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Strawberry Growing in Minnesota

Franc P. Daniels

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UNIVERSITY OF MINNESOTA
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STRAWBERRY GROWING IN MINNESOTA

FRANC P. DANIELS

NO home garden is complete without a generous assortment of small fruits. Any yard that has room for a vegetable garden can support a few berries, and probably no fruit is better adapted to limited garden space than are strawberries. They may be grown commercially on a small scale or as a major farm department occupying many acres on a large scale. There is usually a satisfactory local market in any part of the Northwest, and west of Minnesota is a large section of territory which will probably for many years depend chiefly upon outside sources for its berries. Strawberry marketing is relatively easy as berries, packed in standard boxes or crates, are acceptable on all markets.

There has been much talk recently about berries "running out," and some growers have abandoned the business for that reason. This mysterious ailment is really a "running-in" instead. Wherever it is supposed to exist there can be found instead a "running in" of insects, diseases, and weeds. The only running out that occurs is a running out of the humus or organic matter in the soil as a result of continued cultivation year after year, with no effort to maintain the supply with either barnyard manures or cover crops.

Thoro cultivation and hoeing should be practiced continuously throughout the growing season, as maximum crops can be produced only under the most favorable cultural conditions. Neither hard-packed ground nor weeds will allow the production of good crops.

The control of insects and diseases is becoming increasingly important. The best control methods are clean cultivation and plant restriction, with prompt cutting out and burning of infected parts. In the control of some pests, thoro spraying is necessary, at the right time.

Before considering the culture of the strawberry, we should understand the type of plant with which we are to deal. There is the thick, fleshy crown that develops just at the ground level. From the lower part of the crown the roots grow, and from the upper part, the leaves, fruit stems, and runners. The crown and roots are perennial, the leaves and runners are annual, usually dying at the end of each growing season. The plant is propagated by means of runners—trailing stems that grow out from the crown, run along the ground, and at frequent intervals send down roots that produce new plants. These new plants are used to set out new plantations. In the matted-row system, the solid row is made up of the mother plants and the runner plants that grow from them. The strawberry roots are fine, fibrous, and short, the plants

ordinarily not rooting more than a few inches deep. This means that the plant will have a very limited feeding range, and for that reason the soil should be unusually rich in organic matter and should be well prepared.

VARIETIES

There are two types of strawberry blossoms: perfect or staminate, in which there are both stamens and pistils; and imperfect or pistillate, in which there are no stamens. The latter type is incapable of producing fruit unless pollinated from some other variety. Two or three rows of plants with imperfect flowers should be set to one row with perfect flowers. Care should be taken in the selection of these pollenizers, or perfect-blossomed plants, to see that they bloom at the same time that the imperfect ones do and that they produce pollen abundantly.

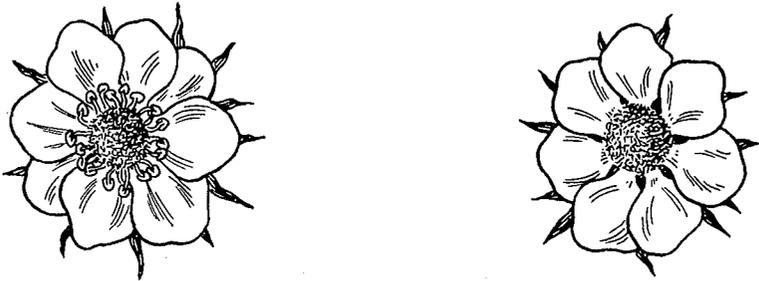


FIG. 1. PERFECT AND IMPERFECT STRAWBERRY BLOSSOMS

The perfect blossom (left) has both stamens and pistils. The imperfect (right) has no stamens and must be pollinated by a variety bearing perfect blossoms in order to bear fruit.

There are also two types of strawberries, based on the time of fruiting—the common June-bearing and the everbearing. The June-bearing, sometimes called the standard strawberry, bears only one crop each year, in June and early July, and the first crop is borne the year after the plants are set. The everbearing varieties bear two crops a year, one at the same time as the June-bearing varieties, and the second four or five weeks later, in late July or early August, continuing to fruit until heavy frosts have killed the blossoms and green berries in the fall. Everbearing varieties planted in the spring will produce an excellent crop of berries in the summer and fall of the same year. The second year they produce two crops, spring and fall, and if carried a third year, will do the same. However, it is seldom desirable to retain the plants more than two years. In some everbearing varieties the runner plants bear fruit the first year; in others only the mother plant will fruit that season.

JUNE-BEARING VARIETIES

The following varieties are all "perfect" or self-pollenizers and are arranged according to time of ripening of fruits.

The Beaver is an early, strong plant-maker and heavy yielder. The berries are large, rather long, and of good color. Quality is not equal to Premier. Because of its dependability and ability to make plants under adverse climatic conditions, Beaver has become very widely grown in recent years.

The Premier is an early, very heavy yielder of large berries of good dessert and canning quality. It maintains its size well throughout the season. It is the leading early berry in most parts of the state.

