

Oklahoma Agricultural Experiment Station,

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SMALL FRUITS.

VARIETIES AND CULTURE.

INTRODUCTION.

In the preparation of this bulletin, it has seemed best to give a general discussion of the entire subject from the standpoint of the farmer for whose information it is published. Discussion of the separate experiments as they were carried out is avoided and the matter is given as information in the form in which it seems most readable and easily understood. The results of experiments that have been made on the different methods of culture, and methods of pruning are considered to be entirely trustworthy only so far as they have been proven, both in process and results, by practical growers. On the other hand, some of the methods that are claimed, by practical growers, to be essential to success, have upon investigation proven to be of little value or without effect upon the crop. This bulletin will not answer all of the questions that the farmer or berry-grower has to solve, and

some of the recommendations here given will be out of date in a few years. This is especially true of the lists of varieties.

The testing of varieties and the study of local conditions is a work that must be carried on as long as fruit growing is practised as a successful industry. The varieties of small fruits and especially of berries vary more in different localities than do the varieties of other fruits and of vegetables. This one fact makes it necessary that every berry-grower should continually test new varieties, if he is to reach the highest degree of success.

Many of the troubles encountered by farmers in growing berries do not need scientific investigation for their solution. A few of these troubles are new, but most of them are well understood and only require the more general dissemination of the knowledge now possessed by successful berry-growers.

BLACKBERRIES.

The blackberry is the most satisfactory of the berry fruits grown in Oklahoma. If it is given good care and cultivation, it is well worth the growing on any kind of soil and on every farm. There are several varieties that have been widely planted and are now giving fair returns. From a commercial standpoint, the Early Harvest is so much better than the other varieties that it is in a class by itself. The other varieties worth mentioning here are: Kittatinny, Snyder, Lawton, and Erie, named in order of merit. Other varieties that show promise of value are: Eldorado, Dallas, Bow Cane, and Kenoyer.

Early Harvest is moderately vigorous, and very hardy. The fruit is medium size, round-oblong, very juicy. It is very productive, and early.

Kittatinny is very vigorous, and hardy. The fruit is large, long, fine appearance and quality. Medium late.

Snyder is vigorous, upright, and very thorny. The fruit is medium size, oblong-oval juicy, and fine flavor.

Lawton is vigorous and has very large spines. The fruit is very large, and of fine quality.

Erie is a strong, spreading grower, and very thorny. The fruit is large, roundish oval, of good quality. Midseason.

Eldorado has fruit of medium size and fine quality.

Dallas has very large fruit of fine quality.

Bow Cane and Kenoyer are new varieties and while they have given satisfaction in a few localities, they should be planted only in an experimental way.

SOIL AND LOCATION.

The blackberry is most profitable when grown on good land. A good clay loam is nearly the ideal. People are inclined to think that the blackberry will do well on any kind of soil because plants are hard to kill. The poor land however seldom produces as profitable a crop of fruit as may be grown uniformly on good land. Rich prairie land is best if it is well drained but if good upland can not be used, the blackberries should be set on bottom land. Land that is capable of carrying plants through a drouth in the summer is necessary to success.

The blackberry patch is usually located near the house and frequently in the apple or peach orchard. This should never be done as it works to the detriment of the berry patch and orchard. The plan of cultivation that will suit one will not suit the other and each planting will be in the way of the other. If well cared for, one row of blackberries two hundred feet long will supply a family with plenty of fruit. A common mistake is to plant too many and give them no care and as a result get no fruit. Setting the plants in a single row along one side of the orchard is a good plan. When set in that form the plants are easily cultivated and kept within bounds.

SETTING THE PLANTS.

Spring and fall setting each has its advantage but neither one should be chosen to the exclusion of the other. Both can be practised entirely successfully in Oklahoma and the choice should be made more with reference to the condition of the soil and the convenience of the work than as to whether the season be spring or fall. If the work can be accomplished and the soil is in good condition in the fall, it is unwise to wait for spring, but do not set the plants in dry soil or in soil that is not well prepared in order that the planting may be done in the fall.

In setting the plants, the rows should be six or eight feet apart and the plants set about two feet apart in the row. If especially choice fruit is desired, the plants may be set five or six feet apart in the row and the plants confined to the hills thus started. This method of

planting will not with ordinary care give as large yields of fruit as the closer planting in the row and letting the plants form a matted row. If the matted row is adopted, the rows should not be closer than eight feet apart.

