

THE S I S
on
THE IRRIGATION OF BEARING ORCHARDS
in
JACKSON COUNTY, OREGON.

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by

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APPROVED

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Department of

The IRRIGATION OF BEARING ORCHARDS

in

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The soil, moisture and climatic conditions of the Southwestern part of Oregon are of such a nature as to make the Country excellently adapted for the production of many kinds of fruit. The soils vary greatly in characteristics, being spotted with areas of widely differing kinds, ranging in texture from a loose granitic formation to a very heavy adobe. With these differences in composition, and the varying depths of soil in places, their waterholding capacity is quite variable.

Although good crops of fruit are produced without irrigation, the application of water is not to be encouraged only where it is absolutely necessary in order to mature a crop. Generally it is not practiced, but on some soils and during dry seasons the use of artificial water is indispensable. Only a small number of growers are using water at present, and it is doubtful if the number is increasing. On account of the close proximity of trees in the rows, slope of land, depth of soil, lack of proper cultivation, or failure to retain the winter rains, irrigation is quite frequently needed.

The methods used in this Valley for handling the water are, for the most part, defective. A large

percentage of the water is lost from the canals by evaporation and leakage, which, by improved systems and better constructed ditches, can be greatly diminished. The better methods of applying water to the soil are being employed and the irrigators are learning to use water in a more judicious manner. When an excess is applied, and in places where water accumulates, some system of drainage should be installed to prevent water-logging of the soil.

For the purpose of determining the number of applications, frequency of application, and amount of water to use for the best results in orchard irrigation, the experiments were carried out that gave the results enumerated in this paper.

The small, percentage of Orchards of Jackson County, both large and small, that are of bearing age are located at random in almost all parts of the country. Although the land is quite spotted nearly every kind of soil in the Valley is growing Orchards that are producing apples. The adaptability of this kind of fruit to the soil and climatic conditions is such that Orchards are growing with little apparent difference from 1200 to 2000 feet in altitude. They are also located on land which slopes at many angles and in almost every direction, and all are within convenient hauling distance from the several stations along the line or tributaries of the railroad which bisects the principal fruit growing districts.

The industry of apple growing in this country starts with the first settlers who found fruit trees to do well. The older Orchards, several of which cover from three to fifteen acres, are still vigorous and productive at 18 to 30 years of age. Those that have been given proper care are in their prime, while others bear evidences of neglect and careless treatment.

All the Orchards that are six years of age, and above, are regarded as bearing Orchards. This class constituted about 36% of the trees in the Valley in 1907.

The universal error of setting trees too close together is emphasized in almost all the older plantings. The trees, which, at from 10 to 30 years of age should be in the prime of condition are becoming badly weakened, and their growth and productivity seriously thwarted because they were not given ample room to develop properly. They have for years been combatting with each other for supremacy in the small area which each requires, but owing to their equally balanced durability all are able to hold out although seriously weakened. Of recent years the orchardists have observed this mistake and have partly corrected it by planting the trees at greater distances, but still some are giving them insufficient space. The roots of vigorously growing trees 14 years of age will meet in the center of the squares when set 30 x 30 feet. The matter

of placing the trees so they can have ample room to feed is very important. When the area is too limited the food supply is soon exhausted, and if moisture is scarce the land is likely to require irrigation. Many of the old Orchards need to be irrigated because the land that they occupy is incapable of storing up enough moisture to afford the trees an ample supply during the season. On the other hand, if they had been spread over a larger area as is not the practice, it is probable that irrigation would not have been needed.

Cultivation also exerts a very strong influence upon the moisture content of the soil. Where it is properly carried on it can quite often be the means of preventing the use of irrigation water. Cultivation performs two functions in its relation to the conservation of moisture. By deep culture, as by plowing, etc., the storage capacity of the soil is increased and hence a greater amount of water is taken up in the winter and held; by keeping a mulch on the surface during the summer evaporation is diminished, the ~~air~~ moisture is retained in the soil and kept available for the trees.

In every instance where cultivation can take the place of irrigation it should be made to do so. The rainfall of Jackson County, which is 35.12 inches at Jacksonville, is ample for fruit production if it is properly stored and conserved. By keeping the soil loose and porous so that the rain and snow water will

enter it instead of running off, a sufficient quantity can be retained. When once incorporated in the soil it must be held, and the proper way to accomplish this is to begin cultivating as early in the spring as it is practicable.

A very good practice is to plow either in the fall or spring. This is quite important in soils of clayey or adobe nature, for by so doing they are loosened up and kept porous, thus making it easier to work, and at the same time increases their water-holding capacity. Almost all farmers and orchardists make the mistake of allowing the plow to run at the same depth each year. The tramping of horses in the bottom of the furrows and the dragging of the plow over the same soil for years creates a hardpan, or plow sole, which prevents the water from percolating downwards as it should, and hence affects the storage of water in the soil. This undesirable condition can be overcome by plowing at different depths each succeeding year; start at 4 or 5 inches and plow 1 or 2 inches deeper each time until a depth of 10 or 12 inches has been reached, then repeat. In old shallow-planted Orchards care must be taken to not tear out too many roots by plowing deeper than has been the regular practice. If severely injured the trees will be so weakened as to prevent their bearing normal crops of fruit until they regain their vitality.

