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Sustainable Gardening for School and Home Gardens: Strawberries

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SUSTAINABLE GARDENING

FOR SCHOOL AND HOME GARDENS

Strawberries

Fragaria x ananassa



QUICK FACTS

- Plant family: *Rosaceae* (Rose)
- Planting Season: Fall
- Harvest season: Winter/spring
- Life Cycle: Perennial
- Transplant to first harvest: 90-100 days



Create a Sustainable Garden by improving soil health, relying on locally available materials and resources, and practicing environmentally sound horticultural practices

History

Strawberries are part of the *Rosaceae* family, also known as the rose family, which includes the ornamental rose, along with apples, almonds, blackberries, cherries, pears and raspberries (see Figure 1). Members of this plant family include woody shrubs or trees, although strawberry plants are more herbaceous with a low-growing habit. Strawberry's scientific name, *Fragaria x ananassa*, includes an 'x' to indicate its hybrid nature, in this case, of two different species.



Figure 1. Strawberries belong to the Rosaceae plant family, along with apples, almonds, blackberries, cherries, pears, raspberries, roses, and many more shrubs and trees.

Wild strawberries have existed since ancient times, mentioned in Rome during the first century A.D., but this crop was not commonly consumed due to the fruit's small size and lack of flavor. The wild wood strawberry (*Fragaria vesca*) and musky strawberry (*Fragaria moschata*) were both cultivated in Europe during the 1300s to 1500s. Garden strawberries were developed from a cross between a native North American strawberry (*Fragaria virginiana*) that is flavorful and productive, though small, with a native Chilean strawberry (*Fragaria chiloensis*) that is larger in size. *F. virginiana* and *F. chiloensis* were transported to France in 1624 and 1712, respectively. An accidental cross between these two species in a French garden produced

large, productive fruits grown on vigorous plants, and the garden strawberry (*Fragaria x ananassa*) was born. The English are responsible for continuing the breeding effort and creating the modern garden strawberry, and by 1800 this crop was transported back to North America (see Figure 2). By 1825 strawberries were being grown in the U.S. and breeders worked to improve fruit quality and productivity.