The Dunlap is a mid-season berry and is the most widely grown of the mid-season varieties.

The Minnehaha is a late, heavy-yielding berry, and is an excellent shipper. In some sections of the state it is considered the best late market strawberry. The quality is only fair. This variety was originated by the Minnesota Fruit Breeding Farm.

VARIETIES FOR TRIAL

The Dorsett was originated by the U. S. Department of Agriculture. It is of good quality, and is a good plant maker. The berries are large, bright red, nicely shaped, well colored inside, and firm. The Dorsett is a heavy producer and a promising market variety.

The Fairfax is an early berry, originated by the U. S. Department of Agriculture. It is a good plant maker and is highly productive. The berries are dark red and are of high quality. The Fairfax is a good canner, holding its shape well after cooking. Like the Dorsett, it is a very promising variety, but both should be more thoroly tested under Minnesota conditions before being planted extensively.

EVERBEARING VARIETIES

Progressive.—The spring crop ripens very early, but the berries are small and the crop light. Fall berries are medium to small, but are produced in great abundance. The Progressive is one of the most regular and dependable producers of a fall crop, but because the berries are small they are recommended particularly for home use.

Mastodon.—The spring crop is larger than that of the Progressive, both in size of berries and quarts produced. The quality is only fair. The fall berries are larger than the Progressive, but sometimes not as heavy a crop is produced. It is usually a satisfactory variety, but under some conditions yields poorly, and in the fall the berries often ripen unevenly with poor color on the under side.

Wayzata (Rockhill No. 26 ?).—The Wayzata was introduced by a Minnesota nurseryman as a selection from a mixture of plants purchased under the name of Rockhill. A limited test at the Minnesota Fruit Breeding Farm indicates that the two varieties are probably the same. Because the name Wayzata is being widely used on plants sold throughout Minnesota, that name is used in this bulletin.

The Wayzata is one of the largest and best-colored of the everbearers grown in Minnesota and the quality is unusually fine. It is not always a dependable plant producer and under many conditions does not produce enough runner plants to allow satisfactory fruit production. Under conditions where a successful stand of plants is produced, it is probably the most satisfactory everbearer now being grown in Minnesota.

CULTURE

Location

The site for strawberry growing should be fairly level so the soil will not wash, but a slight slope for ample water and air drainage is important. For early berries and for the everbearing varieties, a south slope is preferable. For mid-season and late berries most growers select a northern slope. The north slope is cooler and more moist during the fruiting and growing season, and winter conditions are usually more satisfactory. Good water drainage is essential and if not present naturally should be supplied by means of tile drains. Air drainage is equally important, and the site should be high enough to allow cold air to drain off readily to lower areas, thereby giving some protection from late spring and early fall frosts. The soil is more important than the site, and the texture of the soil is more important than its fertility. Any good corn or potato land should be satisfactory for strawberries. A high organic content is important. Most growers prefer sandy loam or a medium loam top soil and a retentive but well-drained subsoil. For early berries, a light soil should be chosen, as two or three days' earliness in ripening in the spring means a great deal in obtaining high prices. For late berries, a heavy soil is desirable, as it tends to hold the berries back a little and is better supplied with moisture when the berries are ripening. If irrigation is practiced, a somewhat sandy soil is preferable.

Many growers are raising strawberries successfully on lowland soils, as peat. When properly handled, an excellent stand of plants is secured and usually a large yield of fruit. The great danger in using lowland is that untimely frosts may ruin the crop.

Lowlands have become very popular for the growing of everbearing varieties because of the large amount of moisture for the berries ripening through late July, August, and September. Lowlands composed

largely of peat are generally deficient in phosphorous and potash, and provision must be made to supply these elements when the natural supply is not sufficient to produce maximum crops.

Preparation of Soil

Wherever possible, a thoroly cultivated crop should precede the strawberries, as the weeds will be fairly well killed out and the soil put in good physical condition. Sod land should be avoided because of danger from grubworms and cutworms. The ideal green manure crop to grow for soil building, preparatory to growing strawberries, is sweet clover as seldom will there be present enough grubworms in sweet clover soil to cause serious trouble for strawberry plants. Heavy applications of barnyard manure should be made before plowing. Many prefer to apply the manure a year before the berries are to be planted. The land should be disked before plowing, and plowing should be deep, 8 or 10 inches if the soil will stand it. Fall plowing is preferable to spring plowing. As early in spring as the ground is tillable, it should be worked into an ideal seedbed by thoro disking and harrowing. Just before planting, the soil should be planked if it is heavy, or rolled if it is light.

Fertilization.—Strawberries need an abundant supply of plant food. Barnyard manure, somewhat rotted, is the best material, for it adds nitrogen, phosphorus, and potash and in addition builds up the organic content of the soil. Applications of 15 to 20 tons per acre before plowing are about the right amount. Rotted barnyard manure is often worked into the soil during the growing season, especially for everbearing strawberries. If a good supply of barnyard manure is not available, or if land is not too high in price, the use of green manures to build up the organic content of the soil and to add to the nitrogen supply (if a legume is used) is advisable. In the four- and five-year rotations, green manures are very important.