The best results are obtained by systematic cultivation continued throughout the year. Instead of working the ground for a while in the spring, then dropping it, the fall or spring plowing should be followed up as soon as the ground is dry enough by a thorough stirring and pulverizing of the surface. A soil mulch, or layer of dust, should be formed by thorough working and maintained all summer by frequent stirrings. The Orchard should be gone over at intervals of ten days or less and this top soil stirred and the mulch gradually deepened as the season progresses. After August 15th cultivation is usually discontinued and the soil allowed to dry out. This is done to cause the trees to rippen their wood and be prepared for the winter.

By constant cropping and clean culture as is the common practice among Orchardists, the fertility of the soil is rapidly depleted, and if nothing is done to prevent it, the land will become weakened to such an extent that the trees begin showing effects of starvation. At the same time the humus disappears from the ground and it becomes more tenacious and harder to cultivate. No tiller of the soil should permit such a condition to exist on his holdings, for when once established it is difficult to overcome, and is also a slow and frequently expensive operation.

The most successful remedy and means of prevention is the growing and working of cover crops into the soil.

Barnyard manure is quite successful when it can be gotten in sufficient quantities, but their application entails more expense than is required to get the same results from growing crops on the ground for that purpose. Commercial fertilizers can be used to supply food for the trees, but they do not benefit the physical condition of the soil, and are often quite expensive.

The constant drain that is made upon the resources of the soil by the trees must be replaced at frequent intervals, and since these soils are well supplied with the mineral elements, it is organic fertilizers that are in the greatest demand. Cover crops sown late in the August, or during September, will come up after the first rains in the fall and make sufficient growth to become well established before winter sets in. When spring opens they grow very fast, and will be from 12 to 16 inches tall by the time they should be cut up and worked into the soil, which is usually during the following April.

If this problem is taken up when the Orchard is still young and properly carried out with good cultivation there need be no fear of the soil becoming exhausted, and at the same time it is kept loose and cultivation is made easy. The humus in the soil helps to keep it loose and friable, and also acts as does a sponge in holding water. The humus present in a soil

determines, to a greater or less degree, the amount of water that it is capable of retaining. Where clayey land, devoid of humus, packs and allows the water to run off, the presence of organic materials like the partially decomposed remains of plants promote the entrance and retention of this moisture. In sandy and gravelly soils, devoid of fine particles humus assists in binding them together, and also in increasing the water-holding capacity of the soil. Some of the soils of this region which now require irrigation, if properly supplied with this much needed organic matter and well cultivated can be made to yield good crops without need of irrigation.

Although a part of the Rogue River Orchards are well cultivated there is still room for improvement in these, and by far the greater number must be given more and better attention if satisfactory results are to be derived from them.

Too many people plow and harrow their land over and over for years, and when asked why they do it are not able to give any logical reason, except that they wish to keep it mellow. No one can expect to do a thing properly unless he knows just why he does it and how to do it correctly; so it is time that every Orchardist should know why he cultivates and how to do it, and then put it into practice.

Irrigation is more or less of an artificial pro-

ceeding and should be avoided only when it is absolutely necessary.

It is quite often necessary to practice irrigation on some soils in a locality, while the others do not require it. Many of the old Orchards are planted so close that it is not possible for the land upon which the trees stand to retain an adequate amount of water to yield to them for the proper maturing of their fruit especially when they are bearing a heavy crop. The depth of soil is quite often insufficient to permit it to hold any quantity of moisture. To keep in storage sufficient water to successfully mature a crop of fruit the soil must be quite deep. If shallow, as the dessert lands of Jackson County are, the rain waters are unable to find lodgement, and run off; the soil is loose and gives up its small amount of moisture at a rapid rate--under such conditions irrigation is indispensable. When, by improper management, the soil is allowed to loose its moisture the addition of a new supply of irrigation is frequently necessary to prevent the loss of the crop.

The Rogue River Valley is blessed with an abundant supply of water. Besides the 1743.24 cubic feet per second which flows in this River above Gold Ray dam during the lowest stages of the stream, various parts of the country are underlaid with a strata of flowing water which is close to the surface and can be

economically pumped. Still another source of supply is that of artesian water. Near Talent there is one of these perpetual streams which flows 9 1/4 miners inches and irrigates 40 acres of bearing apple orchard. Although not completed there is another in the Valley flowing a small stream which shows that this water can be gotten in quantity.

