GROWING STRAWBERRIES IN WASHINGTON
Strawberries are Washington's most important berry crop. Over the past five years an average of 20,000 tons of strawberries has been harvested from close to 7,000 acres annually. Returns to growers have averaged $5.5 million dollars. Washington ranks sixth among the 50 states in strawberry acreage and third in total production. Only one state, California, produces more per acre.

Most of the commercial strawberry production in Washington is west of the Cascade Mountains. Strawberries are grown commercially in three-fourths of the counties in the state.

Eighty-five per cent of the strawberries produced in the state are sold to processors who freeze them. The frozen berries are used as dessert fruit and to make ice cream topping, jams and preserves, and other products. The high quality and excellent flavor of Washington-grown strawberries make them ideal for freezing and for fresh market.

SOILS AND SITES . . .
well drained and protected from frost

Soil Types
Strawberries, like most other crops, do their best in deep, well drained, loamy soils. Light soils with a high proportion of sand are better suited to strawberries than heavy clay soils. With sandy soils, special care must be taken to keep up the organic matter, provide adequate plant food, and maintain enough moisture for good growth and production. A clay hardpan near the soil surface restricts root growth or shuts off the drainage of water in the soil. There should be at least 24 inches of good soil over clay subsoils or hardpan. Highly organic soils such as peat or muck are poorly adapted to strawberry production.

Strawberry plantings on heavy clay soils are likely to be short-lived, due to red stele disease and root rots, unless resistant varieties are used. Heavy clay soils should be avoided if possible. They can be improved by the addition of organic matter and by surface or subsurface drainage.

Site Location
Some surface slope is desirable, particularly with the heavier soils. However, slopes so steep that they lose soil with water run-off or are difficult to work with machinery are poor sites for strawberry plantings.

Spring frosts can, and sometimes do, cut yields by killing blossoms and newly formed fruits. Spring frosts occur most often in low spots, near the bottom of long slopes, or on slopes where air drainage may be blocked by trees. Open, flat prairies are also subject to spring frosts. Open slopes where there is free movement of air over and on down below the level of the field are the most frost free.
Strawberries planted on south or southwest slopes may get caught by spring frosts because they start growth and bloom earlier. South or southwest slopes also dry out more quickly in the summer than those facing other directions.

Strawberries should not be planted on ground that has had potatoes, tomatoes, eggplant, or peppers on it because the soil may have been infected with verticillium wilt by these crops.

Markets and Labor Supply

Anyone planning to grow strawberries must consider possible market outlets and a supply of labor for picking. The larger the planting, the greater the consideration that must be given to these problems. Be sure there is a processing plant or an assured fresh market outlet within reasonable hauling distance. Be sure also that there are enough pickers available to get your crop harvested on time.

PREPARING FIELDS FOR PLANTING

build up the soil and eliminate weeds

A soil improvement program on land to be planted to strawberries will pay off in the long run. Little can be done during the life of a strawberry planting to build up the soil. You may have soil that is in unusually good condition from having been in pasture, hay, or other soil-improving crops. If not, it should be built up by applications of manure or by growing green manure crops. In many instances, it will be worthwhile to devote a full year or more to building up the soil. Suggestions as to crops and their management are given in the section on rebuilding strawberry soils at the end of this bulletin.

Noxious weeds, such as quackgrass, Canada thistle, horsetail rush, or sheep sorrel should be eliminated before planting strawberries. There are no known chemicals that will kill these weeds in strawberries without injuring the strawberry plants.

Ground that has been in sod should be cultivated or cropped at least one season in order to break down the sod and kill out the grass completely before planting to strawberries.

Soil for strawberries should be given the same careful preparation that it would be given for any other row crop. For a high percentage of the plants to survive and grow well, the soil must be well worked, firm, and moist when the plants are set. If planting is to be done by machine, a smooth, even surface is essential in order to get all the plants set at the right depth. This is particularly true when the planter is mounted on a tractor with a rigid hitch.

A soil insecticide such as aldrin or dieldrin should be worked into the top 6 inches of soil before planting. This will protect the planting for three or four years against most species of strawberry root weevils, wireworms, and other soil insects, but will not control the raspberry bud weevil (Nemocetes sp.). Ask your county agent for details on materials and rates.

STRAWBERRY VARIETIES

should be adapted to your market

Varieties of strawberries selected for planting should be productive and not seriously susceptible to disease. They should be easily and rapidly picked and well adapted to the purpose—either processing or fresh market—for which
they are grown. In areas of low winter temperatures, cold tolerance or hardiness is also important. Where late spring frosts occur, late blooming varieties may escape frost damage when early blooming varieties would be damaged. In some sections of the state, varieties that ripen earliest may be ready for harvest before school children are available for picking.

Most varieties that do well and are popular in other sections of the United States have not done well in the Northwest. They have been lacking in yield, flavor, or disease resistance when tested here. Our Experiment Stations have a constant breeding and testing program going on to develop and determine varieties that are best adapted to Washington.

