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BIENNIAL REPORT

DIVISION OF HORTICULTURE

Oregon Agricultural College
Experiment Station

SUB STATIONS:

UMATILLA EXPERIMENT FARM
Hermiston, Oregon
R. W. ALLEN, Superintendent

SOUTHERN OREGON EXPERIMENT STATION
Talent, Oregon
F. C. REIMER, Superintendent

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FIRST BIENNIAL REPORT

Substation, Umatilla Experiment Farm,

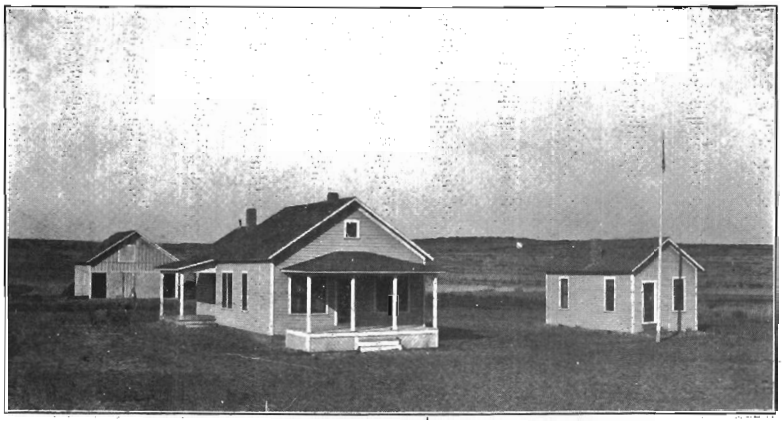
Hermiston, Oregon.

By R. W. ALLEN.

Giving progress of work and
results so far obtained.

This Station was established in 1909 through a cooperative agreement between the U. S. Reclamation Service, the U. S. Department of Agriculture and the Oregon Agricultural College. The Reclamation Service had two twenty-acre homestead units with-held from entry for the purpose, and erected upon this land an office building, cottage, and barn, enclosed it with a permanent fence and supplied a team and wagon for use on the farm.

The U. S. Department, through the office of Western Irrigation Agriculture in the Bureau of Plant Industry, agreed with the Oregon Experiment Station that each of these institutions should furnish half the money required to carry out the work on this station and that the work should be directed by Mr. C. S. Scofield, Agriculturist in charge of Western Irrigation Agriculture Investigation, and Mr. C. I. Lewis, Chief of the Division of Horticulture of the Oregon Agricultural College and Experiment Station.



Farm building erected by the U. S. Reclamation Service.

The work of preparing this land for experimental purposes was begun in June, 1909. Close observations were made on the best methods of procedure in all the work performed, as every step in the reclamation of such land is of importance and should be handled in the proper manner. The clearing and leveling was mostly completed in 1909 and experimental work begun in 1910.

The farm units on the Umatilla Project are ten, twenty, and forty acres in extent, the general plan of those acquainted with the climate and soils of the country being to develop it chiefly along lines of fruit and vegetable growing.

The work that has been taken up at this station is centered upon three principal lines; namely, to determine the best methods to pursue in transforming the comparatively unproductive desert soils into a productive condition; to determine the most valuable varieties of fruit and truck crops that can be profitably grown; and to find the manner in which water can be handled most economically in irrigating the loose sandy soils characteristic of a large part of the Columbia River Valley.

What is probably the most difficult problem confronting the farmers on these sandy soils is that of increasing the fertility of the land to the point where profiable crops of fruit and vegetables can oe grown, and of keeping it at this point.

But very litue is known as to the varieties of fruits best adapted to the extreme soil conditions of the district; and for the purpose of determining, at the earliest possible date, what should be recommended, the test of varieties was begun immediately, and without regard to the infertile condition of the soil, but with a view to building it up as the trees are growing.

A thorough study of the methods of irrigation best suited to the soils and crops of the district was begun with the reclaiming of the land and has been quite well worked out.

Some minor experiments are being conducted to determine the effect of minimum and maximum amounts of water on the development of fruit trees, and to determine the soil moisture conditions of different crops. A cooperative arrangement with the U. S. Forest Service has been made in which a large variety of forest and ornamental plants are being grown to determine their value in this district.

Recently some cooperative work has been arranged with farmers on the heavier soils of the Stanfield District for growing various kinds of cover crops to determine their value as green manures in that locality.

Climate.

The large number of bright days and long growing season characteristic of this district are the result of low altitude in a semi-arid climate. Growing weather usually begins early in April and continues until the latter part of October, thus giving a very long season. The rainfall ranges from 4.5 to 9 inches and is quite well distributed, coming both in the spring and fall.

Frosts destructive to tender vegetation sometimes occur as late as May 15 and as early as Sept. 20. Protection of strawberry beds and orchards will be necessary some seasons during the blossoming period. The winters are usually very open, with slight snow fall and usually minimum temperatures running to zero or below. In winters of extremely low temperature considerable damage has been done to the wood and buds of peach trees. When the thermometer drops to 20 or 25 degrees below zero there is considerable danger of root freezing of trees if the soil in which they are standing has been allowed to become too dry.

The prevailing wind is from the southwest, but the cold winds which sometimes come in winter are from the northeast. During the period from March 1 to July 1 winds of high velocity occur at frequent intervals and at other times during the year occasional severe winds may be expected.

Soil.

The soils of this district are sandy, ranging from a coarse sand to a fine silt. The coarser, and wnat are sometimes termed the lighter soils, comprise most of the lower land, while the silt extends beyond and above the limits of irrigation and embraces the pasture and dry farming district adjacent to the irrigation project.

The sandy soil is mostly coarse in texture, with much open space, readily admitting air and water and thus being very easily moved by these agencies. This open condition permits of rapid percolation of water through the soil and rapid evaporation from it, thus indicating a small capacity for holding moisture and rendering the duty of irrigation water very low. Frequent applications are necessary to keep the ground moist, and to prevent loss from percolation the applications must be light and quickly made. The sandy loam and silt soils are composed of much finer particles which fit closely together and are not as readily moved by wind or moving water. These do not require as frequent irrigation as the coarse sand and can usually be reclaimed in larger areas without protection from the wind.

There never has been a heavy vegetable growth on these lands, so the supply of humus is very deficient. This denotes a shortage of organic plant food and binding material in the soil. These deficiencies must be corrected before the highest state of production can be reached, and excessive soil erosion prevented The sandy soils are harder to bind than those composed of finer particles. Silt soils do not require humus as much to prevent their blowing as to increase their fertility.

Clearing and Leveling New Land.