The available amount is far in excess of the amount that would be required to irrigate the entire tillable area of the country, and since considerable of the land does not require irrigation, the problem before the people is to secure a right to, and get water onto that land to which it can be profitably applied. Although there are at present four ditches in operation, only 2% of the available flowing water is being used. Three of these ditches are small and cover very limited areas, but the fourth is larger than all the others combined and is carrying water to a considerable area of land. This latter one is supplied by Four Mile Lake and Fish Lake near Mt. Pitt, and takes its water from Little Butte Creek some 25 miles from the heart of the orchard district near Medford. It was the plans of the Fish Lake Ditch Company, which has recently disposed of this ditch, to enlarge it so as to cover 40,000 acres of land, and it is the aim of the present owners to do even more. Very few districts requiring irrigation are as fortu-

nate as the Rogue River Valley in having such a large supply of irrigation water so near at hand.

For the most part, the canals now in use are of a very inferior quality. They are long and tortuous, and are thickly beset with wide shallow places, and at many points along their course the leakage is heavy. The best of earth canals, even when the inside is well puddled, loose about 52.2% of their flow; ordinary canals loose from 60 to 90 %. From the large amount of evaporation and leakage that is constantly going on along the line of these ditches it is possible that they do not convey over 30% of the water that is diverted from the streams to the soil in the irrigated fields.

The methods of measuring are also very crude and inaccurate. Under the old management the water was sold from Fish Lake Ditch to the consumer at the rate of \$2.50 for each acre irrigated, and the grower was permitted to use as much as he desired. Under the present control the water is to be sold by measure, so much per cubic foot, or acre foot, which, besides being the fairest and most economical way of apportioning it, is a great factor in preventing excessive use of the water. It is a peculiar trait in human nature to take all that can be gotten for the money. This is demonstrated in the general practice of irrigators who are permitted to use all the water they want per acre. They are likely to overdo it and suffer from the affect

of excessive irrigation. Although much cheaper in the beginning the poorly constructed ditches are in the end of greater cost to the owner than if built well. The loss in revenue from wasted water is what keeps many ditch companies from prospering, and it is not infrequently the means of their failure.

To know when to apply water to the soil is very important. Some Orchardists apply it at certain times regardless of climatic and soil conditions, while others wait until the trees begin to wither before irrigating. Neither method should be practiced, for the first is very uncertain and the second is a serious mistake. No plant should be allowed to show the need of water, for when it is so affected by drouth it is severely injured and does not readily regain its former health. Over irrigation, as well as insufficient amount of moisture, hinders the normal growth of a plant; so, a tree might become diseased by neglect in either under or over irrigation.

The proper time to apply water to the soil is hard to determine, but the best guide is its condition as observed by digging down below the surface for 6 inches or so and testing it. When the soil, from 6 to 10 inches in depth, becomes too dry to cohere when pressed together in the hand, it is time to irrigate. If applied at this time the water will reach the roots of the tree before it is affected by a shortage in the supply.

Quite a number of methods are employed in irrigating different kinds of crops to get the water onto the land, but for orchard work the rill or ditch method has proven the best. Flooding is to be discouraged for it is wasteful of water and wets the entire surface of the ground, a condition which is highly undesirable for this allows the land to bake when the water is turned off. In no case should the ground be allowed to puddle or bake and become hard, for besides giving up moisture at a rapid rate, it quite materially injures its physical condition, making it hard and lifeless and difficult to work.

Some Orchardists prefer several shallow ditches to two or four deep ones in the space between the rows. The former method allows the surface soil to become wet in a short time, and the water is often turned off before it penetrates well down to the roots. The result is that they are induced to grow toward the top of the ground where they frequently become dried out. When a few deep ditches are used, and the water allowed to flow longer, it has sufficient time to percolate downward and fill all the soil occupied by the root system of the tree. The water is much easier to control in the deep furrows, and less of the surface soil is wet, hence a smaller amount of injury is caused by baking. Less water is required to attain the same results in the latter method for the top two inches is not filled

to be immediately lost by evaporation.

Frequent light applications are seldom a success in orcharding, for sufficient water is not applied to thoroughly moisten the entire feeding area of the roots, and, as a result, parts of the root system are unable to thrive. By rushing the water over and wetting the surface, the roots are many times caused to grow upward where they are subjected to more uneven moisture conditions, and are often destroyed by plowing. One good liberal application of water that will permeate all the soil to several feet in depth is quite often sufficient to mature crops.

Care should be taken when irrigating heavily to not use too much water. An excess of water in the soil is very injurious to the growth of plants, for it crowds the air out, and hence hinders the soil bacteria in their work which is the breaking down, or reducing of unavailable forms of food to available forms for plants. A continued excess of water in the soil causes a condition known as water-logging. where this exists apple trees do not thrive, as is shown in Plat 8, Table 1.

The same care should be exercised to retain the moisture after an irrigation as to hold the winter rains during the summer. Every irrigation and shower of rain during the summer months should be followed by a thorough stirring of the surface layer to break

up the capillary tubes and prevent its escaping by evaporation.

In almost every irrigated district drainage becomes necessary on a part of the land. In places where irrigation is only practiced on a few farms located in almost as many different neighborhoods, as is true of the Rogue River Country, artificial drainage is seldom required. Where several farms lying together are irrigated, wet and seepy places will develop and drainage becomes necessary as a means of controlling the moisture conditions and freeing the soil of an excess of water.