The varieties listed here are grown commercially or have qualities that make them promising as commercial varieties in this state. Other varieties may have merit for a special growing situation or marketing purpose.

**Varieties for the Entire State**

**NORTHWEST**

*mid-season, excellent for freezing or fresh market*

Northwest, the leading variety in Washington, is grown throughout the state. Excellent for freezing or fresh market, good for canning. Fruit medium large, conic, bright glossy red, firm, and well flavored when sugared. Plants vigorous and very productive under best conditions for the variety. Adapted to matted row or hill system of planting. Subject to cold injury when winter temperatures drop rapidly from the high 30's or 40's to 20°F. or below. Somewhat resistant to virus, but should be dusted or sprayed for aphids to prevent the spread of virus. Susceptible to cyclamen mites, red stele, and root rots. Does best on medium-light, well drained, irrigated soils. Blooms and ripens five to six days after Marshall. Escapes frost some years when Marshall doesn't.

**MARSHALL**

*early, particularly good for preserves*

Marshall, the one-time favorite in Washington, is still an important variety. Particularly popular with commercial preserve makers. Grown throughout the state. Fruit large, blunt, conic, deep crimson, slightly soft, richly flavored. Plants moderate in vigor and yield. Resistant to cyclamen mite. Very susceptible to virus diseases, must be dusted for aphid control. Has declined in acreage because of susceptibility to virus diseases. Adapted to fairly wide range of soils. Blooms and ripens five to six days ahead of Northwest.

**PUGET BEAUTY**

*early, excellent for fresh market and preserves*

Puget Beauty is excellent for fresh use and preserves. Fruit medium large to large, mostly long conic and slightly necked, easily picked, medium red, glossy, fairly firm but becomes soft after freezing and thawing. Should be picked frequently to avoid over-ripe fruit. Sweet and aromatic as a fresh berry. Carries flavor over into preserves well. Plants fairly vigorous, productive. Fairly resistant to virus diseases. Resistant to red stele and root rots in some situations, but not in others. Adapted to moderately heavy soils, with or without irrigation. Blooms after Marshall, but ripens at practically the same time.

**SILETZ**

*mid-season, fresh-market berry for use primarily where red stele is a problem*

Siletz is barely acceptable as a processing berry, but has some potential on the fresh market. Fruit medium to large, blunt, medium red, glossy. Easily picked, core pulls with cap. Plants very vigorous and productive under good conditions. Berries tend to drop down in size at the end of the harvest season where plants are crowded or lack water. Somewhat resistant to virus. Winter hardy. Very resistant to red stele.
Varieties for Western Washington

COLUMBIA
late, excellent for freezing, resistant to red stele

Columbia has medium to large fruit, averaging very slightly smaller than Northwest. Fruit irregularly conic, bright red, very similar to Northwest in flavor, color, and processing qualities. The large hull or calyx makes picking for processing fairly easy and adds to the appearance of fresh market berries. Surface of ripe berries soft and easily bruised. Columbia needs special care in harvesting and handling for fresh market. Plants very vigorous and productive. Winter hardy in western Washington. Similar to Siletz in resistance to red stele and root rots. Resistant to mildew and fruit rot (Botrytis). Somewhat resistant to virus diseases, but should be dusted or sprayed for aphid control. Subject to damage by spider mites if preventive sprays or dusts are not applied. Needs good soil moisture to hold size through the end of harvest. Blooms and ripens about five to seven days later than Northwest. Yield sometimes as good as Northwest when equally well grown. Cannot be expected to equal Northwest when Northwest is at its best. Better adapted than Northwest to heavier soils, but requires good drainage.

CASCADE
mid-season, for trial as a freezing berry

Cascade is outstanding in firmness, color, and flavor as a freezing and preserving berry. Adapted to medium light, well drained soils. Fruit medium size, blunt or rounded, dark glossy red, sweet rich flavor. Plants vigorous and productive under best conditions for the variety. Apparently winter hardy in western Washington. Somewhat resistant to virus diseases, but should be dusted or sprayed for aphid control. Susceptible to mildew and red stele. Resistant to fruit rot (Botrytis). Blooms and ripens with Northwest. Yields have equalled Northwest only in wet harvest seasons when Cascade develops much less fruit rot.

MOLALLA
mid-season, for trial as a freezing berry in red stele soils

Molalla was released by Oregon State University and the U.S. Department of Agriculture in 1961 and has not been grown in Washington enough for good evaluation. Described at the time of its release as "ripening at mid-season, a week later than Marshall. Berries medium in size, becoming smaller at end of season. Color uniform, red throughout flesh, attractive sliced in frozen pack. Shape conic, flavor sub-acid and excellent in frozen pack. Plants vigorous, dark green, slightly susceptible to mildew, virus tolerant, red stele resistant." Limited observations in Washington indicate that mildew and virus diseases might become a problem with Molalla. Some tendency for tips of berries to remain green or light colored when ripe. Red stele resistance appears to be similar to Columbia or Siletz.

