditions. The fungus spreads rapidly with rainstorms, and the disease favors prolonged wetness.

Research suggests that leaf wetness plays a more critical role than temperature in pathogen infection and disease development. Thus, many cycles of the disease can occur during wet seasons with multiple rain events.

While research is still ongoing, researchers believe that crop residue within strawberry fields is the primary source of inoculum for disease outbreaks during the following season; the fungus can persist in the soil on old infected crowns and strawberry plant debris.

Red Stele

Red Stele is a root and crown rot caused by the soil-inhabiting fungus Phytophthora fragariae.

Symptoms:
Symptoms are more apparent in spring on established plantings, and infections typically occur in patches where the soil remains the wettest. Older leaves will turn yellow, orange, or red, while younger leaves will turn bluish-green. Infected plants have stunted growth, and as the disease progresses, plant size, yield, and berry size will decrease. The fungus will cause lateral roots to die, and the main roots will have a "rattail" appearance. Infected plants eventually wilt and die.

Disease Cycle:
Red Stele favors areas with cool, moist soil conditions, notably heavier clay-like soils. Diseased roots spread spores that can infect healthy roots. Spores travel through the soil solution and infiltrate the tips of the roots in the root system. The roots will begin to rot a few days after infection. As the disease progresses, the fungus will produce more spores that will become incorporated into the soil.

Powdery Mildew

The fungus Sphaerotheca macularis causes powdery mildew.

Symptoms:
Powdery mildew is primarily perceived as a foliage disease, but may also affect flowers and fruit at all stages of development. The first symptom of leaf infection is small, white, powdery colonies on the underside of leaves.

As these colonies enlarge, they will cover the entire underside of the leaves and cause the edges to curl. Purple-reddish blotches will become visible on the upper and lower leaf surfaces as the disease progresses. Infected flowers produce deformed fruit or no fruit at all. The disease causes immature fruits to harden and dry out, while mature fruits become seedy and develop powdery white spores.

Disease Cycle:
This disease favors high humidity and warm temperatures. The fungus responsible for powdery mildew requires a living host for its survival. It may overwinter on old, living leaves.

Anthracnose

Several species of Colletotrichum can cause lesions on petioles and runners, as well as fruit rot, crown rot, and leaf spot.

Symptoms:
Anthracnose can infect the petiole, runners, fruits, and flower buds. Symptoms include light-brown spots on fruit that turn dark brown or black and then enlarge. These lesions are lens-shaped and sunken. Leaf spots will form at the margins of the leaves. If flowers and flower buds become infected, they will look dried out. Lesions on the petioles and runners will develop as red streaks that later lengthen and become sunken and dark. Plants may experience stunted growth, yellowing of the leaves, wilting, and collapse. When crown tissue is infected, it will become brownish-red and decay.

Disease Cycle:
Anthracnose thrives in rainy, warm harvest seasons. This disease primarily spreads by contact with infected water, often by splashing. This fungus overwinters in infected plants and plant debris. Plant tissue is required for the fungus to survive, and the fungus will not remain in the soil for long periods.

Common Leaf Spot (Birds-Eye Leaf Spot)

The fungus Mycosphaerella fragariae causes common leaf spot.

Symptoms:
Infected plants will have small, round, red, and purple spots that develop on the leaves and then progress into spots with lighter centers (tan, gray, or white) with a reddish-purple border. The center may fall out, leaving holes with reddish-purple borders. Spots are most apparent on the leaves but are sometimes present on runners, berry caps, leaf petioles, and berries.

Disease Cycle:
This disease can occur any time during the year except during dry, hot weather. This disease can survive the winter on dead parts of strawberry plants and spread to new foliage through rain or watering.

Phomopsis Leaf Blight

The fungus Phomopsis obscurans causes Phomopsis leaf blight.