The soil should be well prepared for the planting by being placed in a state of thorough cultivation. The work of setting can be greatly facilitated by plowing a deep furrow in which to set the plants. The plants can then be set by placing them against the perpendicular side of the furrow and shoveling some soil over the roots and firming it well with the foot. The plants should be placed two or three inches deeper than they stood in the soil in which they grew. The roots should be carefully handled and distributed as nearly as possible in their natural positions. The roots are small and fibrous and seem of little consequence, but their well-being is necessary to a good growth of the plant the following season. It is a good plan to throw a little loose soil around the stem of the plant to prevent the packed soil from drying and thus injuring the plant. If the planting is done in the fall and the soil becomes very dry during the winter, it is sometimes advisable to cover the plants lightly with coarse manure or litter.

CULTIVATION.

Clean culture is the only method that has brought even a moderate degree of success. The width of the spaces between the rows will not permit of the use of cover crops. The cultivation should begin early in the spring and should be continued throughout the season. In some locations it seems best to check cultivation during the middle and latter part of the summer in order that the wood and buds may ripen before winter. This condition will seldom be met except on low ground and during exceptional seasons. The cultivation should leave the land level and well pulverized. The cultivator should not run more than three or four inches deep and should be of sufficient width to reach under the spreading tops of the vines and cultivate the land up to the edge of the row.

Mulching the patch in the winter and spring is sometimes practised with the aim that this shall take the place of cultivation during the growing season. Mulching will conserve moisture and the plants will sometimes make even a better growth than if the patch had been cultivated. The continuation of the practice of mulching, however, will

cause the roots of the plants to grow near the surface of the ground and the results following are weaker plants, a heavy loss during an extreme drouth, and great difficulty in keeping the plants confined to the row. Mulching for one season is better than no attention but it is not so good as good cultivation.

Good cultivation is one of the best fertilizers that can be applied to a small fruit plantation of any kind. The addition of well rotted barnyard manure to good cultivation makes the fertilizer almost ideal. A dressing of well rotted manure should be given to the blackberry patch every second or third year. This can be worked into the soil with the cultivator and will not hinder cultivation. Some of the commercial fertilizers will give very good returns when applied to the soil in a berry patch but there is no need for the farmer and fruit-grower to use these fertilizers while barnyard manure can be obtained for the hauling of it from the neighboring towns.

The Planet Junior five shoveled cultivator is one of the best tools that can be used for cultivation of the berry patch. It does not run too deep and leaves the surface soil in good condition. Practically all of these one horse, five shoveled cultivators are so built that their width can be easily adjusted by a lever. Any form of a surface cultivation can be used and will do good if it serves to keep the surface pulverized and free from weeds and grass. The common corn cultivator can be used and will do good if it serves to keep the surface between the rows can best be destroyed by having the edge of the shovels square instead of pointed. The pointed shovels will dodge and drag around the sprouts instead of cutting them off, and will break many of the roots that come near the surface and in this way cause an extra supply of sprouts. The hoe should be used to keep the weeds and grass out of the row and to remove any sprouts that have not been cut off by the cultivator.

PRUNING.

The first pruning of the blackberry should be done when the young sprouts are about eighteen inches high. The pruning that is done at this time consists of clipping off the ends of the sprouts. This causes the sprout to send out side shoots and to develop into more stocky plants. This method of summer pruning is greatly modified by many successful berry growers. The height at which the vines are topped varies with the grower, the soil, and the variety. The small or weak

plants should be topped about two feet high and vigorous shoots three feet. Every grower will modify this operation to suit his conditions and to meet his personal ideals. To the beginner, it should be said that the plants will do better if cut too low than if cut too high. Cutting the tops off too late in the season is liable to result in a development of weak side shoots and these usually are badly winter killed the following winter.

In the early spring it is a good plan to go over the patch and cut back all weak and winter killed branches. If the plants have made a very strong growth the tips or even one-third part of the branches may be removed with good results. This cutting back will to some extent thin the fruit and will to that extent tend to improve the size of it. There is no part of the process of blackberry cultivation that is more generally neglected than the work of pruning. For the summer pruning of the growing shoots there is nothing more convenient than a pair of sheep shears. With a pair of sheep shears in one hand and a sharp knife in the other, a man can work very rapidly and the task of pruning will not be a long one.