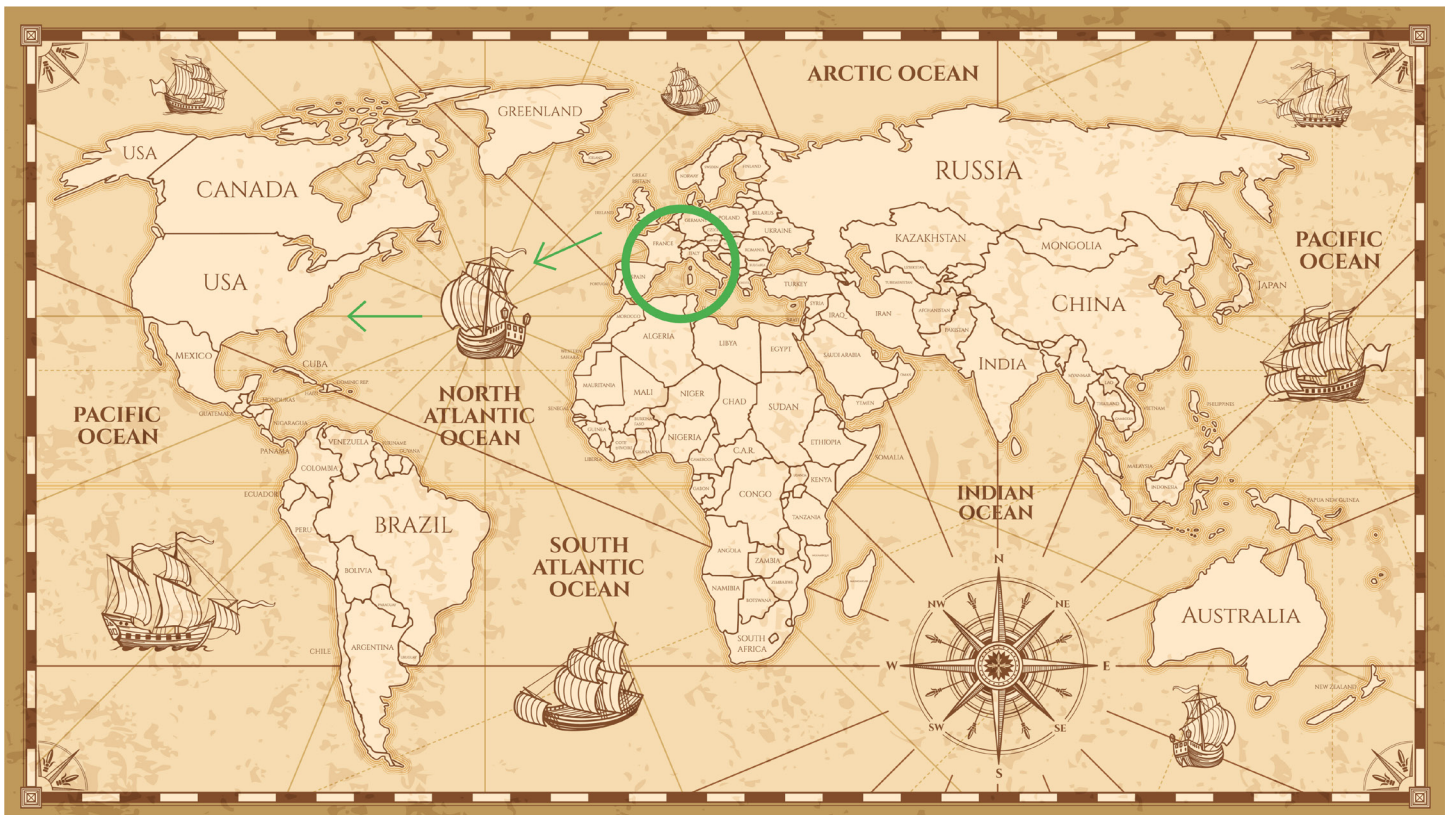


Figure 2. Map showing the origin and migration of strawberries to the U.S.

The red strawberry fruit we call the “berry” is an enlarged flower stem (or receptacle) with many seeds imbedded in the surface (Figure 3). What looks like seeds on the berry (referred to as achenes) are really the “true fruits” (Figure 3). Inside the dry ovary of each achene is a real seed (ovule) with the potential of becoming a unique strawberry plant (seedling) (Figure 3). Like most hybrids, the offspring would likely not preserve the horticultural characteristics of the parent strawberry. To preserve strawberry varieties that yield superior fruit, strawberry propagation is generally accomplished by rooting runner plants that are identical in genetic makeup to the mother plant.

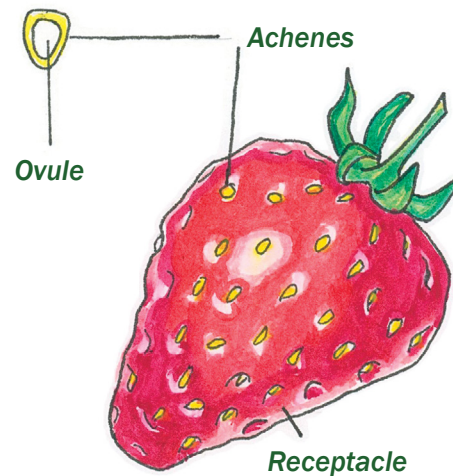


Figure 3. The basic anatomy of a strawberry.

Growing

Varieties

Strawberries are a warm-season crop with varieties that can be grouped into (1) short-day (sometimes called “June-bearing”), (2) everbearing, and (3) day-neutral. Temperatures between 50 and 80 degrees Fahrenheit and a day length of 14 hours or less are required for development of flowers and fruit for most varieties. Fruit production is not constant but occurs in cycles that can be interrupted by freezing weather. Strawberry plants have complete flowers with both male and female parts and adequate pollination is vital for fruit set and proper development.