The sandy land, which is the most readily moved by the wind, is usually covered with a heavy growth of sage brush. The brush should be grubbed and stacked in wind-rows from 30 to 60 feet apart and preferably at right angles to the course of the prevailing wind, which is from the southwest, or along lines running north and south. It is a loss of time to clean off all the small pieces of brush and fine vegetation, as they do not hinder cultivation or grading. This material is beneficial as a protection from the wind, and will soon decay and add some fertility to the land. The direction in which it is necessary to run the irrigating furrows and the length they are to be made will have some influence upon the manner of stacking the brush. A few men have

Sage brush grubbed and stacked in windrows to protect the land. Natural brush in foreground

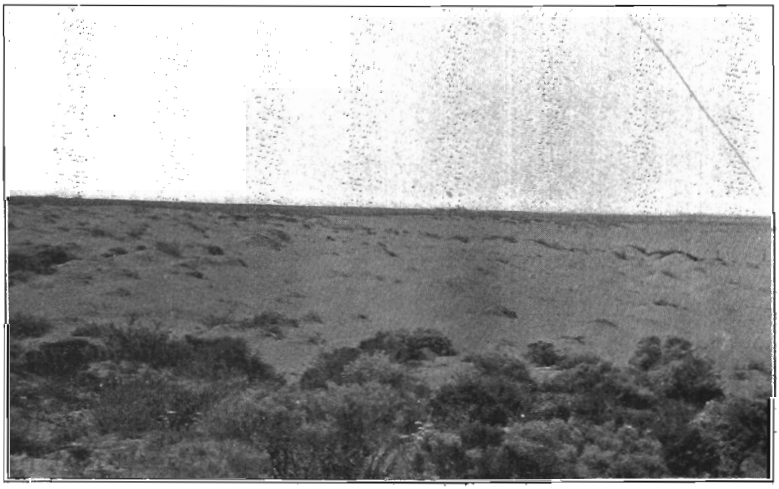
successfully cleared and seeded large areas at one time, but the practice is not advisable on account of the great risk in doing so. Whenever a large tract is cleared and torn up for seeding the wind carries the loose sand particles so rapidly that success in growing crops on the land is almost impossible. Protection of some kind should be afforded the land until a crop has been well started on it.

How to Clear and Level.

When the ground is very uneven and the grading of large areas necessary to get it properly leveled for irrigating, the brush can be "railed" off and burned; but in all such cases straw or manure should be at hand to cover the land.

Railing off the brush, as a general practice, should not be followed; because the tendency, when using such a device, is to clear off large tracts where blowing may result. Hand grubbing is the best method, as it insures the removal of all large roots and costs but very little more.

The best way to proceed with a field is to begin at some convenient point, preferably near where water is taken from the distributing canal, and to level, irrigate and seed a small tract. After the piece is successfully started, the work can be extended gradually. The important thing is not to get more work started than can be properly looked after at one time, and not to get so large an area torn up that it will drift if winds occur.



Sand drift caused from clearing a large tract. The sand is blowing from the open field onto unprepared land and making it very difficult to reclaim.

When the land can be irrigated successfully without much grading, this should be done, for deep grading removes the surface and most productive soil and leaves places where it is very difficult for even the most hardy plants to start.

The preparation of new land should be thorough and complete. In no case should crops be sown until water can be put over the land easily. Careless work not infrequently makes regrading necessary, thus causing a loss of time and additional expense. When deep fills are made, sage brush should not be covered up, as the ground will settle down when this material decays and regrading will become necessary. Wherever deep fills are necessary, some al-

lowance should be made for the later settling of the land.

In preparing land for irrigation care should be taken to have at least 1 foot of fall to every 100 feet for land that is to be cultivated, and not less than 1½ feet for uncultivated crops, such as clover and alfalfa. Water will run in very smooth ditches where the fall is slight, but for satisfactory irrigating there should be at least 1 foot fall per 100 feet, and not over 3 feet fall, on account of washing. Some washing will occur on new ground, but when it has been worked for a time and some humus added, water can be handled very successfully where the fall is greater than 5 feet to the 100. On steep slopes, water should be distributed by contour furrows.

On steep land irrigating can be done to best advantage by running flumes downhill and leading the water off laterally through contour furrows. This method avoids excessive washing and the work can be done much more thoroughly and quickly, but requires at first close attention. The flumes should be placed about 6 inches from the ground so that water can be kept from working downhill under them and causing endless trouble from washing.

Plowing on sandy soils, is not necessary before grading, and should be practiced with care on silt land, as such land blows freely when loosened, unless it is irrigated immediately. Land that is fairly even in general contour can be loosened for grading by cutting the surface with a disk harrow or spring-tooth harrow, then leveling by dragging with a level, or float, as it is usually called. A home-made device can be used for this purpose. To make such an implement use two planks 16 to 24 feet long, 2 inches thick, and 8 to 10 inches wide; set these on end and put near each end a stationary cross piece 4 to 6 feet long of the same material. In the center attach a third cross piece in such a manner that it can be raised and lowered with a lever. Prepare a hitch at one end and brace well with diagonal pieces. This device as it draws over the ground will be found very successful in carrying dirt from small ridges to neighboring hollows. It aids very materially in completing the work of leveling a field. *A four-horse Fresno scraper is the most efficient implement to use for grading whenever much soil is to be moved.

The cost of clearing and grading land ranges from $5 to $50 per acre, depending upon its condition and the class of labor employed. As soon as properly leveled, the land

*For more detailed instruction in regard to this and similar implements for leveling land see Farmer's Bulletin No. 373.

should be irrigated and sown to rye, to protect it until the time for seeding other crops. A stand of alfalfa is much more certain when the seeding is done in a thin crop of rye, or in the stubble after the rye has been cut, than when the alfalfa seed is sown without protection.

When to Clear Land.

Land that is seeded to rye during August and September at the rate of 50 to 60 pounds per acre, and given one irrigation, seldom fails to make a crop. If irrigated once this time, large areas can usually be worked successfully, but without irrigation the seed cannot germinate until winter rains occur, which is frequently too late for the grain to

Irrigation from a flume. The dark strips along the furrows are from the soil which was thrown out in rowing off for irrigating.

make sufficient growth to withstand the cold of winter and the early winds of spring. If the land has a good native covering that has not been removed by grading, such as cactus, grass, or afilaria **(Geranium cicutarium)**, fall sown rye without irrigation usually does well with the protection afforded it by the litter on the ground. A drill should be used in seeding either small grain or alfalfa. When thrown on broadcast and harrowed in, the seed is not bedded as evenly and securely as when put down with a drill; hence more seed is required and poor results are almost certain to follow. To insure prompt germination, the drill should be set to run two or three inches deep. In fall seeding of grain it is not necessary to smooth the surface of the ground be-

hind the drill. Make sure that the fields are level enough to take water easily but leave all litter scattered to protect the surface.

The injurious effect of drifting soil upon crops is due to the constant wearing of the moving particles and the loss of soil from about the roots of the plants. Severe winds drive the particles with sufficient force to cut the plant tissues and quickly destroy the smaller and more tender vegetation.