Removing the old canes is a very disagreeable task. This work should be done as soon as the crop of fruit has been gathered. This will let the plants spend all of their energies in developing the new roots, which are to be the fruiting canes for the following season. All of the old canes cut out should be taken out of the patch and burned to destroy any insects and fungus diseases that they may be harboring at the time. The time of removing the old canes is not a matter of great importance, but they should in every case be removed before the new vines start to grow in the spring. These vines can be cut with a corn knife, a long handled chisel, or with a long handled knife which has a hooked shaped blade prepared especially for this kind of work.

The life of a blackberry patch varies with the soil and the kind of treatment that it receives. The average is about twelve years. The patch can be destroyed by cutting off the vines in the summer and plowing the patch and harrowing it several times during the remaining part of the season.

DEWBERRIES.

The dewberry resembles the blackberry so closely as to be frequently classed with it. There are two varieties that have been well

distributed over Oklahoma, and both of them are proving satisfactory to some growers and both are unsatisfactory to other growers. The Lucretia seems to be the favorite in the northern part of the territory with Austins Improved a close second. In the southern part of the territory the standing of the two varieties is just the reverse.

The Lucretia dewberry is large, oblong, coreless, glossy black, juicy and sweet. It ripens early. The vine is vigorous, hardy, and very thorny.

Austins Improved (Mayes) dewberry is very large, oval-conic, juicy, glossy black, good quality and appearance. It ripens very early. The vine is vigorous, thorny, long, slender, and trailing. The vines are said to be more upright as the plants grow older but they never stand with the tips free of the ground.

The dewberry propagates naturally by taking root at the tip of the vines and forming new plants there. There is normally no trouble in securing a good stand of plants but care must be exercised to avoid the plants becoming too thick in the row. The cultivator passing along the side of the row will keep the vines brushed back in the row so that directing the vines will not necessitate hand labor.

CULTIVATION AND PRUNING.

The entire process of cultivation of the blackberry is equally beneficial to the dewberry. The plants are set in the same manner and given the same attention in every way except pruning. The dewberry should not be pruned during the summer. In the spring the vines are cut back and should be tied up to a trellis.

RASPBERRIES.

The raspberries are not well adapted to the climate of Oklahoma and general planting is not advised. There are many farmers who have small plats of ground that are especially fitted for this plant and if such land is planted to the best varieties of raspberries and the plants are given good care and cultivation, reasonable crops may be expected. On the upland, with poor and indifferent care, the raspberries are not worth the land which they occupy and it is folly to plant them. The Kansas, Millers Red, Gregg and Cardinal are the only varieties that have to any extent proven to be of value. The Golden Queen gives

promise of becoming a valuable variety for some localities and should be planted in an experimental way.

Cardinal is a vigorous grower. It propagates by tips when young but from suckers when the plants are old. Fruit large, soft, juicy, dark red; flavor somewhat musky. It appears to be particularly susceptible to anthracnose.

Gregg is a vigorous grower with upright canes. It is sometimes difficult to propagate owing to the upright growth of the canes. It roots at the tip of the canes. Fruit large, roundish oblate, black with a decided gray bloom. Flesh firm, moderately juicy and sweet. Late.

Kansas is a vigorous grower, very hardy and exceedingly thorny. It takes root at the tips. Fruit very much like the Gregg, but with less bloom and ripens a week earlier. This has given better satisfaction than any other variety planted in Oklahoma.

Millers Red is vigorous and stocky in plant. The fruit is large, firm, bright red. Quality subacid, good. Early. It propagates by suckers.

Golden Queen is vigorous and upright grower, propagating by suckers. Fruit large, juicy, of good quality. Midseason.

LOCATION AND SOIL.

Raspberries delight in a cool, moist soil. The patch should be so located that it will be protected from the southwest wind, and from the effects of the drouth as much as possible. The low bottom land is subject to late frosts and the high upland to hard wind, so that the second bottom land, or land that slopes to the north and has a good wind-break on the south is best for this crop. The land should be very fertile and in good tilth when the plants are set. A rich sandy loam is the best.

SETTING THE PLANTS, AND CULTIVATION.

The directions given for setting the blackberry are equally applicable to the work of setting the raspberry. The raspberry plants are not as large and vigorous as the blackberry and for that reason, require a little more care in handling and setting.

The culture of the raspberry is the same as that of the blackberry. Constant, clean cultivation is the best that can be given and the better the culture the better are the chances for a good crop of fruit.