In Louisiana, short-day varieties are most commonly planted in early October through mid-November, and will start bearing fruit in the winter, continuing until peak production in the spring. For Louisiana and other southern states with a warm climate, fruit

production usually occurs from late February to May. Fruiting is initiated during the shorter days and cooler temperatures of winter (hence the name short-day). Short-day varieties are more popular in Louisiana as they produce fruit during months when weather conditions make strawberries less susceptible to disease (less humid and hot).

Everbearing varieties begin flowering during 12-hour days, while day-neutral varieties are not influenced by length of days (hence the name day-neutral). Everbearing and day-neutral varieties can continuously bear fruit until a hard frost, but fruiting is usually curtailed by high temperatures (above 90 F), making them less ideal for growing in Louisiana.

It is recommended to select disease resistant varieties whenever possible. See the recommended strawberry varieties for Louisiana in Table 1.

Table 1. Recommended Strawberry Varieties for Louisiana

Variety Name	Description	Plant Size	Disease Tolerance
Short-day (June-bearing)			
Benicia	Large, firm, red fruit; mild flavor; vigorous, productive, early variety		Susceptible to Verticillium wilt
Camarosa	Large, wedge-shaped, red fruit; firm; flavorful; vigorous; very productive; grows well in low latitudes; early variety	8-12" spread 10-12" tall	Tolerant
Camino Real	Dark red, wedge-shaped fruit; very flavorful, firm and large; very productive		Susceptible to leaf spot and powdery mildew; resistant to Phytophthora crown rot, Verticillium wilt, anthracnose
Chandler	Bright red fruit; flavorful and sweet; firm, large and well-shaped fruit; semi-early variety; vigorous; very productive; adapted to the South	12-18" spread 6-8" tall	Susceptible
Festival	Deep red, glossy medium fruit; conical shape; firm and flavorful; very productive; long harvest period		Tolerant
Radiance or Fortuna	Large, conical-shaped dark red fruit; early variety; mild flavor; productive; firm		Susceptible to crown rots
Sequoia	Medium, dark red fruit; firm but softens as fruit ripen; very adaptable	18" spread 8-10" tall	Resistant to powdery mildew
Sweet Charlie	Large, deep red fruit; very sweet and juicy; vigorous; very productive; can be grown in containers; early variety	12-20" spread 12" tall	Resistant to leaf spot
Everbearing and Day-neutral			
Albion	Long, conical-shaped, dark red fruit; firm, very flavorful and sweet; consistent production; stores well		Resistant to Phytophthora crown rot, Verticillium wilt, anthracnose
San Andreas	Extra-large red fruit; very consistent and productive; vigorous; flavorful; high quality; firm		Tolerant
Seascape	Large, glossy red fruit; conical-shaped; very flavorful; productive; vigorous; dependable; best adapted for northeastern U.S.		Susceptible to leaf spot
Sweet Ann	Large, conical-shaped red fruit; very sweet and flavorful; fruit shoulders tend to remain white; very productive		Susceptible to Fusarium wilt

Notes: Table varieties selected from recommendations from LSU AgCenter, UF Extension and Texas A&M Extension. Variety descriptions compiled from Lassen Canyon Nursery and Stark Brothers.

Other recommended strawberry varieties for Louisiana include: Douglas, Oso Grande, Selva.

When and How to Plant

It is recommended to start with bare-root strawberry plants or plugs (containerized transplants) in a growing state with a good root system and leaves. It is important to purchase disease-free plants and varieties that are best suited to your area. Plants can be stored under refrigeration and loosely wrapped in plastic until transplanting outdoors. Bare-root plants are the most common type of strawberry plant available at garden centers or farm stores. These plants may or may not have leaves on them. Those that have leaves on them at time of transplanting generally produce greater, earlier fruit than those without leaves. Bare-root transplants require frequent sprinkler irrigation during the heat of

the day for the first 1-2 weeks after transplanting. Plug transplants require less irrigation after transplanting as the root system generally stays intact when the plant is pulled from the container.

Refer to the Strawberry Planting Guide (Table 2) for the recommended dates to plant strawberry bare-root plants/plugs outside. The optimum growing temperature for strawberries is 70-75 F. They should continue growing, blooming and setting fruit until the end of the spring for short-day varieties or until a hard frost for everbearing or day-neutral varieties. For everbearing and day-neutral varieties, fruit production will slow or stop during temperatures above 90 F.

