

# The Strawberry Cultivation in CANADA



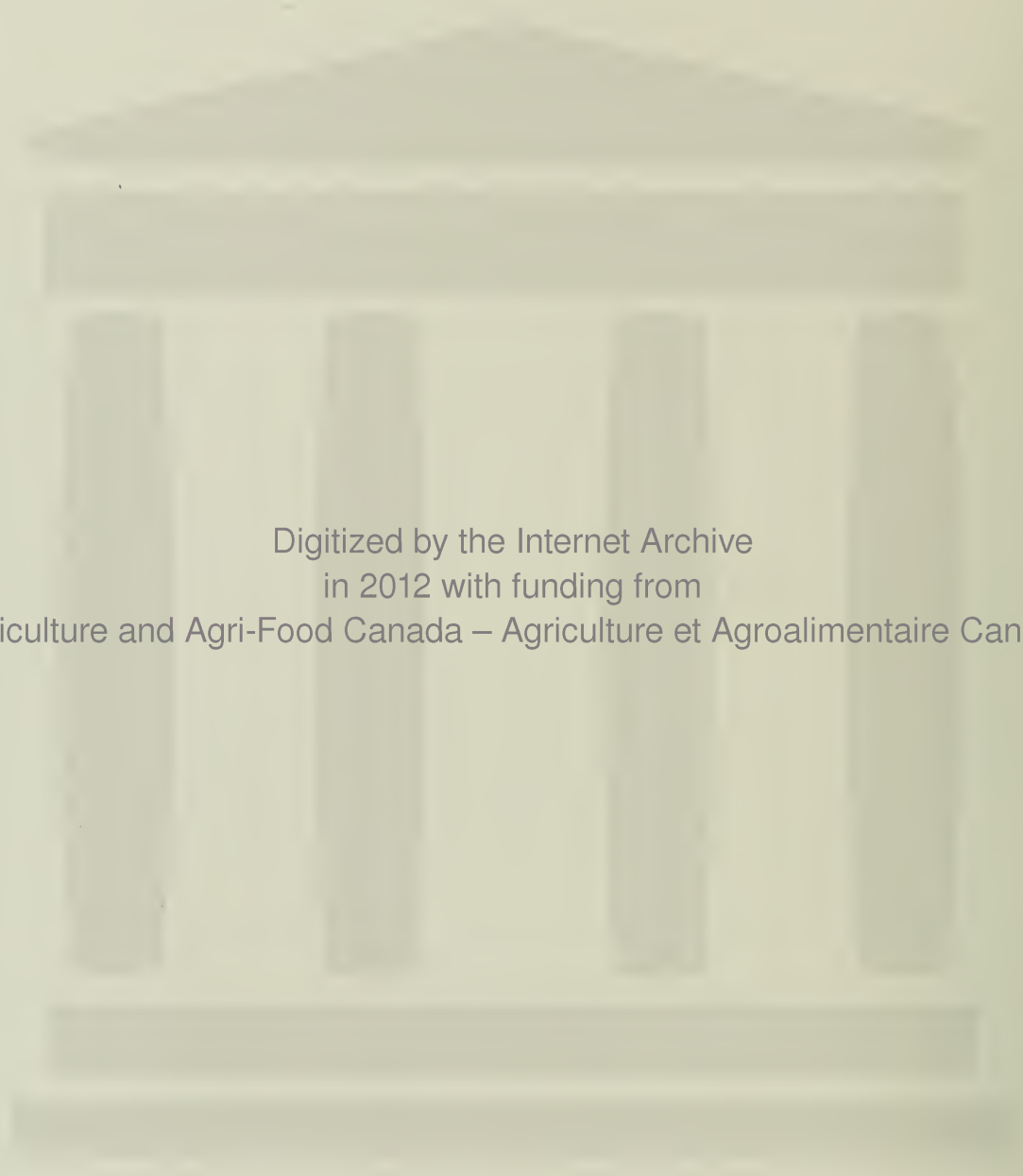
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# THE STRAWBERRY AND ITS CULTIVATION IN CANADA

BY

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WITH

A SECTION ON COMMON STRAWBERRY DISEASES  
AND THEIR CONTROL

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# THE STRAWBERRY AND ITS CULTIVATION

The strawberry is the most important of the small fruits of Canada. The latest census returns show production and value by provinces which indicate the widespread distribution of this cultivated fruit from coast to coast. This wide range of adaptability not only makes the strawberry popular from a commercial standpoint but also renders it especially desirable for the home garden in those parts of Canada where it is difficult to grow many edible fruits.

The strawberry is found wild in Canada from the Atlantic to the Pacific ocean, and from the southern boundary as far north as the 64th parallel. Large quantities of the wild fruits are gathered. The cultivated varieties are grown successfully in almost every district where the wild ones are found, but in some areas they require protection or irrigation. The season for ripe fruit begins early in June in southern Ontario and in parts of British Columbia. At Ottawa the first ripe fruit has been obtained on June 15, and the last picking of the latest variety has been on July 21 for the varieties which usually bear only one crop in the season, but fruit is obtained from the everbearing sorts until late in October, unless frosts are severe. The season in the more southern parts of the province of Quebec is somewhat similar to that at Ottawa, except along the lower St. Lawrence, where it is much later, the fruit not being ripe until about the first week of July, and the season continuing until the second week of August. The season in Nova Scotia and Prince Edward Island extends into August also. In some parts of the Prairie Provinces as well, the season is not over until August. The later the spring and the cooler the summer, the later the strawberry ripens, as a rule.

TOTAL COMMERCIAL PRODUCTION OF STRAWBERRIES AND VALUE BY PROVINCES  
FOR 1941, 1942, 1943

		1941	1942	1943
Nova Scotia.....	Qts.	1,045,000	983,000	1,130,000
	\$	183,000	138,000	249,000
New Brunswick.....	Qts.	1,657,000	1,258,000	1,100,000
	\$	149,000	126,000	209,000
Quebec.....	Qts.	4,442,900	4,442,000	5,552,000
	\$	400,000	444,000	944,000
Ontario.....	Qts.	6,118,000	5,447,000	5,972,000
	\$	551,000	654,000	1,075,000
British Columbia.....	Qts.	10,431,000	5,649,000	2,523,000
	\$	928,000	695,000	840,000
Total.....	Qts.	24,053,000	17,779,000	16,277,000
	\$	2,211,000	2,057,000	3,317,000

Agricultural Branch, Dominion Bureau of Statistics.

With improved transportation methods the distance of shipping this fruit has greatly increased, until today it is not uncommon for carloads to be marketed several thousands of miles from their source of production. This places fresh strawberries on our markets over a very much longer period than would otherwise be the case and no doubt has much to do with keeping down the price during the early part of the local season. Nevertheless the local product always brings at the outset a somewhat higher price than the tail-end of the foreign product, principally because it reaches the consumer in better condition.

The largest proportion of the Canadian production is consumed in Canada. In 1940, Canada's export in strawberries was 3.8 per cent of the total production;

in 1941, 18.5 per cent and in 1942, 6.9 per cent. During the three years previous to the war, 1936-38 inclusive, Canada's annual export was about 5 per cent of the total production. The marked increase in the 1941 export was due to a heavy demand from the United Kingdom for processed berries.

MONTHLY IMPORTS OF STRAWBERRIES ENTERED FOR CONSUMPTION IN CANADA  
1941, 1942, 1943

	1941		1942		1943	
	lb.	\$	lb.	\$	lb.	\$
January.....	4,537	727	2,726	643	2,475	576
February.....	1,968	383	21,071	4,532	6,448	1,835
March.....	20,096	3,839	5,758	1,436	1,964	620
April.....	247,619	26,602	480,969	62,352	70,419	16,322
May.....	3,512,419	237,348	5,312,882	429,422	1,263,674	228,534
June.....	378,605	42,994	1,995,187	199,586	1,154,026	219,396
July.....			3,078	342	3,915	787
August.....						
September.....			34	11		
October.....	120	26				
November.....						
December.....	197	65	540	132	40	48
Total.....	4,165,561	311,984	7,822,245	698,456	2,502,961	468,118

Agricultural Branch, Dominion Bureau of Statistics.

## LOCATION AND SOILS

The prospective strawberry grower if he has not already located, should bear in mind a few important details which may have a considerable bearing on the success of his undertaking. Proximity to a market or some good shipping point is a very important factor. Very frequently growers located near a really good market net greater returns per acre than those who though located in far better fruit areas, are either farther from their market or are catering to a market too well supplied with this fruit. There are still excellent opportunities for the establishment of strawberry plantations close to some of the larger cities and towns which are at present largely dependent for their fruit supply upon distant sources. This closeness to an excellent market goes a long way towards making up for other deficiencies such as possible winter injury, lower yields due to weather conditions, etc.

The possibility of being able to obtain pickers is another important factor which will have an influence on the area to be planted. With the advent of motor transportation this is easier of solution than formerly, for it is now possible to gather up the pickers from a nearby city or town and in a few minutes transport them to the fields where they may remain for the day to be returned in the evening by motor truck.

The actual location of the plantation, however, depends upon factors governing the economical production of the crop. Among the most important of these is to select a situation where good drainage is obtainable. It is not sufficient that underdrainage be present, good surface drainage is absolutely necessary for assured success. The strawberry will not stand being covered with water in early spring or during the later winter. Unless there is sufficient slope to the land this is difficult to overcome in some years, when the ground is frozen for a time after the early spring melting of snow, thus rendering the underdrains of little use for a short period.

Low-lying pockets are also to be avoided especially in districts where late spring frosts may be expected. A gentle hillside or slope permits of better air drainage and often eliminates this trouble entirely.



## SOIL

The strawberry will thrive on a great variety of soils, from a very light sand to a heavy clay, but when it is possible to make a selection, a moderately light friable soil is much to be preferred. From the standpoint of the physical texture a light sand is satisfactory, but being generally deficient in humus and plant food it is not as valuable as a heavier sandy loam or a very light clay loam.

As it is important to get the young runner-plants rooted as early as possible, a soil which does not pack or bake is much more suited to strawberries than a stiffer but possibly naturally richer soil. If a stiff clay is used, constant cultivation and care during the first year is very important.

*Soil Moisture.*—There is considerable variation in locations with reference to their moisture content during a dry season. This is frequently dependent upon the depth of the soil and also upon its physical texture. This is an important consideration where dry spells are frequent during the strawberry-picking season. At the Central Experimental Farm, the soil is a very light sandy loam and, while rather exacting in its fertilizer requirements, has a desirable physical texture rendering it easily worked. On account of its great depth this soil is very retentive of moisture and, although often dry on the top inch, shows plenty of moisture below. A heavier textured but richer soil would probably not be so retentive of moisture.

*Cultivated Land.*—Land which has been in sod for some years should be avoided until a few hoed crops have been grown on it. Such land is likely to be heavily infested with white grub, which causes material damage to a newly set plantation. This pest is not so prevalent on land which has been cultivated for a few years.

## PREPARATION OF THE SOIL

As stated in the previous paragraph, land under cultivation is preferred for a new strawberry plantation. Another exceedingly important factor is control of weeds, especially if the plantation is to be kept for more than one year's fruitings. It is advisable to avoid, therefore, land which is infested with couch grass, or other persistent weeds difficult to control.

A thorough ploughing, disking, harrowing and rolling is necessary before planting. Fall ploughing on certain soils is to be preferred, followed with a thorough pulverization and a levelling and smoothing by a spring-toothed harrow. For ease in planting, rolling is generally recommended previous to the field being marked out.

## FERTILIZERS

The fertilization of the land for a successful strawberry crop is dependent upon a number of factors. As the crop occupies the land for at least two seasons, it is rather exacting in its requirement of humus, which is essential for the proper retention of moisture and the liberation of plant food. As humus can only be supplied by green manure crops or by manure, the quantity to be supplied before the plantation is set out will depend upon the nature of the soil and the length of time the plantation is to be fruited.

On very light sands large quantities of humus will need to be supplied; on loamier soils humus is not such a vital consideration. If only one crop is to be taken from the plantation, a smaller amount of humus will be required than where two or more crops are to be removed.

As manure, in addition to its humus content, contains large quantities of nitrogen, phosphoric acid, and potash, it makes probably the best fertilizer that

can be supplied, although it may be necessary to supplement it with some form of commercial fertilizer. Failing an abundant supply of manure, a rotation which will permit of the ploughing under of a crop of green manure, such as one of the clovers or some other good legume, will supply not only humus but also a quantity of nitrogen.

It is thus quite possible by the use of green manure crops and fertilizers to maintain both the humus content and the plant food of the soil. This is of particular advantage to growers of small fruit who are finding it increasingly difficult to procure manure. When green manure crops are grown the land is not producing a cash crop. The cheaper the land employed, the more economical this method becomes.

Any additional nitrogen required may be applied as nitrate of soda, ammonium nitrate, or ammonium sulphate; phosphoric acid as superphosphate or as bonemeal; and potash as muriate or sulphate of potash.

#### ROLE OF NITROGEN IN STRAWBERRY CULTURE

Nitrogen is the most unstable of the plant food elements and is more often deficient in the soil than other elements; consequently beneficial results are very frequently observed from nitrogen applications. In order to determine the effect of nitrogen at different seasons of the year a series of experiments was inaugurated at the Central Experimental Farm, the results of which are given below.

There are at least three ways in which applications of a nitrogenous fertilizer may affect the yield of strawberries: (1) by causing an actual increase in the number of flowers or fruit buds formed; (2) by causing an increase in the size of the individual fruits; and (3) by increasing the set of the bloom.

(1) This is probably the most important. In the annual report of the Horticultural Division for the year 1921, evidence was presented to show the value of early formed runners in the plantation. The following table taken from that report shows clearly the comparative value of early and late formed stolons or runners as fruit producers. The early formation of runners is dependent upon an available supply of plant food, including nitrogen, in the early part of the planting year. The presence of nitrogen therefore affects the number of fruits formed by encouraging the early formation of runner-plants during the first year of the plantation.

TABLE SHOWING THE PERCENTAGE OF STOLONS FORMED  
ON DIFFERENT DATES

Date	Percentage	
July 7 .....	0.37	} 6.76 per cent formed during month of July produced 6.5 per cent of the fruit.
" 14 .....	1.11	
" 16 .....	0.61	
" 18 .....	0.74	
" 21 .....	0.25	
" 23 .....	1.23	
" 25 .....	0.61	
" 26 .....	0.12	
" 28 .....	1.11	
" 30 .....	0.61	
Aug. 22 .....	0.98	} 25.10 per cent formed during month of August produced 34 per cent of the fruit.
" 6 .....	1.11	
" 8 .....	0.25	
" 11 .....	2.21	
" 14 .....	1.11	
" 18 .....	3.08	
" 22 .....	16.36	
Sept. 3 .....	7.13	} 31.36 per cent formed during month of September produced 39 per cent of the fruit.
" 8 .....	0.49	
" 18 .....	16.61	
" 19 .....	0.12	
" 20 .....	0.71	
Oct. 10 .....	27.43	} 39.22 per cent formed during the month of October produced 19.6 per cent of the fruit.
After Oct. 10.....	11.79	



Dealing first with that part of the experiment where stolons were permitted to remain in their original position, it was found that there was decided correlation between the date the stolon rooted and the ultimate number of fruits it produced. Stolons formed as late as October 20 produced, on the average, only five fruits, whereas stolons formed about the middle of August produced an average of sixteen fruits. This is portrayed graphically in Fig. 1. Runners formed much earlier than this produced about nine to ten fruits. Apparently the reason for the falling off of these extremely early formed stolons is that they are the parents of large numbers of stolons and, like the original parents, become depleted of energy. The number of these early, poor yielders is comparatively small, as will be seen by examining the preceding table which shows the percentage of stolons formed on the different dates. From an examination of this table and the figure, it is evident that the most profitable period of stolon formation lies between the latter part of July and the last of September. Although over one-third of the stolons were formed in October they produced only 19.6 per cent of the crop, which, when compared with 34 per cent of the crop produced by 25 per cent of the stolons which were formed in August, demonstrates the great value of early planting and good care in the early part of the season.