Varieties for Eastern Washington

PREMIER
early, fresh-market berry

Premier is grown for fresh market in eastern Washington. Plants very hardy, vigorous, fairly productive. Early fruit is large, but fruit becomes quite small at end of season. Berries will be light in color unless allowed to develop full color before picking. Early, prolific plant maker, grown in matted row.

EARLIDAWN
early, for trial as fresh-market berry

Earlidawn is hardy, vigorous, and very productive. Fruit large, bright red, short conic, uniform, firm. Flavor tart, but good if well ripened. Early, just ahead of Premier. Harvest period short, usually two to three weeks. Requires fertile soil for matted row. Very susceptible to verticillium wilt. Should not be planted where potatoes, tomatoes, peppers, or eggplant have been grown.
**Midway**

*Mid-season, for trial as fresh-market and freezing berry*

Midway is of the same season and fruit size as Northwest, but was found to be much more productive in test trials in eastern Washington. Fruit bright red, medium long, conic, firm, good flavor, satisfactory for freezing.

**Shasta**

*Mid-season, fresh-market berry for the Walla Walla area*

Shasta has been successful in the Walla Walla area. Fruit mid-season, attractive bright red, firm, conic to blunt, keeps good size throughout the harvest season. Flavor good. Production very good and plant growth excellent. Processing quality not high.

**Everbearing Varieties**

Everbearing varieties are not commercially important in Washington. Several varieties are grown for home use and to a very limited extent for local markets. They are Red Rich, Rockhill, Ogalala, Gem, Streamliner, Superfection, and Twentieth Century. Ogalala has been very productive in eastern Washington. Red Rich and Rockhill are favored in western Washington.

**Selection of Plants**

Strawberry plantings are usually expected to last through three or four years of harvest. The better the plants you use, and the better the care you give them, the longer the planting will last and the more productive it will be. Buying certified plants is the best assurance you can have that they are free from any serious disease or nematode or insect damage. In order to be certified, fields from which plants are taken must have been inspected several times during the growing season by representatives of the Washington State Department of Agriculture. The plants are also inspected at the time they are dug and prepared for storage or delivery.

Most strawberry plants grown for sale in Washington are dug in late winter, before growth starts. They are sorted, trimmed, packed in bundles of 25 plants each, placed in cartons of 1,000 plants, and kept in cold storage until planting time. They make excellent planting stock if they go into storage in good condition, are stored at constant temperatures slightly below freezing, and are kept from drying out.

Plants can be dug and replanted immediately. If you have a source of good, disease- and insect-free plants that can be purchased on this basis, they will start quickly and grow well. Select well-rooted plants from last year’s runners. Trim the roots to 4 or 5 inches. Don’t let them dry out, mold, or become heated.

There is some danger from shipping in plants from other states. Unless you can be sure they were grown under the supervision of a sound certification program, you may introduce viruses or other diseases that will be seriously troublesome.

**Care of Plants**

Plants that come from cold storage at just below freezing will have ice in the cartons and the bundles will be frozen together. Breaking plants or bundles apart while they are still frozen will injure the roots. As soon as the ice is
thawed the plants can be planted satisfactorily.

The less delay between the time the plants are thawed and the time they are planted, the better. If cartons of plants are stacked together in a cool place, the plants will stay cool for several days. If planting must be delayed more than two or three days, it would be best if the plants could be put into storage at slightly above freezing. It is not advisable to put plants back into below freezing storage once they have thawed out and started to warm up.

Remember that it takes two to three days to cool down the cartons in refrigerated storage, the same as it takes time for them to warm up when they come out of storage.

Take from cold storage only enough plants to plant in two or three days. Keep them as cool as possible. Certification of plants assures a degree of freedom from diseases, insects, and nematodes, but it does not give the plants any special resistance or tolerance to damage by drying, heating, molding, or starting to grow between storage and planting.

PLANTING SYSTEMS AND SPACING . . .

There are two main systems

Both matted row and single hill plantings are used successfully in Washington. The matted row system is the more common at present.

Matted Row System

Plants are set 18 inches to 36 inches apart in rows 42 inches apart for the matted row system. Varieties that produce few runner plants (Marshall) are set at the closer distance and vigorous runner producers (Northwest and Siletz) are set at the greater spacing. Runner plants are encouraged to fill in the spaces to make a row 12 to 14 inches wide.

Some growers are finding it advantageous to set plants in the row at 18 to 24 inches and let the first few runner plants set, leaving a modified matted row only about 6 inches wide. Late-formed runner plants are removed, leaving a plant to approximately each 6 inches of row.

Hill System

For the hill system, plants are usually set 15 to 18 inches apart in rows 36 to 42 inches apart. No additional plants are allowed to grow. Runners are cut several times each summer, usually with sharp
hones. On some of the larger plantings, runners are cut mechanically. The runners are pulled to the side of the row with a side delivery rake and are cut off with a coulter or disk attached to the cultivator.

