

The Agricultural Experiment Station

OF THE

Colorado Agricultural College

Western Slope Fruit Investigation

1906

REPORT

Field Horticulturist

By

O. B. WHIPPLE

The Agricultural Experiment Station

FORT COLLINS, COLORADO

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The Western Slope Fruit Investigation.

INTRODUCTORY.

A delegation of fruit growers of Mesa county appeared before the State Board of Agriculture in December, 1905, and requested help from the Experiment Station in questions troublesome to fruit growers of that vicinity, especially along the line of plant diseases, insect pests, and, subsequently, damage from seepage.

The Associated Fruit Growers of Mesa county felt the need of the work sufficiently to pledge \$1,500 toward the cost of such investigation. The conditions surrounding the Experiment Station did not permit its funds to be used for that purpose. Realizing the immediate need, the State Board of Agriculture decided to appropriate money from other funds to carry on the investigation for the year 1906, until the meeting of the Legislature, with the expectation that the Legislature would enable the work to be continued.

The investigation in a general way was to include two men, a Field Horticulturist, and a Field Entomologist, with headquarters in Grand Junction, and subsequently seepage investigations were undertaken. The Field Horticulturist worked under plans prepared by Professor Paddock, and reported directly to him; the Entomologist worked in connection with the Field Horticulturist and also worked under the plans prepared by Prof. C. P. Gillette. The seepage investigations were under the direction of Professor Carpenter, and were carried on by Prof. E. B. House and Mr. F. L. Payne.

Under the instructions, every orchard in Mesa county was to be visited as soon as possible, and inspected, particular attention being given to spraying, pear blight, crown gall, woolly aphid and all orchard pests, cultivation, drainage and irrigation, and in fact, all orchard operations, and an orchard survey was to be conducted at the same time, and an endeavor to get the history of each orchard as far as possible. In this way, it is possible to find the causes contributing to successes and failures, and to decide what practices have proven most successful. Blanks were prepared for the study.

In the seepage investigation, a detailed study was to be made of the location of the seeped lands, and an attempt to determine the cause, in order to be able to prescribe a remedy. While it was expected that several years would be required, the scope of the work expanded, and with the development arising from experience, a smaller part was completed than expected.

The Field Horticulturist at Grand Junction is Mr. O. B. Whipple, who was transferred from Assistant Horticulturist at Fort Collins to take charge of the work. The Field Entomologist is Mr. E. P. Taylor, a graduate of the State Agricultural College of Fort Collins, and formerly Assistant State Entomologist of Illinois, and in the seepage investigations, Prof. E. B. House, of the Experiment Station staff, and Mr. F. L. Payne of Wichita, Kansas, who had before assisted in conducting similar investigations.

This is a report of the Field Horticulturist to the Director for 1906. It was not originally intended for publication, but it is believed it will be useful, and therefore is issued as a bulletin. The other related reports are in preparation.

It is desirable that the work should be carried on for a series of years and should extend as soon as possible to other fruit growing districts, as desired by Professor Paddock and the fruit growers of the Western Slope, and this continuation depends upon funds available for the purpose.

L. G. CARPENTER, Director.

Report of the Field Horticulturist for 1906.

O. B. WHIPPLE.

My time as field horticulturist has been largely devoted to the study of orchard conditions in Mesa county. During the season I have made two trips to Delta county to investigate the conditions there. I find it nearly impossible to divide my time to any great extent with other counties. After more experience in field work under these conditions the work can, no doubt, be carried on over a larger territory. Very little experimental work has been undertaken during the past season as it seemed best to follow conditions in the field one season that we might take up experimental work more intelligently the ensuing year.

In my work I have given special attention to plant diseases, cultivation, watering, pruning and the collection of data on the fruit industry.