Where the desired vigor of plant growth is not produced through the use of barnyard manures and green manures, commercial fertilizer will usually prove profitable. Patches that are low in vigor and that have not responded to other treatments should be given commercial fertilizers late in July or early August. The use of nitrogen will be particularly beneficial, and that alone may be sufficient. However, under some soil conditions a complete fertilizer, with phosphorous and potash in addition to the nitrogen, may prove profitable. A common practice where new set plantings are to be fertilized is to apply nitrogen when the first new leaves start from the crown. On peat soils there is seldom any need of using nitrogen. In fact, nitrogen may bring harmful re-

sults by over-stimulating vegetative growth. The addition of phosphorous and potash is essential for most peat soils.

Planting Time

With few exceptions, the best time to plant strawberries is in the early spring. The plants should be set as soon as the ground can be worked into proper condition for planting, but in unusual seasons, when this can be done abnormally early, it is well to delay planting until danger of severe ground freezing is past. Plants may be set all through the spring, but the later they are set, the greater will be the handicap. Late-set plants will be slower in sending out runners, and experiments have proved that the earlier runner plants can be induced to root, the better will be the chances for maximum crops. Late summer and fall planting is practiced occasionally, if there is an abundant supply of moisture or if artificial watering can be done. It is, however, a doubtful practice, entailing extra work with much risk.



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FIG. 2. WIDE MATTED ROWS WITH PART OF MULCH REMOVED AND PLACED BETWEEN THE ROWS

Training System

There are two main systems of strawberry growing, the hill and the matted row, with many intermediate modifications and variations. In the hill system the plants are set fairly close together, and no runners are allowed to develop. The crowns then stool out, producing large multiple crowns, and the mother plants become very large. Many ber-

ries are produced in this way in the south and western states, but at present it is a relatively unimportant and hazardous practice for growers in the north and should be used only under especially favorable conditions, and then only for everbearers.

For horse cultivation in the hill system, the plants are usually set 12 to 18 inches apart in the row, with $2\frac{1}{2}$ to 3 feet between the rows. For hand or wheel-hoe cultivation, the distance between the rows may be 18 to 24 inches.

Matted-Row System

In the matted-row system, the runners are allowed to develop in all directions from the mother plant. They take root and form a solid mat of plants. The rows vary in width from only 12 inches, about the spread of the mother plant's foliage, to 4 feet or more. It is seldom profitable, however, to let the rows grow more than 3 feet, and under ordinary conditions the most profitable production comes from rows between 18 and 24 inches wide. The common planting plans are:

15 to 18 inches apart in the row by 3 to 4 feet between rows for the very narrow mat, especially for the everbearing varieties.

18 to 24 inches apart in the row by 4 to 5 feet between rows for the wide mat.

Probably the best average is 24 inches apart, in rows 4 feet apart. Allow them to develop a mat 18 to 24 inches wide, after which all runners are cut off. The objection to the wider row is that plants will set too thickly and many of the later rooting ones will not produce fruit, and will become, in effect, simply weeds. Plants in a matted row should be thinned to a minimum spacing of 6 inches apart for best production. There are several methods of thinning, the most accurate and expensive of which is with a hoe. Some growers drag and cross-drag the field with a spike-toothed harrow at the end of the season's growth. This treatment will injure few, if any, of the well-established plants, but will tear out a great many of the late-rooted and crowding plants.

Planting Stock

Only strong, well-developed plants from one-year-old fields should be used. Plants that rooted late the previous growing season should be discarded, as they will be slower to establish themselves and to send out new runners. Old or "parent" plants should never be used. In digging plants, it is preferable to dig the entire row rather than a strip on each side. In this way, the strongest plants are selected and the weaker ones, which rooted late the season before, are discarded.

Handling Stock

Probably one of the most common causes for failure to get a good stand is careless handling of the plants from the time they arrive from the nursery until they are planted. When unpacking, run the hand in among the bunches of plants; if they are cool and moist, it will be all right to leave them in the package in a cool place, as the vegetable cellar, for a few hours. If hot and dry, they should be unpacked at once, the bunches opened, and the roots puddled in muddy water. Then they should be heeled-in, in a cool shady place. Never water plants in the package. Heeling-in should be done as carefully as planting, for it is a temporary planting. The crown should be held at the ground line and moist soil drawn about the roots and well firmed. The plants should then be watered and protected from wind and sun. If they are kept heeled-in for any considerable time, they should be watered at frequent intervals. Plants that are in very poor condition upon arrival may be saved by this treatment.