In some instances, plants for the single hill system are planted 2 to 3 feet apart in the row. One or two runner plants are allowed to develop and are set by hand in the row between the original plants. All other runners are removed. A few growers in Washington are using the double row hill system popular in California and Oregon.

Plants Needed per Acre

You can estimate the number of plants per acre for any spacing by dividing 43,560 by the number of square feet for each plant. Be sure to allow space for roadways, packing or loading platforms, ditches, and room to turn machinery at the ends of the rows. Here are the number of plants required per acre for some commonly used spacings:

- **36 inches between rows**
  - 18 inches between plants—9680 plants per acre
  - 24 inches between plants—7591 plants per acre
  - 30 inches between plants—5808 plants per acre
  - 36 inches between plants—4840 plants per acre

- **42 inches between rows**
  - 18 inches between plants—8296 plants per acre
  - 24 inches between plants—6223 plants per acre
  - 30 inches between plants—4986 plants per acre
  - 36 inches between plants—4149 plants per acre

SETTING PLANTS IN THE FIELD . . .

**Time of Planting**

Spring planting is the general practice among commercial strawberry growers in Washington. Certified plants are seldom available in large quantities in the fall. In western Washington weed control through the first fall, winter, and early spring would be an added expense. In the colder areas of eastern Washington, alternate freezing and thawing may damage fall-set plants by heaving during the winter.
Top—Spade shoved into the ground to a depth of about 6 inches.

Next—Plant placed in hole at exactly the right depth so that the soil will just cover the top roots. The roots are spread out.

Next—Loose soil worked against the roots of the plant as it is held in position.

Bottom—Soil firmed around the plant carefully to keep from pushing it below the proper depth.

Take advantage of early spring moisture and coolness to get your strawberry plants well established before warm, dry weather comes. Late April or early May in western Washington and April in eastern Washington are the best times to plant. A sharp frost of 28° F., or below, immediately after planting can injure strawberry plants severely. Pick a period of cool, cloudy weather to do your planting, if you can, rather than planting on bright, warm, or windy days.

**Planting Success**

The success of your strawberry planting operation depends primarily on five things:

1. Well prepared soil.
2. Plants that are in good condition.
3. Setting plants at the right depth.
4. Moist soil, well firmed around the roots.
5. Planting early enough to get the plants established before warm, dry weather.

The earlier your plants get started, and the faster they grow the first season, the heavier the production.

Set the plants in the ground so that the soil, when it is firmed or settled, just covers the tops of the roots. Be sure that the soil is pressed down firmly around the roots. Watering the newly set plants will pay dividends any time the soil is dry enough to work well.

**Planting by Hand**

For hand setting, the field should be marked off in both directions. This will make it possible to line the plants up for cultivation either way.
The fastest and best method of setting plants by hand is with a spade. Two people are required to do the job. One handles the spade, the other carries and sets the plants. The worker handling the spade shoves it into the ground about 6 inches and pushes it back and forth to open a hole. The plant setter slips his hand into the hole with the roots of the plant spread fan-like across his fingers, pushing the roots well down into the hole. The plant setter then lifts the crown to the right level and removes his hand. The worker handling the spade lifts out the spade without disturbing the roots; then with a couple of short strokes with the spade, he works the soil over against the roots and presses the dirt down firmly with the toe of his shoe.

If the plants are to be watered, a third person can be added to the planting crew. He should pour about a cupful of water around the roots of each plant as it is brought into final position by the plant setter.

**Machine Planting**

Machine planting has become common on acreages large enough to justify purchasing or renting machines. The planting machine must be pulled slowly enough for the workers on the machine to set the plants in the right position in the planting mechanism. Having the planter adjusted so that the plants are set at the right depth is also important. The field should be well leveled for machine planting. If the planter is mounted on the tractor with a rigid hitch, the planter will be forced deeper or shallower each time the front wheels start up or down a hump or dip. Most of the newer machines have a flexible hitch. Straight, even rows are essential for cultivating, fertilizing, dusting, and other tractor-powered jobs.

The soil should be loose enough for the planter to operate at an even depth, getting the roots well down into the soil. It should not be too loose or fluffy. The packer wheels on the planter must firm the soil down well against the roots, firmly enough so that the plants cannot be easily pulled from the soil by hand. It is a good idea to have one or two workers follow the planter to see that there are no skips and that all of the plants are properly and firmly set.

Most planters are equipped with tanks and measuring devices to water each plant as it is set in the ground. If you are not going to irrigate immediately after planting, water the plants as they are set.

In western Washington, some growers use a starter solution made by adding 1 quart of 52 per cent phosphoric acid to each 25 gallons of water. It is applied at the rate of 1 cup per plant.

**SUMMER CARE OF YOUNG PLANTINGS**

*help plants build up reserves early*

As soon as the plants start to grow they should be fertilized. See page 16 for kinds and amounts of fertilizer.