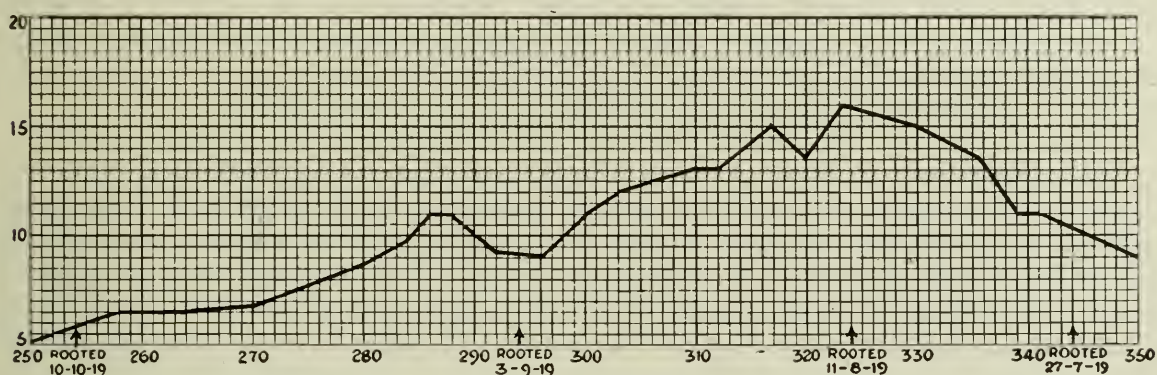


Fig. 1.—Showing relation between yield and age of the stolon. Age of the plants in days, dating from the time of formation to July 1, 1920.

Further work with nitrogen application has shown that when a heavy application of manure is applied the year previous to planting and the land used for a hoed crop, there is in a good average soil a sufficient supply of nitrogen and other plant food to encourage maximum runner formation in the early part of the season. This same series of experiments demonstrated, however, that even though there appeared to be a sufficient supply of nitrogen to promote maximum vegetative extension or runner formation, an application of nitrogen made in September of the planting year caused a very appreciable increase in yield. The exact yields of the plots treated at various times were as follows:—

	Yield per plot Lb.
Nitrated 1 month after planting.....	22.30
“ August 15.....	23.00
“ September 15.....	23.30
“ September 15 and again in spring.....	24.20
Not nitrated at all.....	19.10

The table shows a gain of over four pounds per plot derived from the application of nitrogen by making the application at a period when there were a large number of plants forming their fruit buds for next year's crop.

(2) The size of the individual berry or fruit may further affect the total yield. This may be influenced by spring applications of nitrogen, especially in soils where nitrogen is inclined to be deficient.

(3) Spring applications of nitrogen during the fruiting year may also increase the ultimate yield by improving the set. As in size, this would be more evident in soils low in nitrogen than where the supply of nitrogen is abundant. Results from experiments indicate that the total set of all bloom was increased by about five per cent by a spring application of nitrogenous fertilizer before bloom. A closer analysis showed that the increase on the later blooms such as the quaternary or last formed blossoms ran as high as 26 per cent.

As already intimated it is difficult to set out very definite fertilizer recommendations for all conditions, but the following have widespread application.

#### *Recommendations.*

Strawberries require a soil high in organic matter, retentive of moisture. Unless the soil is naturally well supplied with humus, it is necessary to build up the supply for a year or two previous to planting.

Barnyard manure, green manure crops or mulch, for example, hay or straw, must be the basis of the soil fertility program. Maintenance of fertility in a strawberry plantation is very simple if plenty of barnyard manure is available. Where manure is not available, it is necessary to resort to the use of green manure crops or mulch. Commercial fertilizers are beneficial as a supplement.

The application of 20 to 25 tons per acre of manure applied to a hoed crop one year before planting is a suitable way of preparing land. However, if barnyard manure is not available the land should be fitted by sowing a green manure crop fertilized with 400 pounds of a 5-10-13 mixture. The average soil prepared in this way contains a sufficient supply of nitrogen and other plant food to encourage maximum growth in the early part of the season. If soil is below average in fertility or has not been previously fitted an application of a complete fertilizer such as a 9-5-7 or 5-10-13 should be made about one month after planting or after plants have become well established. Additional side dressings of nitrogen at the rate of 100 to 125 pounds per acre in mid and late August may be made to stimulate formation of fruit buds.

#### PLANT SYMPTOMS

As an aid to the diagnosis of faulty nutrition, foliage symptoms of strawberries are useful.

*Potash deficiency* may be indicated in midsummer by a scorching of the margin of the leaves. At first this takes the form of a pale yellowish margin which later turns brown as if burned or scorched. Plants exhibiting this symptom are generally indicating a desire for more potassium.

*Phosphorus deficiency* in the strawberry is indicated by a bronzing of the foliage on the upper surface generally accompanied by some purpling on the under-side of the leaf. The typical marginal scorch of the potash deficiency is not present.

*Nitrogen deficiency* is exhibited by pale green or yellowish foliage during summer, which may turn prematurely reddish in colour.

*Autumn tints*—In late summer or early autumn strawberries develop autumn tints which also indicate the fertilizer requirements. It is seldom that in any plantation one cannot find a few tinted leaves, but unless very prevalent and accompanied by poor growth there is little to worry about.



## HOW TO APPLY FERTILIZERS

In using commercial fertilizers they may be broadcast on the soil previous to planting, and cultivated in or applied between the rows shortly after planting and worked in with regular cultivators.

A word of caution is pertinent at this point.

Applications of nitrogenous fertilizers made at planting or very shortly after often give injurious results, the young plants not being able to utilize much fertilizer at that time. It is recommended, therefore, that fertilizers such as ammonium nitrate or sulphate of ammonia be not applied until at least one month after the plants are set.

Where nitrogenous fertilizers have been used after the plants are forming runners, good results have come from broadcasting ammonium nitrate right on the plants during a dry day. On such a day very little adheres to the foliage, and if a piece of bagging or brush is dragged over the plantation any nitrate that does adhere is quickly dislodged. With sulphate of ammonia, this method has not been so successful, considerable foliage injury resulting from this treatment. Apparently between the rows is the only method of application for this fertilizer.

## PLANTS AND THEIR TREATMENT

### NURSERY-GROWN PLANTS

The majority of the nurseries issue their catalogues at the beginning of the new year. The varieties to be grown should be chosen and the order placed early in the winter with date of shipment specified. It is of very little importance in what section of the country the plants are grown, except that stock in the southern districts may be too far advanced for successful planting when spring opens in the northern sections. The plants should be ordered to arrive as early in the spring as possible after the soil can be worked. Only the best obtainable stock should be used for setting a new plantation.



Fig. 2

- No. 1—Over-developed crown, and too small a root.
- No. 2—Crown and root too small.
- No. 3—A very young and unsuitable plant.
- No. 4—A properly developed plant for transplanting.



If the plants are obtained from a distance it is desirable to order more than are actually required, as there is usually considerable loss. The extra plants may be heeled-in and used to fill the vacancies as soon as it is known which plants are not going to grow. Strawberry plants will stand shipment for long distances if properly packed. It is usually more satisfactory, however, to order from a nearby nursery, in which case the plants are for the most part dug a short time before they are required for planting.

The plants should be set out as soon as possible after their arrival. It is often, however, not convenient to plant at once; but in any case, when the plants are received from the nursery, they should be carefully unpacked and heeled-in, or trenched. If permitted to remain in the original package for a short time, they are likely to heat or dry out, and may be seriously injured. Roots in good condition are of a light or yellowish colour, while those which have heated are dark and it is a waste of time to set out plants with such roots.

The plants should be heeled-in in a well-drained spot protected from the sun and wind. V-shaped trenches about six inches deep and placed fairly close together are the most satisfactory. If the plants are tied in bunches, each bunch should be opened, the plants separated and spread out in the trench, thus allowing the moist earth to readily come in contact with the roots. The soil should be firmly tramped or packed against the roots to prevent drying, but do not permit the crowns to be covered. It is desirable to water the plants well after heeling them in. By the time the soil is ready for planting these heeled-in plants may have made new roots and be in better condition for planting than if they had been set out at once.

The number of plants required for an acre if set out 18 inches apart in the rows, is about 8,300, and to provide for loss in shipment at least 8,500 should be ordered. If a free plant-maker like Senator Dunlap is planted, the plants need not be less than two feet apart in the row, and 6,500 plants should be sufficient to order.

Pot-grown plants are the most satisfactory for autumn planting. These plants may be purchased from nurseries which specialize in that type of stock, but are usually expensive and only justified under special conditions. Pot plants are obtained by sinking 2½-inch pots to the rim in the ground several weeks before the plants are to be rooted. The pots are filled with rich friable soil and sunk from six to eight inches from the original plant. As soon as the new runners reach the pots, they are placed over the soil and soon root and make good plants by late summer. The advantage they have over plants rooted in the ordinary way is that when they are transplanted they are taken from the pot and replanted with a ball of earth without disturbing the roots. Hence they are but little checked and will soon go on growing again, making strong plants which will bear more fruit than those rooted in the ordinary way.

It is a good practice to prune the plants before they are set out; all the larger well developed leaves, except about two of the healthiest ones, should be removed. This prevents any excess loss of moisture before the plant becomes established and may often save it when dry weather sets in immediately after planting. Long and straggling roots are best removed at this time to facilitate planting.

#### HOME-GROWN PLANTS

When possible, it is better for the grower to raise his own plants as they can be dug and used fresh. Moreover, in recent years many other problems have

arisen such as degeneracy, root-rot and tarsonemid mite. These can be much more readily controlled by such a practice. It is more desirable, for this purpose, to have a propagating area than to take plants from old beds which have fruited or from the outer edge of the newer rows, which are going to fruit for the first time, as runners from a fruiting plantation lack vigour.



Fig. 3—A first-class plant, trimmed for planting; plenty of young white roots.

The grower should at the outset endeavour to plant only really healthy vigorous strains of a variety. Following planting, the propagation bed should be rogued frequently, at least three times on a good stock and five times on an indifferent one. Rogue out all the unhealthy or suspicious looking plants and those lacking vigour. It is better to recognize roguing rather from the point of view of looking



for definitely healthy plants than for abnormalities. Roguing is one of the most important operations in growing strawberries.

In selecting the plants for transplanting, the whole propagating row should be dug and the best plants only selected. These are plants with large root systems and well developed crowns. The oldest plants with oversized crowns and smaller root systems should be avoided, likewise those with very little root and small crowns. Aside from this, experience shows that it matters little whether the plants come from close to the original parent or far from it. Only those plants with white roots are used. The ones with dark or discoloured roots are probably too old or have been injured by winter, and should be discarded.

#### MAINTENANCE OF DISEASE-FREE STOCKS

Elsewhere in this bulletin will be found information on the various diseases to which strawberry plants are subject.

Probably one of the worst troubles with strawberries are the known viruses such as yellow edge, crinkle and so forth, plus the unidentified troubles which are probably of virus origin.

Unfortunately, many of the present day varieties are symptomless carriers for a long time, and these disorders bring about a gradual decline in vigour which may not be recognised until almost the entire plantation is affected and the yield is seriously reduced. The only sure way of avoiding this is to use properly indexed disease-free plants, but at present this system is not being used generally in Canada.

In the meantime growers would be well advised to adhere to the following practices:

- (1) Do not set out a new plantation with plants from a fruiting row.
- (2) Maintain separate rows for propagation purposes. These rows should be planted each year.
- (3) Each clone may consist of a group of four plants of a variety set on the square, eighteen inches apart. These squares or clones should be separated from all others by a distance of thirty-six inches. At no time should the runners from the various clones be allowed to come closer than twelve inches of each other.
- (4) Rogue the propagation rows frequently and thoroughly.
- (5) Since most varieties are symptomless carriers of certain virus disorders, do not wait for definite symptoms of virus to appear.
- (6) Rogue on the basis of health and vigour. In other words remove and destroy all poor vigour and unhealthy looking plants. If a plant in a clone or group is suspected destroy the whole clone.
- (7) Since virus diseases are spread by aphids thorough spraying to control these insects should be carried out.

#### PLANTS FOR SHIPMENT

In shipping strawberry plants great care is necessary in packing to avoid drying out and overheating. At the Horticultural Division, Central Experimental Farm, three sizes of packages are commonly used. One size is a small mail package, for from a dozen to 50 plants, another is an ordinary 11-quart basket for 100 to 200, and the third is a regular slatted crate for large shipments.





Fig. 4.—Eleven-quart basket package before wrapping.

(1) The small mail package is very popular for customers only wishing small lots and if care is taken in packing, is satisfactory for rather long distances. The plants are tied into a bundle with raffia and then wrapped around with sphagnum moss, which has been well soaked and squeezed free of surplus water. A piece of oiled paper is then securely wrapped around the package so that the leaves are exposed (see Fig. 6) and the whole then wrapped and tied in manilla wrapping paper. If preferred, one may use a specially prepared paper which consists of two layers of paper stuck together by tar compound. This is both waterproof and airtight and prevents drying out (which is the object of the oiled paper) while the open end provides the necessary ventilation.

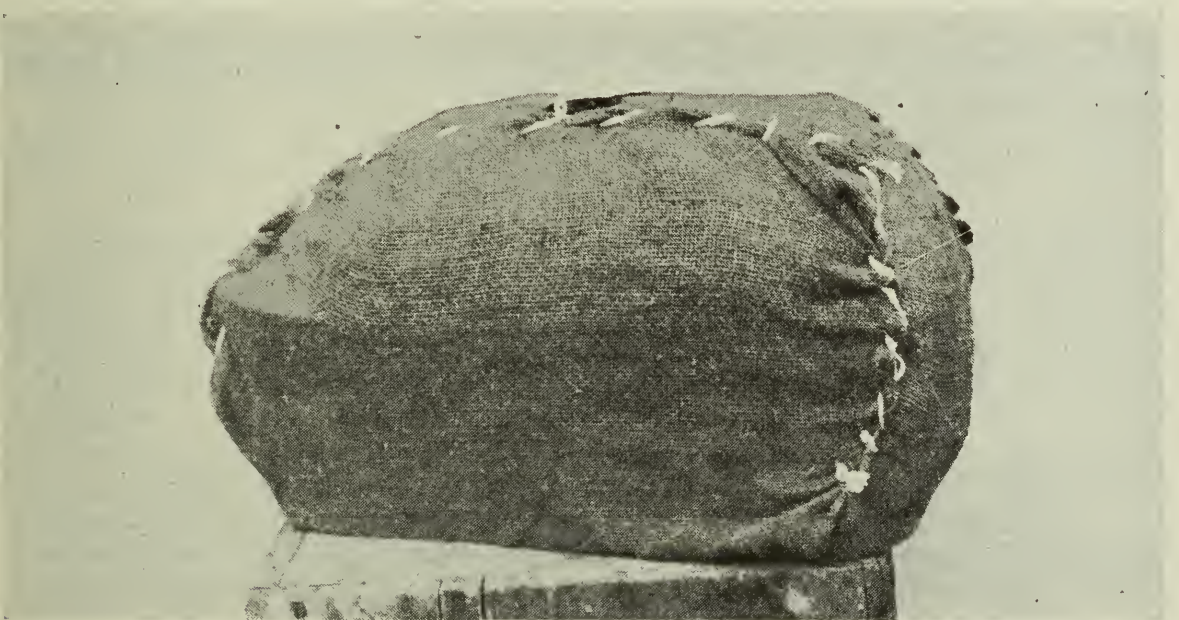


Fig. 5.—Eleven-quart basket package ready for shipment.