The kinds of drains in common use vary greatly in cost and efficiency. Where rocks are plentiful they can be used to advantage by placing them in ditches and covering them over; inverted "V" troughs are used to a limited extent in the same manner; but, although not the cheapest, the tile drains are unquestionably the best since they last indefinitely, and when properly put in seldom cause any trouble. The texture of the soil and depth of placing has considerable to do with the number of drains required. In land of a heavy clay or adobe nature the drains must be placed much closer than in ground of a loose, sandy or loamy character. The heavy soil do not permit the water to move as fast as the others, so if not placed fairly close they will fail to drain

the land before some damage is done.

In the adobe soils of Southern Oregon, tilling will give the best result if placed from 3 to 5 feet deep, and 20 to 30 feet apart. In the looser soils they do fairly efficient work when laid 30 to 40 feet apart. The cost of tiling land varies considerably. Three inch tile when placed 20 feet apart costs \$31.68 per acre, and when the drains are put every 40 feet the expense is about one-half that amount, the present quotations being \$15.00 per M for 3 inch, and \$20.00 for 4 inch. With 3 inches of fall in 100 feet a 3 inch tile will carry 21 gallons of water per minute, with 1 foot of fall, 60 gallons. With the same fall a 4 inch tile will carry 36 and 108 gallons, respectively.

Besides freeing the soil of excessive amounts of water these subterranean channels afford a means by which air finds its way up from them to the surface, and by so doing greatly benefits the land. Aeration of the soil which is accomplished by cultivation and by instillation of tile drains is an operation of considerable importance for it assists in the oxidation and subsequent setting free of quantities of plant food that are "locked up" in the ground.

EXPERIMENTS.

The following experiments were outlined for the purpose of investigation, and to solve, if possible, some of the more perplexing problems that have for some time confronted the fruit growers of this country who have been obliged to resort to it have found themselves confronted with numerous difficulties. It has been their desire to begin properly and make their work a success from the start, but were unable to do it. Some preferred flooding to the furrow system of applying the water; frequent light applications of water were in some instances preferred to one or more heavy irrigations, and as a result each grower was experimenting along the line which appeared best to him. After several years of this unsystematic work they were unable to arrive at any conclusion as to the best routine to follow, so these experiments were planned to meet the demands of the people, and work out for them the few most important problems with which they are dealing.

During the summer of 1908 the writer carried out two experiments, the results of which are given here, each of these two large experiments is divided into several parts which make a total of fourteen small ones.

Experiment 1 which consists of 8 small plats of ground, each with several trees has one plat which received no irrigation; another, which had standing water

near the base of the trees during the entire summer; the other 6 were each irrigated once at different dates with an interval of 15 days between each succeeding operation. The first was irrigated July 1st; the second July 15th, etc., throughout the entire season.

Experiment 2, which was outlined in 5 parts was carried out in as many orchards. In each case part of the trees secured were set aside as a dry check, and no water was applied, but they received good cultivation; the other parts were irrigated 5 times and cultivated after each application. Several kinds of soil were encountered and the action of water on each was noted in this experiment.

Measurement of Water.

The Miners Inch system of measuring was employed in determining the amount applied at each irrigation. Boxes were constructed in such a manner as to allow the least possible friction or retardation of the water in flowing through the graduated opening. Six inches of pressure was maintained under which condition a hole 1 inch square allows approximately nine gallons of water to escape during each minute of flow. Complete and accurate notes were kept of the amount of water applied, and the resulting data is as near correct as can be gotten by the method employed. Although not generally used for large amounts of water, this system of measuring is fairly accurate and is the most convenient to use in determining the extent of

of small streams. This is especially true in this particular work, for the equipment required for other systems, as the trapezoidal or rectangular weirs, is much harder to install, and more difficult to move about.

The box was placed near the pat to be irrigated and the water raised sufficiently to pour into it by being run on small levees or through short flumes.

Experiment 1,---To Determine the Best Time to Irrigate Bearing Apple Trees, assuming that but One Application is needed.

For this purpose 2 rows were secured in Block 1 of the Talent Orchard Company's Orchards at Talent, Oregon. These trees, 52 in number, were divided into 8 groups or plats and numbered. The first one being at the lower side of the Orchard, and the 8th one which included only 2 trees, was near the artesian well that supplies water for the entire tract. The trees used in this experiment were of the Yellow Newtown variety, eighteen years old, and were set 50 feet apart, which is a very liberal distance for that district. They are large and spreading and are quite vigorous and productive. This locality is characterized by a deep, black, gravelly clay-loam soil which is underlaid with a porous yellow clay; it is well drained and gives the trees a large area through which the roots can spread and gather food materials.

The part of the Orchard in which the experiment was conducted was not plowed until late, but received good

cultivation after plowing. After each of the first 5 plats were irrigated the entire Orchard was cultivated with a springtooth or dragharrow, but after September 1st only plats 6 and 7 were cultivated, and the work not being extended to the rest of the Orchard for fear of keeping the trees growing too late in the season.