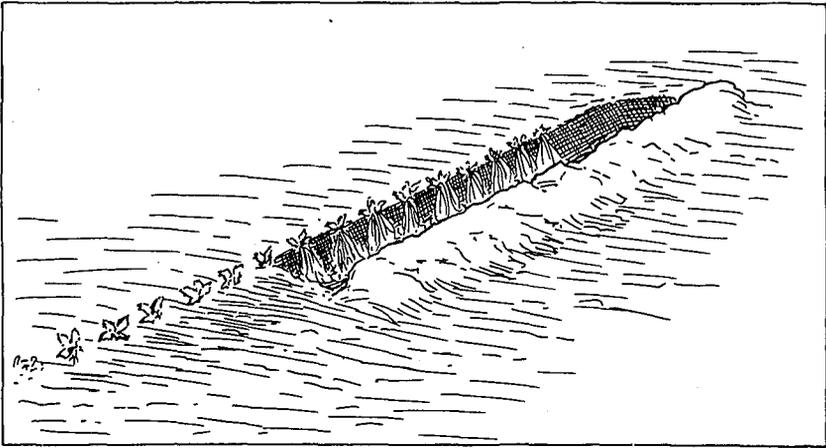


FIG. 3. METHOD OF HEELING-IN STRAWBERRY PLANTS

Pruning

Generally, strawberry plants need to be pruned before they are planted. If they are to be heeled-in, they should be pruned first, usually while they are in the original bunch. The amount of pruning depends on the time of year, the development of the plant, and the conditions of the soil and weather. Part of the leaves are removed to reduce transpiration before the roots become established. Early in the spring, when the leaves are few and small, little if any leaf pruning is necessary.

Later, when there are several large leaves, remove all but one or two, cutting the stems at the crown with a knife. There is more danger of cutting off too few leaves than too many. Any blossom buds and all dead leaves and runners should be removed. The roots are usually shortened to 4 or 5 inches.

Planting

Any good live strawberry plant should grow if properly handled and if planted in a well-prepared soil. *It must at no time suffer from lack of moisture. If that one fact is kept in mind all through the handling and setting of the plants, the results should be satisfactory.* The ground should be stirred just before planting in order to kill weeds and to conserve moisture. Then it should be planked or rolled, as men-

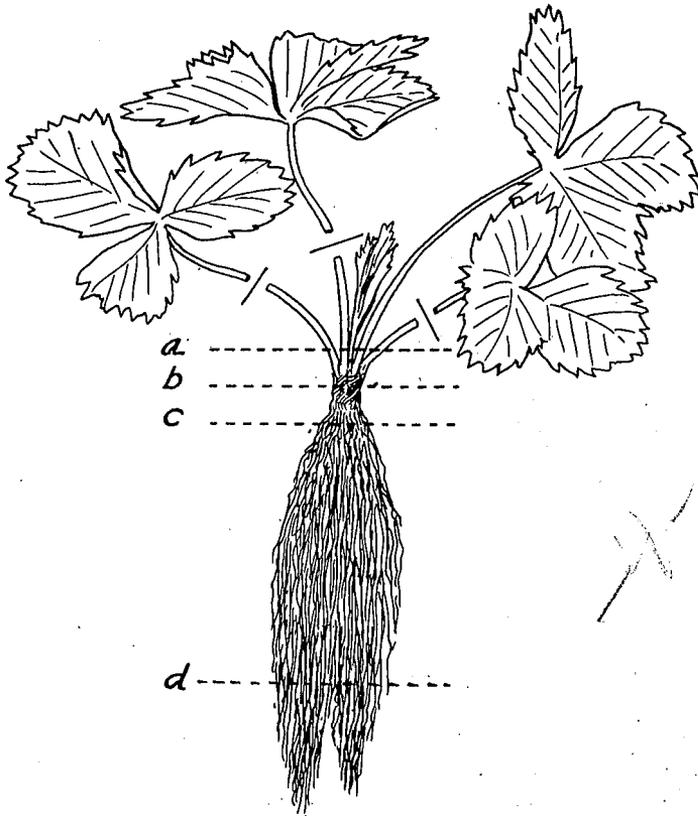


FIG. 4. STRAWBERRY PLANTS SHOWING PRUNING AND DEPTH OF PLANTING

a. Planted too deep.
b. Planted correctly.

c. Planted too shallow.
d. Pruning of root.

tioned, and marked. An adjustable marker of the sled type is commonly used. Many growers prefer to mark both ways, as that allows cross-cultivation until the plants begin to run. If possible, a cool, cloudy, moist day, on which there is little wind, should be selected for planting. Days with hot, drying winds should be avoided. Take the plants out of the crate or out of the ground, if they are heeled-in, only as needed in the field. Puddle the roots as they are taken up and carry the plants in a pail with some muddy water in the bottom. This should be covered to protect them from the sun and wind. Drop the plants in the holes only a short distance ahead of the planter. Two essential precautions must be observed: (1) The plants must be set with the ground line at about the center of the crown, and (2) the roots must be well spread and have firm contact with moist soil. If the ground is dry and dusty on top, it is well to scrape the dust off before planting so that it will not get into the hole and help to dry out the roots.