(2) The basket package consists of an 11-quart basket without the handle, and is very useful where from 100 to 200 plants are to be shipped. The basket is simply lined with a piece of oiled paper or other prepared paper and then lined with moss; the plants being packed in upright with moss between every few layers.



A piece of burlap over the whole makes it secure and permits of sufficient ventilation (Figs. 4-5).

(3) For large shipments a regular strawberry crate is an excellent package. It is desirable to line the crate with oiled paper and then with a thin layer of wet moss. The plants can then be packed in an upright manner with a little moss



Fig. 6.—Mail package ready for shipping.

between each layer. After the first tier of plants is in, if it is necessary to put in a second, a slatted bottom may be inserted and cleats fastened to the sides, and the second tier packed as the first. After the crate is filled a slatted top without any further covering completes the package.

## WHEN AND HOW TO PLANT

Strawberries may be planted either in the spring or fall, depending on the district where they are grown. In British Columbia fall planting is preferable to spring planting, while in Quebec and Ontario spring planting is more desirable. In most districts in Canada, planting early in the spring as soon as the soil can be prepared is usually preferable to fall planting. Some growers believe that by planting in August, they can secure a sufficient stand of plants to obtain a crop the following year. This is, however, exceedingly difficult to attain even when using pot-layered plants and little benefit is gained. There is, nevertheless, another aspect which may favour fall planting, namely, setting the plants in the fall preceding an anticipated spring planting. In the milder districts, plants set in late August or September in a favourable location generally come through the winter very satisfactorily, and will commence runner formation earlier than spring set plants. The value of these early runners is discussed in detail in the section dealing with the role of nitrogen in strawberry culture, and on the basis of the data presented, it will be readily seen how fall planting might materially increase the crop. With plants set in the fall, it is usually necessary to remove surplus runners in the early part of the second fall to prevent overcrowding. The greatest disadvantage in fall planting is the frequency of dry spells in the autumn which makes

transplanting difficult and uncertain until too late in the season. Of course where irrigation is available, this factor is eliminated. There is always the danger, particularly in eastern Ontario and Quebec, of fall-set plants not becoming firmly rooted prior to winter setting in, in which case the plants heave badly the following spring and a heavy loss of plants results. It should also be borne in mind that fall-set plants require extra care in cultivation and winter protection.



Fig. 7.—A quick method of marking out rows.

When spring planting is practised, it should be the object of every grower to plant as early as possible to get the benefit of the cool weather and moisture of that period of the year.

Before commencing planting operations it is important that the soil be in first class condition. Brief mention was made of this in an earlier paragraph but it will not be amiss to again draw attention to the matter. On light loamy soil, after the disk and levelling harrows have completed their work, it will generally be sufficient to roll the land before marking, but if the soil is at all inclined to lumpiness, it is a good practice to go over it with a plunker previous to rolling.

The plants may be set in straight rows by being planted against a string drawn taut across the patch, provided the distance is short. A home-made marker is most generally employed. This implement may be cheaply constructed out of 2-inch by 4-inch plank, in which a series of half-inch holes are bored along the centre of the widest surface, six inches apart and in these are inserted wooden teeth. A handle attached at right angles to the 2- by 4-inch piece and supported by means of iron braces, serves as a tongue for drawing the marker over the ground (see Fig. 7).

As soon as the distances have been decided upon, the marker is first pulled across the field to mark the rows and is then drawn at right angles to the rows, to mark the intersections where the plants are to be set. As the distance between plants is not the same as the distance between the rows the teeth will need to be



changed accordingly. Long rows are desirable, as, with them, time will be saved in cultivation.

Planting may be done with a spade or with a trowel or dibble. Some growers stake off rows one way from three and a half to four feet apart, and with a light plough make a shallow furrow and then set the plants about 18 inches apart along the sharp edge of the furrow, drawing the soil about the plant and firming it well with the hand. When planted with a spade two persons are required to do the work, usually a man and a boy. The man inserts the spade into the ground and by pressing it backward and forward opens a hole (Fig. 8-1). To prevent the soil from refilling the hole, the boy places the plant in position (Fig. 8-2) before withdrawing spade. The spade is then withdrawn and inserted a short distance from the plant and soil is pressed about roots completely filling in the hole (Fig. 8-3). In the final operation the man presses the soil firmly around the plant with his foot, leaving the crown of the plant level with the ground (Fig. 8-4). This method is very rapid and if the soil is well pressed against the plant, is quite successful.

A surer method of obtaining a stand is by using a trowel or dibble for opening the hole, whereby the plant is more likely to be set the proper depth, and more care usually exercised in spreading the roots and firming the soil about the plants. By this method the same person opens the hole and sets the plants. Great care should be taken to have the crown of the plant just at the surface of the ground

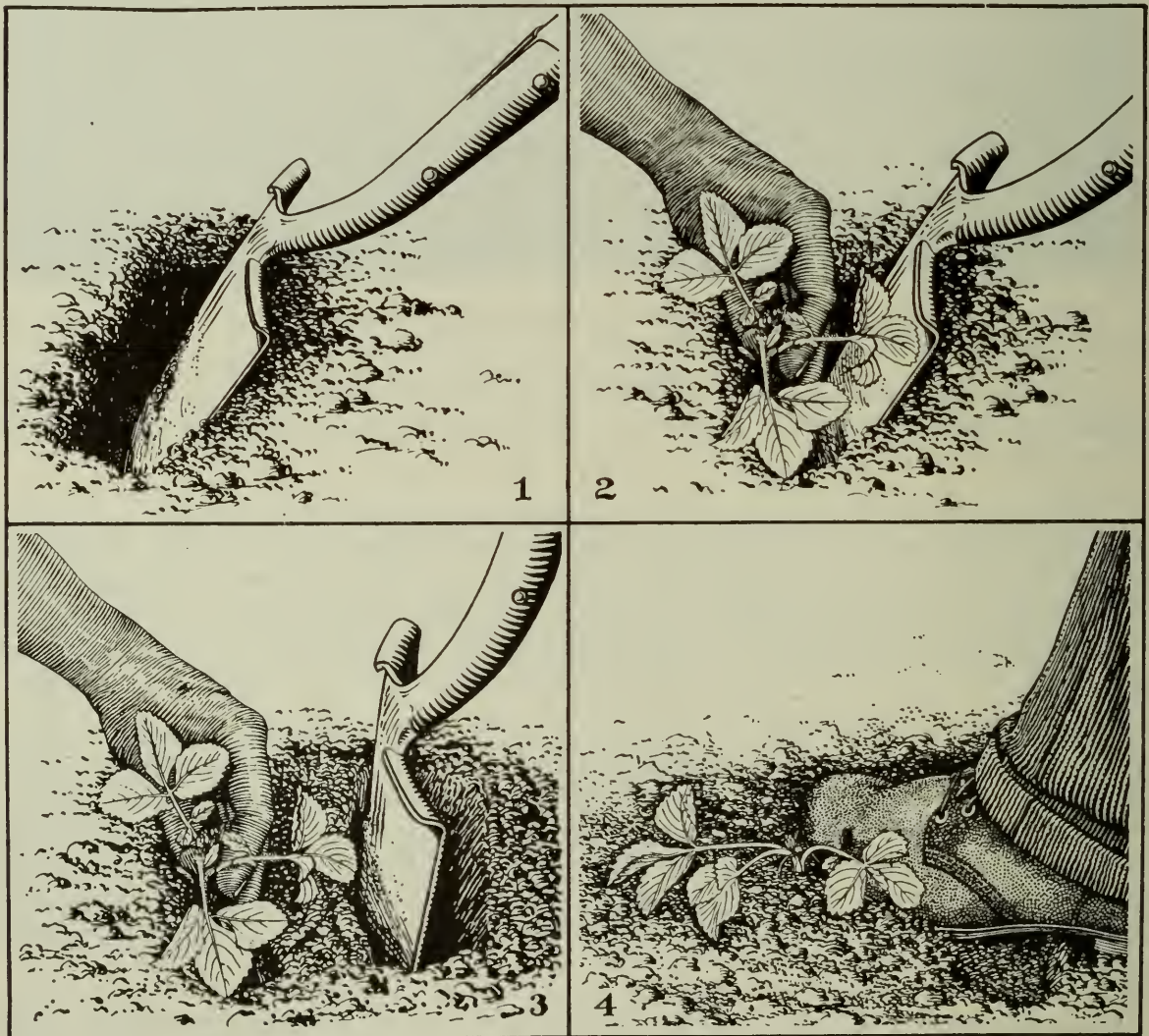


Fig. 8.—1. Spade inserted and hole opened. 2. Placing plant in position. 3. Pressing soil against roots. 4. Firming soil around plant.



after it has been pressed in when planted. If the plant is set too high the roots and crown will dry out, and if too low will be smothered. Care should be taken when planting to spread the roots against the side of the hole.

Planting machines are used by some growers, and give good satisfaction when the work is well done, the soil in very good condition, and the season favourable. When the soil is not in good condition, and not well levelled, the plants are sometimes set at different depths and the stand is not good. When planting, the plants should be carried in wet sacking or in a pail with water in it, as the roots must not be allowed to dry out.

Professor T. G. Bunting of Macdonald College had the following to say on the use of transplanting machines on large areas:

"A transplanting machine is indispensable on the larger acreages of strawberries. It greatly reduces the cost of planting, increases the speed and provides

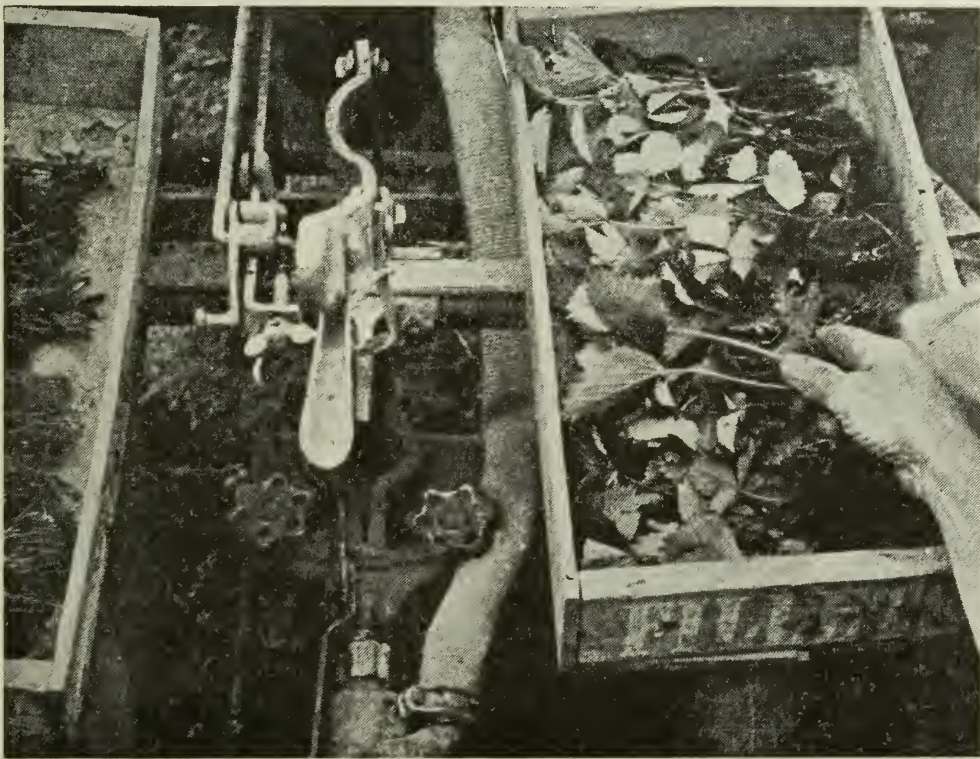


Fig. 9.—Planting machine; showing box containing plants.

facilities for watering the plants as they are set in the rows if the soil is somewhat dry. It is operated by a man and team, with two boys, who, seated at the rear and at the sides, place the plants in the trench made by the machine. The depth of this trench and the amount of water applied may easily be regulated. This machine, with experienced labour, will set as many as 25,000 plants, three to four acres, per day at a cost of 40 to 50 cents per thousand. To this must be added some additional cost for the more careful preparation of the plants for machine planting as compared with hand setting. The plants should be carefully prepared, uniform in size, have the roots well straightened out and all dead leaves and runners removed so that the operators may handle them as rapidly as the machine moves. In loose or light soil the machine may not pack the soil firmly enough about the roots, and the operators may miss an occasional plant especially at the ends of the rows. In this case it is well to have an additional man follow the machine to tramp the soil about the plants, straighten misplaced ones, and fill any gaps that may occur. Careless planting may mean greatly decreased yields and low returns."



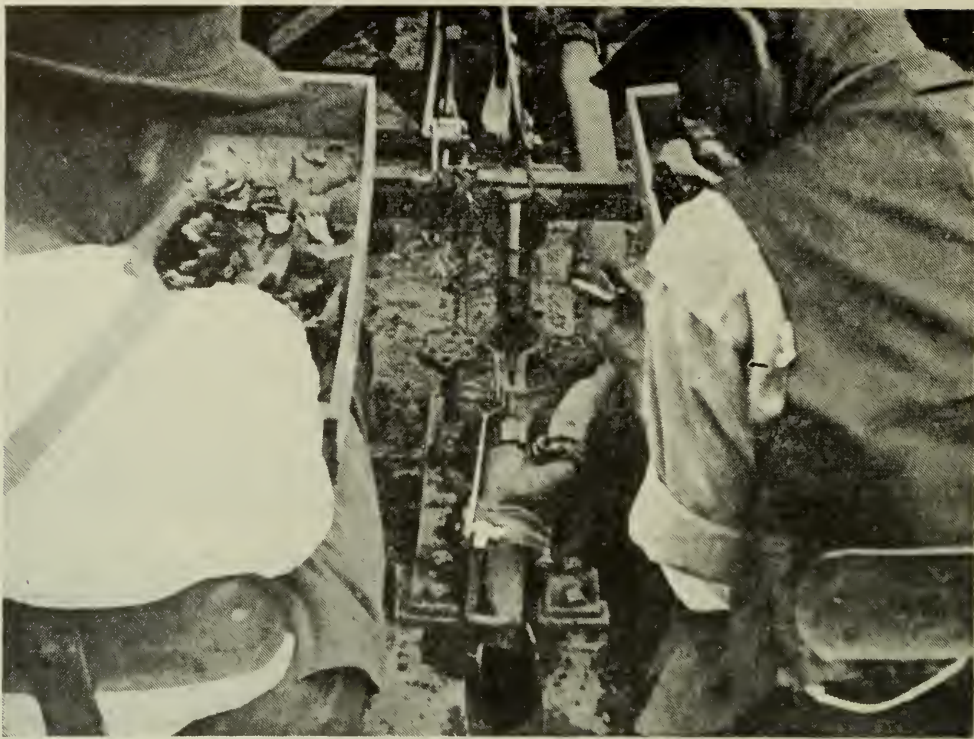


Fig. 10.—Planting machine; showing operator ready to place plants.