Applying Irrigation.

The proper use of irrigation water on these sandy lands is one of the most perplexing problems with which the farmer has to deal. The waste of water in this locality may be due to running it through poorly made furrows and furrows that are too long, by turning too little into each furrow and by allowing it to run for too long a time.

In its virgin condition sandy land is difficult to irrigate without the waste of water by percolation. To pervent this, organic matter should be added as rapidly as possible. It fills the open spaces in the soil, increases its water-holding capacity and checks the rapid movement of water through it.

With frequent applications of water, there is danger of excessive loss by evaporation, as well as by percolation. This loss can be greatly diminished by irrigating in furrows and never wetting the entire surface. Practically all the moisture required to dampen the surface of the soil two to four inches deep is immediately lost by evaporation, whether the land is cultivated or not. The length and the distance apart of irrigating furrows exert a decided influence upon the loss of water. Long furrows should be avoided, as heavy losses result from percolation near the flumes or ditches from which water is being distributed. The greatest economy can be practiced by not running the water too far. Two hundred feet on sandy soil and from 300 to 600 feet on fine soils is far enough. By turning a good head into the furrow until it gets across the field, then cutting it down until there is just enough leaving the flume to keep the furrow full, excessive loss is prevented. This wets the ground evenly and makes it possible to change the stream to other furrows as soon as the first ones are sufficiently moistened. It is frequently necessary to open up the furrows in alfalfa fields after each crop is harvested.

Every irrigator should endeavor to prevent the waste of water by heavy applications or by the loss of water at the

ends of the furrows. No benefit can be derived from excessive irrigation, and many times the overirrigated crops suffer, as does the adjacent low-lying land, where water rises to or above the surface, rendering it unproductive and many times alkaline.

Flumes and Ditches.

The ultimate saving of labor, the greater ease and uniformity of distribution and the decrease in amount of water used makes the use of flumes an economy on the sandy lands of the Umatilla Project. When run in ditches and distributed by means of lath boxes, the water is usually backed up and kept standing in the ditches. In this condition it sinks

Type of concrete division and measuring box in use on the Experiment Farm.

rapidly into the ground and heavy losses result. Ditches are also very liable to break and wash the soil, thus damaging the land and crops.

All laterals and flumes should be made large enough to carry a good head of water, for irrigating by rotation is the most economical way of distributing the water, besides giving greater satisfaction to the irrigator. By using the rotation method the work of irrigating can be done periodically and with less work. This method also gives the farmer more freedom to do other things.

Cedar lumber, which can be purchased on the project at prices ranging from $20 to $25 per thousand feet, is the best

material to use for flume construction, as it does not warp or check as badly as fir. When lumber of greater width than 8 inches is used, 1½ inch thickness is preferable to thinner stuff. The flumes should be securely nailed and strengthened by having collars put around them every six to ten feet. When placed in the field, flumes should not be laid on the ground, as the lumber decays rapidly. They should be held up by supports placed under them at or near the collars. These braces prevent the flumes from sagging and twisting, troubles which result if they are not properly laid. When the flumes are raised five or six inches from the ground, earth can be easily put under them where needed, and the water handled much better than along flumes that rest on the ground or are partly buried in the soil.

The joints and cracks should be covered with coal-tar-pitch or some form of flume cement to prevent leakage. Materials for this purpose can be got for two or three cents a pound. To use them economically tney should be applied hot with a brush or swab. A warm day is preferable for doing this work, as the materials spread much better than during the cool weather.

The size of the flume needed depends upon the amount of water it is to carry and the amount of fall it is given. The proper size can best be determined by observing flumes in operation under similar conditions. They should be large enough, however to carry a good stream, which will lessen the chance of overflowing. The most satisfactory method of diverting water from a flume is by the use of holes bored near the bottom. For stoppers, pick out a soft board somewhat over one inch in thickness; saw and split into small blocks and whittle out the plugs. One person will make from 50 to 60 in an hour. To regulate the flow of water from the holes, fasten a small piece of lumber in the bottoms of the flume just beyond each opening. Make secure with one nail driven through the Center. These pieces can be turned cross-wise or lengthwise of the flume properly to control the discharge from the holes.

For carrying water across uneven land and fields where none is to be taken out for irrigating, concrete pipe lines are preferable to flumes. The initial cost is greater, but the structures are much more permanent. Flumes usually do not last over 6 or 8 years, whereas, a well constructed pipe line will last indefinitely and cause no trouble by loss of water.

SOIL FERTILITY.

The loose and comparatively unproductive condition of these sandy soils makes it necessary to give them some treatment that will supply the needed constituents. A physical analysis shows them to contain from 75 per cent to 90 per cent coarse sand, and only a very small amount of silt or clay. This composition indicates a soil with a high percentage of open space through which water moves rapidly by precolation and but slightly through the agency of capillary action. Air also moves freely thru it carrying moisture away rapidly by evaporation and hastening the oxidation of organic matter. In mineral elements it is quite rich, but is very deficient in humus and nitrogen. Strong productive orchard soils such as can be expected to produce hardy trees and liberal crops without being quickly depleted in nitrogen, contain as much as .2 per cent. of nitrogen and sometimes as high as .5 per cent., while this soil contains but .02 per cent. The immediate need of a liberal supply of nitrogen and humus is very apparent. The following experiments are designed to develop the most rapid, and at the same time the most economical means of supplying the lack of fertility and to close up the p re spaces to prevent the rapid loss of moisture and of humus from the soil..

Experiment No. 1.

This experiment was planned to determine under what conditions of culture and intercropping, apple trees will develop to best advantage when planted in virgin soils, and at the same time to find a suitable method of handling the soil so as to increase its fertility while the orchard is being developed.

The land was prepared by grading and fluming for irrigation in October, 1909, and the trees planted in the spring, 1912. All the stock used was one year of age. The trees were placed 32 feet apart in the field. This experiment covers an area of 4 acres and comprises 1 acre each of Winesap, Jonathan, Spitzenburg and Rome Beauty apples. There are 2 rows of each variety containing 20 trees each. The field is divided transversely into 5 plats, each containing 32 trees and an equal number of all the varieties used. By this arrangement the effect of the cultural methods used can be determined on each of the 4 varieties.

Plat 1 is being given a rotation of leguminous cover crops and vegetables, having one crop each in a year.

Plat 2 is being given a simple rotation of rye in the

winter and a leguminous crop of vetch or peas during the summer, both of which are to be used as green manure.

Plat 3 is being fertilized with an occasional light application of stable manure and has a crop of rye grown on it each winter. The crop of rye is used as green manure in the spring.

Plat 4 will be kept permanently in alfalfa between the rows, a strip 12 feet wide along each row being systematically cultivated during the entire growing season.

Plat 5 is to be kept in a thick stand of alfalfa without cultivation at any time.