Not all the trees in each plate were used in figuring up the yield, for some were of other varieties, and a few produced a very short crop, which made it impracticable to figure them in. Some difference was noted in the time of ripening which indicated that the un-irrigated check and those that received water earliest in the season matured their fruit a little ahead of the others. The fruit hung on well, and the large number of windfalls shown in some places in Table 2 is partly due to carelessness of some of the pickers.

Table # 1.

Number of Plat.	Amount of Water.	Dates Applied.	Apples Picked.
1			Oct. 27.
2	60480.00 Gal.	July 15-14	Oct. 27.
3	63874.08 "	" 28-29	" 28.
4	97386.72 "	Aug. 13-14	" 28.
5	73350.72 "	" 28-29	" 28.
6	76917.60 "	Sept. 11-12	" 28.
7	71280.00 "	" 26-27	" 29.
8	Water stood at roots all summer!		29.

Table 1 gives the amount of water applied to the different plats, the dates of applications, and the time the fruit was picked.

Table # 2.

No. of Plat.	Yield per Acre.	Average per Tree.	3 1/2 Tier and above.
1	15876.40 lb.	503.75 lb.	21.5 %
2	30650.88 "	638.56 "	8.0 "
3	42272.78 "	880.68 "	17.0 "
4	27839.52 "	579.99 "	13.8 "
5	30688.32 "	659.34 "	11.9 "
6	29756.34 "	619.93 "	7.6 "
7	22841.28 "	475.86 "	12.0 "
8	4476.00 "	93.25 "	00.0 "

Table # 2. Continued.

No. of Plat.	4 Tier.	4 1/2 Tier and below.	Windfalls.
1	48.9 %	23.4 %	6.2 %
2	58.0 "	29.0 "	5.0 "
3	44.0 "	35.0 "	4.0 "
4	46.4 "	34.4 "	5.3 "
5	39.9 "	42.8 "	5.4 "
6	35.87 "	48.8 "	7.7 "
7	44.1 "	35.5 "	9.0 "
8	10.0 "	79.0 "	11.0 "

In this Table are given the yield per acre as calculated from the crop borne on the plat in the experiment, the average yield per tree in each plat, the yield of different sized apples in each plat and the percentage of windfalls in each part of the experiment. By noting the yield of Plat 8 it can readily be seen that those trees which had standing water at their base during the growing season have fallen far short of the others, both in yield and size of fruit.

The difference in quality was equally as pronounced, for the apples from Plat 8 were pithy and tasteless,

and were of a dark green color with a yellow spot on the side that hung toward the sun. The unirrigated check 1 did much better than Plat 8, but fell considerably short of the irrigated parts. Plat 3 to which the ater was applied July 28th yielded the heaviest crop of any. No set date can be fixed on which to apply water, but the results of this one years trial on that particular soil indicate that when but one application is to be made it will give the best results if put on late in July, or when the fruit is from three-fourths to one and one-fourth inches in diameter.

Table # 3.

No. of Plat.	Average Number defective per 100	Length of Growth 1907	Length of Growth 1908.
1	5.63	11.43	8.04
2	6.02	10.05	8.21
3	3.50	12.73	8.17
4	9.00	11.81	9.05
5	8.16	10.99	7.23
6	4.10	12.75	7.89
7	9.14	11.96	7.99
8	1.50	10.21	6.77

Table #3 gives the number of defective apples per 100 on the different parts of the experiment and shows that where the ap les were allowed to hang for some time after maturing that water-core was much more pronounced.

The growth of wood was decidedly less in 1908 than in 1907, which was probably influenced by the decided difference in moisture conditions that prevailed during

the two seasons. In 1907 there were several hard summer rains and the trees were irrigated quite heavily, but in 1908 there were no summer rains and only one irrigation was given.

All in all, this experiment has been very successful. It shows that one irrigation is better than thorough cultivation alone; under these conditions it also shows by comparison that the crop on all the trees irrigated once was equally as good as on the rest of the Orchard which received three lighter applications. It also shows that standing water in large quantities near the trees or water-logging of the soil, which was a result of the standing water, is very harmful to the productivity of apple trees.

Experiment # 2.

To Determine the Best Time to Apply Water when Three Irrigations are to be made.

Each of the 5 parts of this experiment are located in different Orchards, One on the granitic soil at Ashland, one on the clay soil on Griffin Creek, two on the dark clay loam along the Bear Creek Bottom near Medford, and the fifth on the "sticky" or adobe four miles east of Medford. Yellow Newtown, Spitzenburg and Ben Davis varieties were used, the latter, however, was only present in one experiment. A different combination of the 3 dates of irrigation was used in each of the 5 parts of

this experiment.

Experiment 2-A. Irrigated July 1st, August 17th, and September 29th.

The water was pumped by electric power applied to a double-cylinder pump and was taken from a large well at one corner of the Orchard. The land is of a loose granitic nature and is generally deficient in humus, and is often quite shallow. It is confined to a small area in and around Ashland, which is fairly well adapted to the growing of peaches and small fruits, but for pears and apples is too light to give satisfactory results. It all slopes considerably and is well drained.