Table 2. Strawberry Planting Guide

Plant Outside Dates	Plant Spacing (inches)	Row Spacing (inches)	Bed Spacing (inches)	Days to Harvest*	Yield Per 10 ft.
North LA: Sept. 15-Nov. 15 South LA: Sept. 25-Nov. 25	12-18 (6-8 for containers)	Double-set, 12-14 apart	48-60	90-100	9-12 lbs.

*Transplant to first harvest.
Note: Table adapted from LSU AgCenter and UF Extension Planting Guides.

It is recommended to plant strawberries in double-set rows (i.e., two rows per bed, 12-14 inches apart) for increased yield (see Figure 4). At the recommended spacing, strawberry plants/plugs should be set deep enough into the ground so that the roots are positioned straight down into the soil (not bent) and the bud and crown of the plant placed just above the soil line. It is important not to set the transplant too deep, covering the crown, or too shallow, leaving the roots exposed.

Where to Plant

Strawberry is a perennial warm-season crop grown as an annual and prefers well-drained, sandy soil and full sun (at least 6 hours/day). It doesn't tolerate heavy, clay soil. Strawberry plants grow well in a soil pH between 5.2 and 6.2, but growth is optimized in a soil pH of 6.0-6.2. It is strongly recommended to plant strawberries in box beds or in traditional raised garden rows that are about 8-12 inches tall to ensure good drainage and prevent disease. If only growing a few plants, strawberries can be grown in containers that are at least 8 inches deep with drainage holes. In all types of gardens, it is recommended to add a 2-3-inch layer of compost, peat, rotted hay or other organic matter and mix into the soil to optimize plant health.

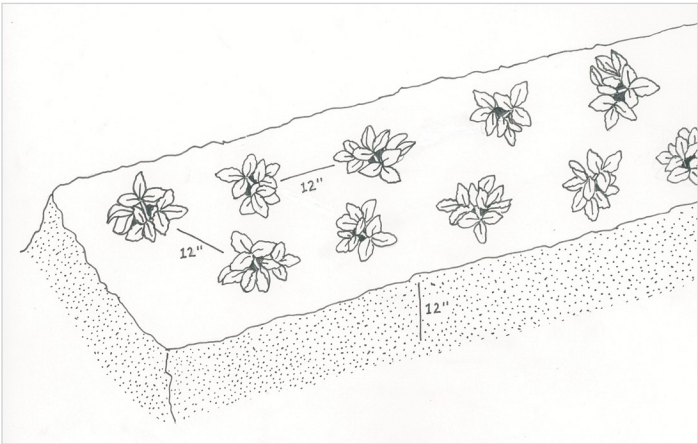


Figure 4. Recommended spacing for strawberries.

Black plastic mulch — or a plastic fabric/film — is strongly recommended to increase soil temperature, yield, fruit size and quality while controlling weeds and preventing fruit rot. Mulch is strongly recommended for strawberry plants; when fruit touches the soil, it will be prone to fruit rot. If plastic mulch is not used, place 4-6 inches of straw or pine mulch to create a barrier between the plants and the soil. It is recommended to use drip irrigation with plastic mulch to optimize yield and quality.

Early plantings may require row covers for protection depending on the weather and whether plants have acclimated to cool temperatures. Row covers or other coverings are recommended to protect strawberry plants from frost and to retain heat for earlier fruit production. Strawberry flowers and fruit can be damaged by air temperatures below 32 F. Leaves and crowns of strawberry plants that have been acclimated to cool fall or winter weather do not sustain permanent damage unless exposed to air temperatures near 20 F. In Louisiana, the most practical method for gardeners to protect flowers from freeze damage may be to cover plants with blankets, sheets or frost cloth. Place the covers loosely over the plants and secure with staples, sandbags or stones before the cold temperature event. Floating polypropylene row covers that are 1-2 ounces per square foot also work well. Protecting plants with coverings inhibits pollination, so remove during the day and re-cover at night. Using wire hoops every 10 feet under the row cover helps to keep the fabric directly off the plants (this is particularly important for flowering plants). A small “tunnel” may also be created using PVC hoops and clear plastic sheeting to create a greenhouse effect. Depending on the air temperature, the sides can be raised or lowered. For container-grown strawberry plants, move the containers into a garage, shed or other enclosure during low temperatures.