The soil conditions prevailing on this ground are somewhat uneven from the fact that grading was necessary, and by this operation some portions have been rendered less pro-

Hairy vetch (Vicia villosa) in soil-fertility experiment No. 1, plat 1. October 15, 1911.

ductive than others.

Plat 1.

This area shows a marked improvement in the soil conditions as compared with the virgin soil. The two crops of green manure which have been added have greatly increased the water holding capactiy and fertility of the soil, have made it somewhat darker in color and rendered it less susceptible to blowing, and caused it to wash less while irrigating. The marked improvement in the soil condition did not appear until this season when a heavy succulent crop of vetch and rye was worked into it early in the spring. The ground was later planted to corn, some stalks of which were 9 or 10 feet in height and carried from one to three

well filled ears. Corn having similar treatment on adjacent unfertilized soils made only a moderate growth. This plat appears to be improving at a more rapid rate than the rest, notwithstanding the fact that it is yielding a garden crop each year in excess of what the other parts of the experiment are doing.

Plat 2.

This plat shows some improvement in soil texture but the difference is not as marked as in the first instance. This result is evidently due to the fact that the fall sown crops of vetch on the first area have made uniformly better and heavier growth than the spring sown crops. Vetch and Canadian field peas quit growing as soon as overtaken by warm weather.

Plat 3.

This area shows considerable fiber in the soil and does not blow readily. Changes toward betterment of the soil conditions, however, are not showing as rapidly as in the other portions of the experiment. The plant material applied to this area is only partly decayed, on account of the land not all being irriagted. The trees have grown rapidly and are nearly as large as those in the first two plats.

Plat 4.

The trees on this plat have grown nicely, especially in 1912. They have almost kept up with those in the fertilized plats. The soil has made very little if any change in physical condition, although it has been irrigated and cultivated much the same as that upon which the cover crops were grown.

The trees growing on this land have not shown any distress from the crowding of the alfalfa. From this it would seem that in such light soils there would be no injury sustained from growing alfalfa between the rows, if the water supply is sufficient. So far, the results obtained are much better than in a solid field of alfalfa.

Plat 5.

The presence of alfalfa close around the trees has greatly hindered their development. On account of the thick stand of alfalfa it has been difficult at times to irrigate the trees properly. Each year the loss has been rather heavy and at no time have the trees made satisfactory growth.

The results from this experiment so far noted seem to indicate that the organic fertilizers added by growing crops and working them into the soil each year bring about rapid improvement in the soil conditions. The soil is being

changed from its loose sandy character to a loamy nature with more or less of body to it. The water-holding capacity has also been greatly increased, a fact which is especially noticeable in the rapidity with which water spreads in the soil through capillary action.

Experiment 2.

The poor producing power of these desert soils before being built up by some methods of adding organic fertilizers and the consequent slow growth and heavy losses of trees set on the virgin soil, have caused considerable speculation on proper methods to pursue in starting an orchard. Many trees grow very slowly, and assume ragged and unsymmetrical shapes when grown on new ground. The loss of trees is also quite heavy, which makes the practice appear

Plowing red clover under in soil fertility experiment.

of questionable value. Land that has been properly prepared by the growth and incorporation of some crop will doubtless produce a more thrifty and symmetrical orchard. The question then arises, What method is best—to plant on virgin soil, or to wait and plant on prepared land?

To ascertain what success can be had with trees set on new land and crowded with commercial fertilizers an experiment has been started.

It is also expected that some important knowledge can be gained regarding the length and productivity of fruit trees grown under adverse conditions compared with those grown under normal conditions.

Two acres of ground was set aside for this work. One acre was seeded to alfalfa in 1910. Trees were planted on

the new soil plats in 1911 and it is the purpose to plant on the alfalfa sod in 1913. Four varieties of peach trees, chosen for this experiment, were planted in rows running across the plat divisions so as to put an equal number of each variety in every part of the experiment.

The growth of the alfalfa has been very satisfactory; in 1912 the entire plat was plowed and the third crop of hay incorporated into the soil.

The peach trees on the new soil and fertilized plat have made a very satisfactory growth, excepting in one portion where the surface soil was graded off. A heavy loss of trees was rcorded in this experiment the first year on account of the freezing of some stock that had begun growing too early in the spring. Considerable emphasis is being put upon this experiment on account of the assistance it is expected to afford to individuals starting orchards on similar lands that will be developed in the future.

Experiment 3.

This experiment was designed to determine if possible what can be gained by the application of mineral and organic fertilizers when used with the leguminous and other crops to increase the soil fertility. Composite samples were taken from each of the 16 plats before the first fertilizer applications were made. Chemical determinations are being made from these samples at the Agricultural Experiment Station. This data is to be used in comparison with analysis made at subsequent dates as a basis for determining the progress and value of the experiment The plan is to make an application of the fertilizers each year, to keep some crop growing on the land and at stated intervals to take samples of soil and have them analysed. By checking up with the analysis of the virgin soil it can readily be seen what differences have been brought about. In this way it will be possible in a few years to determine what fertilizers give the best results, and to what extent the various kinds should be used to get the best returns from the soil. It is also hoped that some information can be gained regarding the manner in which the plant food materials are locked up in the soil. The land upon which this experiment is located was heavily graded in places, making it very uneven in fertility. This natural variation renders the comparison of results between different plats impracticable, but the object sought is to determine the ultimate benefit of each fertilizer on the ground to which it is applied. This can be determined by comparison of crops produced and the dif-

ference in plant food materials shown to be present by the soil analysis. The fertilizer materials used are nitrate of soda, muriate of potash, acid phosphate, land plaster, tankage, dry blood, complete fertilizer and stable manure. All these are being put on in both light and heavy applications. The work was begun in 1910 by applying the fertilizers to green rye, the first crop sown on the land. The second year the fertilizers were applied at the time of seeding clover. The third year of the experiment, 1912, no fertilizers were used but in September the third crop of clover grown that season was plowed under. Weights are being kept of all crops taken from the experimental plats and the results used to determine which treatment is conducive to the greatest crop yields. While the duration of this experiment is indefinite, it is expected that some indications will appear within an additional year or two which will show a superiority in value of some of the treatments.

VARIETY TEST OF FRUITS.

This series of experiments covers the more common fruits which might be grown to advantage in this district. The conditions are so different from those of any other fruit growing community in the state that the varieties that will succeed best must be definitely determined before responsible advice can be given out.

In all this work the most hardy varieties of commercial importance have been selected for testing and in a few instances selections have been made to determine the value of some fruit for the home garden. By keeping close watch on the action of the many varieties of fruits, the station will soon be able to advise correctly regarding the vigor, productiveness and quality of all the more common fruits when produced under prevailing conditions existing in this district.