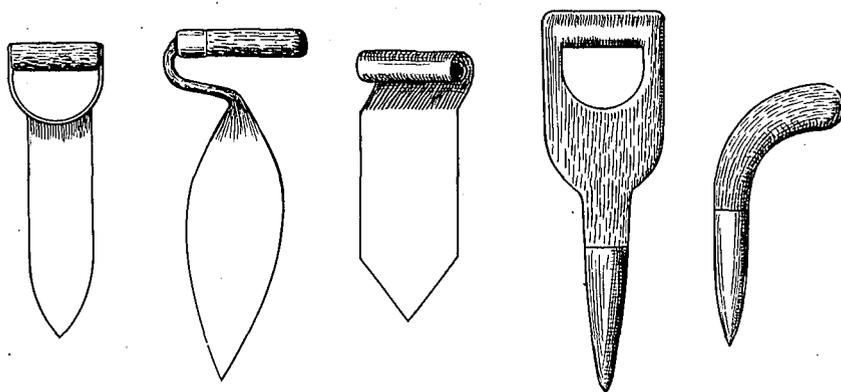


FIG. 5. TYPES OF DIBBLES COMMONLY USED

The round pointed dibbles on the right are not satisfactory because they make too small a hole for the roots.

There are several planting methods. Some use a dibble, but unless a wide dibble is used roots will not have room to spread sufficiently. Some use a spade, one person pushing the spade into the ground to a depth of about 6 inches, then pushing it forward, leaving an opening in which a second person places the plant. The first person then withdraws the spade, places it in the ground a few inches forward, and pulls it toward the plant, in this manner firming the soil against the plant.

If the crown is placed too deep the plant will smother, and if not deep enough it will dry out. If the soil is not well firmed about the roots, the leaves will wilt and the plant will soon die.

Culture the First Year

Cultivation should be started immediately after planting, the same day if possible. It should be frequent and shallow, preferably using a cultivator with fine teeth, as it keeps the soil fine and level. Cultivation should be given every 10 days and after every rain, and should be continued until the end of September. A spike-toothed cultivator with from 11 to 14 teeth is one of the best horse implements. From the time the plant is set until the runners begin to grow, a wheel hoe straddling the row of plants will eliminate a great deal of hand labor and will accomplish the work satisfactorily in a short time. After the plants start to run, the hoe must be used between the plants to maintain a dust mulch and keep down the weeds. All blossoms should be kept off the June-bearing plants the first year and off the everbearing plants until the first week in July, when they may be allowed to set fruit. Early in the season the runners should be worked into the row, either with the cultivator or by hand, and turned to fill in any vacancies.

Runners should be encouraged to root as early as possible, for the early-rooting plants will be the strongest, best-producing plants. To encourage rooting, the runner may be pressed into moist soil or held firmly to the ground by placing a little loose dirt over it. If the under side of the runner plant is kept in contact with the moist soil for a few hours, it will quickly send out roots.

Later, when the rows have reached the desired width in the mat system, additional runners are cut off. They are usually cut with a sharpened disk about 8 inches in diameter, called a runner cutter. This may be attached to the horse cultivator and the runners cut at the same time the cultivating is done, or in a small patch the cutter may be put on a handle and the runners cut by hand. When the runner cutter is not used, the work is done with a hoe.

In addition to limiting the width of the matted row to 18 to 24 inches, it is often necessary to thin the plants in the row itself. A spacing of 6 inches between the plants gives the most satisfactory distribution of food, moisture, and light for the plants, and, as a result, the largest production of No. 1 berries. Unwanted runners may be hoed out or raked out with an iron rake late in the season. Large fields may be harrowed with a spike-tooth harrow, with the teeth slanting back rather sharply.

This raking or harrowing is done about the middle of September and, if necessary, again early in October. The actual time is determined by the rate of production of runners. This treatment not only provides a more favorable spacing for the remaining plants, but eliminates the majority of the runners which would normally root late in the year.

Most of these late-rooted runners would be too young or weak to produce fruit if allowed to remain, and so would act only as weeds, competing directly with other plants for food and moisture.

In the hill system of culture, all runners are kept off during the entire year.

Winter Protection

Strawberries should be well mulched with straw or other material for winter protection. In some years the plants will come through uninjured without any protection, but usually some are killed and many are injured unless they are covered.

Much of the so-called "winter injury" occurs in the fall, with the coming of the first hard freezes, before the winter mulch has been applied. At this stage of their development, strawberry crowns cannot endure severe temperatures without injury. It is difficult to give an exact time for the covering, but it should be applied before the ground freezes to a depth of more than an inch or two. There is usually less danger of getting the cover on a trifle too early than too late.

The purposes of the mulch are:

1. To prevent injury to the crowns from severe late fall freezes.
2. To prevent alternate freezing and thawing of the ground during late fall, winter, and early spring.
3. To prevent drying out of the plants during the winter.
4. To prevent too early starting in the spring, which might be followed by injury to the blossoms.
5. The straw, after adjustment in spring, is available for frost protection in case of late killing frosts.
6. The mulch conserves the moisture from the time the plants are uncovered until the berries have been picked.
7. It keeps down the weeds during that time.
8. It keeps the berries clean and makes a clean place for pickers to work.