Fig. 11.—Full view of planting machine.



## THE MATTED-ROW SYSTEM

There are in general two systems of growing strawberry plants, the matted row, and the hill system.

In Eastern Canada most commercial growers use and prefer the matted row, whereas in British Columbia the hill system is in general use. The great objection to the hill system in the East is the danger of heaving which causes considerable root and crown injury with consequent reduction of crop. After six years of repeated trials with the hill system at the Central Experimental Farm, Ottawa, in only one season did the acreage yields approach those obtained from the matted-row method.

The planting distance, in the matted-row system is to some extent regulated by the variety, locality and soil type. Because of the value of having as large a percentage as possible of August-formed plants, comparatively narrow rows will give greater returns per acre than wide ones. When a large number of narrow rows are obtained it becomes possible to get a full stand of plants earlier in the season after which later formed runners may be removed by an edger or cutter. A distance of three to three and one-half feet between the rows as planted is ample and the spacing of the plants in the row may be regulated by the varieties used. Senator Dunlap, a very prolific plant-maker may be safely set at 24 inches while varieties like Parsons Beauty, Glen Mary, and Portia are satisfactory at 18 inches.

While many who grow strawberries in the matted row do not take the trouble to place the runners as they form, but let them root without assistance, it pays to place them, as the sooner they take root the stronger the plants will be by autumn, and the more fruit will be produced next season. All that is necessary is to place the runners so that they will be as uniformly distributed as possible in order to economize space, and to put a little soil over them to hold them in place but leaving the terminal buds bare. In the Prairie Provinces where winds prevent the prompt rooting of runners, it is important to hold them in place until they root, using pieces of sod, stones, an inverted crotch, or by any other suitable method. To get the best results, runners should not be closer than from four to six inches apart, preferably six inches, all other being destroyed; but in practice it is often difficult to accomplish this and to restrict them to this area, as some varieties make a great many runners. These are, however, the kinds which have the most need of thinning, as when the plants are very thick the fruit is too small. The width of the row formed by autumn will depend on the number of runners which are made, but if planted early and properly cared for, most varieties will make a row two feet or more wide. At this width there would be a path 18 inches wide left for the pickers between the rows. As some varieties would cover the whole space between the rows with runners in one season, it is necessary to remove those not wanted with the cultivator or hoe.

The so-called single-hedge- and double-hedge-row systems are merely modifications of the matted row. Instead of the runners being allowed to form indiscriminately, most of them are removed and the rest placed where it is desired for them to grow. In the single-hedge-row system, two or four runners are left on, and these are placed in line with the row on each side of the parent plant.

When grown in this way the rows are two and one-half to three feet apart and the original plants about two feet or more apart in the rows. When the row is formed the plants are six to eight inches apart in a single row.

In the double-row system, six runners are left to each plant in the row and two on each side of the original row, all about equal distance apart. Trained in this way the original rows should be about three feet apart and the plants two feet or more in the row.

The twin-hedge-row system provides for two rows 16 to 18 inches apart with the plants at first about two feet apart in the row, with a wider space of two

feet for a path and for cultivation between each pair of rows. The hedge-row system requires considerably more labour than the matted row but the returns will often well pay the grower for the extra amount of work. By this method the plants get more opportunity to develop strong crowns; better cultivation can be given, and more of the plant food in the soil will be available; resulting in larger and better fruit.

### HILL SYSTEM

This system is the one largely used by British Columbia growers excepting those of the Okanagan and West Kootenay. In this system the plants are generally set about 18 by 36 inches. This permits of cultivation both ways during the first season. Where this method succeeds large berries may be grown. The blossoms are pinched off the first season as in the matted-row system and all runners are removed as formed and before rooting. This will generally require about four or five cuttings, and may be done with a knife, a very sharp hoe or a pair of sheep-shears. By this method very strong crowns are developed; the plants having more room, become vigorous and as a result the fruit is large, and sometimes as good crops are obtained as from the matted row.

However, winter injury is much more likely to occur when plants are grown individually, and if plants grown in hills die from heaving or from some other form of winter-killing they leave large blanks, causing a great lessening of the crops. Unless kept well cultivated or well mulched in summer, plants suffer more in drought periods in hills than in the matted row where the crowns are better protected by foliage. If the plants are kept well mulched, very fine fruit is produced when strawberries are grown in hills, which sometimes makes this method preferable when growing strawberries for home use. In the milder parts of British Columbia, especially where there is a dry summer without irrigation water available, the hill system is used, as competition for moisture is less than in a matted row.

The Dominion Experimental Station for Vancouver Island, at Saanichton, British Columbia, has published the following report on a trial of several systems of growing strawberries under their conditions.

#### SYSTEM OF PLANTING—VANCOUVER ISLAND

Method of Growing	1924				1925			
	Yield crate berries	Yield jam berries	Total yield	Per- centage crate berries	Yield crate berries	Yield jam berries	Total yield	Per- centage crate berries
	lb. per acre	lb. per acre	lb. per acre		lb. per acre	lb. per acre	lb. per acre	
Hill.....	3,826	1,618	5,444	70.2	814	1,355	2,169	37.5
Hedge row.....	3,378	1,693	5,571	69.6	605	702	1,307	46.3
Half-matted row.....	3,391	1,751	5,142	65.9	1,549	1,113	2,662	58.2
Full-matted row.....	1,510	1,002	2,512	60.1	1,321	1,284	2,605	50.7

#### YIELD FOR TWO YEARS

Hill.....	4,640	2,973	7,613	60.9
Hedge row.....	4,483	2,395	6,878	65.1
Half-matted row.....	4,940	2,864	7,804	63.3
Full-matted row.....	2,831	2,286	5,117	55.3

It will be noted that in one year (1924) the hill system outyielded the full-matted row by more than 115 per cent, and in 1925 the matted row outyielded the hill system by about 20 per cent, while the results for two years were decidedly in favour of the hill system.



## CARE OF THE YOUNG PLANTATION

During the first season frequent cultivation is essential to success. As soon as the plants are set out a cultivation with a spike-tooth cultivator should be given. This should be followed up at intervals of about two weeks or oftener, largely depending upon soil and weather conditions. Not only is this cultivation necessary for the elimination of weeds, but also for maintaining a friable condition of the soil necessary for the young rooting runners, and to provide air to the soil for the liberation of plant food. On all except very light soils the early cultivations (after the first one) should be fairly deep, in order to loosen the soil and promote soil activities. For this purpose a scuffer will generally give better results than the spike-tooth. The strawberry, being a plant whose roots go almost straight down, can be cultivated at close quarters.

Hoeing also will be necessary to destroy weeds which cannot be reached by the cultivator. Some growers prefer a wheel hoe or hand cultivator for this purpose, and generally two or three times during the first year is all that is necessary



Fig. 12.—Strawberry plantation, Central Experimental Farm, Ottawa, Canada.  
Mulched for winter.

to go over the plantation with this implement. As the season advances and the runners commence to form, it will become necessary to narrow the cultivator in order not to disturb the newly rooted plants. After midsummer when light cultivation is sufficient, the spike-tooth cultivator is used. The placing of the runners can usually be done when hoeing through the plantation. On small plantations it is generally possible to pay more attention to this than on larger areas. It is a good plan when cultivating to start always from the same corner and in the same direction, as in this way one is not so likely to rip out plants which the cultivator has previously trailed into position.

### WINTER PROTECTION

Strawberry plants may be injured by extreme winter temperatures or by heaving caused by intermittent freezing and thawing. Proper mulching will



provide the necessary protection. It also shelters the crowns and roots from the drying action of winter winds.

There are many materials suitable for mulching a strawberry plantation. Clean wheat or rye straw is probably the most satisfactory as it does not pack tightly over the plants. Marsh hay is good as it is relatively free from weed seeds. Green manure is sometimes used, but as it usually contains many weed seeds, and sometimes may smother the plants, it is not recommended.

The mulch should be applied after the plants have become dormant, preferably after the first severe frost before the temperature falls to around 20° F., which would be likely to injure the crowns of the plants. This period will vary considerably with locality but is generally in the month of November. It is advisable to spread the material uniformly over the plantation; two or three inches being sufficient depth to afford necessary protection to the plants. A heavier



Fig. 13.—Renovating an old strawberry patch. The rows are just narrowed down by ploughing through the centre.

mulch may smother the plants and further may cause heating in the spring before it is removed. The amount of mulch required is from three to three and one-half tons per acre.

It has occasionally been recommended to grow a mulch crop, such as oats, between the rows of strawberries during the latter part of the summer which could be used to hold the snow in the winter. This practice is not desirable since the two crops compete with each other for moisture and nutrients.

The mulch should be allowed to remain on the plants until the frosty weather of the early spring is over, the duration of time depending on the behaviour of the plants. The best index for removing mulch is the appearance of new leaf growth and a slightly yellowed foliage colour. In any case, the mulch should not be removed as long as the plants remain dormant. When the plants are uncovered, only partially remove the straw to the pathways between the rows. A



light scattering of straw mingled among the plants is beneficial, as it helps to conserve moisture.

### RENEWING THE PLANTATION

The most satisfactory results are obtained when only one full crop is gathered from a plantation. If, for instance, plants are set this spring, the plantation should be ploughed up after the fruiting season of next year. There will thus be a new plantation made every year. By this system, much better fruit is obtained as the plants are not so thick in the row and the soil can be kept freer of weeds. Where the white grub is troublesome, it is important to renew the plantation every year, as this pest increases rapidly in old plantations and sometimes almost ruins the crop. It is quite possible to obtain two good crops or even more from a plantation by careful management, but the older the plantation the less the crop will be and the smaller the fruit as a rule. In the Maritime Provinces where the summer is relatively cool and moist, plantations are left longer than in the drier and warmer parts of Canada.



Fig. 14.—Renovating an old strawberry patch. After ploughing the rows, the land between the rows is hoed to turn up the old plants.

### RENOVATING AND OLD BED

If the land is free of weeds it is possible to obtain good results by keeping a plantation longer than one year. This usually entails a certain amount of renovation at the end of the first fruiting season. The amount and system of renovating will largely depend upon the condition of the plantation. Experience has shown that where the manure is applied the year previous to planting, and dependence placed upon fertilizers for subsequent applications of plant food, there is very little trouble with weeds. Under such conditions it is comparatively easy to renovate. The method is as follows: as soon as the picking is over, the straw is raked up and carried to one side of the plantation. After this, each row is ploughed or cut down to a width of about 18 inches (Fig. 13). The plants thus ploughed up are then gathered up and destroyed, and the cultivator run through the rows.





Fig. 15.—Renovating an old strawberry patch. After cultivating, hoe around the plants remaining with a three-cornered hoe, and weed.



Fig. 16.—Renovating an old strawberry patch. The plants are next thinned in the row and the debris is raked up and burned.



The few weeds growing among the remaining plants are pulled by hand. As soon as this cleaning up has taken place, an application of ammonium nitrate is made to the plantation at the rate of 100 pounds or more to the acre. Sulphate of ammonia would be satisfactory except for the fact that it is difficult to broadcast it over the plants without causing serious burning. If used it should be put between the rows. Frequent cultivation throughout the remainder of the year will usually result in the plantation going into winter in good condition.

When the old bed is grown up with grass and weeds, more drastic measures are necessary. In such instances, after the removal of the straw the whole plantation is mowed and the mowings burned as quickly as possible. After this the



Fig. 17—Renovating an old strawberry patch. After renovating the debris, apply a little nitrate of soda and cultivate it in.

rows are narrowed down to about one foot in width and the ploughed-out plants raked up and destroyed. This leaves a narrow row of plants and weeds that can be hoed to leave clumps of plants every eight or nine inches. In narrowing the rows it is always well to work from one side of the plantation so that the old row is split down the centre leaving the newer plants on the outer edge as the remaining narrow strip. After this hoeing, an application of nitrate of soda or manure ploughed in between the rows is given, followed by frequent cultivation.

Some growers, after narrowing the rows, do the cross-thinning by a harrow or drag, and then finish off with the hoe and cultivator.

In some parts of the Maritimes where plantations fruit for many years and where the rows are a little farther apart, the practice is simply to plough between the rows so as to leave a wide furrow, which is filled with manure. A cross-harrowing then covers this furrow with earth. This is followed up with hoeing, hand weeding and cultivating.

## IRRIGATION

Since the strawberry plant is shallow rooted an ample supply of moisture, particularly at harvest time, is essential for good yields. If an adequate supply of water is available and can be utilized without great expense, irrigation will pay well.

Two general methods of irrigation are commonly used, namely, surface or ditch irrigation and overhead or sprinkler. The surface or ditch system is the

cheaper of the two and can be used in fields with gentle, fairly uniform grades and on heavy soils. With this system furrows are ploughed between the rows and these are fed from a headland row which runs at right angles to these. In place of furrows a porous canvas hose can be used on both heavy and light soil types. The hose is laid along the row on the ground and as each row is watered it is moved on to the next row. A cap is fitted in the end of the hose so that the water is compelled to ooze out through the pores of the canvas. It is important that the hose be cleaned and dried at the end of each season otherwise its life will be relatively short. The surface system of irrigation is perhaps more satisfactory than the overhead system in that the water does not come in contact with the leaves and fruit. This tends to lessen the spread of leaf and fruit diseases if present.

Although the overhead system is relatively expensive it is nevertheless superior in some respects to the surface system. With this method a uniform distribution of water is possible and soil erosion is not a factor. Although many overhead systems are permanent, movable less expensive systems are equally satisfactory, particularly for the small grower. With the overhead system water is applied as a spray from pipes fitted with spray nozzles or from sprinkler heads.

## VARIETIES

It occasionally happens that a grower having a variety of strawberry which yields much better with him than other varieties which he has growing alongside, decides to discard all other kinds and grow that one variety. He does so, and is disappointed to find that he has very few berries, and these ill-shaped and worthless. He does not know what to think about it, but writes to the Experimental Farm to learn the cause of the failure. The reply is sent back: "Are you aware the flowers of strawberries may be either perfect (bisexual) or pistillate; in other words, do you know that some varieties of strawberries produce blossoms which have both male and female organs, while other varieties have only female organs? If you do not, the solution of your difficulty is very easy."