The interest taken in the work by the growers has been very gratifying, and at no time have we experienced any difficulty in securing the co-operation of careful growers in carrying on experiments. The success of our work depends to a large extent upon this friendly co-operation of the fruit growers. Our correspondence with growers has not been all we desired but will no doubt increase as we become better acquainted and the plan of our work better known. Requests for information have been numerous but on account of the limited time spent in the office, some growers have no doubt become discouraged in trying to reach us by telephone. I have tried to spend as many evenings as possible in the office where I hope the growers will learn to find me.

The orchard survey work has not progressed as rapidly as we at first hoped it would on account of the time required for other investigations. This survey has been carried on in connection with other work as far as possible. This part of the investigations can no doubt be pushed more rapidly during the remainder of the year, and, while the summer season is the ideal time for this work, I think the object of the survey can be accomplished during the winter season.

PLANT DISEASES.

Observations on plant diseases have been very interesting and some important conclusions have been reached.

ALTERNARIA.

Experiments were undertaken during the season to determine the best method of controlling this rot which was thought to be damaging the fruit and foliage of Keiffer pear and Ben Davis and Gano apples. Three orchards were selected where severe injury was reported during the summer of 1905 and experiments outlined. Inquiries among orchard men led me to believe that a part of this injury, at least, might be due to spraying, and the experiments were planned with this point in mind. In one orchard a block of seventy-five Keiffer pear trees was selected and divided into blocks I, II and III. Block I was sprayed with Bordeaux mixture (3-4-50) on April 14th. The buds were well started at this time and were out far enough to expose the individual blossom stems. This block was again sprayed on May 8th with Bordeaux mixture (2-4-50), with 3 lbs. of arsenate of lead added to each fifty gallons of Bordeaux for the first codling moth spray.

Block II was sprayed on May 5th and 8th with Bordeaux applied at the same strength and with the same insecticide as used in block I, and was again sprayed with the same material on June 8th.

Block III was sprayed with arsenate of lead only, during the entire season. On July 10th block II was divided, and half was sprayed with arsenite of lime while the remainder and all other blocks were sprayed with arsenate of lead. A light rain followed and black blotches on the fruit were quite noticeable by the first of August. All other blocks sprayed with arsenate of lead during the entire season were perfectly clean. This indicates that the injury in the part of block II sprayed with arsenite of lime was due to burning.

In the second orchard a block of fifty Keiffer pears and a block of fifty Gano and Ben Davis apples were selected for experiments. The block of Keiffer pears was divided into two blocks and block I was sprayed on May 8th, or just after the blossoms had fallen, with Bordeaux mixture (2-4-50) with two and one half pounds of arsenate of lead added to each fifty gallons of Bordeaux. The brand of arsenate of lead used was of poor manufacture, and on May 23rd the check trees making up block II and sprayed on May 12th with arsenate of lead only, were found to be badly burned, while the foliage and fruit of block I showed no injury. The injury on block II was mostly to foliage though some fruits were burned, most of which dropped early. Block I was saved by the excess of lime in the Bordeaux which combined with the free arsenic in the lead. A good grade of lead was used on all blocks after this spraying.

Block I was again sprayed on June 9th with Bordeaux mix-

ture and arsenate of lead. No further signs of burning or *Alternaria* rot appeared on either block during the remainder of the season.

The fifty Ben Davis and Gano apples were sprayed with Bordeaux on the same dates as the pears, leaving the remainder of the orchard as a check. The owner being anxious to get the first codling moth spray on at the proper time, applied it five days earlier. Both blocks were injured severely by this first spraying with lead. Most of the injured fruits dropped early and at picking time no injury from burning or *Alternaria* was noticeable on the fruit of either check or sprayed trees. On the shaded portions of large trees sprayed with Bordeaux a slight russeting of the fruit was noticed but not serious enough to cause damage.

The experiments in the third orchard were practically the same, only on a smaller scale. A good grade of arsenate of lead was used and no injury from burning or *Alternaria* rot was found at picking time.

With these experiments, and after observations in many other orchards the following conclusions were reached:

First; that *Alternaria* is in most cases a secondary factor in causing the decay of fruit.