The trees in this Experiment are of the Spitzenberg variety, are 18 years of age; they have made a very full growth and are now quite badly affected with pear-blight. This is one of the two Orchards in the Valley set by the Quincunx System; the trees are 30 feet apart which allows 85 to the acre.

If this land is permitted to dry out in the spring before it is plowed it becomes very hard as was evident from the condition of some small places that were missed by the plow. After being broken up it is loose and easily worked, but needs considerable stirring for it gives up its moisture quickly if not well cared for. The cultivation of this Orchard was light, it was harrowed several times after plowing and once after each irrigation, but was not worked as well as it should have been.

greater part of its fruit early in the season. The fruit that did come to maturity was very peculiar in appearance. The few apples that reached four tier in size were all right, but the smaller ones were poorly colored, punky and almost tasteless. The flesh was of greenish hue, and but little juice was contained in them. The greater number of apples from both parts of the experiment were of the extreme conic type, and were characterized by their color being lighter than in other parts of the Valley, and the light part was a deep yellow tint.

Table #5.

	Average Length of Growth 1908.	Average Thick- ness 1908.
Irrgtd. Part.	23.5 Inch.	.186 Inch.
Dry Check	15.75 "	.156 "

Table 5 gives the average length and thickness, and growth of branches on the two parts of this experiment. It is large in both cases which is due to the fact that the trees were severely pruned the year before. The unirrigated trees presented a weakly appearance throughout the summer, ripened their wood early, and shed most of their leaves fully a month before the rest of the Orchard did. The irrigated part, which

received more water than the Orchard proper, retained its leaves until late in December; the tips of the growing branches remained soft until late, but the fruit buds ripened early.

Experiment 2-B. Irrigated July 27th and 28th, August 8th and 9th, and September 1st, 2nd and 3rd.

This part of Experiment 2 was carried out on a deep, black, clay-loam soil near Bear Creek in an Orchard owned by J. G. Gore. It is located Two miles south of Medford on the Ashland road. The water used was pumped from Bear Creek by means of a six inch centrifugal pump propelled by a ten horse-power gasoline engine. The water is lifted into a flume which carries it to the farther side of the field from where it is run down a gentle slope toward the Creek through deep furrows.

The trees are of the Spitzenberg variety; are set 24 feet square, which allows 76 to the acre. They are 20 years of age and in good condition. Mr. Gore irrigates heavily and does but little more cultivating than to stir the ground thoroughly to keep it from baking after irrigation. The land along the Creek is deep and fairly loose, and has a great water holding capacity, and with proper tillage would doubtless produce good crops with but one irrigation.

Table #6 gives the amount of water applied per acre, the yield and percentage of the different sized apple per acre, as calculated from the different parts of the experiment.

Table #6.

Water used.	Dates Applied.	Yield per Acre.	Average per tree.
318216.35 gal.	July 27-28, Aug. 8-9 and Sept. 1, 2 & 3.	43213.44 lb.	555.41 lb.
Dry Check		53008.32 "	684.32 "

Table #6 Continued.

	4 Tier and Above	4 1/2 tier and Below	Windfalls.
Irrigated Prt.	76%	17%	7%
Dry Check.	66"	35"	9"

The first tow irrigations on this plat were quite heavy. The yield was good and the color was good throughout, but was somewhat deeper and more even on the unirrigated trees than elsewhere in the Orchard. This Table shows more windfalls to have come from the trees not irrigated, but the yield of the irrigated part is less than the other, which is contrary to the expectation of many. The plats were small and the unirrigated trees were close to the irrigated ones. In this deep soil the trees probably shared liberally in the water applied to their neighbors. The trees

of the dry check, however, were not as thickly set
 with leaved, and produced a slightly greater number of
 apples; their vigor was denoted by the measurements
 in Table 7, show the unirrigated ones to have made
 a much smaller growth than the others. The fruit buds
 formed earlier, and the leaves fell from the dry check
 before they did from the rest of the Orchard. This
 early maturing of leaves and fruit show that the lack
 of water shortened the growing period of the trees
 materially.

Table 7.

	Average Number Defective per 100	Length of Growth, 1908	Thickness of Growth, 1908.
Irrigtd. Prt.	3	16.08 In.	.165 In.
Dry Check	3	11.47 "	.160"

This Orchard was heavily pruned during the winter
 of 1907-1908. The leaves on the growing tips held on
 until late in December, but were in greater numbers
 on the irrigated part when the last observations were
 made December 9th, 1908.

Experiment 2-C was carried out on Mr. Edward
 Judy's place on Griffin Creek, three miles southwest
 of Medford. The soil in that locality is of a clayey
 nature. It has some gravel in it and is sloping
 enough to insure good drainage. His water supply is

furnished by a large well from which he pumps with a centrifugal pump and gasoline engine. The trees are of the Newton variety, 17 years of age and stand 30 feet apart. They are large, strong and productive.