The most common mulch material is straw, wheat straw being desirable when obtainable. The ideal material should be free from weeds, should spread evenly on the ground, should not be blown off easily, should not pack too tightly, keeping out the air, and should contain some fine material which can be worked in around the plants. Sometimes strawy manure is used. Many growers prefer short marsh hay because it covers well and is free from weed seeds. Long coarse marsh hay is not desirable because it does not make a very tight mulch and because it blows easily. Cornstalks are poor, but if shredded are satisfactory. The average amount of mulch material used is 2 or 3 inches.

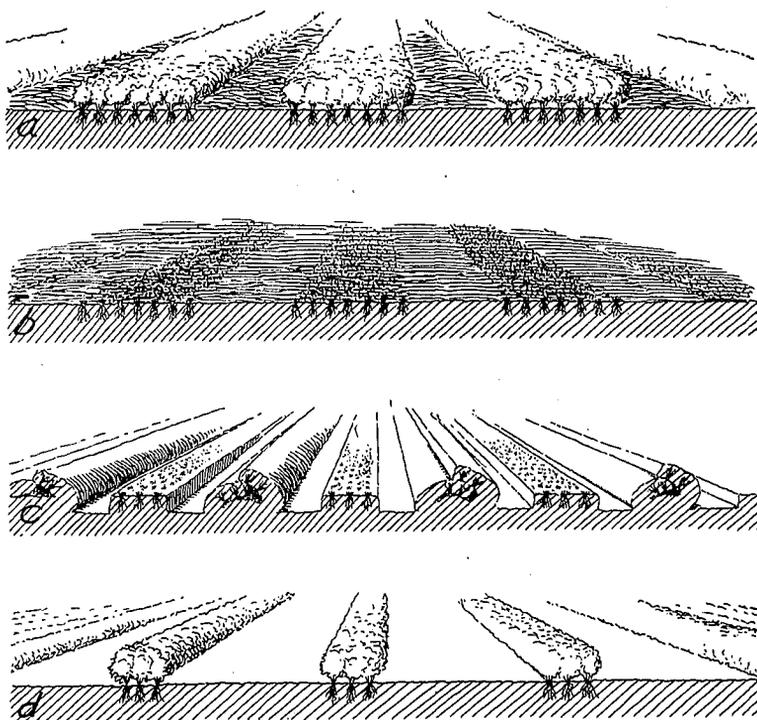


FIG. 6. RENOVATION OF OLD STRAWBERRY BED
 a. Matted rows and mulch before treatment.
 b. Tops cut and burned with most of mulch.
 c. Plowing under a strip from each side of the matted row.
 d. Healthy new foliage growing from renovated plants.

A common rule is to cover the plants so that all foliage is hidden and then put on a little more for good measure. In the western part of the state and in the prairie districts, a heavier mulch should be given.

Culture the Second Year

The straw mulch should be removed or adjusted early in the spring, at least before any considerable growth has been made. For early berries, it is best to remove part of the mulch as soon as the ground is thawed. In removing the mulch, just enough should be taken off directly over the plants to allow the plants to grow through, the straw that is removed being left in the aisle on top of the straw already there. If the straw is left on until after the plants begin to grow, more will have to be taken off than if it is removed earlier. Never allow the plants to grow until they begin to be yellow before loosening the straw, which

is sometimes done with the hands, the person crawling along on hands and knees. Less careful work is done with a four- or five-tined fork or with a wooden hay rake. If there is danger of the mulch blowing about the patch, it may be held in place by a forkful of dirt at frequent intervals. From this time until the harvest of the berries, no other attention need be given the patch other than pulling any weeds by hand.

Harvesting the Crop

In picking the berries, they should be handled with extreme care, for any break in the skin will be followed by rapid molding or spoiling. Berries should never be squeezed, or dropped or tossed into the box, and never should more berries be held in the hand than will rest there without any grasping. Fruits deteriorate more rapidly after they have been picked than they do on the vine, especially if left in the sun. They should be taken into a shady, cool place as soon as possible after picking. The berries are usually put into quart boxes, altho the fall crop is commonly put into pint boxes. The pickers are furnished carriers or trays holding six boxes and having a handle. In this part of the country, grading or sorting is done as they are picked, small, rough, very ripe, or otherwise undesirable berries being put in a separate box or thrown away. The stem should never be separated from the berry. Stems