Plant Care

It is recommended to follow [sustainable gardening](#) principles.

Watering: Strawberries have a high demand for water and should be watered daily for the week or two after planting. Sufficient water is also critical during fruit production due to the shallow root system. Drip irrigation is very helpful to ensure consistent, adequate water for the long production season. Aim for 1 inch of water per week (rainfall and/or supplemental irrigation). Later in the season, with warmer weather and when the plants are larger, watering 2-3 times per week may be needed.

Fertilization: Although strawberries are grown as an annual in Louisiana, they may perennialize with good drainage, regular watering and the addition of organic matter when preparing the bed. Organic matter feeds soil microbes, which assist in gathering nutrients for plant roots. Small, malformed fruit may be due to calcium or boron deficiency but are just as likely to be caused by late

frost injury. If fruit continues to be misshapen after the season warms, conduct a soil test and discuss results with a local county extension agent.

Organic fertilizers such as compost, fish emulsion, composted poultry litter or manure, worm castings, and blood or bone meal originate from living organisms. They are far more environmentally sustainable and safe than traditional synthetic fertilizers. They naturally release nutrients more slowly and over a longer period of time. When applying organic fertilizer, it is important to use in unison with compost, cover crops and crop rotation, which all work together to build soil health. Learn how to convert inorganic fertilizer recommendations to organic fertilizers [here](#).

Alternatively, a synthetic fertilizer may be used during bed preparation at the rate of 2 pounds (4 cups) of 13-13-13 for every 25 feet of row or 75 square feet. Broadcast or sprinkle evenly over the soil before transplanting and then mix in about 3-6 inches deep using a rake. Side-dress in early February and early April. Side-dressing is the addition of fertilizer to the soil around already established plants when the plant begins to fruit or vine, primarily to provide nitrogen. If using synthetic fertilizer, sprinkle a small amount lightly around each plant, keeping it several inches away from the plant stem; water into the soil. Because of their slow, steady release of nitrogen, crops fertilized with organic fertilizer do not usually need to be side-dressed, though fish emulsion is a good, quick-release organic source of nitrogen for side-dressing if leaf yellowing occurs.

Weeds: Plastic mulch will control most of the weeds; hand pull weeds close to the plant, especially those growing in the planting holes. It is important not to allow weeds to shade strawberry plants since they have a low, compact, sprawling habit.

Insect pests and diseases: Common strawberry insect pests include aphids, spider mites and thrips, along with birds, snails, slugs and worms. Strawberry plants are susceptible to foliar and fungal diseases (e.g., anthracnose, downy and powdery mildew, and leaf spot). Some strawberry varieties are more resistant to disease, and these should be selected and planted. Generally recommended tools for prevention are using mulches, avoiding overhead irrigation (except during plant establishment), adequate plant spacing and weed control. See Table 3 to aid in diagnosis and management of some common strawberry insect pests and diseases.

Table 3. Organic and Natural Management for Common Strawberry Insect Pests and Diseases