One of the most important jobs the first year is to keep the planting free of weeds. Cultivation and hoeing should...
be shallow so as not to disturb strawberry plant roots. Chemical weed control can do much to eliminate the cost of hand work. Get information on materials, timing, and rates from your county agent.

Strawberry plants should not be allowed to set fruit the first season. Much more will be gained by directing the vigor of the plant into growth than by producing a few fruits. Remove the blossom clusters as early as it can be done economically. This can usually be combined with the first hoeing.

**Training the Plants**

If the strawberry planting is to be handled as a matted row, the runners should be trained into the row. This is done with cultivators for the most part. It is best if the cultivators can be run along each row in the same direction at each cultivation after the runners get started. This will avoid dragging the runners back and forth. The runner plants should be encouraged to root just as early as possible. Those that root the earliest will produce the biggest crop the following year.

Varieties that are prolific runner makers may make too dense a mat if all runners are pulled into a narrow row. This can be avoided to some extent by letting the late runners set over a wider row and cutting the row down at the end of the growing season.

If the planting is to be handled as single hills, the runners should be cut several times during the season. Cut them off before multiple leaves, crowns, and roots develop at the ends of the runners. Sharp hoes are usually used when runners are cut by hand. Cutting runners mechanically is being done satisfactorily by some growers.

**HARVESTING THE CROP . . .**

Teach and train pickers

For highest quality, strawberries for processing must be picked as they ripen and reach the peak of their flavor. For fresh market, they are picked just ahead of fully ripe. They are then firm enough to stand handling and not over-ripe when they reach the consumer.

For processing, the berries are picked with the hulls or caps off. To pick without hulls, hold the **stem** and **hull** with the fingertips of one hand. Grasp the berry lightly with the fingers of the other hand and pull free with a slight twist.

For fresh market, strawberries are picked with the hulls or caps on. Hold the stem with one hand. Put the other hand over the berry and grasp the stem next to the cap. Break the stem as close to the cap as possible, catching the berry in the palm of the hand.

Most berry fields should be picked every two to three days in warm weather and at least every four to five days in cool weather. Eight to ten good pickers per acre may be needed to keep the field picked in warm weather. In cool weather, four to six pickers per acre may keep your field clean. Picking the berries early in the day helps keep them firm and reduces damage. It also gets them to the packer in plenty of time to be processed during each day’s run.

For a successful berry harvest, it is important that you have enough pickers, give them the training and supervision they need, and provide them with cool, clean drinking water and adequate toilet facilities. Having a shady area near the field where pickers can eat lunch and rest is a decided advantage.

Growers who have large acreages must devote some time to recruiting pickers. This can be done, in part, through ads in local papers, or over radio and TV, or through local labor offices. Many
growers keep names and addresses of prospective pickers and send out cards or letters ahead of harvest each year. The use of busses to take pickers to and from the fields is a common practice. It is a necessity if pickers are to come from considerable distances.

It is important that each picker know what is expected of him—what he is to do, and how to do it. What degree of ripeness, how full to fill the boxes, and what to do with rotten fruits or small berries must be explained. Be sure that your pickers know how to move along the row, work over the plants, and hold the berries to get them picked with the most speed and the least damage to berries and plants. Having someone to help each new picker get started will pay dividends by the end of the harvest season.

Not having good drinking water, clean and sanitary toilet facilities, and a comfortable place to eat and relax during the noon hour keeps a lot of good potential workers from becoming strawberry pickers. Good pickers are likely to have a choice of places to work. Make them want to work for you by having the best working conditions you can.

**SUMMER CARE OF BEARING PLANTINGS . . . influences the next crop**

What happens to your strawberry planting after harvest has a lot to do with the following year’s crop. During the summer and fall the plants build up food reserves and form fruit buds for the next year’s crop. The single crop varieties which make up the commercial plantings in Washington tend to go into a semi-dormant rest period following harvest. The quicker you can get them into renewed activity and growth, the better the next crop.

Where irrigation is available, or where there is enough moisture for plant
growth, the strawberry planting should be cleared of weeds, fertilized, irrigated, and treated with chemicals for weed control as soon after harvest as these operations can be carried out. Matted rows should be cut down to 10- to 12-inch widths before the planting is fertilized and irrigated.

If you don't have irrigation, and the soil in your berry planting is too dry for plant growth, more time can be taken to carry out the clean-up and fertilizing operations. Be sure that you get them taken care of in time to take advantage of late summer and fall rains. Give your plants every possible advantage so that they will make every bit of growth possible through the summer and fall.

Some growers mow and rake off the tops of the strawberry plants and weeds at the end of harvest. If the strawberry leaves are browned and have little life, mowing should not damage the plants. Where the leaves are fresh, green, and active, the plants will be set back.

Matted rows are usually narrowed down by a rotary-type cultivator or sharp disk attachment on the tractor that cuts the plants from both edges of the row, leaving the centers intact. Care should be taken to move the soil back against the shoulder of the row.