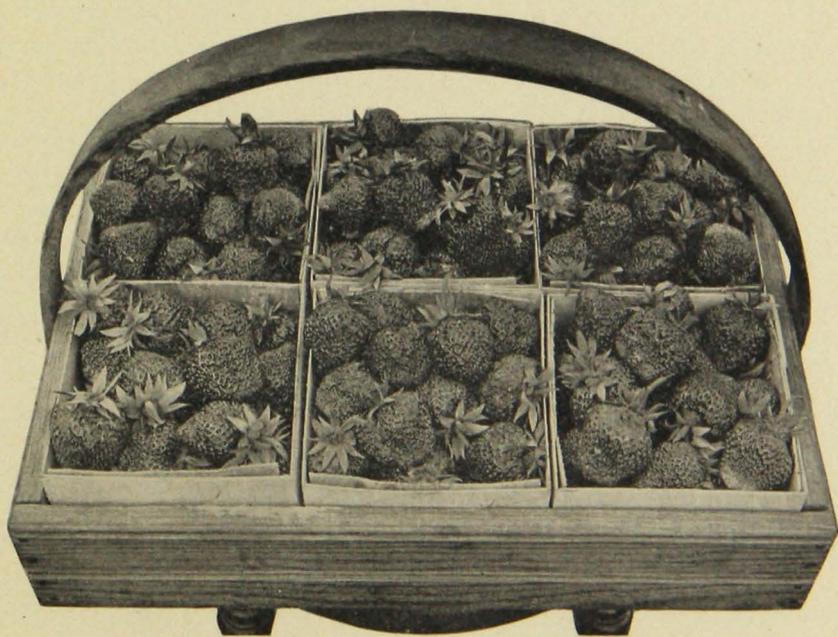


FIG. 7. TYPE OF CARRIER COMMONLY USED BY STRAWBERRY PICKERS

about half an inch in length make the most attractive package. Berries for a distant market are picked when three-fourths or four-fifths red, still showing a white tip. For local market, they may be allowed to color fully. The box should be well heaped, and as soon as a carrier is full it should be taken to a shady place at the side of the field, usually a packing shed, and the box put into the 16- or 24-quart crate.

Treatment of Bed After Harvest

The usual practice is to gather fruit from a patch of June-bearing strawberry plants for only two years. If insects and diseases are very severe, it is best to take only one crop, and plow up the patch as soon as it is picked. If a second crop is to be grown, the old bed should be renewed or renovated. There are three main steps:

1. The destroying of old foliage and part of the mulch in order to control insects and diseases.

2. The narrowing of the rows if they are more than 12 inches wide.

3. The loosening of the soil in the aisle.

There are several different methods of renewal. This is perhaps the most common and most generally satisfactory. First mow the foliage, using an ordinary mower on a large patch, or a scythe on a small one. When thoroly dry, the foliage and mulch may be burned right on the patch, as the flames will pass over the plants quickly and there will be little or no injury to the crowns. If conditions are not favorable for this, the leaves should be raked up and hauled off the field and burned elsewhere. A turning plow is then run along each side of the rows, narrowing the row of plants to 8 to 12 inches, throwing up a back furrow in the center of the aisle. If manure is to be applied, it should be put on at this time, putting it in the furrows thus formed. The next step is to work these ridges or back furrows down with a heavy cultivator or a common spike-toothed harrow, with the teeth slightly slanting. When the furrows are well filled, the field is harrowed and cross-harrowed in order to level the ground and to work a little new soil over the rows of plants. Then a heavy cultivator is run down the aisles to loosen the soil in the center. Some use a heavy cultivator instead of the plow. Then the row itself is hoed to destroy weak plants and any weeds that may persist. In the hill system, the foliage is cut and destroyed as above and the soil loosened with a heavy cultivator, omitting the plowing. Some soil should be worked over the old crowns. The rest of the year the patch is treated exactly as in the one-year-old bed, receiving thoro cultivation and a winter protection of straw late in the fall.

Culture the Third Year

The care and handling of the strawberry patch the third year is identical with that of the second year until the crop has been harvested. Then the usual and the safest plan is to plow up the entire field.

EVERBEARING OR FALL-BEARING STRAWBERRIES

Everbearing strawberries are practically the same as spring-bearing, except that they have two seasons of fruiting each year. This fruiting habit makes necessary some changes in planting distances and cultural practices, chiefly because of the greater need for available food and moisture. The plants are ordinarily grown in a mat from 12 to 15 inches wide or in the hill system, and are set a little closer in the row and the rows a little nearer together than for spring-bearing varieties.

Culture the First Year

The culture the first year is the same as for the spring-bearing varieties except that blossom cutting is necessarily kept up for a longer period, for in a short time after the normal spring blossoms have been removed, it is again necessary to cut off the blossoms that appear for the summer or fall crop. This should be kept up at least until the first of July. It allows the plants to build up a better root and fruiting system and results in a much better late summer and fall crop than if the early blossoms had been allowed to fruit. They should seldom be removed after the middle of July. As the runners begin to blossom heavily early in July, the work of removing blossoms after this time becomes very tedious and is usually not done. It is often advantageous to mulch the plants early in August, in the hill system. In the narrow mat system, the mulch is sometimes worked in among the plants, an aisle being left for cultivation, and at other times the whole bed is mulched. Lawn clippings, when available, are excellent for working in among the plants. Well-rotted manure, when finely pulverized, is good, but should be covered with some other material, as lawn clippings or straw. The mulch should be very heavy if cultivation is to be done away with entirely. The winter covering is the same as for June-bearing varieties if the patch is to be carried over for cropping the second year.