PRUNING.

Raspberries require but little pruning. The old canes should be removed as soon as the fruiting season has passed. The longest canes should be cut back some in the spring and the vines tied to a stake to hold them off the ground. A low trellis can be used for this purpose and if the vines are very vigorous, the trellis is to be preferred. The plants should not be summer pruned as they send out weak side shoots when clipped back in the growing season, and the following crop is greatly reduced.

STRAWBERRIES.

The strawberry is one of the most delicious fruits but it could not rank high by any sort of measurement for food value or as a staple crop in this locality. It is one of the most hardy fruit plants but is very susceptible to the slightest change in soil and climate. New varieties of strawberries are introduced every year and some of the old varieties are discarded every year. Some of the varieties are not stable in their characteristics and will change in a few years to such an extent that they should be given a new name. The varieties in any given list of strawberries can not be named in order of merit with any degree of satisfaction. The slightest change of soil will be in favor of one variety and to the detriment of another. For this reason, the varieties here given are named in alphabetical order.

The following described varieties have been planted and have given satisfactory returns in several localities. There are no doubt other varieties that will do as well in Oklahoma as any of those given in the list but they are not so generally known.

Aroma is large, light red, late. Flowers perfect. One of the best.

Crescent is medium size, midseason. Flowers pistillate.

Excelsior is large, very firm. Flowers perfect. One of the earliest.

Gandy is large, firm, good flavor, late. Flowers perfect. One of the best.

Jessie, is very large, midseason. Flowers perfect.

Lady Thompson is large, early and productive. Flowers perfect.

Mitchels Early is small, soft, early. Flowers perfect. Very popular.

Parker Earle is medium size, late. Flowers perfect.

Ridgeway is large, midseason. Flowers perfect.

Sample is large, late. Flowers pistillate.

Senator Dunlap is medium size, midseason. Flowers perfect. One of the best.

Wawfield is medium size, early. Flowers pistilate. One of the best.

SOIL AND LOCATION.

The strawberry can be grown on any kind of fertile soil. There are varieties that are especially adapted to sandy soils and others are especially adapted to clay soils. The varieties most commonly grown in the west are capable of producing fair crops on any kind of fertile soil if the season is favorable and the plants are given good care. The soil should be well drained and fertile. If possible it is wise to start the strawberry bed on land that is free from weeds and grass. It is a good plan to give the bed a heavy dressing of well rotted manure and work it into the soil well before the plants are set. The strawberry bed will usually be located near the house and one of the best places is in one corner, or across the end of the garden.

SETTING THE PLANTS.

Spring setting has given the best results. Fall set plants seldom make much growth in the fall and the dry weather during the winter kills a great many and very materially reduces the vitality of the remaining plants. During March is the best time for the work of transplanting but the work can be done later than this, and under favorable weather conditions, the planting can be done as early as February.

The space between plants in the field depends upon the method of cultivation to be used and the purpose for which the plants are grown. If the planting is done for the purpose of supplying the home family with fruit in season, the plants may be set in one row as long as necessary, or they may be set in rows eighteen inches to two feet apart. The plants can be set much closer than this and the planting be a success. The closer planting, however, necessitates hand cultivation and more care and attention than does the planting where each plant is given more room. In growing the berries for market, the usual practise is to set the plants in rows three or four feet apart. The plants are set twelve to eighteen inches apart in the row. On good land, the plants can be set two feet apart in the row and they will fill the space between plants in the row before the following spring.

The general method is to grow the plants in a continuous or matted row. The plants are confined to the row and no further attention is paid to them. The greatest fault to be found with this system is that the plants become too thick in the row and the size of the berries is very materially reduced. This can be avoided by keeping the row narrow and by hand thinning the plants. It is a simple matter to direct the runners along the row and to clip them off as soon as a full stand of plants has been formed. If the grower desires to produce strictly choice berries, the plants may be confined to hills, and in this way the plants can be easily thinned, and the size of the fruit increased. The hill system of culture will not produce as great a quantity of berries per acre as the matted row system and comparatively few growers will give the plants the required attention to make the hill system a complete success.