IRRIGATION . . .

for high yields and large berries

Irrigation is a necessity in most parts of eastern Washington if good yields of strawberries are to be produced. In western Washington, irrigation will increase the size and yields of strawberries materially most years.

Strawberries take most of their moisture from the top 18 inches of soil. Practically none is taken from below 2 feet even when the soil is deep and well drained. Soils vary in the amount of water they will hold as a reservoir for crop growth. Light sandy soils may hold less than 1 inch of water per foot of soil depth. Moisture in these soils is depleted quickly during the growing season. Irrigations must be more frequent and in smaller amounts than for heavier soils. Medium and heavy textured soils may hold 2 inches of usable water or slightly more per foot of soil depth. Thus, the medium and heavier soils may carry a substantial reservoir of water into the growing season. They can take up and hold more water at each irrigation and need to be irrigated less often.

Air temperature, humidity, day length, and air movement have considerable effect on the moisture needs of plants. Evaporation of water from the soil surface and transpiration of moisture through plant leaves on bright, dry, windy days may be twice as much, or more, as on dull, cloudy days.

Newly set strawberry fields should be kept well irrigated throughout their first season. If a matted row is to be developed, the earlier the runner plants can be rooted down, the more fruit buds they will form for the following year's crop. If the original plants are maintained as individual hills, the larger and more vigorous their crowns, the more fruit buds they will set in late summer and fall.

After the first year there are two critical periods during the growing season when good soil moisture is especially important. The first is before and during harvest for the production of a good crop of large berries. The other is in late August and on into the fall when fruit buds for the following year's crop are formed.

Research work and field practice have shown that only about 65 per cent of the water applied through sprinklers can be depended upon for use by plants. Thus,
for each inch of water needed by plants, 1½ inches should be applied.

Western Washington

In western Washington, 2½ to 3 inches of moisture are needed by strawberry plants in the month of May and 3½ inches in June. This includes moisture from both rainfall and irrigation. In July and August, the plants need about 4 inches of moisture each month.

Letting the soil become somewhat dry and the plants become semi-dormant for a short period after harvest does not seem to be injurious. Beginning in early August, however, the plants should be irrigated so they will be in good, vigorous condition when fruit bud formation starts in late August or early September.

Many growers in western Washington hesitate to irrigate strawberries during harvest because of the likelihood of increased rot or mold. It becomes a calculated risk as to whether increased soil moisture and increased berry size will more than offset the loss from rot. The use of fungicides during bloom and during harvest, right after rainfall or irrigation, will minimize rot losses and materially reduce the amount of rot most years.

Eastern Washington

In eastern Washington, 3 to 4 inches of water are needed by strawberry plants per month in April and May, 4 to 5 inches per month in June, July, and August, 3 to 4 inches in September, and 1 or 2 inches in October. This includes moisture from both rainfall and irrigation. In central Washington it may be necessary to irrigate as often as every three days if high temperatures occur during the period of fruit development and harvest.

FERTILIZERS FOR STRAWBERRIES...

The high value of the crop harvested in relation to fertilizer costs makes it economical to fertilize strawberries liberally.

Application and Timing

Newly set plantings should be fertilized as soon as the plants start to grow. With bearing plantings, the best time to fertilize is soon after harvest. This will put the plants in vigorous condition in the late summer and fall, the time when fruit buds for the following year’s crop are formed.

Strawberry plants do not have large root systems. Biggest returns from fertilizer are obtained when the fertilizer is placed in the root area near the plants after the crop has been harvested. Band application of phosphorus is particularly important. Put the fertilizer in a furrow or band 4 to 6 inches deep and 3 to 4 inches from the plants in single hill plantings. With established matted rows, the fertilizer may be placed down each side or right down the middle of the row. If the matted rows are 10 inches or wider, half of the fertilizer can be put down the middle and a fourth down each side to advantage. Some plants will be killed or injured by drilling down the middle of matted rows. In heavily matted rows, killing some of the plants and reducing competition will not be harmful.

If equipment to put the fertilizer in the soil is not available, scatter the fertilizer in a narrow band on the soil near the plants in single hill plantings. Work it into the soil with a cultivator. With matted rows, scatter the fertilizer over the row if placement equipment is not available. Irrigate it in if you can.

Most western Washington soils tie up or fix phosphorus. This means you should
### STRAWBERRY FERTILIZER NEEDS PER ACRE*