Symptoms:
The first symptoms are small brown spots encircled by a purple halo. As the disease progresses, spots develop into V-shaped lesions with a dark brown edge and light brown center. The wide portion of the V is near the edge of the leaf. Brown spots may develop on runner stolons, fruit trusses, and petioles, impacting growth. When fruit caps become infected, both the fruit and caps will turn brown, leading to phomopsis soft rot.

Disease Cycle:
This fungus favors long wet periods, and the temperature has little effect on disease development. The fungus overwinters on older, infected leaves. Early-season rain or irrigation will spread the fungus's spores. Leaves are infected early in the growing season, but symptoms may not appear until later in the season.

Leaf Scorch

The fungus Diplocarpon earlianum causes leaf scorch.

Symptoms:
Irregular dark purple-red spots will appear on the upper leaf surface. Spots will gradually increase in size and may merge to dominate large portions of the leaves. Dead leaf tissue may dry and turn brown. Spots develop on the petioles and caps. Severe cases of leaf scorch may lead to stunted growth due to foliage reduction, decreased plant vigor, and lower yields.

Disease Cycle:
This fungus favors long periods of rain and leaf wetness. The fungus can develop under a wide range of temperatures, but extremely hot or cold temperatures may slow its development. The fungus can survive on living and dead plant tissues, but is typically worse in older plantings.

Angular Leaf Spot

The bacterial species Xanthomonas fragariae causes angular leaf spot.

Symptoms:
Symptoms appear as water-soaked spots on the lower surface of older leaves, located between the small veins of the leaf. The lesions will appear translucent, creating a visible windowpane effect when holding leaves to the light. As the disease progresses, the lesions will expand into an angular shape and become necrotic.
The fruit cap may turn brown or black, while the berry otherwise appears normal. Under moist conditions, the bacterium will secrete a substance that, when dry, appears as a white, scaly film. The pathogen infects the foliage and fruit and invades the plant's vascular system, causing a general decline.

Disease Cycle:
This disease develops in prolonged cold and wet conditions and favors temperatures just above freezing. This bacterium overwinters in infected plants and dead leaves. The exudate from infected leaves can spread to uninfected plants by water. Young tissue is easily infected.

Botrytis

The fungal pathogen Botrytis cinerea causes gray mold.

Symptoms:
In dry conditions, a gray, fuzzy, web-like coating develops on the fruit. When the berry is in contact with the soil, other rotten fruit, or damp surfaces, rot may appear and destroy the berry within 48 hours. Gray mold may be present during all development stages of strawberry fruit production. Gray mold can live in the green tissue but be dormant. Light brown lesions will develop on the stem, sides of the fruit, or flower petals. On undeveloped fruit, the fruit may be deformed and die before maturation.

Disease Cycle:
Fruit rot starts with a blossom infection that ultimately affects the developing fruits, causing them to rot. As the disease progresses, spores are produced and are blown or splashed onto healthy foliage. Once the fungus is established, it can continuously produce spores throughout the growing season.

The disease is most severe during bloom and harvest in seasons with long periods of rain, complemented by cool temperatures and high humidity. The Botrytis cinerea fungus overwinters on old leaves and plant debris. Dead plants and fallen leaves should be removed and burned or buried.

COMMON PHYSIOLOGICAL DISORDERS

A physiological disorder is a result of the environment (water, nutrients, temperature, light, etc). Strawberry plants are very sensitive to unfavorable environmental conditions, affecting both foliage and fruit. Signs of physiological disorders can take days or weeks to appear, necessitating environmental and crop monitoring for prevention.

Tip Burn

Tip burn is caused by a localized deficiency of calcium in leaf and calyx primordia tissue.

Fruit Malformation

The U.S. standards define strawberries as "underdeveloped" when a berry has not attained a normal shape, and define "badly deformed" when serious damage has occurred. Factors that cause malformation include poor pollination, temperature, too little light, and pests.

Fruit Splitting/Cracking

The most common cause of fruit splitting/cracking is water. Fruits may split when water sits on them and is absorbed unevenly. Irregular watering during development and the ripening period may also cause fruit splitting. Other factors include insect injury.