His cultivation for the season consisted of a late spring plowing followed up at intervals by light harrowings.

Table #8.

	Water Used.	Dates of Applcn.	Yield per Acre.	Average yield per Tree
Irrigtd. prt.	49410 Gal.	Aug. 5, 25 Sept. 20.	11781.60 lb.	245.45 lb.
Dry Check			8784.00 "	183.00 "

Table #8 continued.

	4 Tier and Above	4 1/2 Tier and Below	Windfalls.
Irrigated Plat.	84 %	8 %	8 %
Dry Check.	41 %	29 %	30 "

The results of this experiment as given in Table 8 show that irrigation in this instance has greatly enlarged the crop. While the greater weight of apples on the unirrigated area reached 4 Tier in size, the greater number of them were undersize for market requirements. The fruit ripened early on the dry check and hung several days before it was picked. The quality of it was good, but considerable of it was affected by water-core, calyx-crack, etc., which

was probably influenced more or less by the over ripe condition when picked.

Table #9.

	No. Defective	Length Growth	Length Growth
	per 100	1907	1908
Irrigtd Plat	35	10.8 In.	9.34 In.
Dry Check	29	9.8 "	6.30 "

Table #9 Continued.

Thickness of Growth 1908.	
Irrigtd. Plt.	.176 Inches.
Dry Check	.158 "

By this Table it can be seen that the past 2 years' growth of wood is much smaller on the dry check than on the other trees. This is probably due to the fact that these trees have not been irrigated either year. They ripened their wood early, and the leaves were almost all off when the fruit was picked October 23rd. These trees all set a good crop of fruit buds, and the terminal growth on the irrigated ones hardened their wood early in December.

Experiment 2-D.

This was carried out in a yellow Newton Orchard

located two miles north of Medford, owned by Mr. S. L. Bennet. It is on the Bear Creek Bottom where the soil is a deep black clay-loam. It is much the same as was irrigated in Experiment 2-B, and has a close resemblance to that on which Experiment 1 was conducted. The slope is sufficient to insure good drainage and easy application of the water. The water used was from the Fish Lake Ditch Company's canal.

The trees, which are 18 years old, are set 24 feet square (76 per acre), and have been kept in good condition and are large and vigorous. This Orchard was plowed and well cultivated in the spring and worked frequently during the summer. A thorough stirring after each irrigation was given with an orchard cultivator, great care being exercised to get it stirred before it had lain long enough to bake.

Table 10 shows the amount of water applied, the dates of irrigations and the yield per acre of apples as calculated from the irrigated part and dry check.

Table #10.

	Water	Dates of	Yield per	Average per
	Used	Application.	Acre.	Tree.
Irr. Part	110753.78	July 11, Aug. 14-17,	38657.5 lb	508.65 lb.
Dry Check		Sept. 9-11	54632.0 "	455.68 "

Table #10 Continued.

	4 Tier and Above	4 1/2 Tier and above
	per Acre.	per Acre.
Irrigtd.pt.	72 %	28%
Dry Check	53 %	47%

Again the use of water shows an increase in the yield of fruit. No appreciable difference could be detected in the shape of this fruit or its quality, but the unirrigated trees ripened their fruit somewhat earlier than the others, as was also true of the wood and leaves, as shown by Table 11.

Table #11.

	No. Defec- tive per	Length of growth	Length of growth	Thickness of growth
	100	1907	1908	1908
Irr. Part	10	6.08 In.	8 In.	.164 In.
Dry Check	8	5.44 "	7.2 In.	.137 "

Experiment 2-E was carried out in the Trouson & Guthrie Orchard 4 miles northeast of Medford on the Eagle Point Road. In it are 3 varieties of trees, Spitzenburg, Newtown and Ben Davis; the experiment plat was taken across the end of the field and some of each variety of trees was included. The land, which is an adobe, slopes gently to the west and has sufficient fall to insure good drainage, but causes the irrigation water to wash when taken straight down the hill. Although it varies considerably in color, there is more of this kind of land than of any other on which Orchards are located in the valley. Practically all the more nearly level part of the Orchard Belt way from the Creek, and the Foot Hills along the east side of the Bear Creek Valley are composed of this heavy tenacious soil.

The trees are 13 years old and are small for their age. They are set 24 feet apart, which, in this as in any other soil is too close. To produce paying crops orchard trees require a much larger feeding area than such close planting affords.

The cultivation in this Orchard began with a thorough spring plowing, and was followed up by frequent stirrings with an orchard cultivator to maintain the kind of a mulch that it is possible to form on such soils.

Owing to the dryness of the season it was found necessary to irrigate the part set aside as a dry check; this only received one application, however, and produced a good crop of fruit.

Besides losing water at a rapid rate this kind of soil cements together and becomes hard if not stirred after it is irrigated.

Table # 4.

Water used.	Dates of application.	Yield per Acre.	Average per tree.
106105.5 Gal.	July 1, Aug. 17, Sept. 28-29.	3939.75 lb.	46.35 lb.
Dry Check-----		1140.75 "	13.42" "

Table # 4 Continued.