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<thead>
<tr>
<th>YEAR</th>
<th>WESTERN WASHINGTON</th>
<th>EASTERN WASHINGTON</th>
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<tr>
<td></td>
<td>Soils low in phosphorus and potassium</td>
<td>Soils high in phosphorus and potassium</td>
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<tr>
<td>Year plants are set</td>
<td>500-600 lbs. 6-20-20 as soon as plants start growth</td>
<td>300 lbs. ammonium sulfate** or its equivalent (60 lbs. N) as soon as plants are started, or broadcast prior to planting</td>
</tr>
<tr>
<td></td>
<td>150 lbs. ammonium sulfate or its equivalent (30 lbs. N) August 1-15</td>
<td></td>
</tr>
<tr>
<td>Year of first crop</td>
<td>Non-irrigated upland soils 500 lbs. 6-20-20 after harvest</td>
<td>200-300 lbs. ammonium sulfate after harvest</td>
</tr>
<tr>
<td></td>
<td>Irrigated upland soils 600 lbs. 6-20-20 after harvest</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bottom land soils 500 lbs. 6-20-20 after harvest</td>
<td></td>
</tr>
<tr>
<td>Year of second crop</td>
<td>Same as first crop year</td>
<td>400-800 lbs. 16-20-0 after harvest</td>
</tr>
<tr>
<td>Year of third crop</td>
<td>Same as first crop year</td>
<td>Same as second crop year</td>
</tr>
</tbody>
</table>

* For 350 square feet or 100 feet of row, assuming rows are 3½ feet apart, use ¾ pound (1½ cups) for each 100 pounds per acre.

** Divide between planting and mid-summer on light soils.

Band phosphorus because phosphorus fertilizer that is broadcast and mixed with a large quantity of soil is tied up much more rapidly than if it is concentrated in a band. Research has shown that when nitrogen and phosphorus are applied together in a band, there is a greater uptake of both elements than when they are applied separately, as in different bands or when nitrogen is broadcast.

Fertilizers applied in the spring are of little value to strawberry plants that were able to build up reserves and fruit buds in the fall. Applying too much nitrogen in the spring is likely to produce heavy foliage, soft berries, and increased rot. On some of the lighter, coarser soils, or in case of winter injury to the plants, light applications of not more than 20 pounds of actual nitrogen per acre in the spring might be beneficial.

### Fertilizer Needs

Soil tests are good guides to the amount of phosphorus and potassium needed. They are particularly valuable in determining the fertilizer program for new plantings. Mailing boxes and instructions for taking soil samples to be tested at Washington State University are available at your county agent’s office. With such tests, it is possible to make fertilizer recommendations that will be most nearly right for the wide variety of soils on which strawberries are grown. The accompanying table will serve as a general guide to strawberry fertilizer needs per acre. Your soil may need more, or less, or a different combination of fertilizer elements than suggested here.

Liquid and dry forms of fertilizer are just about equal in effect, pound for pound of plant food. Your choice between the two forms should be decided by the cost and convenience of getting a given quantity of plant food where your strawberry plants can use it to best advantage.

### Boron Deficiency

Boron deficiency is most apt to occur south of the Lewis River, but may also occur in other areas of Washington.
Yields and vigor are reduced by too little boron. In severe cases of boron deficiency, some of the young leaves will be blackened across the tips. As these leaves grow, they become puckered because the cells at the edge of the blackened area do not grow. Fruit may be rough and misshapen from boron deficiency.

Soil analysis for boron is available through the soil testing laboratory at Washington State University. This test is the surest way of finding out whether your soil needs boron. If you want a boron test run, make special request for it when you send the soil sample to the University.

If boron is needed, broadcast one of the boron-containing materials in the late winter or early spring at a rate that will provide 2 pounds of actual boron per acre. Liquid or soluble forms that can be applied as a spray are available. It may be necessary to apply boron each year where it is most severely lacking.

Strawberry plants can be injured by too much boron. Don’t exceed the rate of 2 pounds of actual boron per acre. Don’t band or place fertilizers containing boron in a concentrated area near the row. Apply them evenly over the entire soil surface.

In the irrigated sections of eastern Washington large amounts of boron may have been placed in the soil to meet the needs of alfalfa and other crops having a high boron requirement. Strawberries planted in this soil may suffer from boron toxicity.

Other Deficiencies

Calcium, sulfur, and magnesium may be lacking in soils in some parts of the state. Soil calcium content and the degree of acidity (pH) are determined in the regular soil tests at WSU. Magnesium tests, at an extra cost, will be made by special request. Sulfur tests are not available at present.

Strawberries tolerate a wide range of soil acidity. Lime is recommended only if the soil has a pH of less than 5.0 or a calcium level below 800 pounds per acre. If lime is needed, apply dolomitic limestone at 1,000 pounds per acre on light soils and 2,000 pounds per acre on heavy soils. Gypsum can be used to supply calcium without changing the soil pH. It is usually more costly than lime. The lime or gypsum should be applied several months in advance of planting and mixed thoroughly with the top soil.

Many of the common fertilizers contain sulfur as well as nitrogen, phosphorus, and potassium. Where these are used, no other sulfur should be needed. Otherwise, test strips are recommended before general field application of sulfur. Apply at the rate of 15 to 20 pounds of sulfur (approximately 100 pounds of gypsum) per acre.

If dolomitic limestone is used to adjust the pH or to add calcium, no other magnesium should be needed. Otherwise, a test strip or trial application of 20 to 30 pounds of magnesium (200 to 300 pounds of epsom salts) per acre is suggested before general field application.