In this determination there are 47 varieties of apples, 14 of pears, 23 of prunes and plums, 23 of cherries, 45 of peaches, 7 varieties of quinces, 4 of nectarines and 13 of apricots, also 28 varieties of grapes, 42 varieties of canefruits and 74 varieties of strawberries.

The cultural treatment of these experiments is to be conducted as nearly the same each year as it can be made. The land was first prepared in the fall of 1909 and the major part of the planting done in 1910. The tract upon which the trees are located has a general slope to the south and is exposed to the direct action of prevailing winds. On this account it has been found necessary to keep

rye growing on the ground each year. By so doing, the standing crop prevents wind action on the soil and also affords considerable shelter and protection to the trees. This practice will need to be followed until the trees become of sufficient size to prevent wind action on the soil. During the first two years the progress of this work was very unsatisfactory on account of the heavy loss of trees and general slow growth. This trouble was much less keenly felt in 1912 on account of the greater age of most of the trees and better conditions of culture and irrigation that were afforded them.

The percentage of loss for 3 years is as follows:

Kind of Fruit	Percentage loss 1910	Percentage loss 1911	Percentage loss 1912
Apples	10	2.85	1.4
Quinces		20.	14.2
Pears	38	11.9	2.4
Prunes and plums	40.75	23.8	14.2
Cherries	63.46	30.55	18.5
Nectarines and apricots	10	8.82	8.82
Peaches	18.25	10.66	4.
Of all trees set	24.70	10.9	6.9

The heavy loss of trees in 1910 is due to several conditions. At that time the land had just been graded and was very uneven in fertility. In this unreclaimed condition the soil was very loose and soft, and difficult to irrigate. On account of the south slope of the land, too, and its open texture, it becomes very warm when exposed to direct sunlight. Hence some loss was sustained both from drouth and from sunscald. The trees lost from sunscald were mostly the ones that had become weakened by lack of moisture, and this difficulty was not overcome until the bodies of the trees were shaded near the ground.

On account of the large number of varieties selected, it was impossible to get all young stock. Most of the two year old stuff planted was lost. The trees that died out in the second year were mainly of the ones replanted that season. The marked improvement in 1912 is due in part to the slight improvment in soil conditions that has been brought about, a better distribution system for the water, and also to more competent help for the work of irrigating. In these three years the growing of an annual crop of rye has done a great deal toward checking wind erosion on this soil.

Experiment 1. Apples—From the above table it can readily be seen that the apple is the most hardy tree fruit that has been included in this work. Practically all the trees have grown from the first planting, and they are uniformly strong and thrifty. Some variation is noticeable in parts of the experiment, but these are due to the characteristic growth of some varieties and to the uneven condition of the soil upon which they are grown.

Experiment 2. Pears—The action of pears during the first year is very peculiar. Some trees start off and make a nice growth; others throw out leaves from most all the buds present and stop growing at that point, the leaves remaining on the tree the entire season; while other trees do not leaf out at all, though the buds remain normal and the bark of the tree perfectly green and normal in appearance. During the second year the more vigorous growing trees of the first season again make a good advance; many of those that do not grow the first year now start growing, and part of them, by the close of the season, become larger than those with two years' growth. The losses were much heavier in large pear trees than in small ones. The reason for this seems to be that in the large stock the wood dries out badly.

Commercial Handling of Pears.

To acquire commercial figures on the growth and production of pears, an experiment was begun in 1910. A group of 50 trees of the Bartlett variety were set out for this purpose. The Bartlett was selected on account of its superior quality and great vigor of growth. Considerable difficulty was experienced the first year, and the loss of trees amounted to 36 per cent. The growth of the remaining trees was very slow and very slight. Sunscald played an important part in the losses sustained, and the peculiar conditions described above were present on many of these trees. In 1911 the loss was reduced to 6 per cent and a great many of the trees made a fair growth. The advance in 1912 was far ahead of either previous year and no trees were lost. The moisture conditions of the soil have been shown to exert a great influence on the growth of these trees. A portion of the planting extends onto a low ground where the water table comes near the surface. The trees in this part made a very large growth and at the present time are two to three times as large as the others in the experiment. This increased growth indicates with a fair degree of certainty that pears should be given a preference of lower and more

moist soils. Pears are able to withstand alkali salts in greater quantity than most other fruits, a fact, which would make them best adapted to subirrigated land, where such salts are liable to accumulate.

Experiment 3. Quince.—The high percentage of loss tabulated does not give a correct idea of the results of this work. There were only a few trees of quinces planted and the loss of one or two of them makes the percentage run high. From all appearances the quince is going to do about as well as the pear.

Experiment 4. Prunes and Plums.—The entire planting of prunes and plums is located on fairly steep land upon which more or less grading was done. The stock secured was not all first class in quality, consequently losses have been quite heavy. Only a few varieties of prunes seem to thrive here, the stronger ones being Peach plum, Bradshaw and Maynard. The better commercial varieties such as Italian, Hungarian and Petite are making a very unsatisfactory showing on the sand, but grow quite well on the finer soils.

Experiment 5. Cherries.—The heaviest loss sustained from any fruit in the work was in cherries. On the warm southern exposure and loose soil it has been quite difficult to get any of the sweet varieties started. Some of the more tender ones, such as Royal Ann, Lambert, and Yellow Spanish have been planted three times. The sour varieties most all keep alive, but are not growing as rapidly as they should. Prunes and cherries do not appear to be hardy enough to grow on the virgin soil, but will no doubt succeed better after the fertility of the land has been sufficiently increased. On the adjoining silt soils they do much better.

Experiment 6. Nectarines, Peaches, and Apricots.—These fruits all do quite well. The loss the first year was fairly heavy on account of poor soil, and improper moisture conditions during a part of the time but since then the trees have made considerable growth. All the trees on this sandy soil become low and wide and in this way they afford considerable protection to themselves from the wind and intense light.

Experiment 7. Cane Fruits.—The work in variety testing of cane fruits was taken up to determine to what extent the different kinds will be successful on this coarse sandy soil, and if possible to determine which sorts are of the greatest commercial importance. The natural habitat of most of these fruits is in humid climates and on this account it is not expected that a large percentage of them will

succeed in the warm dry atmosphere and light soil of this place.

Currants.

In this determination 7 varieties of currants were used. During each of the 3 years that the work has been carried on the loss has been almost 100 per cent. Good plants have been secured and proper attention given them. They were irrigated and cultivated at frequent intervals and were shaded when warm weather set in. The plants usually start off nicely in the spring but die out rapidly when warm weather comes on, indicating that the dry atmosphere and high temperature of the soil and air are conditions to which they are not adapted. It has been noticed at different places in the district that wherever they are grown in the shade or on highly fertilized ground occasional plants are doing well. The Perfection and Lee's Prolific show better adaptability than any others tried.

Gooseberries.