The male and female organs in plants perform the same functions as in animals. The fine dust formed on the stamens, which is shed when the flower is in bloom, is the fertilizing agent, which falls on the pistil and fertilization takes place. If the stamens are absent, or nearly all absent, as is the case in imperfect or pistillate flowers, no fruit, or very little fruit, is formed. If a perfect (staminate or bisexual flowering variety) and an imperfect flowering variety are growing in close proximity, the flowers of both will be fertilized, as insects and wind carry the pollen or dust from the perfect to the imperfect flowers. It very often happens that the imperfect flowering varieties produce the best crops when properly pollinated, and this experience may lead fruit growers who are ignorant of the foregoing fact to make the mistake of planting only one variety, which may be imperfect. While most flowers may be classed as either perfect or imperfect there are gradations between. Occasionally a staminate variety is as imperfect as a pistillate, or more imperfect as it will not set fruit under any conditions.

One row of a perfect flowering sort should be planted to about every two or three rows of an imperfect variety for good results. The proportion will depend on the amount of pollen produced by the perfect sort. Of course, it is not necessary to plant an imperfect variety at all, as there are plenty of good sorts which have perfect flowers. It is essential to have the perfect and the imperfect varieties in full bloom at the same time, as if the former bloomed before the latter there would be no object in planting it as a pollinator.

Owing to the ease with which a new variety of strawberry is originated, and the short time it takes to fruit the same, the number of new sorts each year in America is very large. Only a small proportion of those which are produced



are better than, or even equal to, the best which are already on the market, but often the originator is not the most competent person to judge the relative value of his seedling, and as a result many sorts are offered for sale each year. It is the work of the experimental farms to test these new varieties as they appear, and having compared them with standard sorts, publish, when deemed advisable, a reliable description of them and the yield obtained. During the past 30 years 576 named varieties have been tested at the Central Experimental Farm. Of this number only a very few of those grown during the first two years are still under test. This does not mean that nearly all the varieties tested at first have deteriorated, but that better kinds introduced since have taken their places. In 1926 there were 87 varieties under test.

#### CAUSES OF POORLY SHAPED BERRIES

There are two causes of poorly shaped berries or nubbins. The most common is unfavourable weather conditions. The flower and growing fruit are very susceptible to injury from cold winds or cold weather. Sometimes part of the berry is injured, while another part being perhaps more protected, escapes and develops normally. Another cause of poorly shaped fruit is faulty pollination. The supply of pollen is either deficient in the fruit itself, or there has not been enough brought by wind and insects to pollinate all the stigmas of the berry. Bees do not work much in bad weather. Extremely dry, hot weather may injure the pollen. Rainy weather during the blossoming season may cause much poorly shaped fruit by preventing proper pollination. The remedy is to plant varieties with abundant pollen and mix these with any imperfect sorts which may be grown. Keeping the plants back as much as possible in the spring, by not removing the mulch early, will help to avoid injury from cold winds and frosts.



Fig. 18.—Imperfect flower.

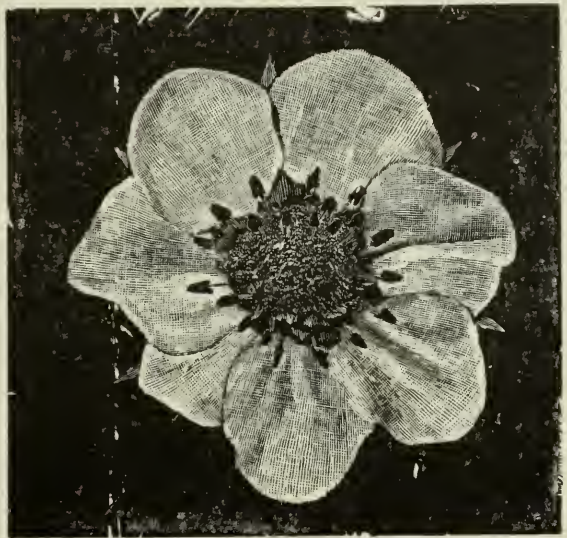


Fig. 19.—Perfect flower.

#### SELECTION OF VARIETIES

In addition to considering the sex of the varieties to be planted, there are other characteristics of the fruit and plant which the grower should consider in making his selection.

Firmness or ability to hold up and ship well, while not the character generally considered first, should take first place in determining the fitness of a variety for commercial use. Too much attention has been paid in the past to yield, with the result that many of the most common varieties are exceedingly bad shippers and

reach the market in such poor condition that only in years of great scarcity do they realize anything like profitable prices. Appearance and size are two other considerations of prime importance; yielding ability is also of course a great factor; while hardiness, disease resistance or susceptibility, runner-forming habits, and adaptability to certain soils all have to be given consideration in the final selection. Eating quality, especially for discriminating markets, is of prime importance, and season of ripening has much to do with the final selection of some growers who are catering to special markets where early and late fruit is in special demand.

Probably no fruit is so susceptible to varying soil and climate conditions as is the strawberry, so that a variety which does well in one district may not succeed in another close at hand.

In the following lists the varieties are given which in each province are the most popular.

### EVERBEARING STRAWBERRIES

The so-called everbearing or fall bearing strawberries are increasing somewhat in popularity, particularly in the Prairie Provinces. A plantation of everbearers should be handled in a somewhat different manner than a plantation of June bearing sorts.

Sometimes it is expected that the everbearers will produce a full crop in June and follow with another crop in the fall. Experience indicates that better results are obtained by taking a crop in the fall of the planting year, and a June crop in the following season. With this in view and considering that these do not make as many runners as the June sorts, the planting scheme is modified somewhat.

In the first place if planted in the early fall or late autumn there are not only earlier rooted stolons but more plants for the first fall crop; and secondly, if planted closer together than is ordinarily recommended for June sorts, much greater returns per acre are secured. Planting in double rows three feet apart from centre to centre is sufficiently far apart. The two rows constituting the double rows may be one foot apart, with the plants one foot apart in each row, but placed so that they are alternate instead of opposite. This is close planting, but sufficiently far apart for any varieties tested that are worth growing.

As the fall bearer is forming fruit buds during early summer or shortly after rooting for the fall crop, it is imperative for best results to have an available supply of plant food, especially nitrogen. An application of nitrate of soda made in June in soils not overstocked with nitrogen will give good results in this respect.

### VARIETIES RECOMMENDED FOR VARIOUS DISTRICTS

In a bulletin of this kind which remains in print for several years it is only possible to refer to those old and true varieties which have definitely found a place and to a few of the newer ones which have promise of being outstanding. There are many varieties being introduced these days but only a few appear to find extensive favour.

It is important to remember that strawberry growing is beset with more diseases and disorders today than formerly and this appears to be the cause for the early decline of many new sorts which otherwise possess much merit. It is rather significant that certain old sorts like Dunlap appear to stand up to these various disorders better than many newer varieties that are really superior in all other respects.

The recommendations which are in this bulletin are based on reports from Dominion Experimental Stations and provincial institutions.



## NOVA SCOTIA

*Annapolis and Cornwallis Valleys—*

Commercial.—Premier (per.), Senator Dunlap (per.), Catskill (per.)

Newer sorts for trial.—Pathfinder (per.), Louise (imp.)—Elgin (per.) as a pollinator for Louise.

*Northern and Eastern Part of the Province—*

Commercial.—Senator Dunlap (per.).

Everbearers.—Gem. (per.).

Newer sorts for trial.—Catskill (per.).

*Yarmouth County—*

Commercial.—Jessie (per.).

Commercial.—Senator Dunlap (per.).

Newer sorts for trial.—Valentine (per.), Mackenzie (per.), Dorsett (per.), Catskill (per.), Elgin (per.).

## PRINCE EDWARD ISLAND

Commercial.—Senator Dunlap (per.), Premier (per.), Louise (imp.)—Elgin (per.) as a pollinator for Louise.

Newer sorts for trial.—Valentine (per.), Catskill (per.), King (per.).

## QUEBEC

Commercial.—Valentine (per.), Premier (per.), Senator Dunlap (per.), King (per.), Louise (imp.)—Elgin (per.) as a pollinator for Louise.

Newer sorts for trial.—Tupper (per.), Aberdeen (per.).

## ONTARIO

*General—*

Commercial.—Valentine (per.), Premier (per.), Senator Dunlap (per.), Dorsett (per.), Parsons Beauty (per.), Fairfax (per.).

Newer sorts for trial.—Catskill (per.), Culver (per.), Dresden (per.), Sparkle (per.), Crimson Glow (per.), Tupper (imp.), Louise (imp.)—Elgin (per.) as a pollinator for Louise.

*Kingston, East—*

Commercial.—Valentine (per.), Premier (per.), Senator Dunlap (per.), Sparkle (per.).

Newer sorts for trial.—Mackenzie (per.), Dresden (per.), Robinson (per.), Temple (per.), Suwanee (per.), Fairpeake (per.), Elgin (per.).

## MANITOBA

Junebearers.—Senator Dunlap (per.), Burgundy (imp.), Premier (per.), Arrowhead (per.).

Everbearers.—Gem (Per.), Sparta (per.), Evermore (per.).

## SASKATCHEWAN

Junebearers.—Senator Dunlap (per.), Dakota (per.).

Everbearers.—Gem (per.), Sparta (per.).

## ALBERTA

Junebearers.—British Sovereign (per.), Senator Dunlap (per.), Premier (per.), Glenmore (per.).

Everbearers.—Gem (per.), Mastodon (per.), Pixie (per.).

Newer sorts for trial.—Tupper (imp.), Borden (per.), Sparta (per.), Cooper (per.).

## BRITISH COLUMBIA

*Vancouver Island—*

Junebearers—British Sovereign

Everbearers—Rockhill

*Lower Mainland—*

Junebearers—British Sovereign and Pathfinder (early)

Everbearers—Rockhill, Reward and Gem.

*Salmon Arm and Clearwater—*

Junebearers—British Sovereign

*Okanagan—*

Junebearers—British Sovereign

*Kootenay—*

Junebearers—British Sovereign, Gibson, Parsons Beauty, Dunlap and Narcissa.

Everbearers—Gem, Mastodon, Rockhill.

*Terrace—*

Junebearers—British Sovereign.

## DESCRIPTION OF VARIETIES

**ABERDEEN** (per.)—Orig. J. E. Kuhns, Cliffwood, N. J. Berries are of commercial size, attractive bright red with salmon flesh, medium firm, rather sprightly like Premier and fairly good quality. Plants are vigorous, fruit stalks weak and fruit mostly on the ground, slight leaf spot but resistant to red stele disease, prolific plant maker and very productive. A productive mid to late season variety that ships well.

**ARROWHEAD** (MINN. 1118) (per.) (Duluth  $\times$  Dunlap).—Orig. Minn. Fruit Breeding Farm, St. Paul, Minn. and introduced in 1945. Fruit large, regular, conic, glossy dark red; flesh, firm, dark red, medium juicy, fine texture; flavour sprightly, tart. It is a good plant maker and the plants are vigorous, exceptionally winter hardy and moderately productive. A mid-season to medium late variety of real value because of its plant hardiness.

**BORDEN** (per.) (Nor J  $\times$  Parsons Beauty)  $\times$  (*Fragaria* species  $\times$  Jessie).—Orig. C.E.F., Ottawa. Bears very large conic fruits that are glossy medium red in colour. The berries are of medium quality, firm and are good shippers. The plants are very vigorous and productive but they do not runner freely. This is a good variety for growing on the hill system.

**BRITISH SOVEREIGN** (per.).—A variety originated in British Columbia. The history of this variety as recorded in Circular No. 58, British Columbia Department of Agriculture, is as follows:

“This is a variety which, so far as is known, is of British Columbia origin. In 1920 a Japanese grower of Coghlan, B. C., purchased some Campbell strawberry plants from Queensborough, Lulu Island. Six plants were noted to be different; they were allowed to produce runners and were kept separate from the main planting. In 1921 about 100 plants were set out. By 1923 the variety was beginning to attract attention. It was jokingly called “Bull’s Tongue”. This name was twisted by Japanese growers into “Gold Stone”, and then to “Golden White” and “Gordon White”. Maple Ridge growers who secured the variety about 1926 gave it the name Victoria. Plantings did not increase very rapidly, but by 1928 production was sufficient to make Prairie shipments, and the berry attracted attention on the Prairie markets and also on the wholesale market in Vancouver”.

Fruit conical to roundish, large, dark red; flesh red, juicy, firm; quality good. Plants are only moderately vigorous with a medium number of runners. A mid-season variety which is excellent for jam making as berries tend to remain whole in the process.

**BURGUNDY** (MINN. 1192) (imp.) (Easypicker  $\times$  Duluth).—Orig. Minn. Fruit Breeding Farm, St. Paul, Minn. and introduced in 1942. Berries medium to large, roundish-wedge, dark glossy red, surface seeded; flesh dark, firm and flavour sprightly. Plants are very hardy, vigorous, runner freely, and productive. A



hardy late season variety that grows well under Manitoba conditions but has not been overly productive at Ottawa. It cans and freezes well.

**CATSKILL** (per.) (Marshall × Premier).—Orig. New York State Agr. Exp. Stat., Geneva, N. Y. In 1930 this seedling received an award of merit from the Massachusetts Horticultural Society. Fruit roundish, wedge, slightly irregular, large to very large, dark glossy red; moderately firm; mildly sub-acid; good quality. It is a prolific plant maker and the plants are vigorous, healthy and yield heavy crops. A mid-season variety that has become very popular because of its productiveness and large sized berries of good quality.

**CRIMSON GLOW** (per.) (Fairfax × N. J. 51).—New Jersey Agr. Exp. Sta. and introduced in 1940. Fruit is medium to large, uniform; oblate conic; glossy dark red; firm mild sub-acid flavour and very good quality. The plants are vigorous, healthy, have upright fruit stalks and runner freely. Its greatest value probably is for the home garden. It is a mid-season berry.

**CULVER** (per.) (Marshall × Premier).—Orig. New York State Agr. Exp. Sta., Geneva, N. Y. An outstanding variety at Ottawa. Dark coloured fruit, dark fleshed, good quality, moderately firm. A mid season sort. Plants vigorous, dark green foliage and good runner makers.

**DAKOTA** (per.) (Jessie × wild strawberry of Manitoba.—Orig. N. E. Hansen, Brookings, South Dakota. Fruit below medium to small, bright red; quality above medium; runners very numerous. This variety has proved hardier than any other variety tested at the experimental stations on the prairies.

**DORSETT** (per.) (Royal Sovereign × Premier).—Orig. by United States Department of Agriculture. A very attractive, bright scarlet berry with salmon coloured flesh, juicy, of very good quality, firm and a good shipper. Plants very vigorous and prolific runner makers. Drops off in size very rapidly, probably due to too much competition when planted the standard distances. A good quality dessert variety.

**DRESDEN** (per.) (Beacon × Premier).—Orig. New York State Agr. Exp. Sta., Geneva, N. Y. Berries are very large, mostly wedge conic, uniform, and hold size fairly well; attractive, moderately firm; and fairly good quality. The plants are vigorous, healthy and very productive. Fruit stalks are rather sprawling and do not hold the fruit up off the ground well and care must be exercised in picking as the stalks break easily. It ripens with Premier, is outstanding for its high yielding capacity and large size of berries and should be given a trial.

**ELGIN** (per.) (Ettersburg 214 × Wm. Belt).—Orig. C. E. F., Ottawa. The fruits are large sized, wedge-conic, light red, moderately firm, rather acid in flavour but of quite good quality. The plants and fruit stalks are of medium height and they runner very well. The foliage is thick and leathery and very resistant to disease. This is the latest variety ever grown at Ottawa. It ripens three to four days after Louise.