Symptoms	Diagnosis	Organic and Natural Management
<ul style="list-style-type: none"> Wet, humid conditions Brown-black leaf spots Dark lesions on stems; girdling Crown infection; flower blight Fruit rot; water-soaked lesions that turn into sunken black spots Stunted plants; reduced yield 	Anthracnose	<ul style="list-style-type: none"> Plant resistant varieties Adequate plant spacing Avoid working in wet fields Mulch, avoid overhead irrigation Regular harvest; remove diseased fruit and plants Weed control Organic/natural fungicides
<ul style="list-style-type: none"> Curled and yellowed leaves Sticky honeydew on leaves Stunted plants Plant death 	Aphids	<ul style="list-style-type: none"> Timely planting and harvest Reduce water stress Weed control Use water jet to dislodge Reflective mulches, insect barrier fabric Beneficial insects: lady bugs, lacewings, predatory stink bugs, syrphid flies Insecticidal soap, neem oil, pyrethrin, Azera
<ul style="list-style-type: none"> Damp, cool conditions Small, yellowing, angular patches on leaves Damping off 	Downy mildew	<ul style="list-style-type: none"> Plant resistant varieties Reduce leaf moisture by improving air circulation, morning irrigation Remove crop debris and weeds Organic/natural fungicides
<ul style="list-style-type: none"> Sunken lesions on fruit with fuzzy white-gray mold; shriveling Starts on calyx (pointed) end Blossoms lose petals, turn brown Cool, damp spring weather 	Gray mold	<ul style="list-style-type: none"> Adequate plant spacing Weed control Drip irrigation to avoid wet foliage Raised beds and mulch Till in crop debris Harvest in dry weather
<ul style="list-style-type: none"> Warm, humid conditions between 59-77 F Small, round, red-brown spot on upper leaves, turning brown-gray in the center with purple margin Older spots have black spores in center of lesions 	Leaf spot	<ul style="list-style-type: none"> Plant resistant varieties Avoid overhead irrigation Avoid working in fields when plants are wet Reduce plant stress Copper-based fungicide spray
<ul style="list-style-type: none"> Larvae (caterpillars) damage leaves and fruit Small black pellets (frass) on leaves 	Lepidoptera	<ul style="list-style-type: none"> Pheromone traps Weed control Beneficial insects: parasitic wasps Remove and destroy caterpillars
<ul style="list-style-type: none"> Wet soil at plant base Stunted plants, off-color Red, discolored root core Plant wilt and death 	Phytophthora root and crown rot	<ul style="list-style-type: none"> Well-draining soil; add compost Plant resistant varieties Remove diseased plants

Symptoms	Diagnosis	Organic and Natural Management
<ul style="list-style-type: none"> • Small, round white spots with fungal growth on older leaves with dark mottled underside • Leaves covered with talc-like powder; leaf yellows and dies • Malformed or stunted fruit • White, powdery spores on fruit • Hot, humid conditions (60-80 F) 	Powdery mildew	<ul style="list-style-type: none"> • Plant resistant varieties • Good soil health and air circulation • Increase plant spacing • Eliminate weeds • Organic/natural fungicides containing sulfur
<ul style="list-style-type: none"> • Uneven distribution of stunted plants • Pale green/yellow leaves; wilt • Root galls, knots, swellings 	Root-knot nematodes	<ul style="list-style-type: none"> • Plant resistant varieties • Soil solarization, nematicides • Crop rotation
<ul style="list-style-type: none"> • Spiderlike pests, very small • Feeding on underside of leaves causes yellow spots and tiny webs • Leaf and plant discoloration • Stunted plants, plant death • Begins around garden perimeter, grassy areas 	Spider mites	<ul style="list-style-type: none"> • Timely plant and harvest • Adequate irrigation • Beneficial insects: predatory mites and beetles • Restrict mowing grass close to crops • Paraffinic and neem oil, sulfur dust, Chenopodium terpene extract, Soluble Silica, Aramite, Biomite
<ul style="list-style-type: none"> • Damage to flowers • Bronzed shoulders of fruit • Deformed, twisted plants • Stunted plants; wilt 	Thrips	<ul style="list-style-type: none"> • Trap cropping and resistant varieties • Fine insect netting (50+mesh) • Beneficial insects: flower bugs, lacewings, predatory mites • Spinosad, insecticidal soap, paraffinic oil, Chenopodium extract

Note: Adapted from LSU AgCenter, Texas A&M AgriLife Extension, UMass Extension, Alabama A&M and Auburn Universities Extension, and University of Minnesota Extension. The Louisiana Pesticide Law regulates the use of pesticides in schools to protect children and staff from harmful exposure to chemicals and is enforced by LDAF. The recommended alternative to routine pesticide use is integrated pest management (IPM), which combines pest control, disease management techniques and organic/natural alternatives, many of which are found in this table.