Second; that it does not seem to be able to gain entrance to the fruit through healthy tissue, unless it be in cases where it enters the core cavity through the calyx tube, but may follow any injury, as spray burn, bruises or worm holes. During the season it has been found under these conditions, as well as on blighted fruit spurs of the pear and in the germ cavity of peaches with split pits.

Third; that Keiffer pears cannot be sprayed with any degree of safety with other than a standard make of arsenate of lead. The nearer mature the fruit, the more liable it is to injury, and if possible, no sprays should be applied later than July 10th. With thorough spraying early in the season, applications later than this date are unnecessary.

Fourth; that if Gano and Ben Davis apples are to be sprayed with arsenite of lime, special care should be given to its preparation and a good clear day selected during which to apply it.

PEAR BLIGHT.

Pear blight has been severe on many varieties of pears this season and many neglected orchards are practically gone. Where reasonable care is given to cutting out affected limbs, most varieties are doing well. By very careful cutting, many growers are proving that pear culture is still profitable. A great deal may be accomplished, I believe, in selecting varieties. Comparisons made during the season of pear orchards seeded to grass with those under cultivation seem to show little difference in the amount of blight.

The Flemish Beauty, Clapp Favorite and Idaho, fortunately three worthless varieties from a commercial standpoint, should never be planted, as they blight badly. Not only this, but trees of these varieties should be taken out. While it is possible that these varieties may be worked over to other varieties to advan-

tage, it seems very probable from observations of the season that sooner or later blight will get into the trunk and kill the tree. So often does this seem to be true in the case of the Idaho that it would seem advisable to discourage the working over of this variety. Some of the commercial varieties which seem to be most free from blight are Keiffer, Anjou, Mt. Vernon, Garber, Howell and Seckel. Le Conte, Sugar, Bosc and Sudduth, four varieties not so well known, seem to be quite free from blight. Unfortunately when once attacked, Bartlett seems to suffer quite severely. Winter Nelis is fairly resistant, while Clairgeau seems to suffer severely from attacks in the trunk and larger branches. Persistent cutting out, I think, will do much to save the pear orchards. If it does not pay to cut out the blight, it does not pay to grow pears and owners of badly infested orchards should pull them out. Many growers pronounce their pear orchards the most profitable piece of land on the ranch, but these are men who cut out the blight. The general practice with these men is to cut out blight at least three times during the summer.

Blossom and twig blight in the apple seems to be on the increase and has attracted a great deal of attention the past season. It has not only caused a loss of crop, but a great deal of anxiety in regard to the future of the trees attacked. However, the only loss seems to be in the destruction of the crop before it has set, and the killing of whole fruit spurs carrying blighted blossoms. Only in a few sweet apples and in very severe cases has the blight done any damage to larger limbs. The general tendency seems to be for the blight to kill the spur back to the branch from which it springs and then die out. In especially bad cases in Tolman Sweet we have found branches of one and two year old wood killed. Even where the fruit spur is hardly more than a bud, it seems to be an exception for blight to do any damage to the branch from which it springs.

There seems to be some difference in varieties as to their resistance to blossom blight. All the sweet apples blight badly. The Ralls, Dr. Walker, Wealthy, Pewaukee and Jonathan are also subject to severe attacks. No varieties seem to be immune in badly infected orchards, but the Winesap, Gano and Ben Davis are as resistant as any. However it seems hardly possible to give definite lists, for there are exceptions, and the tables are often turned.

"Twig blight" is also bad in some varieties, as the sweet apples, Jonathan, Pewaukee, Red Romanite, Willow Twig and Transcendent Crab. In this case the blight rarely affects more than the current season's growth. Badly blighted pear trees neglected by the owner of the orchard or a nearby neighbor were often found to be the original source of infection in these badly blighted orchards. With more careful cutting out of pear blight,

I think the blossom and twig blight in apples would tend to decrease. Some growers have trimmed out all blighted spurs and, while it improves the looks of the tree enough to pay for the trouble, I hardly think leaving these spurs would increase the liability to attack the following year, as by mid-summer all blighted spurs are thoroughly dried and it would seem impossible for any hold-over blight to exist in them. I believe pear trees are, in the majority of cases, responsible for carrying the blight through to the next blossoming season.