Seven varieties of gooseberries have also been used. In this work, loss has been heavy but the results obtained are much more satisfactory than with currants. When properly handled indications are that they will make a fair commercial crop. The bushes do not grow to large size but appear to be quite hardy and are exceedingly productive. A little fertilizer added to soils upon which gooseberries are being grown makes a decided difference in the vigor of the plants. The best varieties from present indications are Victoria, Smith's Improved, and Houghton No. 1.

Raspberries.

Only a few varieties of raspberries have given any promise. The raw condition of this new land and the dry atmosphere seem to be very uncongenial for them. They do nicely when placed along ditch banks where there is an abundant supply of water and in alfalfa sod where the ground is shaded. When subjected to clean culture, even though the moisture supply is abundant, they do not thrive. Brandywine, Cuthbert, and Gregg have so far proved to be the most hardy varieties, but they have not done at all well.

Dewberries.

Dewberries give more promise than any other of the cane fruits. Their low growth and spreading habit seem to adapt them splendidly to the conditions of this district. By this habit of growth the fruit is shaded, and also protected from the wind by the foliage of the plant. They ripen at a period when there is practically no other fruit on

the market, thus finding a chance of ready sale. On account of this shading of the fruit and low growth, they are far superior to the raspberry and woody caned blackberry which produce their fruit on upright canes where it is exposed to the drying influence of the sun and wind. Such canes are often broken by the wind and the fruit is lost. The Premo and Lucretia varieties are preferred.

Blackberries.

The upright canes of the blackberries cause the fruit to be exposed to the sun and wind, by which they are frequently dried before reaching maturity. The stronger growing varieties are Kittatiny, Lawton, Snyder, and Wilson's Early. They produce a good quality of fruit when protected from the wind and give an abundant yield. They also do well when placed along ditches of running water but do not flourish on the sandy soils when subjected to clean culture. Very satisfactory results have been received from growing them in alfalfa sod where the ground is shaded. On the silt soils in some parts of the district they do unusually well when given no care beyond a liberal supply of water.

Loganberries.

The loganberry and phenomenal were tried in comparison and it has been found that the latter is very poorly adapted to this district. The loganberry grows nicely when properly fertilized, and when given winter protection will be an excellent commercial crop. On account of the freezing of the canes during severe weather, covering is necessary. For this purpose the new canes should be gathered together in the rows and covered the same as grape vines. These plants will admit of being set closer together than in the humid districts of the state and should be pruned accordingly. Six feet is a good distance and they should either be put on a low trellis or allowed to hang over small frames put about each individual plant. One advantage of this plant is that it shades its fruit much the same as the dewberry.

Himalaya and Mammoth.

The himalaya and mammoth blackberries make a very strong growth but have not fruited to any extent so far. The indications are that they will not be a profitable commercial crop. A few vines can be grown to advantage, however, in the home garden. They also need to be covered in winter for fear that extreme temperture will injure them.

Evergreen Blackberry.

The evergreen blackberry, which is coming into promise

in some parts of the northwest as a commercial fruit, grows quite well here. The vine growth is not as large as in other districts, but it has a strong tendency toward heavy fruiting and produces an excellent berry. The tendency is for it to grow flat upon the ground, a habit which makes the use of a low trellis necessary.

In a general way the results from the variety test of cane fruits has been unsatisfactory. This is partly due to the undesirable location upon which they were grown. The southern exposure causes the soils to become quite warm in summer. The plants were put on the raw soil with no preparation, and this has shown conclusively that the ground must be fertilized before planting these crops.

Soil conditions on the project differ greatly, however, and it has been noted that the silt loam soils are growing most of these fruits to very good advantage. The adverse conditions under which this work has been conducted permit of definite selection of only the most hardy varieties. The selection will be of more value, in a way, than if the plants had been grown on a productive soil.

Experiment 8. Grapes. The sandy soil and long summer seasons of the Columbia River Valley make it well adapted to the production of certain varieties of grapes. The hardy American sorts give better promise than the tender European or Vinifera varieties, although most of the viniferas make much the stronger growth. For the purpose of determining which are the better commercial kinds, and which are desirable varieties for home use, a small assortment has been planted upon which to make these determinations.

The planting consists if 8 Vinifera and 12 American varieties, only a few of which have fruited. The character of vine growth and fruiting habit indicate that the Black Hamburg, Flame Tokay, Muscat of Alexandria, and Thompson's Seedless are the best vinifera sorts. The Seedless variety is much more resistant to winter injury than any others of this class. It does not freeze down during mild winters, while the Tokay is probably the most susceptible to freezing and must be carefully covered.

To prevent the loss of vinefera plants through freezing, it becomes necessary to cover them in the fall. To determine which is the best method to pursue in this work several experiments have been tried out. The use of straw, barn yard litter, and clean soil has been made. Of the three materials it was plainly shown that the field soil is the best covering to use. It appears that the straw affords sufficient

protection during the cold weather but upon the approach of warm days the damp mass begins to heat and often destroys the buds and occasionally the wood of the vine. Barnyard litter acts practically the same. Plants covered with soil usually look very dark when uncovered, but upon examination are found to be in excellent condition; the wood green and firm and the buds well preserved.

When covering is to be done, the vines need to be carefully pruned as soon as they become dormant in the fall. One of two methods of pruning should be followed, of which either might be found of value for different varieties. The stump system of pruning in a modified form is preferable for some, but a modified long armed renewal is being used the most extensively. The thing to be accomplished in each case is to keep the vines permanently close to the ground to facilitate covering. The usual stump method of pruning will allow the crown to become too high to be covered economically, hence a low stump is preferable. The time for this work usually comes during October or early in November. Vines trained to a stump are covered to best advantage by the use of a shovel. The long armed system of pruning can best be covered by plowing dirt on to them from the sides of the row. This method necessitates the use of a shovel to complete the work. When vines are protected in this way there is no need of uncovering them at a certain time in the spring; for if the work is delayed, new shoots come out readily and the uncovering can be done at any convenient time before warm weather sets in.

The growing of vinefera grapes is confronted by two serious conditions, one the liability of winter freezing and the other the almost universal presence of crown gall. This disease does not appear to affect materially the vitality of the vines in all cases during the growing season; but the canes of the current year's growth are frequently destroyed by it before the ensuing year, when they are expected to produce fruit. As yet it has not been determined if some plants are more immune t this trouble than others. Crown gall has caused but little, if any, loss among the American varieties.

The test of American varieties indicates at the present time that the Worden, Salem, Niagara and Concord are among the very best. Of these, the Worden shows many superior qualities. It is a strong grower, produces early and abundantly and the quality of fruit is very good. Most of these varieties are very hardy and seem to be generally well adapted.