**FAIRFAX** (per.) (Parentage unknown).—Orig. by U. S. D. A. Rather dark coloured but quite attractive, conic to wedge conic in shape, very fine fleshed, a good shipper, almost sweet in flavour and of excellent quality. Very vigorous and a prolific runner maker. Has same fault as Dorsett in losing size. Outstanding for quality and is of particular value for the home garden.

**FAIRPEAKE** (per.) (Chesapeake × Fairfax).—Orig. by U. S. D. A. Fruit medium to large, wedge conic, somewhat irregular, bright medium red, firm, sweet, very high quality. Plants are vigorous, resistant to leaf spot, and produce a moderate number of runners. It is a late mid season variety that produces attractive firm berries of good quality. A good shipper.

**GIBSON** (per.)—The berries are large, irregular conic in shape, dark in colour; with dark red, firm flesh; and mildly sub-acid flavour. The plants are vigorous,

healthy and productive. This variety is popular in the Kootenay and Okanagan districts in British Columbia where it does well on the lighter soil.

GLENMORE.—Orig. by Wm. Oakes, Miami, Man. It is superior to Senator Dunlap in size and quality of fruit under Manitoba conditions. Plants vigorous, healthy and good runner makers.

JESSIE (per.) (Sharpless  $\times$  Miner's Prolific).—Orig. 1880. F. W. Loudon, Janesville, Wisconsin. Introduced 1886. An old variety grown in the southern U.S.A., also on the Pacific coast of the U.S.A. Requires high culture and a moist climate. Does well and sometimes better in the second and third crops. Large size, pale colour, and almost white flesh. A good shipper. Largely grown in southern Nova Scotia.

KING (per.) (Delecto  $\times$  Cassandra) selfed.—Orig. C. E. F., Ottawa. The berries are large sized, irregularly wedge shaped with a large calyx and well defined neck. The dark colour and medium dark flesh make it an excellent variety for canning and jam making. The quality is very good and it is firm enough to be a good shipper, although as grown in some districts the fruit tends to bruise slightly on the surface. The plants are vigorous and runner freely but are somewhat susceptible to mildew. It is a medium early variety, ripening about one picking after Premier.

LOUISE (imp.) (Ettersburg 80 selfed).—Orig. C. E. F., Ottawa. This is one of the finest flavoured berries. The fruit is medium to large in size, bright glossy red in colour, very attractive, and very firm and meaty in texture. The plants are vigorous, the fruit stalks are stout and erect but the foliage is rather susceptible to leaf spot. It is late in season and a very good shipper.

MACKENZIE (per.) (Excelsior  $\times$  Premier).—Orig. C. E. F., Ottawa. Bears large sized, conic shaped, attractive, good quality berries. It is two or three days later than Premier but under Ottawa conditions it is usually more productive and holds up better in size. The plants are vigorous, healthy and runner freely.

MAGOON (per.) (Chance seedling).—Orig. W. J. Magoon, Portland, Oregon; introd. 1894. Fruit roundish, somewhat irregular, medium to large, deep red; flesh deep red, moderately firm, sub-acid; good quality; season medium to late; plant very vigorous, runners only moderately numerous. A popular variety in British Columbia. Has not proved of value at Ottawa.

MARSHALL (per.) (Chance seedling).—Orig. 1890, Marshall F. Ewell, Marshfield Hills, Mass.; introd. 1893. Fruit pointed-conical to roundish, large to very large, dark red; rather conspicuous seeds; flesh bright red, juicy, firm; sub-acid, good flavour; very good quality; season medium, plant moderately vigorous, runners moderately numerous, foliage good though rusting slightly to considerably. Productive only where heavily fertilized and where there is abundance of moisture. One of the tenderest American varieties, but one of the best in quality.

PARSONS BEAUTY (per.) (Chance seedling).—Orig. about 1895. R. G. Parsons, Parsonburg, Md.; introd. 1899. Fruit obtusely conical, above medium to large in size, bright red, glossy; prominent seeds; flesh bright red, juicy, tender, firm; sub-acid, above medium quality; season medium late, plant vigorous, large number of runners; foliage moderately good, rusts slightly to considerably. Productive only where heavily fertilized and where there is abundance of moisture. One of the tenderest American varieties, but one of the best in quality.

PATHFINDER (per.) (Premier  $\times$  Aberdeen).—Orig. New Jersey Agri. Exp. Sta. The fruits are of medium size, blunt conic, attractive; moderately firm; mildly acid flavour; and good quality. The plants are vigorous, healthy, said to be resistant to red stele root disease and produce plenty of runners. Looks promising as a mid season berry, ripens three days later than Premier.

PAXTON (per.) (Sir Joseph Paxton).—This is an English variety, but is probably different from the variety grown in B. C. under that name. The B. C. Paxton is



reputed to be an imperfect or pistillate variety. A very vigorous grower and good runner maker. Foliage dark green, habit somewhat recumbent. Fruit dark in colour, productive. Of value only in B. C.

**PREMIER** (per.).—Orig. A. B. Howard, Belchertown, Mass. Introduced about 1909. Fruit large, long conical to somewhat wedge-shaped, bright scarlet; flesh light red, medium firm, quality good, a fair shipper; productive; season medium early; plant vigorous; runners numerous. This variety has become very popular and is now planted extensively.

**ROBINSON** (per.) (Premier  $\times$  Washington).—Orig. by J. C. Haley, Dowagiac, Mich., in 1934. The berries are large, wedge conic inclined to be rough, bright glossy red, very attractive; moderately firm in flesh; sub-acid flavour; and good quality. The plants are vigorous, healthy and very prolific plant makers. It is inclined to be rough but because of its size and productiveness should be given extended trial. Ripens with Premier.

**SENATOR DUNLAP** (Dunlap) (per.). Parentage uncertain.—Orig. 1890. J. R. Reasoner, Urbana, Ill.; introd. 1900. Fruit pointed, wedge and long wedge-conical, necked, medium to large size, deep glossy red; seeds not especially prominent; flesh rich red, juicy, tender; briskly sub-acid; moderately firm; above medium quality; season early, plants vigorous, large number of runners; foliage moderately good, rusts considerably in old beds. The most generally popular variety. This variety is more suitable for heavy soils. Being a heavy runner maker it should be planted far apart in rows. Although very popular it is not of great merit at Ottawa, producing only about three pickings of good size, falling off almost at once to very small berries.

**SPARKLE** (per.) (Fairfax  $\times$  Aberdeen) —Orig. New Jersey Agr. Exp. Sta., is a mid-season variety of considerable promise. Berries are of good commercial size, bright glossy red, attractive, firm and of good quality. A highly productive variety with a long fruiting season. At Ottawa this variety is vigorous, runners freely and has shown considerable drought resistance.

**SUWANEE** (per.) (Missionary  $\times$  Premier).—Developed co-operatively by U. S. D. A. and the North Carolina Agr. Exp. Sta. The fruits are of commercial size, long conic, light red, moderately firm, salmon flesh, sweet and very high quality. The plants are vigorous, quite healthy and good plant makers. It comes in after Premier and resembles Blakemore in many respects but the berries are larger at Ottawa. Because of its high quality is well suited for home use.

**TEMPLE** (per.) (Aberdeen  $\times$  Fairfax).—Orig. co-operatively by the U. S. D. A. and the Md. Agr. Exp. Sta., is similar to Premier in season. Fruits large, blunt, conical, dark glossy red, smooth, uniform, firm, well suited to shipping, sub-acid flavour and good quality. Plants are vigorous, healthy, resistant to leaf spot and red stele disease and a prolific plant maker. A productive attractive variety that ships well.

**TUPPER** (imp.) (Ettersburg 214  $\times$  Cassandra).—Orig. C. E. F., Ottawa. This variety bears large conic-shaped, bright coloured berries of fair quality, but they are not firm enough to withstand shipping. The plants are vigorous, and good runner makers. The foliage is dark green, tall and erect and resistant to disease. It is a very productive medium late variety of particular value for the home garden and local market.

**VALENTINE** (per.) (Premier  $\times$  Vanguard).—Orig. Horticultural Experiment Station, Vineland Station, Ontario, and was introduced in 1941. Fruit medium to large and holds its size well throughout the season; round conic in shape and smooth; dark glossy red with fairly prominent seeds, attractive; firm; moderately acid; and medium quality. Plants are large, vigorous, healthy, good plant makers, and stand drought conditions well. Because of its earliness and productiveness Valentine should be widely tested. It ripens a full picking ahead of Premier.

## EVERBEARERS

EVERMORE MINN. 1166 (per.) (Duluth  $\times$  Dunlap).—Orig. Minn. Fruit Breeding Farm, St. Paul, Minn., and introduced in 1945. Fruit above medium, long conic, dark glossy red, firm, sprightly flavour and medium quality. Plants are vigorous, healthy, hardy and runner quite well for an everbearer. A real hardy everbearer.

GEM (per.) (Progressive seedling).—Orig. F. J. Keflinger, Farwell, Michigan, in 1933. Fruit medium, round conic, bright red; small yellow and red seeds; medium firm flesh; quite acid flavour; and medium quality. Plants vigorous, healthy, hardy, and good runner makers but fruit stalks are short and weak. It is an early maturing variety that cans well.

MASTODON (per.) (Superb  $\times$  Kellogg).—Orig. Geo. Voe, Northern Indiana, in 1917. Fruit medium in size, long wedge conic in shape; bright red; yellow and red seeds; quite firm in flesh; sub-acid flavour; and fairly good quality. Plants vigorous, healthy, medium hardy but rather poor plant makers. Fruit stalks are medium in length and strong. A mid to late season variety. Not as productive as Gem but better in quality.

PIXIE (per.) (August Beauty  $\times$  O.P. Sdlg. of Dunlap).—Orig. by A. J. Porter, Honeywood Nursery, Parkside, Sask. Berries are medium, dark red, medium firm, very good for canning. Plants are vigorous, good runner makers, resistant to leaf diseases and very productive. It is outstanding for earliness of fall crop and productiveness.

SPARTA (per.) (Gem  $\times$  Fairfax).—Orig. A. J. Porter, Honeywood Nursery, Parkside, Sask. Fruit conic to long conic, bright red, very uniform; firm flesh; flavour mildly sub-acid and good quality. Plants large; vigorous, healthy, being resistant to leaf spot; leaves large, thick and dark in colour; and runners numerous. Summer crop ripens week or more later than Gem and fall crop also matures somewhat later but yield in fall not as heavy as Gem variety.

## COMMON STRAWBERRY DISEASES AND THEIR CONTROL <sup>(1)</sup>

### LEAF SPOT

Caused by *Mycosphaerella Fragariae* (Schw.) Lindau.

As the name implies, the symptom of this disease is a spotting on the leaf surface. At first these spots are small, reddish or purplish in colour, but as they increase in size their centres become grey or almost white, their borders remaining a distinct purplish colour. The spots are scattered irregularly over the surface of the leaves, and when numerous, may kill the leaves, thus reducing the vigour of the plant.

*Control*—Where this disease is troublesome, spraying with bordeaux mixture 5-5-100 (1) when growth is well started in the spring and (2) when the first blossoms appear, should provide satisfactory control. Spraying the new plantings during the summer may eliminate the necessity of using bordeaux in the fruiting plantation.

In setting out new plantations do not use plants severely spotted but use only strong, healthy plants removing any leaves which may be spotted. Mowing and burning old leaves also helps to check leaf spot.

The Premier is resistant to leaf spot infection whereas Glen Mary, Parson's Beauty and Valentine are susceptible varieties.

### LEAF SCORCH

Caused by *Diplocarpon Earliana* (Ell. & Ev.) Wolf.

Scorch is also a disease of the foliage but is not so general in its distribution as leaf spot. In its early stages it may easily be mistaken for leaf spot, since at

(1)—Contributed by Division of Botany and Plant Pathology, Science Service, Department of Agriculture, Ottawa.



that time, the spots in both cases are purplish in colour. Later, the scorch spots are larger and more irregular in outline than those of leaf spot, forming actual blotches. As the season advances, these blotches enlarge and coalesce. In severe cases the entire leaf may become purplish in colour. The blotches soon become dry and the leaves take on a burned appearance. Plants severely infected may be killed or seriously weakened.

Leaf scorch is seldom serious in the first year of a plantation.

*Control*—The same remedial measures as outlined for leaf spot are effective in the control of this disease.

#### POWDERY MILDEW

Caused by *Sphaerotheca Humuli* (D.D.) Burr.

Powdery mildew has long been recognized as a serious disease of the strawberry and it is now the most important leaf disease in some strawberry growing districts in Ontario. Though it is seldom widespread in occurrence, it is often very destructive locally.

The earliest and most conspicuous symptom of the disease is the curling upwards of the leaves, so that their lower surface is exposed. A close examination of this will show the white, mildewy growth of the fungus which causes this disease. In severe cases the leaves become dry and the plant may be totally destroyed. If the attack of the mildew occurs before picking time the loss in yield may be considerable, sometimes amounting to almost a complete loss of crop.

*Control*—At the first appearance of mildew apply a sulphur dust or preferably a 15-85 copper-lime dust directing the material to the underside of the leaves. The application should be repeated at 7-10 day intervals especially in plantings with heavily matted rows or under conditions of excessive moisture or high humidity.

#### GREY MOULD

Caused by *Botrytis cinerea* Pers.

This is a fruit disease and in some seasons it affects not only ripe fruit on the plant but partially matured fruit as well. It also causes loss of fruit in transit.

The disease is first apparent as a brown discoloration on the fruit which spreads rapidly throughout the berry, causing it to rot completely. Later, the fruit dries out and soon becomes covered with the fine grey powdery growth of the causal fungus.

The fungus develops most readily under humid conditions, and thus is likely to be most destructive in wet seasons and especially in plantations with poor soil and air drainage.

*Control*—Select locations to provide adequate soil and air drainage. Mulching with clean straw, hay etc. has been found beneficial in checking the development of rot. Do not use nitrogenous fertilizers in the spring of the fruiting year. All berries showing signs of fruit rot should be discarded at picking time to avoid contaminating sound fruit in transit.

#### LEAK

Caused by *Rhizopus* spp.

The most common and destructive rot of strawberries in transit or in storage is known as leak and is caused by the common bread mould. The ripe fruit rots rapidly, the tissues collapse and the juice is lost. It is not uncommon for the juice to drip from boxes of badly infected fruit.

The leak fungus gains entrance through bruised tissue. Accordingly it is a good practice to pick and handle the fruit with the greatest care to prevent injury and to discard any soft berries. Use only clean containers in handling the fruit. Leak develops slowly at temperatures below 50°F. and therefore, if the fruit is

held at a low temperature, the possible development of leak or other rots is diminished.

### STRAWBERRY ROOT-ROT

The presence of root-rot in a planting is shown first at fruiting time when affected plants wilt and dry up. Frequently the disease occurs in localized areas in heavier soil or in poorly drained locations. An examination of the roots of diseased plants reveals a noticeable lack of fibrous roots and the presence of brown and black lesions on the larger roots.

Plants infected with root-rot are similar in appearance to plants injured during the winter. They are generally stunted and have a flat appearance.