PEACH MILDEW.

Probably owing to the unusual amount of rain during the early part of the season, peach mildew has been of more importance than usual. Losses from those of small per cents to those of total crops have been reported. Measures used in combatting this disease should be of a preventative nature rather than as a cure. After the fungus has once obtained a good foothold on the fruit, nothing can be done to save the peach. The fungus may be killed, but the flesh underneath refuses to grow and at ripening time we have a one sided peach or a peach with a sunken spot on it. The disease is capable of destroying a crop in a short time and prompt action is important.

Observations made in orchards where the attack was severe show that one thorough spraying with half-strength Bordeaux (2-4-50) will destroy the mildew. Thorough winter spraying of infested orchards with full strength Bordeaux should prove a very important safe-guard. The first appearance of the disease in early summer should be followed by prompt action on the part of the owner, and the orchard thoroughly sprayed with half strength Bordeaux. A week's delay in some orchards often means a loss of fifty per cent of the crop and two weeks a total loss.

GUMMOSIS.

Cases of Gummosis in peach trees have been found occasionally. Gum starts to flow from the trunk or larger branches during the early part of the summer and large drops are formed on the bark, often reaching an inch in diameter and are nearly as round as marbles. In severe cases the tree dies in the latter part of the season. While the number of cases reported need cause no alarm, the loss of a single tree in an orchard does not add to its value, and with reasonable care, I think the loss might be avoided.

While no large number of trees have been treated, experiments seem to show that a vertical slitting of the bark about the affected trunk or branch during the early stages will save the tree. Use a sharp knife for this work and do not be afraid of cutting too deep. Make the cuts about two inches apart. While I do not pronounce this a sure cure in all cases, it seems worthy of a trial on trees in the first stages. When the drops of gum reach the size of marbles, the tissues are broken down to such an extent that no practical method of treatment would save the tree.

ROOT ROTS.

Two apparently distinct forms of root rot are found. One form, which is proving the least destructive of the two, seems to show no preference for varieties, and confines itself to that part of the tree below the ground. The other seems to work exclusively on the Ben Davis and Gano, and the trunk as well as the roots are affected. The disease often extends upward into the large branches. The first indication of the disease is the appearance on the trunk of spots of a chocolate color. When peeled off the bark has a peculiar marbled appearance, the diseased portions standing out in sharp contrast to the healthy tissue. The disease soon kills the bark and it dries down to the wood, taking on a dark brown color. Two seasons are required for the disease to kill the tree. The first season the trunk is girdled and the foliage drops early. This early ripening of the foliage is often the most prominent symptom, and diseased trees can be easily picked out in the early fall. Trees showing an early bronzing of the foliage are generally found girdled by this disease. The second season the tree starts into leaf as the normal tree, generally setting fruit, and dies in mid-summer, the fruit and leaves clinging. The disease seems to be infectious, as the trees appear in groups, and in many cases it appears as though it were carried by water. When a diseased tree is found, several more are generally found in the same row. However, other varieties besides the Ben Davis and Gano may stand in the same row with diseased trees on either side and show no sign of contracting the disease. The fact that Ben Davis and Gano are very tender as regards the application of arsenical sprays has suggested to my mind that the trouble may be due to arsenic collecting about the crown of the tree and killing the bark. However, the fact that trees sprayed with arsenate of lead and arsenite of lime are alike affected, seems to be contrary to such a hypothesis.

Prompt removal of the trees affected seems at present to be the only treatment that can be suggested. Reports indicate that the disease has only been in the orchards two or three years at the most. Soil conditions seem to have no relation to the disease, as it is found on all kinds of soils.