The plants should be set in level, well prepared ground. The best plan is to set them by a line or mark. A garden trowel, or a flat dibble is the most convenient tool to work with. A spade or narrow shovel can be used but these tools are larger than necessary. The trowel should be thrust into the soil and then pushed to one side sufficiently to permit the plant to be placed in the hole before the trowel is withdrawn. The roots of the plant should be spread in a fan shape against the soil with the plant in a perpendicular position. The trowel is then withdrawn and set in the ground a little to one side and the soil pressed over against the plant. The pressure of the foot on the soil by the plant then finishes the work. Care must be exercised to see that the plants are placed at the same depth in the ground at which they grew in their original bed. Attempts to arrange the roots in the position in which they grew in the soil uniformly result in failure. If the roots are spread out in a circular form and an attempt is made to have the roots enclose a cone of soil, the plant will usually be set too low or too high and thus an uneven stand of plants secured. In setting plants in light, upland soil, the roots that are spread in a horizontal position are usually killed by drouth and are never of any value to the plant.

The roots of strawberry plants are usually of sufficient vigor to avoid the necessity of pruning. The plants that are grown on sandy soil produce very long roots and it is frequently a good plan to cut off the tip of the roots with a sharp knife before they are set. The roots

that are very long and slender will make a better start in growth if the tips are cut back. Roots that are cut back before the plants are set will start side roots and quickly form a good root system.

CULTIVATION.

The strawberry bed should be thoroughly cultivated the first season. The cultivation may be deep at the start and should be more shallow as the season advances and the roots of the plants spread. During the summer, the cultivation should be just deep enough to form a soil mulch and to keep down the weeds. The five shovel cultivator is one of the best tools for the cultivation work. The cultivator passing by the row will keep the runners in the row and avoid any hand work for this purpose. The cultivation should be continued in the fall as long as the plants continue to grow.

About the middle of December or the first of January, the bed should be mulched with clean hay or straw. Any kind of coarse litter can be used for this purpose but due care should be exercised to see that the mulch material is free from weed seed. The mulch should not be thick enough to completely shade the plants but just sufficient to protect them from repeated freezing and thawing and the dry winter wind. In the spring before the growth starts, the mulch should be raked from over the row and spread in the space between the rows for a mulch until the fruit has been gathered. The mulch should then be removed and the cultivation continued as during the previous summer. It is sometimes desirable to remove the mulch from the land when it is taken off the rows in the spring and cultivate the bed throughout the entire season. When the mulch is removed for the purpose of giving the bed clean cultivation, a small part of the mulch should be left on the ground and should be worked around the plants under the fruit. If some means like this is not employed to hold the fruit from the soil, a great part of it will become very dirty and unfit for use.

If the bed has grown up with weeds and grass during the summer, it is a good plan to burn off the patch in the late summer or early fall. This plan if judiciously followed will do much to free the bed from insect and fungus diseases. In large fields, it is sometimes advisable to run a mower over the patch before the burning is done in order that all of the old, diseased leaves may be destroyed.

The strawberry bed that is properly tended will bear a good crop

the second year after it is set. The third year should be a good crop year also and from then on the crop will deteriorate very rapidly. It is the best plan to set a new bed every year or every other year at most. The same piece of land can be kept in strawberries for a long time by letting the runners fill the space between the rows with plants and then plowing out the old rows. This practise however is not to be recommended as it makes the work of fighting strawberry pests double what it would be on new land. The strawberry should be grown on very fertile land as the work of manuring the land cannot be done well in a strawberry bed. If the bed is to be continued on the same land for more than three years, a good dressing of well rotted manure should be applied and worked into the soil.

GOOSEBERRIES AND CURRANTS.

The gooseberry and the currant cannot be grown successfully in Oklahoma. There may be a few especially favored locations where a few plants can be grown and fruited with some degree of success but these plants cannot endure the hot summers of Oklahoma when planted in the average garden. They grow best on cool, moist land and require clean, shallow cultivation throughout the season. The Downing is the most hardy gooseberry and should be the variety selected if an attempt is made to grow gooseberries. All varieties of currants tested have failed so completely that no one variety can be named in preference to the others.

PROFITS IN BERRY GROWING.

There are a few men in Oklahoma who have made a nice profit from their land and labor by growing berries for the local market. There are a very few others who have made a profit by growing and shipping berries to distant markets. The greatest gain to the people of the territory at large has been made by the men who have grown a good supply of good berries for home use. These men have increased the comforts of life in their homes and the farms are made more profitable and enjoyable. If there is a good local market for the small fruit, there is more profit in it to the average grower than in the best of the wholesale markets. The local markets do not require standard varieties, grading of the fruit, careful packing, or shipping quality of the fruit; all of which are required by the wholesale market. To meet

these requirements of the wholesale market frequently costs the value of the fruit and the shipper or grower loses the fruit and is compelled to pay freight or express charges besides.