WEED CONTROL

good control the first season important

Weed control is often the most difficult and costly job in producing strawberries. Research is being carried on constantly to reduce this problem and the costs involved. There are several weedicides on the market that are effective against annual weeds if used properly. However, there are no known chemicals that will kill perennial weeds in strawberry plantings without damaging
the plants. For further information on chemical control and details on materials and rates contact your county agent.

Keeping the planting free of weeds the first season is important. Much can be done the year or two prior to planting to reduce potential weed problems by cultivation and summer fallow. If weeds can be kept from going to seed and matted rows can get well filled with strawberry plants, weed problems in following years will be reduced. If the new plants are set in check rows they can be cultivated both ways until runners start. Some hoeing will be necessary the first season. It should be started as soon as the first weeds begin to grow.

Hoeing and cultivation should be shallow to avoid damage to the roots of the strawberry plants. Hoe or cultivate only as often as needed to control weeds.

Geese are used by some strawberry growers to control grasses, chickweed, and horsetail rush. They will not keep strawberry plantings free of all weeds. Geese may do some damage to young strawberry foliage, buds, or small berries if they are fenced in with too little to eat. They must be removed from the field before the first berries start to ripen.

The number of geese used per acre varies, but is usually from two to four. They must be provided with drinking water and some feed, in addition to the weeds they eat. Young geese that are still growing are best.

**APPLYING MULCHES . . .**

*to hold moisture or protect plants from cold*

Mulches may be of considerable value in holding soil moisture in dry areas. A wide variety of materials such as hay, straw, sawdust, shavings, wood chips, pea vines, and strawy manure can be used. Use 2 to 3 inches of the heavier materials, like sawdust or chips, or a little more of the lighter materials. If the mulch is to be kept for the life of the planting, additional materials should be added each year. A little extra nitrogen may be needed to offset the breakdown of some of the woody or strawy materials. Right after planting is a good time to apply the mulch.

Mulches are not needed for protection from cold weather except in the coldest portions of the state. If mulch is needed for protection from cold, spread on enough to keep the soil from freezing or thawing quickly. From 4 to 6 inches of coarse hay or straw should be enough. Spread it over the field after the plants have become dormant in the fall, at the time the ground freezes. This is usually during November. The mulch should be taken off about the time growth starts in the spring. Some of the mulch may be left on to keep the berries clean or to conserve moisture. If very much of it is worked into the soil, extra nitrogen should be added to offset the nitrogen that is taken from the soil to break down the mulch.

**REBUILDING STRAWBERRY SOILS . . .**

*with winter cover and green manure crops*

**First Season Program**

When the crop has been harvested in the last year of production, the field should be plowed or disked. If there is enough soil moisture, or if irrigation is available, a green manure crop can be planted as soon as the soil can be worked into a good seedbed. Rye will make the
The corn can be sweet corn for processing or fresh market. However, one of the silage corns would produce more organic material. This would be of greater benefit to the soil in the long run. Regardless of the kind of corn used, it should be disked and plowed down after it has reached full growth, but before the stalks ripen or become tough and woody.

A second winter cover crop of rye (western Washington) or rye and vetch (eastern Washington) can be planted in September to be turned under in the spring before replanting to strawberries.

Fertilize Green Manure Crops
Fertilizing green manure or winter cover crops will pay good dividends. Fertilizers will increase the volume of organic matter, help break down the raw material, and add to general soil fertility. Plant foods taken up by cover or green manure crops are made available over a long period of time. They are not leached from the soil as rapidly as the more soluble materials in commercial fertilizers. Western Washington soils do not tie up or fix phosphorus from green manure crops as much as they fix the phosphorus from most commercial fertilizers.

In western Washington, apply 500 pounds of 10-10-10 fertilizer per acre at seeding to each planting of rye or grain used for a green manure or cover crop. In eastern Washington, use 250 pounds of sulfate of ammonia per acre, or its equivalent, with each cover or green manure crop of rye or other grain.

Three Year Program
If three years or more can be taken between strawberry plantings, perennial grasses and legumes can be grown to advantage. Roots of some of the perennial crops go much deeper and develop longer lasting organic matter. The cost of repeated seeding and turning under is eliminated.
GROWING STRAWBERRIES IN WASHINGTON

Start with the best plants possible.

Use certified plants. They are free from virus diseases that cut yields and shorten the lives of strawberry plantings.

Keep your plants in good condition until you get them in the ground. Don’t let them dry out, mold, or heat.

Get them off to a good start.

Build up your soil with manures or cover crops. Do a good job of preparing it for setting the plants.

Set your plants at the right depth so that the crown is just above the soil surface. Press the soil firmly against the roots. Water the plants right after setting.

Fertilize for fruit buds.

Fruit buds are formed in the late summer and fall for the following year’s crop. Fertilize new plantings as soon as the plants start to grow. Fertilize old plantings soon after harvest.

Control pests and diseases.

Eliminate noxious weeds before planting strawberries. Get information on chemical weed control and insect and disease control from your county agent.

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