CROWN GALL.

Only a few cases of crown gall have come to my observation in Mesa county, a few trees having been killed by it. A disease which appears very much the same and no doubt the same disease that is called crown gall by other stations, seems to be doing considerable injury to the *Vinifera* vineyards of this section. Rose of Peru seems to suffer most severely. Muscat, Tokay and Cornichon have been found affected, however. When the disease attacks the crown of the plant, death seems to follow in one or two years. When the canes are affected, growth seldom starts from above the gall, but new growth starts from below and the plant keeps alive, but bears very poor crops. While it is probably transmitted from plant to plant in the vineyard, this is uncertain, but observations in the vineyards seem to bear out the statement.

I think it would be well to remove diseased vines and give closer inspection to nursery stock. Under the present system, grapes are passed without inspection.

PHYSIOLOGICAL TROUBLES.

Many yellow pear trees are found in the valley. Observations seem to indicate poor soil conditions, probably due in most cases to excessive watering. The foliage takes on a yellow cast, and in the last stages the leaves become thickly sprinkled with small deadened spots and fall from the tree. The trees grow more enfeebled from year to year and are finally pulled out.

SMALL PEACHES.

Many growers claimed that their peaches did not attain the customary size while they were very sure that they had thinned as carefully as in previous years. There is no doubt some truth in the assertion and also a cause. The peach trees were severely frozen in most localities during the winter of 1904-05. Not only were the peach buds killed, but the wood was damaged to quite a serious extent. Many of these trees were not pruned as heavily as they should have been following such a freeze, and did not make

a good recovery. The winter of 1905-06 was less severe and the fruit buds passed the winter safely. While the growers thinned their peaches as carefully as usual, the trees, having failed to fully recover from the severe freeze in one growing season, were unable to mature the normal crop. Where severely pruned, the trees matured their crop well. Following severe freezes which injure the wood, it would be well to thin the first crop more closely.

COPPER SULPHATE INJURY.

Copper sulphate has been placed about trees with injurious results by some orchard men. When taken up by the roots the material blasts the foliage and causes it to fall. The most tell-tale effect is a blackening of the outer ring of the sap wood and cambium. When taken up by the roots in a concentrated form, the wood and bark near the base of the tree are killed in strips of varying width. Nearer the top where the material spreads more, the tendency is for the leaves to drop, and later a new growth starts. The upper limbs probably recover. The strips of bark on the trunk and limbs, however, seem to be perfectly dead.

The stock solution used in spraying with arsenite of lime, prepared by dissolving white arsenic in water and sal soda, is very destructive to plant life. The general practice of keeping this solution in the orchard under a tree should be discouraged. If a small amount is spilled, or if the vessel leaks, the material will soon kill the tree. In fact, it almost appears as though in some cases the material will kill peach trees when placed under them in an open vessel. The fumes given off when boiling this solution will kill trees without a doubt, and this boiling should be done some distance from the orchard. I have seen trees standing twenty feet from an open packing house door killed on the side next to the packing house in which the material was boiled.

Some Ben Davis and Gano orchards have shown a very sickly yellow color during the summer, and investigations have shown that the trees were suffering from arsenical poisoning. The trees were sprayed with arsenite of lime in which the quantity of lime used was deficient, or with an arsenate of lead which contained a large amount of free arsenic. The growth of foliage is scant and the color yellow. Though the material may have been used only once, the effect seemed to last through the season. There seems no reason to believe but that the trees will recover the coming season.

THINNING APPLES.