If a grower decides to grow for the wholesale market, he must grow the kind and quality of fruit demanded by the market and pack it in the kind of package demanded and place it on the market in good condition. The grower should visit the market to which he expects to ship and there learn what is in demand and how best to meet that demand. This is a business in itself and can not be taught in books.

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DISEASES AND INSECTS, AND THEIR TREATMENT.

INTRODUCTION.

A number of diseases and insects affect the small fruits in this Territory, and the losses they occasion are often a serious drain on the fruit-growers' income. As fruit growing becomes old in any section of the country, the foes to it multiply. This is true of insects, and especially so of diseases.

The object of this part of the bulletin is briefly to describe the most important diseases and insects that attack these fruits, and to outline methods of treatment which experience has shown to be successful in holding them in check. The mass of matter contributed by our experiment station scientists is freely drawn upon, selection being guided by personal observation in the field, and by the degree to which they vitally concern the Oklahoma fruit-grower.

INSECTS AFFECTING THE BLACKBERRY AND THE RASPBERRY.

AFFECTING THE ROOTS.

Raspberry Root-borer or the Blackberry crown-borer. (*Bembecia marginata*.)—This insect has been introduced into some of the berry fields of Oklahoma. The adult is a good-sized clear-winged moth, black and yellow in color, with orange colored front wings. It resembles a very large yellow-jacket in a general way, but in reality is a moth. In the larva or worm stage, the insect (commonly called the

borer) is of a bright yellow color and measures about one inch in length. The head is a reddish brown and the jaws are black. The legs on the forward part of the body are brownish at the tips. It is in this stage that the insect does about all of the damage to the plant. The borer is found about the level of the ground, either in the canes above or among the roots below, sometimes completely girdling the root beneath the surface of the soil. The young are said sometimes to go up into the new growth.

Remedy: No better remedy can be recommended than that of cutting out the borer and digging up and burning the dead bushes. Other remedies, such as spraying and the use of bisulphide of carbon, have been recommended, but these are unnecessary when so simple a means of destruction as the above is at hand.

AFFECTING THE CANES.

The Raspberry and Blackberry Cane-borer. (*Oberia bimaculata*): The adult form of the cane-borer is a slender, cylindrical beetle, of a black color with a yellow band back of the head. The beetle is about a half an inch long and is provided with long feelers or antennae. During May or June the eggs are laid in a characteristic manner. New growth of cane is partially girdled in two places about an inch apart and the egg is laid in a puncture midway between the two girdlings. The cane drops off above the top girdle, and the portion remaining withers and dries, giving favorable conditions for the development of the egg. After the egg hatches, the little yellow, brown-headed larva begins to bore down the stalk, feeding on the pith and passing the winter in the tunnel, or bores on down into the root. The next spring the insect emerges as an adult in the beetle form.

Remedies: The wilted or fallen appearance of the young shoots, due to the girdling and puncturing, makes it easy to recognize where this pest has done its work. The shoots should be cut off below the punctured part and burned. The canes should be watched during the summer and if any are found to be wilting, they should be cut out close to the ground and burned.

The Red-Necked Agrilus, or The Maker of the Gouty-Gall. (*Agrilus ruficollis*): About pruning time galls or swollen places are often noticed on the canes; the swollen places are usually badly cracked. On paring off the outside skin spiral tunnels are found beneath, caused

by the larva of a little beetle about a fourth of an inch long. This larva, or grub, is white and flattened, with a wide prothorax, or neck, and a forked tail. The adult form of this insect is a slender beetle, bronze in color with a reddish-bronze prothorax, or neck, which latter gives it its name. The pest works in both wild and cultivated plants, but seems to prefer the wild ones.

Remedy: Cut out the galled plants when pruning, and burn. Good fruit cannot be obtained from galled canes, so there should be no hesitancy in cutting them out.

The Tree-Cricket: The tree-cricket lays its eggs in a characteristic manner in the blackberry and raspberry canes, and also in young twigs of peach trees. Long rows of punctures, from one to several inches in length, will appear along the side of the cane, where the insect has inserted her eggs. The damage to the cane is the splitting that always ensues along these lines of punctures. The little cricket which causes this trouble is light colored, very delicate, and has good sized wings. They do no other damage, and if not in large numbers may be ignored.