Harvest and Storage

Strawberries should be harvested when fruit is red and ripe during the coolest part of the day, usually early morning. Ripe fruits are tender and bruise easily, so a gentle picking method and post-harvest care is needed. To harvest strawberries without damaging the plant, pinch the stems (pedicels) to remove rather than pulling the fruit off. This should leave a short stem attached to the fruit, which also helps to minimize touching the fruit directly during processing. Another harvest method is to hold the fruit between thumb and forefinger and snap the fruit from the stem by twisting the forearm and wrist. Berries won't continue to ripen after harvest. The fruit starts to deteriorate soon after it is totally red, so it is recommended to harvest fruit regularly, every 2-4 days.

During fruit production, strawberries may be harvested every few days for up to 6 months. Do not wash fruit until ready to eat as this will cause molding. After harvest, the crop needs to be cooled down to remove field heat and placed in a refrigerator or cooler where there is high humidity. Removing field heat will avoid moisture loss and wilting and preserve quality and shelf life. Strawberries should be placed in pint-sized plastic mesh baskets or clamshell containers and stored between 32-34 F (95% humidity). If strawberries are not eaten immediately, they should be placed in a refrigerator. Berries are very perishable so should be consumed within a week.

Preserve strawberries by freezing whole or sliced or can into jellies and jams.

Nutrition

Strawberries Are Nutritious and Good for You

Rich in vitamin C

Important for bones, skin and blood vessels.

High in potassium

Essential for body function, especially the heart, kidney, nerves, bones and muscles.

Good source of dietary fiber

Important for bowel health, lowering cholesterol, controlling blood sugar and maintaining a healthy weight.

Recipes

Basics of cooking with strawberries: extension.purdue.edu/foodlink/food.php?food=strawberry

General information on selecting, pairing, preparing and storing. Also includes a list of recipes.

Video on how to prepare strawberries: youtu.be/VzJC8EwBOC8

Ever wondered about the basics of how to use strawberries? Chef Allison Kingery shows a couple of options for preparing your fruit.

Guide to preserving strawberries: extension.purdue.edu/extmedia/HHS/HHS-806-W.pdf

Enjoy strawberries all year by freezing or canning fresh strawberries.

Taste Test Ideas



Strawberry Oatmeal



Strawberry Smoothie



Strawberry Yogurt Parfait

Other websites with many strawberry recipes:

Arizona Health Zone

Visit www.azhealthzone.org/recipes and search for strawberry recipes.

USDA MyPlate Kitchen

Visit www.myplate.gov/myplate-kitchen/recipes and search for strawberry recipes.

California's Eat Fresh

Visit eatfresh.org/find-a-recipe and search for strawberry recipes.

Produce for Better Health Foundation

fruitsandveggies.org/fruits-and-veggies/strawberries/?view=recipes
Recipes include strawberry parfait, berry cheesecake pops and more.

Louisiana HARVEST of the MONTH

Strawberry Salsa

Home Recipe

Serves: 9

Prep Time: 15 minutes

Ingredients

- 1 pint of strawberries, hulled and finely diced
- 1 jalapeno, stem and seeds removed, finely diced
- ½ of a small red onion, peeled and finely diced (about ½ cup)
- ⅔ cup finely chopped fresh cilantro, loosely packed
- Juice of 1 lime, about 2 tablespoons
- Pinch of salt and black pepper

Nutrients Per ¼ Cup Serving

- | | |
|-----------------|----------|
| • Calories | 16 |
| • Total Fat | 0.13 g |
| • Saturated Fat | 0.01 g |
| • Cholesterol | 0 mg |
| • Sodium | 33.72 mg |
| • Carbohydrates | 3.8 g |
| • Dietary Fiber | 1 g |
| • Protein | 0.42 g |
| • Calcium | 43.8 mg |
| • Iron | 0.18 mg |
| • Vitamin C | 24.7 mg |

Cooking Instructions

Toss all ingredients together until combined. Season with extra salt and pepper, if needed.



For More Information

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Sources

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Washington, D.C. 20250-9410;
2. Fax: (202) 690-7442; or
3. Email: program.intake@usda.gov.

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