Experiments were undertaken in thinning apples during the early part of the season. An orchard was selected in which large

blocks of Jonathan and Winesap were carrying a very heavy load. The thinning was done in the early part of July. The apples were actually counted on some trees and a definite number left. Assuming that from 150 to 160 apples of these varieties make a box of fancy apples, the trees were thinned to produce from six to twelve boxes. The trees were eleven years old and the best results on the Jonathan seemed to come from trees yielding eight boxes, running about 160 apples to the box. Trees bearing more than this, run smaller in size and less uniform. The Winesap gave better results when thinned to about six or seven boxes. Trees of Jonathan thinned to eight boxes would yield 95 per cent or over fancy fruits as far as size and color were concerned. Unthinned trees which packed about sixteen boxes gave 50 per cent of small fancy fruit, but on the days the thinned trees were stripped not 50 per cent could be picked from the unthinned trees on account of poor color. At least 25 per cent did not reach a good color. Thinned trees which picked twelve boxes required two pickings and run on an average about 90 per cent fancy. These trees averaged about fifteen feet in height and had a twenty foot spread.

Observations will be made next season on the thinned and unthinned trees to determine the effect of thinning on the ensuing year's crop. The rule followed was to leave only one fruit on a spur and remove those from the tips of limbs. Observations on unthinned trees showed that apples on the tips of limbs seldom reach a good size.

GRAPE GROWING.

The associations and growers have complained of poor results in shipping grapes. The trouble seemed to be that they molded before they got to market. Correspondence was taken up with California growers and observations carried on in the vineyards during the season.

From California rules, and from my own observations, I believe the growers use more water than is necessary. In one case, I actually found the bunches shriveling from excessive watering.

The reason some varieties do not ship well is no doubt because they are not ripe enough. The short season does not give them time to thoroughly mature. The California people say a grape must be ripe to ship well. Another point, I believe, is carelessness in packing, in not cutting out injured berries nor allowing the stems to wilt. Grapes packed tight while the stems are stiff crack easily and this gives entrance to mold. Owing to the method of pruning practiced to allow of easy covering, many of the bunches come in contact with the ground and should be thoroughly dried before packing. Experiments have been taken up to determine a more

satisfactory method of pruning which will hold the grapes off the ground and still allow of the vines being easily covered. The general tendency seems to be to prune too short, and light crops of inferior bunches are the result. No varieties should be pruned shorter than four eyes, and the Muscat, Sweetwater, Sultana, Emperor and Thompson Seedless should be pruned to eight. Some system of training must be found which will hold the fruit off the ground. More care should be given to watering. Three waterings, I believe, are enough. Dry soil conditions should prevail during the ripening period.

As to varieties, the Flame Tokay and Cornichon seem best adapted to the Palisade region where early frosts do not strike. For the rest of this district, Muscat, Rose of Peru, Tinfadel and Chasselas Victoria must be used. Flame Tokay may succeed on early soil where the soil conditions can be well controlled. Thompson Seedless, Sultana and Sweetwater do well, but do not sell.

Grape mildew (*Uncinula spiralis*) has caused some loss in vineyards, and experiments have been started this fall to determine the best method of controlling it. One block was given a fall treatment of Bordeaux before covering, and other blocks will be sprayed the coming season and various fungicides tested.

Experiments were undertaken to show the value of sacking Vinifera grapes to protect them from rots and mildew and to improve their appearance. The cost of sacking was found to be about one-half cent per pound for most varieties, while those producing larger bunches can no doubt be sacked at one-half this cost. The earlier varieties seemed to fare very well in sacks, unless they were subject to cracking, as some of the more tender skinned varieties are. Bunches in sacks laying on the ground split and molded badly. For the late varieties sacking proved to be a failure as it retarded the coloring and ripening and seemed to give no protection from frost. The stems were frozen the first frosty night and the bunches wilted and failed to ripen. The Muscat and Thompson's Seedless did very well sacked and their appearance was much improved.

SETTING YOUNG TREES.

Practically all the systems of laying out orchards and planting young trees are used in the fruit sections of western Colorado. The distance of setting varies from 16'x16' to 30'x32' for apples and from 12'x12' to 20'x20' for peaches, but the experienced growers are giving the greater distance.