Remedy: Burning the punctured canes before the eggs hatch will insure against damages the following year.

AFFECTING THE FOLIAGE.

Saw-fly. (*Selandria rubi*): During April and May the raspberry saw-fly appears among the canes of this plant. It is a black, four-winged fly, the abdomen being tinged with red. The fly lays its eggs at this time within the leaves, generally near the vines. The worms or larva that hatch out are at first very nearly white, but later become dark green, and are densely covered with green spines. The worm measures about three-fourths of an inch in length. They sometimes occur in great numbers and eat numerous holes in the foliage, especially of the red raspberry. The foliage may be almost entirely devoured. The worms go into the ground to change into the adult or fly stage.

Remedy: These worms readily succumb to any of the poisons, such as Paris green, hellebore, or pyrethrum, but unfortunately the canes are in bloom at that time and if enough poison is used to kill the slugs, the bees, necessary for fertilization, are destroyed. Kerosene emulsion has been used successfully, but care must be exercised in its use to be effective—to see that each larva is struck with the emulsion. Hand picking of the worms has been practiced with good results.

INSECTS AFFECTING THE DEWBERRY.

(See insects affecting the Raspberry and Blackberry.)

INSECTS AFFECTING THE STRAWBERRY.

AFFECTING THE ROOTS.

The Strawberry Root-borer. (*Typophorus canellus.*): The strawberry root-borer works on the strawberry during both its beetle and worm-stages. The full grown beetles appear in large numbers in April and May, and are about one-eighth of an inch in length, stout, highly polished, generally brown with four black spots on the back, and feed on the leaves, later laying eggs in the ground. The larvae that hatch from the eggs, in the course of a few days, are minute white grubs, about one-eighth of an inch in length, with a reddish-brown head. This grub feeds on the roots, causing the plants to wilt and die.

Remedies: When the beetles appear in the spring, and the plants have not formed blooms and there are no sets or fruit present, the plants may be sprayed with Paris green. If blooms are present, hellebore may be used. Ground infested with the strawberry root-borer should not be reset to strawberries for several years.

June-bugs, May-Beetles, or Dor-bugs. (*Lachnosterna spp.*): The common June-bug, May-beetle, Dor-bug, etc., feeds in the adult stage on various trees and shrubs. The eggs are laid in grass land in June and the grub that hatches will feed upon all sorts of vegetation. When numerous enough, these common white grubs will devour the roots of grasses to such an extent that the sod can be rolled back like a carpet. They work sad havoc among the roots of strawberries. The grub requires two years to develop, and passes the pupal, or resting stage, in the ground.

Remedy: Late fall plowing breaks up the pupal cells and exposes the larvae and pupae to their enemies. Since they thrive in sod land, it would not be well to follow sod or grass land with strawberries.

AFFECTING THE FOLIAGE.

The Strawberry Saw-fly. (*Harpiphorus maculatus.*) The strawberry saw-fly is a four-winged fly which appears in the spring and de-

posits its eggs in the tissues of the leaf or stem of the strawberry plant. The eggs hatch in a short time and the worm-like larvae begin to feed upon the leaves, gnawing small circular holes. When mature they are pale green worms, about three-fourths of an inch in length. It requires five or six weeks for the development. The larvae after maturing, go beneath the surface of the ground, where they pass into the resting stage and later emerge as adult flies. The worm is easily recognized by its numerous legs. There are twenty-two legs, which distinguish it from the caterpillars of moths, none of which, living on the strawberry, have so many.

Remedies: Hellebore may be used to poison the worms, if the fruit has set, while Paris green may be used before or after the fruiting season. Dry slacked lime sifted on the worms will kill them. The skin of the larvae is sticky and tender, and the lime will cling to it and act as a caustic.

The Strawberry Leaf-roller, (*Phoopteris comtana*:) The adult of the leaf roller is a small brown moth, about one-half an inch in length, with black and white markings. The moth comes early in the spring and lays its eggs upon the leaves of the strawberry. The larva or worm which hatches from the egg is yellowish green when full grown, nearly one-half an inch in length, and very slender. The effect of the feeding of these worms upon the leaves causes them to curl up tightly into little clumps, which are bound up by silken webs. The soft tissue of the leaf is eaten and what remains turns reddish-brown and gives the plant a burned appearance.