*Cause*—This disease is not caused by a single organism, nor is it influenced by a single set of conditions. Rather, it is considered to be the result of the attack of several soil organisms, acting singly, or in various combinations, in which such environmental factors as temperature, moisture, drainage, etc., play an important role.

*Control*—(1) Secure healthy stock from plantations free from root-rot.

(2) Carefully grade the stock before planting, discarding all plants with black roots.

(3) If possible, choose a well-drained site that has not grown strawberries for many years.

(4) Practise rotation of crops. Plan strawberry plantings so that at least four years will intervene before strawberries are again planted in the same location. The turning under of one or more crops of soybeans previous to planting strawberries has been found to be beneficial in preventing root-rot at the Dominion Laboratory of Plant Pathology, St. Catharines, Ont.

(5) Follow the recommendations in this bulletin regarding soil and fertilizer requirements.

(6) Protect the plants from winter injury by the use of mulch materials.

(7) The Premier variety is quite susceptible to root-rot.

### JUNE YELLOWS

This trouble has been found on a number of varieties and in many different sections of Canada. The symptoms first appear in early spring as a yellowing of the unfolding leaves. This is followed by a yellowish green mottling and puckering of the leaf tissue. Affected plants become stunted and unproductive.

A peculiar characteristic of this trouble is that the yellow coloration gradually disappears with the approach of hot weather, so that by mid-July an affected plantation may appear to be healthy. In reality, however, the trouble has not disappeared since "yellows" again becomes prominent the following spring.

All runners from "yellowed" plants are affected with "yellows", therefore, should not be used as stock for planting.

*Cause*—Though the cause of this trouble is not definitely known it is now generally considered to be due to a hereditary factor and is non-infectious.

*Control*—Avoid the use of stock from affected plantations.

### VIRUS DISEASES

These are diseases caused by entities too small to be seen with an ordinary microscope. They are spread from plant to plant by the strawberry aphid. Once a plant becomes infected it never recovers and its runner progeny are likewise diseased.

Varieties of strawberries differ in their susceptibility to injury from virus infection. In some there seems to be little or no effect on plant growth or crop.



yield. In others the plants become progressively dwarfed with the outer leaves tending to flatten towards the ground and the inner ones either "cupping" and becoming yellow at the margin (the disease known as *Xanthosis*, *yellow-edge*, and *yellow*s) or becoming puckered and distorted and often mottled (the disease known as *crinkle*).

The etiology of the different virus diseases of strawberry is still somewhat obscure, but evidence is accumulating which would indicate that, in their severe forms at least, the diseases xanthosis and crinkle are the results of multiple infection by two or more virus entities.

- Control*—(1) Rogue all infected plants as soon as observed.  
(2) Do not take planting stock from an affected plantation.

#### RED STELE

Caused by *Phytophthora Fragariae* Hickman

This is probably the most serious disease affecting strawberries and growers should be constantly on the alert for its appearance in their plantings.

Red stele, a root-rot disease, shows up in early spring as irregular patches of stunted plants, with their older leaves wilted and dying. The newer leaves are severely stunted, and have a bluish-green cast. However, the important symptoms are to be found on the roots. The main roots are largely devoid of rootlets and die from the tips up. This gives the roots a "rat tail" appearance. The central core of such roots is red and this is one of the most certain diagnostic symptoms of the disease. The red coloration readily indentifies the disease up to the end of June after which it becomes less reliable.

*Control*.—In districts where this disease is known to occur, growers should take every precaution to secure only disease-free plants for setting out new plantations. At least a 3 or 4 year rotation is advisable.

Suspected cases of this disease should be reported to the nearest Laboratory of Plant Pathology.

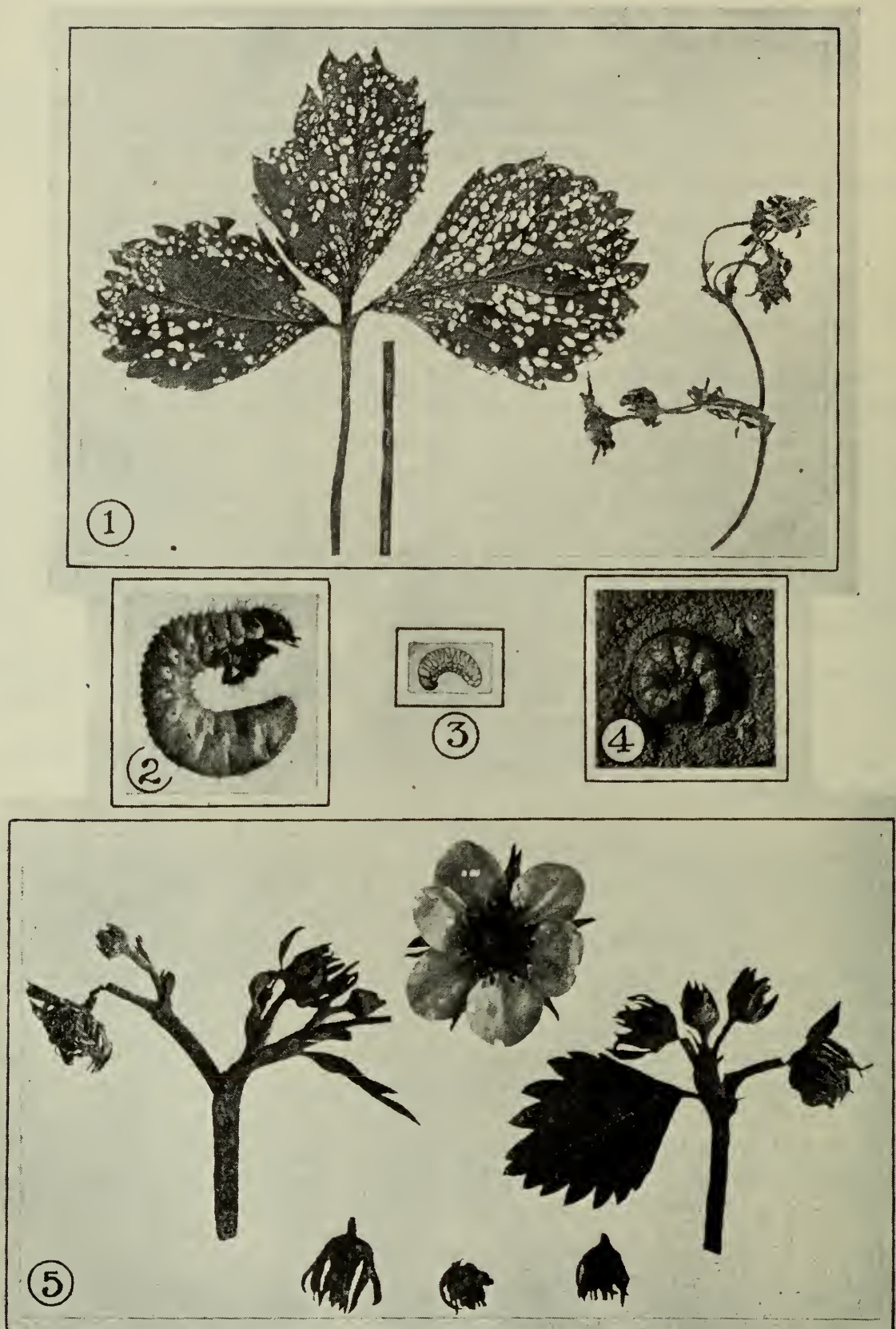


Fig. 20—1. Work of strawberry leaf beetle. 2. White grub. 3. Strawberry root weevil. 4. Cutworm. 5. Work of strawberry weevil.



## COMMON STRAWBERRY INSECTS AND THEIR CONTROL<sup>1</sup>

In Canada strawberries are seriously attacked by comparatively few insects, and if the general practices given below are followed the necessity for control measures may often be avoided. It should be noted, however, that strawberry insect problems may differ in various parts of the country, and that practices considered good in one locality may not be satisfactory or may have to be modified in another locality. For example, early spring burning of the plantation is widely practised in the Maritime Provinces to control the strawberry fruit bug and other pests but is not considered advisable in Ontario. Again, in certain areas of British Columbia, the root weevils may require control measures every year whereas in Ontario these are not necessary until an outbreak occurs. For these reasons only a general account can be given here and growers are urged to consult local agricultural authorities for further details.

### GENERAL PRACTICES

1. Set out only healthy plants.
2. Plant on land previously occupied by hoed crops that have been kept free from weeds. Avoid planting on land that was in sod the previous year.
3. Set new plantings as far as possible from old ones.
4. Keep the field free from weeds and grass and clean up any surrounding rough land; destroy wild brambles, raspberries, and thickets that may provide shelter for harmful insects.

The key given below is an aid to quick diagnosis of insect injury, but control measures should not be undertaken until the grower feels assured, from reading the full text, that the description fits his particular case. If in doubt send a sample of the insect and its damage to Fruit Insect Investigations, Division of Entomology, Science Service Bldg., Department of Agriculture, Ottawa. Samples up to 12 oz. in weight may be sent through the mail free of postage.

### INJURY TO BLOSSOM BUDS

Blossom stems cut, causing the buds to wilt, drop off, or hang by a thread.....*Strawberry weevil*

### INJURY TO FRUIT

Berries distorted or malformed, developing into so-called nubbins.....*Strawberry fruit bug and tarnished plant bug.*

### INJURY TO LEAVES

Holes eaten in leaves by small, shiny beetles, giving the foliage a "shot-holed" appearance.....*Strawberry leaf beetle*

Leaves folded, usually along the midrib, by small greenish or brownish caterpillars that feed within the shelters thus formed.....*Strawberry leaf roller*

White spittle masses on leaf stems and other parts of plants.....*Meadow spittlebug*

Leaves chewed during the night by smooth, stout caterpillars that hide under the soil by day.....*Cutworms*

Leaves in centre of plant inrolled, crinkled, and deformed.....*Cyclamen mite*

### INJURY TO CROWNS

Small, pink caterpillars boring in crown .....*Strawberry crown miner*

Larger, whitish caterpillars boring in crown.....*Strawberry crown moth*

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<sup>1</sup>Contribution No. 2739, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

## INJURY TO ROOTS

Large, whitish grubs, with six distinct legs, eating the roots and killing the plants.....	<i>White grubs</i>
Small, whitish grubs, without legs, feeding on rootlets and weakening or killing the plants.....	<i>Strawberry root weevil</i>
Thin, shiny brown larvae feeding on roots.....	<i>Wireworms</i>

## INJURY TO COLLAR

Plants cut off near ground-level by smooth, stout caterpillars that hide under the soil by day.....	<i>Cutworms</i>
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## THE STRAWBERRY LEAF BEETLE

*Paria canella* (Fab.)

In spring and autumn strawberry plants are occasionally attacked by a dark-brown or black, shiny, oval-shaped beetle about one-eighth of an inch long that eats holes in the leaves, giving them a lacework effect. This insect feeds also on raspberry, blackberry, greenhouse roses, and some other plants.

The beetles hibernate among old leaves, straw, or trash, and as soon as growth commences in the spring they feed voraciously on the leaves. Eggs are laid in the soil close to the crowns of the plants and on the undersides of dead leaves lying around the plants. The very small larvae that hatch from these eggs burrow into the soil and feed on the rootlets of the strawberry plants, where they may cause considerable injury when present in sufficient numbers. When full-grown the larvae are about one-sixth of an inch long. They then pupate in the soil, and the new beetles emerge from about the end of July to September. After feeding for a while the beetles go into winter quarters.

*Control.*—As soon as the beetles are found feeding on the leaves, spray thoroughly with lead arsenate, 5 lb., or calcium arsenate,  $3\frac{3}{4}$  lb., in 100 gal. or a 5-7½-100 bordeaux mixture. This spray should only be applied before the fruit is formed or after the crop has been picked.

DDT has given good control of the insect on greenhouse roses and may be tried in the strawberry plantation. When the earliest blossoms appear, spray with 50 per cent wettable DDT, 2 lb. of the spray powder in 100 gal. of a 5-7½-100 bordeaux mixture. Add the DDT last, when the tank is about full.

## THE STRAWBERRY WEEVIL

*Anthonomus signatus* Say

This insect, a very small, reddish-brown or blackish snout beetle, approximately one-tenth of an inch long, may very seriously reduce the crop by cutting off unopened blossom buds. Occasionally it attacks blackberry and raspberry.

The beetles begin to appear in the spring when the first few strawberry blossoms open. Their presence at this time is indicated by small round holes that they eat in the petals. The presence of these holes should warn the grower to keep a close watch on the plantation and to make preparations for spraying or dusting the plants. The female weevil punctures the side of an unopened blossom bud and through it inserts an egg into the interior of the bud. She then crawls down the stem a short distance, girdles it, and leaves the bud hanging by a thread or severs the stem completely so that the bud falls to the ground. The egg hatches, the larva develops inside the bud, and a new beetle comes out in July about the time the crop has been harvested. There is but one generation a year, and the new beetles hibernate in the plantation itself and in brambles or hedgerows of wild and escaped raspberry canes that may be growing in the vicinity.



*Control.*—As soon as bud cutting begins, dust the plantation with a mixture composed of 70 per cent finely ground gypsum and 30 per cent synthetic cryolite. If it rains within 8 days, make a second application at once. Apply the dust with a power duster or a good hand blower, preferably in the morning when the dew is going off and when there is little or no wind.

Effective control has been obtained with a 3 per cent DDT dust, which should be applied as soon as bud cutting begins. DDT may also be used as a liquid spray applied as soon as the first few blossom petals have been found with typical weevil injury. Use 50 per cent wettable DDT, 2 lb. of spray powder in 100 gal. of a 5-7½-100 bordeaux mixture. Add the DDT last, when the tank is about full.

Injury from this insect may be reduced and sometimes prevented by clearing up all thickets, bushes, fence rows, and wild raspberries and strawberries in the vicinity of the strawberry plantation. Set out new plantings as far as possible from the old.

### THE STRAWBERRY FRUIT BUG

*Calorocoris norvegicus* (Gmelin)

In Nova Scotia, and possibly elsewhere, this small, active, green bug frequently causes extensive damage to the developing fruit. In severe cases the fruit may fail to develop, but in lighter infestations the berries may be distorted or malformed, developing into so-called nubbins. The bugs, in both the mature and immature stages, are very active and furtive and are not likely to be observed unless a careful search is made. For this reason the damage caused by this insect is usually attributed to some other agency such as frost or imperfect pollination.

Though a complete study of the life-history of this insect has not yet been made, observations indicate that the winter is passed in the egg stage. The eggs are deposited in the stems of the strawberry plants and also some weeds, including sheep sorrel, one of the insect's favoured food plants. The young bugs appear in the spring soon after the first blossoms open and may begin stinging the fruit as soon as it starts to form. About the time the fruit is ripe the bugs are full-grown, and they soon leave the strawberries and may be found on a number of plants, including many field and garden crops, grasses, and weeds.

*Control.*—Spray with 50 per cent wettable DDT, 2 lb. of the spray powder in 100 gal. of a 5-7½-100 bordeaux mixture, when the first blossoms appear. Add the DDT last, when the tank is about full. Keeping the plantation free from weeds, especially sheep sorrel, will help in control.