The grapes produced at this place contain a large amount of sugar and are much sweeter than the same varieties produced in the cooler parts of the northwest. At present there is a large demand on the Pacific Coast for American grapes that are sweet and desirable for eating. The fact that several car loads are being shipped in from New York annually shows that we have a good market close at hand for large quantities of this fruit.

This experiment is located in a very exposed position where the plants are subjected to extreme summer heat and direct action of the prevailing winds. The growth of the vines is small, which condition is attributed to the exposure and to the lack of proper food material in the soil. At the present time steps are being taken to build up the soil in the grape vineyard in order to increase the size and vigor of the vines.

Most varieties of grapes have been found to blossom after the period of late frosts, a condition which makes them the most uniform in production of any of the fruit crops. Grapes ripen early enough in this locality to be placed upon the market ahead of those from the cooler districts of the northwest.

The vines frequently sustain injuries from the action of the wind, hence they should be protected by windbreaks, or trellised, since trellising will also diminish this trouble. The trellis, whenever possible, should be run at right angles to the wind, for in this way the first few rows of vines afford a great deal of protection to the vineyard. If the wind is allowed to blow lengthwise with the rows, it causes considerable damage to the vines by whipping them about and moving them on the wires. In this country where the growth is small and the wind action heavy, a low trellis is preferable. The slow and weakly growth of the plants in this experiment indicate that the ground should be prepared by the application of available plant food before starting a vineyard.

In addition to the variety test, a small commercial planting of grape vines was made in order to determine what can be expected by the commercial grower. In this work 4 varieties were used, the Worden, Salem, Moore's Early, and Concord. The Worden seems to be far superior to the other three varieties. The Salem is good, but the Moore's Early is not at all adapted to these conditions. The loss of vines each year has been very heavy and the growth of living vines quite small and unsatisfactory. The Concord, also, is much weaker than the other two varieties, but could

probably be grown to advantage if well fertilized, because it is a heavy producer. The entire vineyard has been subjected to the same cultural treatment and has been irrigated at intervals of from 6 to 10 days. Rye has been sown between the rows each fall to afford protection to the plants during the windy season. Work has been continued for 3 years and the results so far obtained have not been sufficiently verified to make these observations conclusive.

Experiment 9. Strawberries. The ground upon which this determination is being made is very uneven in character. Some heavy grading was done which has rendered portions of the field almost devoid of plant food materials and doubly enriched other portions. In new land the greater amount of fertility is within a few inches of the surface and when this is graded away in places, it leaves exposed an open sandy subsoil very low in fertility. This ground had no special preparation before the plants were set out and as a result the growth has been very small and the losses correspondingly heavy. Seventy-four varieties have been set to date, of these 34 are two years old, 14 one year old, and 26 were set in the spring of 1912. From the one and two year old plants some figures have been taken on yields. In 1911 the heaviest yield from one year old plants was gathered from the Miller, Sample, Texas and Arizona Everbearing. In 1912 the heaviest yield from one year old plants was received from Sharpless, Good Luck, Parker's Early and Kansas, but none of these produced as heavily as the one year old plants in 1911. The two year old plants produced less in 1912 than in 1911. The second crop yield was heaviest on Sample, Texas, Arizona Everbearing and Magoon. Sample was the only variety which produced as heavily in its second year as in its first. These results indicate that well grown one year old plants will produce more fruit the first year than in subsequent seasons when properly handled. If this is so it will bear out the experience of many growers in showing that the plants soon begin to depreciate in yield and should not be kept too long if profit is to be derived from them each year. It is planned to extend this determination to at least 100 varieties with a view to finding, if possible, a superior market variety for this district. On account of the early season and light warm soil, the growing of early fruit is anticipated to be a profitable industry. As a means of assistance in this matter the station is trying to find the most valuable fruit for the purpose. The Clark Seedling, which is superior for shipping, does not yield as it should and an attempt is being made to get some-

thing that will produce a marketable fruit in paying quantities.

The chief difficulty in this work is the uneven condition of the soil which makes it hard to compare varieties grown on different parts of the field.

Systems of Planting.

An experiment is in progress to determine which system of planting is the best adapted to the conditions prevailing in the district. A half acre of ground was divided into 4 parts, one subdivision being set by the double hedge row system, one by the single hedge row, one allowed to mat and the fourth devoted to the hill system of planting.

The Clark Seedling variety was used and all the plants set out in September 1910. On account of soil conditions described above and considerable action from the wind, the growth of these plants has been very small and the yield correspondingly light. One crop has been picked, which has given no indications of the superiority of either system; it is expected, however, that within another year some conclusions might be drawn as to which system is preferable. The hill and single hedge rows have some preference in being the easiest to cultivate and keep free of weeds.

Some observations have been made in connection with strawberry work which indicate that either August planting or early spring planting should be practiced. Plants set out after August do not get sufficient growth to bear profitably the next year, and a large number are sometimes lost during the winter. Late spring plantings are usually overtaken with warm weather before they get well started and do not grow well. It is also apparent that where sandy soils are used they should be thoroughly prepared before starting a bed; for if this is not done the plants cannot yield profitable returns.

For home use, where a variety is desired that fruits through a long season, the Arizona Everbearing has proved to be of great value. The habit of this plant is to begin ripening its berries early, and to continue until the season of nearly all other varieties is over. It has a heavy foliage and shades its fruits, thus preventing injury from wind and summer heat.

GARDEN CROPS.

Experiment 1. Asparagus Growing. On certain areas in the Columbia River Valley asparagus is becoming a very profitable commercial crop. In order to determine what could be done with it at this station a small tract of land has

been set aside and two varieties of asparagus planted. The varieties under observation are the Converse Colossal and Palmetto. It is hoped to determine from this experiment the possibility of growing asparagus successfully for market under the conditions in this district, and also to determine some points regarding the fertilization of the soil for such a crop. This experiment is to be used, moreover, as a demonstration of the proper methods to employ in growing asparagus. On account of the high state of fertility that this crop requires, the ground was heavily fertilized previous to setting the plants. Two crops, grown on the land, were incorporated into it, and sometime previous to planting, manure was added at the rate of 30 loads to the acre. The plants were set out in the early spring of 1911. One year old plants of fair quality were used. As the fertilizer was not well decayed in the soil, the first year's growth was rather small. The Palmetto variety is much the stronger growing and indications are that it is of the greatest commercial importance. A few plants were reset in 1912 and the bed as a whole is in excellent condition for producing a commercial crop next year. Some commercial fertilizers, principally nitrates, are to be used on portions of this area, to determine the best method of procedure to stimulate a strong growth.

Experiment 2. Rhubarb. To determine the value of this product as a commercial crop, or for home use, some plantings were made in 1910. The roots were put in the ground late and the results were very unsatisfactory. Their action indicates that more fertility is needed in the soil and that careful shading is required during the summer. Another planting, made in 1911, acted very much like the one put out the previous year. The third planting in 1912,which consisted of Victoria, Linneaus, and Mammoth plants, was by far the most successful. At this time the fertility of the soil had been greatly increased, the plants were set earlier in the year and were shaded during the summer. All three conditions have favored the success of the experiment. In the course of this work several varieties other than those mentioned have been tried, but these three are much the hardiest and are also good commercial varieties.