Remedies: Spray the plants with Paris green or London purple after the fruit has been gathered. Two applications may be required. Since the first brood passes the resting stage in the rolled leaf, cutting and burning the foliage will practically exterminate the pest.

DISEASES OF THE RASPBERRY AND THE BLACKBERRY.

Anthraxnose; Cane rust. (*Glaeosporium necator*.) This fungus attacks, not only the young canes of raspberries and blackberries, but also dewberries. It appears during the latter part of May and June upon the lower parts of the cane. Circular or oval spots with gray centers and purple rims appear upon the canes. Later the affected areas may run together, causing a sunken and cracked condition of the cane, not infrequently causing its death. The leaves are frequently attacked, but with no such serious results. When the disease extends to the

fruit stems further development of the berries is stopped, giving them a dried-up appearance.

Treatment: The best treatment which can be now recommended is to spray the bushes thoroughly with copper sulfate solution before the buds swell in the spring, and to follow this, every two weeks until mid-summer, with thorough sprayings of the Bordeaux mixture. If this treatment does not hold the disease in check, cut off all of the growth close to the ground during the fall or spring and burn it. If the new cane the following spring is sprayed as above described, the disease will be so reduced that but little will appear during the next few years. This method means the loss of one year's crop and it might be more advisable to pull up the entire plantation and set a new one, composed of less susceptible varieties, upon other land.

Orange rust; Red-rust. (*Caecoma luminatum*.) This is a fungus disease which attacks blackberries and raspberries, and when a plant is once infected it cannot be cured. The presence of the disease is recognized by the copious production of orange colored masses of spores on the under side of the leaves of diseased plants. This condition is preceded by a condition of the plant in which the leaves are smaller with a pale green color, distinguishing them from the healthy tissues.

Treatment: Digging and burning of affected plants is the only practical remedy yet known. Spraying the foliage with a fungicide to prevent the entrance of the fungus into the leaves might be followed by good results.

DISEASES OF THE DEWBERRY.

(See diseases of the blackberry and raspberry.)

So-Called Winter Killing of Dewberries: In the early spring the dying out of dewberry vines has been a common complaint. It has generally been attributed to winter killing, but weather conditions have not been proven to be the cause of the death of the plants. Unknown fungus diseases play a large role in the so-called winter killing.

Treatment: The following procedure has been recommended by F. D. Chester, of the Delaware Experiment Station: First, as soon as the crop is gathered, all the old canes should be cut close to the ground, collected and burned. Second, new growth should be cut back to short lengths. Third, new growth should be sprayed with Bordeaux mixture immediately after cutting and again at intervals of three weeks, with a total of three sprayings.

DISEASES OF THE STRAWBERRY.

Leaf Blight; Rust; Sunburn. (*Sphaerella Fragariae*). The first symptoms of this disease is the formation on the leaves, of small purple spots, which gradually increase in size until they are from an eighth to a quarter of an inch in diameter. This disease may appear at any time during the growing season. As the season advances, the spots turn from a purple color to a lighter reddish-brown, the edges remaining purple. Leaves badly affected turn dark and are of no value to the plant.

Treatment: Spray the plants with Bordeaux mixture, beginning as soon as growth starts in the spring and continuing the treatment through the summer, with the non-bearing plants; the treatment being made at intervals of three or four weeks. Bearing plants, if sprayed in the spring, and again when the blossoms first open, will be greatly benefitted. After harvesting the fruit, mowing off the old foliage, removing and burning it, will result in the destruction of much of the disease, and if the new growth is then sprayed at intervals of three or four weeks, until two or three applications have been made, good results will be obtained.

Mildew. (*Sphaerotheca Castagnei*.) This fungus appears on the berries and the surface of the strawberry leaves during the summer, covering them with a thin, white substance which resembles delicate cobweb. Leaves that are affected curl up and appear to be suffering from drouth. The disease is rarely serious.

Treatment: When the disease first appears, spray the plants with copper sulfate solution. Sulfur scattered upon the leaves and between the plants has been found to be beneficial in checking the disease.

SPRAYING MIXTURES.

The methods of preparing and using the sprays recommended for the treatment of diseases and insect attacks are given in bulletin number 64 of the Oklahoma Experiment Station, which may be had upon application.

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