### THE TARNISHED PLANT BUG

*Lygus oblineatus* (Say)

This common bug, which attacks many plants, has caused damage to strawberries in Manitoba very similar to that of the strawberry fruit bug. Control measures are the same as for the strawberry fruit bug.

### THE STRAWBERRY LEAF ROLLER

*Ancylis comptana fragariae* (W. & R.)

There are several species of leaf rollers that may occasionally attack strawberries, and the species named above may not always be the one responsible for injury. However, the following notes on the strawberry leaf roller are more or less applicable to the others. Characteristically the leaves are found folded over, and if they are opened up a very active caterpillar may be found feeding within.

The insect winters in the larval stage in the folded leaves. In spring the larvae pupate and give rise to small, inconspicuous moths about three-eighths of an inch long. Eggs are laid by the moths singly on the leaves and are difficult to see. The young caterpillars feed on the surfaces of the leaves and soon begin to tie the leaves together, usually commencing by bridging with silk the hollow formed by the midrib on the upper surface of the leaf. The silk strands are increased and tightened until the halves of the leaf come together. In this shelter the larva is well protected and cannot be reached with a poison spray. When full-grown the caterpillars are about half an inch long, greenish or brownish, and very active when disturbed. These pupate, and a new brood of moths appears in late summer to repeat the process.

*Control.*—In bearing plantations, if the presence of this insect is not detected until the leaves are folded, as is usually the case, the caterpillars are protected from sprays and nothing can be done until the crop is harvested. Immediately after the crop is harvested, (1) if no more crops are to be taken off, plough the plantation; (2) if another crop is to be harvested, spray at once with lead arsenate, 5 lb., or calcium arsenate,  $3\frac{3}{4}$  lb., in 100 gal. of a 5-7½-100 bordeaux mixture, thoroughly coating the plants. Spray again in 10 days (in wet weather it may be better to spray three times at 7-day intervals). In the following spring, just before blossoms open, spray with the same mixture.

New plantings should be set as far as possible from infested ones. Wherever possible, avoid using plants from infested plantings. When setting out the plants, pinch all folded leaves between finger and thumb to kill the larvae within, and keep the leaves coated with spray until old plantings have been ploughed under. Spray as soon as the plants are set out, with the mixture recommended for the old plantation, and repeat when the coating is removed by weathering or when new, unprotected growth appears. Protection by spraying must be given until neighbouring sources of infestation have been removed or treated.

#### CUTWORMS

Several species of cutworms may cause much damage in strawberry plantations by cutting off the new plants at ground-level and by chewing the foliage of older plants. In general, most cutworms are similar in appearance, being smooth, cylindrical caterpillars an inch, more or less, in length and of a dull earth colour. They feed during the night and hide in the soil during the day. Cutworms usually cease causing damage before the end of June. The adults are drab-coloured moths that fly during the night and are often attracted to lights.

*Control.*—The following poisoned bait will control cutworms:—

Bran.....	25 lb.
Paris green.....	1 lb.
Water.....	about 2½ gal.

Mix the bran and poison; then add water slowly to this mixture while stirring. Scatter the bait thinly on the ground after sundown, along the rows where the cutworms are present. It is important that this should be done in the evening and only after a warm day. Where cutworms are abundant one baiting may not be sufficient.

In the case of a new planting that will not be cropped until the next year, a grower may prefer to spray or dust. Spray with 50 per cent wettable DDT, 2 lb. of the spray powder in 100 gal. of water, or dust with a 3 per cent DDT dust.

#### WHITE GRUBS

White grubs—the larvae of the well-known June beetles (or June ‘bugs’)—are the large, stout, greyish-white grubs, usually curved in an almost complete



circle when at rest, which are not infrequently found feeding on the roots of strawberries. They either kill or seriously weaken the plants and are usually most destructive where strawberries are planted after sod. There are a number of species in Eastern Canada and one, the northwestern June beetle, confined to British Columbia.

The life-histories of the injurious species are fairly similar. The beetles appear in early summer and commonly fly about in the evening and at night, particularly around trees, upon the leaves of which they feed. They lay their eggs in soil covered with vegetation, chiefly on grass land. The eggs hatch and the tiny grubs feed on the roots of plants until late autumn, when they burrow deeper into the soil; they remain dormant until the spring of the following year. With warmer weather they come nearer the surface again and continue their feeding throughout the season. After a second winter they continue feeding until late summer, when they pupate and transform to adult beetles, which remain in the soil until the next season.

In the East most damage is done by the second-year grubs. In Ontario and Quebec there are definite broods, and injury is likely to occur every three years, the year of occurrence depending on the district. In the West the northwestern June beetle may cause injury every year.

*Control.*—In the East strawberries should not be planted on land that was weedy or in the previous year. Experiments are under way with some soil insecticides, but at present no definite recommendations can be given.

In the West the Dominion Entomological Laboratory at Victoria has, during the past four years, obtained very satisfactory results in field experiments in controlling white grubs in the soil. Three new and promising soil insecticides, benzene hexachloride (BHC), chlordane, and ethylene dibromide, appear to give satisfactory commercial control under field conditions. These materials are available in Canada under various trade names. Dusts containing 5 per cent benzene hexachloride ( $\frac{1}{2}$  per cent gamma isomer) or 5 per cent chlordane are cheap and effective materials when used at about 100 pounds per acre. They should be evenly distributed over the soil and immediately ploughed in. Where small plots are to be treated, a small hand-drawn fertilizer cart or spreader may be used for applying dusts. Where larger acreages are to be treated, a large fertilizer spreader can be readily adjusted and pulled over the field by tractor. Results appear to indicate that these materials are effective when applied at any time of the year, and they have not caused injury to strawberry plants. Both of the insecticides appear to have a residual effect, each remaining toxic to the white grubs for more than one year. No tainting of the fruit has resulted from the large-scale commercial use of benzene hexachloride or chlordane in British Columbia during the past 3 years.

Ethylene dibromide seems to be safe and effective if used when the soil temperature is above 55°F. at the time of application. It is a volatile liquid that must be applied when there is no crop growing in the field. A waiting period of 10 to 14 days is required prior to planting. Soil temperatures are generally suitable in late summer or fall after the crop is harvested. The commercial 20 per cent ethylene dibromide, when applied at 8 to 10 gallons per acre, has caused no harmful effect on either the crop or the soil. It does not appear to have any residual effect on the white grubs; in other words, it will not prevent re-infestation of the land the year after it is applied. A simple plough equipment for applying liquid insecticides to the soil is described in Processed Publication No. 68, published by the Division of Entomology, Department of Agriculture, Ottawa.

Approximate cost of the materials per acre is as follows: benzene hexachloride, \$10.00, chlordane, \$15.00, ethylene dibromide, \$25.00. As one application of

benzene hexachloride or chlordane will control the northwestern June beetle for several years, the cost per year is relatively low.

#### WIREWORMS

Of the various species, the one that most commonly causes damage to strawberries in British Columbia is the Puget Sound wireworm, *Ctenicera aeripennis aeripennis* (Kby.). The adults are commonly called click beetles and their life-history is similar to that of white grubs. Damage usually results when strawberries are planted after sod. Excellent control of wireworms has been obtained by applying benzene hexachloride, chlordane, or ethylene dibromide as recommended for the control of the northwestern June beetle. In the East, however, no control measures have been necessary to date beyond that of avoiding the planting of strawberries on land that was weedy or in sod the previous year.

#### THE STRAWBERRY ROOT WEEVIL

*Brachyrhinus ovatus* (L.)

The strawberry root weevil, though widely distributed in Canada, ranks as a serious pest of strawberries only in British Columbia, where it is most prevalent on light or sandy soils. The adult—a small dark beetle, egg-shaped in general outline and about one-quarter of an inch long—nibbles strawberry leaves; but the all-important injury is caused by the small, white, legless grubs feeding on the roots, thus weakening or killing the plants. (See also "The Black Vine Weevil".)

The weevils pass the winter in two stages, (1) as adults hibernating among the strawberry plants or in almost any sheltered spot and (2) as immature grubs in the soil around the roots of the strawberry plants. In spring the grubs commence feeding again and soon reach maturity. They pupate in the soil and transform to adults toward the end of May. These new beetles, together with those that have overwintered, may occur in enormous numbers. Every weevil of this species is a female capable of laying fertile eggs. The eggs are deposited in the soil, usually near the crown of the plant, and the grubs feed on the fine rootlets. A few of the grubs reach maturity in autumn and pupate in the soil. Adults emerge in late autumn and hibernate. The majority of the grubs, however, remain dormant through the winter and mature the following spring.

*Control.*—Weevil injury may be greatly lessened by setting out new plantings as far as possible from old ones and by planting strawberries after a non-host crop such as potatoes, mangels, or similar hoed crops. Avoid planting after grass or clover sod. Where the plantation has become infested, satisfactory control may be obtained only by the use of a poisoned bait.

Baits should be applied to kill the adults before they lay their eggs, and when an infestation is severe it is advisable to apply them twice, once about mid-April to kill the overwintering adults and again during June, when the overwintering larvae develop into adults. The June treatment is the main poisoning operation and, if poisoned bait is to be used at all, should not be delayed. Proper timing, which is essential to ensure good results, may be accomplished as follows:-

(1) Mid-April: leaves should be examined frequently for the ragged-edge effect resulting from the beetles' feeding on them. When "ragging" is observed (adults can be found in the soil at the base of the plants at this time) the bait should be applied.

(2) June 10-30: soil about the crowns of the plants should be examined for presence of grubs, pupae, and adult beetles. When 80 to 90 per cent of the pupae have changed to the adult stage the bait should be applied.



Particular attention should be paid to plants bordering on old plantings, fence rows, or sod land where weevils are abundant. These heavily infested areas should be located early and baited to prevent the spread of weevils to the remainder of the crop field.

One tablespoon of bait is applied per plant (hill system), care being taken that the mixture falls to the ground close to the crown rather than on growing foliage or tender stems. The application should be made during dry, warm weather if possible. About 80 to 100 lb. of bait is sufficient for treating one acre.

*Baits.*—Proprietary baits consisting of ground apple waste and sodium fluosilicate have given satisfactory results in British Columbia. They should not be applied too dry and may be moistened with a little water if necessary. If the grower prefers to mix his own bait, one of the following may be used.

(1) Raisins.....	50 lb.
Shorts.....	50 lb.
Sodium fluosilicate.....	5 lb.

Where sodium fluosilicate cannot be obtained, 7 lb. of the less effective sodium fluoride may be used instead. Spoiled or second-grade raisins are satisfactory and may often be purchased cheaply. Low-grade figs may also be used.

Soak the raisins in 5 quarts of water for 6 to 12 hours, or until they are moist. Mix the dry shorts and the sodium fluosilicate together thoroughly; then add the raisins, from which the water has been drained, and mix again. The bait should then be put through a butcher's meat mincer, set to cut coarsely, to form a slightly moist crumbly mash.

(2) Bran.....	50 lb.
Water.....	5 gal.
Sugar (or stock molasses, used with less water).....	10 lb.
Sodium fluosilicate (preferable).....	5 lb.
or Calcium arsenate.....	5 lb.

Dissolve the sugar in water; then mix the solution with the bran until it is uniformly moistened. Add the poison and thoroughly mix again. The bait must be used within a day or two after mixing or it will mould and lose its effectiveness.

#### THE BLACK VINE WEEVIL

*Brachyrhinus sulcatus* (F.)

The habits, damage, and method of control of this insect are much the same as those of the strawberry root weevil. This weevil, is however, much larger and seems to prefer heavier types of soils. As the adults emerge approximately two weeks later than those of the strawberry root weevil, the bait is usually applied after the crop has been picked.

#### THE CYCLAMEN MITE

*Tarsonemus pallidus* Banks

This mite is not uncommon on strawberries in many sections of Canada but only occasionally causes sufficient damage to be noticed by the grower. On infested plants the unopened leaves turn yellowish, then brownish, and may die, or they may fail to open properly and remain crinkled and deformed. The mites can scarcely be observed with the eyes alone but can be found with a magnifying lens if the young, unopened leaves are unrolled so as to expose them. Since the symptoms are not clearly marked in the early stages, the presence of the mites is the only certain criterion.

The mites shun the light and prefer the seclusion of the folds of unopened leaves, where they feed and lay their eggs. As the leaves expand, the mites avoid exposure by moving to younger, unopened leaves. In these and the crowns they pass the winter, and begin feeding and reproducing the following spring.

*Control.*—The only effective control measure known at the present time is to dip the young plants in hot water before they are set out in the spring. Experiments have shown that plants should be immersed in water at a temperature of 110°F., but not higher, for 20 minutes. After this they should be quickly cooled by plunging them in a bath of cold water. To ensure control it is recommended that if the plants are tied into bundles (25-50) the strings should be cut before dipping; otherwise the temperature in the centre of the bundle will fail to reach 110°F., or will reach it so slowly that complete mortality of the mites will not take place. It is most important that the temperature of the water be held at 110° during the entire period of immersion, for if the temperature reaches 115° the plants will be killed and if it falls to 107° the mites will not be killed. A reliable and easily read thermometer should be used and the water kept stirred to ensure even temperature throughout. Plants should be set out as soon as possible after treatment.

#### THE MEADOW SPITTLEBUG

*Philaenus leucophthalmus* (L.)

This insect commonly attacks weeds and other plants but occasionally appears on strawberries in sufficient numbers to reduce the crop and weaken the plants. Injury is most marked when an infestation coincides with a dry season.

The eggs, the stage in which winter is passed, are probably laid on the leaves and stems of the plants. They begin to hatch about the time the earliest strawberry blossoms appear, and the young nymphs feed on the plants by piercing the tissue and sucking out the plant juices in much the same way as aphids. Very soon the nymphs are surrounded by drops of clear liquid and later by considerable amounts of white spittle. They are most commonly found on and between the flower-bud clusters when the latter are still compact, on leaf stems, and on the young growth of the crown. Each spittle mass may contain one or more nymphs. The nymphs develop into adults about the time the crop is harvested. The adults both fly and hop, are usually dull brown in colour, and are about one-quarter of an inch long. There is only one brood.

*Control.*—Once the spittle masses appear, the nymphs are rather well protected and effective control is difficult. Where it is known, from the previous year's experience, that an attack is likely to occur, the plantation should be sprayed, as soon as the earliest blossoms appear, with 50 per cent wettable DDT, 2 lb. of the spray powder in 100 gal. of a 5-7½-100 bordeaux mixture. Add the DDT last, when the tank is about full. Sufficient pressure must be used to drive the spray into the compact young growth. This will require the use of a gun rather than a mist nozzle or cluster of nozzles.

#### THE STRAWBERRY CROWN MINER

*Aristotelia fragariae* Busck

If a small, pinkish larva is found burrowing in the crown it is likely to be the crown miner. The adult is a small grey moth. Different species are found in the East and the West but they are very similar. The insect is rarely troublesome where a short rotation is followed and new plantings are set some distance from old ones.



## THE STRAWBERRY CROWN MOTH

*Ramosia bibionipennis* (Bdvl.)

This insect seems to be largely confined to the west coast.

The adult, which resembles a wasp, is a clear-wing moth with the abdomen banded with yellow. Injured plants appear wilted or unthrifty and, when pulled, frequently break off, disclosing the whitish larvae within. At present no control measure is known beyond digging up and destroying all infested plants.

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