Culture the Second Year

The patch is usually handled in the same manner as a "June-bearing" field until after the June crop is picked. Some growers do not pick the crop in the spring, but remove the blossoms so that all of the plant's

vitality will be preserved for the fall crop. If this is done, the mulch is removed from the aisles in the spring and they are kept cultivated.

In the renewal, the foliage should not be cut unless leaf-rollers or foliage diseases are abundant. Plowing and cultivating are confined to the aisle, no plants being destroyed, for the rows are narrow and the same plants will produce another crop in a few weeks. The ground should be heavily fertilized with well-rotted manure at this time, and cultivation should be thoro and frequent. In a few weeks the fall crop will appear and then the treatment is the same as in the previous year, the application of a mulch at this time being, if anything, more common than in the first year. At the end of the picking season the common and wisest practice is to plow up the patch. It is seldom profitable, except under most favorable conditions, to keep everbearers for a third season.

Everbearing strawberry plants need better care, better culture, heavier fertilization, and more careful spacing and thinning than do June-bearing varieties.

STRAWBERRY INSECTS

Strawberry weevil.—The strawberry weevil is a small beetle that lays its eggs in the blossom bud. After depositing the egg, the female girdles the stem so that it either falls to the ground or hangs loosely by the tissue. The injury from this insect may be very severe, at times resulting in the loss of as high as 90 per cent of the crop. The adult winters over in trash, most frequently in grassy or weedy plots such as are frequently found along fence rows and at the edges of a field.

The best control measure is a short rotation in which only one or two crops are taken from a bed of June-bearing varieties, and where the old beds are plowed up immediately after picking the last crop. Locations adjoining woodlots, waste lands, or overgrown fence rows should be avoided, and new plantings should be made at a considerable distance from the old ones. If there is a light infestation and plants are being sprayed with a fungicide for disease control, an addition of one pound of arsenate of lead to 50 gallons of liquid will decrease the numbers of these pests. Most effective control will be obtained through proper rotation, sanitation, and avoiding the use of fields close to trash or growth suitable for winter hibernation of the adult.

Strawberry root louse.—This pest is sometimes very destructive. Infested fields should be plowed up at once to prevent its spread. The purchase of certified strawberry plants is the best protection.

Strawberry leaf roller.—Strawberry leaf roller does its damage in the larva stage when it is a slender, active caterpillar about $\frac{1}{2}$ inch long. The adult female, a small brown moth, deposits the egg near the base of the midrib of the leaf. After hatching, the larva spins a small web, drawing the two halves of the leaf together, and feeds on the inner surface. After the leaf is so folded, spraying is of no use. There are from one to three complete generations in a season.

The spray control is arsenate of lead, $1\frac{1}{2}$ pounds to 50 gallons of water, applied on the leaves before folding has begun. Subsequent applications should be made as new foliage develops in the spring. If there is more than one generation, later sprayings may be necessary. Mowing and burning of the foliage at renovation time is very helpful in the control of leaf roller.

Tarnished plant bug.—This insect injures immature berries, causing nubbins to form. It is almost impossible to control. Using the same location and sanitation precautions as recommended for strawberry weevil control will be as effective as anything that can be done.

White grub.—The white grub is the most troublesome and injurious enemy of strawberry plants in Minnesota. The adult is commonly known as the June beetle, brown in color and almost an inch long. The larva, which does the damage, is the whitish worm commonly known as the grubworm or white grub. The grubs destroy the strawberry roots by feeding on them. The damage is usually most noticeable in newly set patches because of the small number of plants, but the injury may be equally serious in older fields.

Control must start two years in advance of setting the plants. The plants should not be set on land that has been in sod for some time. Since sweet clover and alfalfa fields are infected only slightly, whenever possible, strawberries should be grown on land on which one of these crops has been grown two seasons previously. During the period of egg laying, the adults feed at night on foliage of shade trees, particularly oak, willows, and poplars. Fields close to such plantings should be avoided.

Ground beetles and crickets.—Insects of these types commonly do severe damage to ripened fruits in the field. Should the damage become serious, various poison baits are frequently effective.

STRAWBERRY DISEASES

Leaf spot.—This disease is caused by a fungus. The spots appearing on the leaves are first reddish or purple. As the infested area gradually dies, the spots enlarge and appear brown and dry. Some

varieties of strawberries are more susceptible than others in Minnesota, particularly Dunlap and Progressive.

To control the disease, set out only healthy plants and spray them early in the season with 4-4-50 Bordeaux mixture. Careful mowing and burning of all foliage when the field is renewed is usually effective. If the disease is quite prevalent, a second application of Bordeaux mixture on the new foliage is recommended.

Virus diseases.—Strawberry plants are subject to a number of virus diseases, notably yellows, xanthosis, and witches-broom. It is impossible to maintain a patch in satisfactory vigor or production when the plants are infected with these diseases. Altho they are not generally prevalent in Minnesota, any plants that become infected with them should be destroyed immediately.

Buying only clean, certified plants is the best control. The State Nursery Inspection Service in Minnesota is particularly rigid regarding these diseases, and it is recommended that only plants that have been properly certified as to freedom from dangerous diseases and insects be used to establish plantings.