The practice of setting Missouri Pippin, as fillers, in with the standard varieties of apples is quite common. In the peach districts peaches are often used for the same purpose. I hardly think the practice is to be encouraged, as the average grower will not take them out

before they crowd. The tendency is to leave them in until the shape of the other trees is ruined.

Trees as a rule are not handled carefully in transplanting and a larger per cent is lost than is necessary. The most common method of setting is to plow a furrow and with a little additional digging, set the trees in this. For the first watering, the water is generally run through this furrow. It is then filled, or left open for other waterings. Many leave it open the whole season, but it is generally thought best to fill it in and water from the sides before the sun gets too hot. The practice of leaving this furrow open for most of the summer seems to give good results, but there is a tendency, I believe, to set too deep. I think it a very good method if the furrow is very shallow. The most common method of watering is to fill this furrow after the watering at planting time, and run new furrows on either side of the row and as close as possible. This system will give excellent results if the man who is irrigating sees that water passes all the trees properly. It is possible to water trees too often, however, and the man who is inclined to water too heavy should keep his ditches at some distance from the trees. With a scant supply of water, the system of watering in the original furrow in which the trees were set will give the best results. Young orchards are either cultivated, or planted to secondary crops. The most common secondary crops are cantaloupes, potatoes, corn, oats and white beans. Cantaloupes do well on the lighter soils but other crops are generally sown on heavy soils. Oats is a poor crop for the young orchard, as it is generally cut just in time to force the grasshoppers to eat leaves and bark from the trees before frost. The cutting of any noticeable growth in the orchard at mid-season is a dangerous practice on this account. On sandy soils cantaloupes are proving a favorite crop. The furrows for watering the cantaloupes should be as far from the tree rows as possible that late watering of the trees may be avoided. This is very important in young peach orchards. Many inexperienced growers water their peach trees too late, and as a result, have them killed back during the winter.

Young trees are seldom pruned carefully enough after the first year, and long, willowy branches which bend to the ground with the first load of fruit is the result. Greater distance in planting should be urged and more care in regard to the forming of the young tree. Too many second class trees are set, the growers failing to realize that a poor tree is dear at any price.

GENERAL ORCHARD CONDITIONS.

It is a general practice among orchard men to water too much and neglect cultivation, and often the soil is handled very poorly. A large per cent of the soil is rather heavy to be handled well under

irrigation, and with the method of watering commonly used, it is often impossible to touch these soils with the cultivator from the first watering in early summer until the following spring.

It is often the case that shallow furrows and a large head of water are used and the result is a flooding of the whole surface. When dry enough to work again, the soil has run together and the surface is so hard that it is impossible to cultivate it, and the grower resorts to frequent watering to keep the orchard going. In these soils the water settles slowly and a smaller head run in deeper ditches would no doubt prove more satisfactory.

I think growers with these heavy adobe soils should also resort to the planting of cover crops to improve soil texture. They could gradually be brought into shape where they could be more easily handled after irrigation. Growers, as a rule, pay too little attention to the sub-soil. Too often, the rule followed is, if you can kick up dust on the surface, irrigate. The appearance of the tree indicates to a great extent its needs, but after all, it is an examination of the sub-soil which most surely determines whether the orchard needs water or not.

General rules which it might be well for growers to follow in applying water are as follows:

The more sandy the soil, the greater the number of ditches, the shorter the run in both time and distance.

The longer the ditches, the larger the head.

The stiffer the soil, the fewer and deeper the ditches; the longer the run in time and distance, and the smaller the head.

PROBLEMS FOR THE ENSUING YEAR.

Some of the problems for the coming year as brought out by this season's work are as follows:

Pear Blight and its control, giving especial attention to the form known as blossom blight in apples.

Peach mildew and the effects of lime-sulfur wash as a winter spray in comparison with Bordeaux mixture.

Grape mildew (*Uncinula spiralis*) and its control and the effect of winter and summer spraying.

Observations on grape growing in general with reference to watering, pruning, packing and shipping.

Further study of the root-rots of apples to determine, if possible, the causes and remedies.