Irrigtd. Part.	4Tier and Above.	4 1/2 and Below.	Windfalls.
	34%	57%	9%
Dry Check.	15%	61%	24%

Table # 4 shows the amount of water applied per acre, the yield per acre of fruit as calculated from the experiment plats, the yield per tree and the percentages of the different sized fruit from the irrigated part and dry check.

From this table it can be seen that the yield was light on both the irrigated and unirrigated areas; while the former produce a large percentage of marketable sized apples, the unirrigated check only yielded four tier of fruit at the rate of 170 pounds per acre. The dry check was quite badly affected by drouth and lost the

Table 12 gives the duty of the water as applied to both experimental plats, and the yield per acre of each variety with 1 and 3 irrigations.

Table # 12.

Variety.	Plat.	Water used.	Dates of Application.	Yield per acre.
Spitz.	Irri.	91552.72 Gal.	July 22. Aug. 24, Sept. 23.	20447.80 lb.
"	Dry	34716.96 "	Aug. 24	20162.80 "
Newtown	Irri.	91552.72 "	July 22, Aug. 24, Sept. 23.	26057.36 "
"	Dry	34716.96 "	Aug. 24.	23537.20 "
B. Davis	Irri.	91552.72 "	July 22, Aug. 24, Sept. 23.	31597.00 "
" "	Dry	34716.96 "	Aug. 24.	41491.25 "

Table # 12 Continued.

Variety.	Plat.	Average Yield per tree.	4 Tier and above.	4 1/2T. and below.	wnd fls.
Spitz.	Irri.	269.05	27	55	18
"	Dry	265.30	54	31	31
N-town	Irri.	342.86	19	77	44
"	Dry	309.70	15	79	5
B. Davis	Irri	415.7	28	69	3
" "	Dry	545.94	67	28	5

The dry check produced a greater number of apples of the Spitzenberg and Ben Davis variety that reach 4 Tier in size than the irrigated part did, and the Ben Davis trees irrigated once produced a greater total yield than the others. The advantage of the part irrigated but once

over the rest of the experiment is doubtless due to the fact that it was the outside row and consequently has a much larger feeding area. The roots on one side are able to spread out without coming into contact with those of the neighboring row. The old unbroken fence row on the outside of the field also supplies more or less of food material to the last row of trees.

The Spitzenberg apples were well colored and very even in size and shape, but little difference being noted under the different treatments. The Newtons that were irrigated but once ripened earlier than the rest, but those receiving the most water were worse affected with calyx-crack, water-core, etc., as shown by Table 13.

The Ben Davis apples ripened together, but the lighter irrigated trees produced more heavily, which is due to the causes already cited, and also to the fact that the trees in the inside rows are much smaller than the others. The latter difficulty was unavoidable in selecting the plats, so it must be considered that if the trees had been of the same size the results probably would have been as shown by the other two varieties under the same condition.

Table #13.

Variety	No. of Irriga- tions	No. Apples Defective per 100	Length Growth 1907	Length Growth 1908	Thickness Growth 1908
Spitzn.	3			18.23 In.	.116 In.
"	1			16.15 "	.140 "
Y. NTOWN	3	15	7.93	8.81.	.151 "
"	1	9	6.90	8.70 "	.142 "
B. Davis	3	3	8.06	6.58 "	.166 "
"	1	3	7.45	8.03 "	.142 "

This Table fails to show any marked results of irrigation on the growth of trees, but shows it to be very uneven, influenced considerably by crop production. In but few instances did twigs and branches bearing fruit make any terminal growth this year. The number of fruit buds that formed on these trees was small. The wood ripened early on the entire Orchard.

The Orchards of the Rogue River Valley have grown to exceed 9000 acres in 1907, and fruit growing is yet practically a new business. The close planting and poor cultivation have in many instances brought on a badly depleted condition of the soil, which necessitates the use of fertilizers, and especially humus, to restore its normal quality.

With the abundant available supply of water that can be comparatively easily gotten from streams and wells, almost the entire country can be put under irrigation. Practical and economical methods of hand-

ling the water are being adopted, and the knowledge of proper irrigation methods is rapidly being gained throughout the country. Some problems in drainage are confronting the growers, part of which is being put under control while other of these problems are given no attention.

As a result of the experiments carried out in 1908, which was a dry season, it is concluded that water should not be allowed to stand in large quantities at or near the base of a tree; one liberal irrigation with cultivation produces more fruit than systematic cultivation; when but one application is to be made it gives best results if put on during the latter part of July or the first few days in August.

Three irrigations produced larger growth of wood and prolonged the growing season, but did not give the red apples quite as deep a color as they took on on the dry check. The quality was appreciably no different in all but two plats in which the unirrigated fruit was small and insipid in taste. As a general thing the percentage of marketable sized fruit ran higher on the irrigated plats, but the dry check had a greater proportionate number of windfalls on account of their being ripened at an earlier date and allowed to hang sometime before being picked.

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