Experiment 3. Melons. The early season and warm summer weather, together with the light soil of the district, suggest that melons can be grown to good advantage. Early planting on new land has been unsuccessful from a market standpoint. The tendency of the fruit is to be small and malformed, ripening unevenly and generally not of salable

quality. The improvement of soil conditions is making a great difference in the quality of the melons grown. From the results of some observations made this past year it has been decided that in many instances the melon fields have been over-irrigated. However, no definite determinations have yet been made. The work carried on at the station for the past three years has been to determine the best commercial variety or varieties for the district. In all, fourteen varieties have been tried, and so far the Cleckley Sweet (Monte Christo) is far superior to any other. It does not yield as heavily as some; but the melons are uniform, of good quality, and are one of the best shippers produced. At present the chief problem is that of marketing. The number of varieties grown is too large in proportion to the bulk of the output to permit the shipping of special varieties in car lots. When the people become organized in their growing and shipping operations, the melon industry promises well for the district and should be pushed to the front as rapidly as possible.

Experiment 4. Potatoes. Work in the determination of potato varieties has been carried on for three years, the principal aim being to find which has the highest value for early production. The early season of this country will permit potatoes being grown and put on the market at a time when they bring a very good price. This work is being conducted in co-operation with the department of Agriculture which is furnishing the seed. The results so far obtained indicate that the Early Rose, Irish Cobbler, and Early Ohio are excellent for this purpose.

The high cost of seed when purchased from the outside has brought up a problem regarding the advisability of planting home grown potatoes. A small determination was undertaken along this line in 1912. Early potatoes were taken at time of maturity and replanted, with the result, however, that only a few germinated and none produced a second crop. Since the first crop tubers cannot be held over the long summer season to good advantage, and since our experiment shows that two crops cannot be grown in order that first class seed can be held for the next spring planting, it follows that seed potatoes, at present, must be imported.

Another experiment has been tried to determine the value of seed potatoes grown on the sandy soil under normal conditions. Seed from potatoes of the Burbank, Earl Ohio, Peach Blow, Irish Cobbler, Pearl, and Green Mountain varieties grown on the Experiment Station last year were

planted this season. The result is that of the Burbank 87 per cent only are maketable, Early Ohio 83 per cent., Peach Blow 75 per cent., Irish Cobbler none, Pearl none, and Green Mountain none. These results check very closely with the condition of the tubers when planted. The tubers of the varieties which produced a large percentage of good potatoes were in good shape at the time of planting, but the ones which produced nothing were in a very bad condition. Until proper storage facilities are provided it will be difficult and many times impractical to keep early potatoes for planting.

Late varieties of potatoes such as the Burbank and Peach Blow sometimes produce the greatest yield. On the sandy soils the use of fertilizer is necessary to insure success in potato growing. Land into which one cover crop or one heavy application of stable manure has been incorporated yields much better than the raw land.

Experiment 5. Corn. A three year test of the more common varieties of sweet corn, shows the Golden West, Country Gentleman, and Golden Bantam to be somewhat superior to others tried. On account of the uneven condition of the soil, the crop is usually very irregular in height and vigor, but the results show that corn can be profitably grown in every home garden. Several varieties of field corn have also been grown, the results obtained from which were even better than with sweet corn.

Experiment 6. Egg Plant. Work has been continued with egg plant for three years, using the same four varieties each year. In this time the fertility of the soil has been greatly increased, with very marked results. Our experiments with egg plant show plainly that varieties must be selected which shade their fruit. The Black Pekin, upon which the fruit is exposed, has been badly injured each year by sunscald. New York Improved and Black Beauty are the two best varieties tried. They make a strong growth and produce large yields of fruit of the best quality. The vigor of plants and the yield in this district are far above the average for this crop, and it should be grown and shipped in large quantities. While markets do not appear to be very good, this seems to be chiefly due to the fact that it is not known that good egg plant is being produced in Oregon. Several car loads of egg plant are being shipped annually from California into Oregon and Washington. By putting small lots onto the different markets in the northwest a few times, and by advertising and showing that a superior article is being grown close home, a large demand can be created for the output.

Experiment 7. Peanuts. Peanuts make a very strong growth but the season is somewhat too short. A great deal of fruit sets but only a portion of it matures. This is a promising crop for the home garden and might be developed into a commercial industry of some importance should early maturing varieties be found. On the variety determination of 1912 three varieties were used which produced salable nuts giving calculated yields as follows:

Spanish 242 lbs., African 135.5 lbs. and Jumbo 427.85 lbs. per acre. Two rows of Jumbo nuts which were given two applications of nitrate of soda yielded at the rate of 508.2 lbs.

The African set about as many pods as either of the others, but only a part of the peas became developed. The greater number of the Jumbo nuts were well filled. Those to which nitrate was applied developed the largest plants, and set a great many pods but they were not all mature. Early planting and liberal applications of nitrogenous fertilizers will greatly enlarge the yield of nuts.

Experiment 8. Tomatoes. The Western Tomato blight which has become so destructive through the eastern part of the state during the past few years causes a greater loss to this plant on the light sandy soils than anywhere else observed. It is so severe that plants even of the most hardy variety cannot be grown successfully. For the purpose of determining, if possible, some method of producing this fruit, and in an endeavor to find a variety, which shows considerable resistance, an experiment has been undertaken. Nineteen varieties have been tried, but of these only one shows any particular ability to resist the trouble. Out of 1200 plants started in 1912 one plant of the French Marvel variety produced fruit. The plants in this determination were subjected to several different methods of culture, namely, the planting of seed directly in the field, the shading of plants with canvas, covering with lattice work and spraying with lime, covering the ground with barnyard litter and with straw, and in another instance the placing of manure in pits under the plants. When warm weather came on, the loss of vitality from the entire patch was so general that no superior value could be determined from any one of the methods of treatment employed. The plant which finally fruited had no special treatment, being entirely in the open and having blighted plants all about it. No indication of blight was shown on this plant until some of the fruit had ripened, at which time it was attacked by the trouble and died in a short time. As a further determination along this

line some soil was sent from about the plants that died last year to the Deparment of Agriculture, and from these samples an endeavor was made to produce tne blight under Atlantic coast conditions. The result was that no blight trouble appeared, but the plants remained very small and sickly, presenting an appearance of malnutrition.

Careful observations have been made this year and seed selected from plants in different parts of the district which have shown more or less resistance to this trouble. It is hoped that in time something can be selected or created with a power to resist this disease sufficiently to permit its being grown for home use.

COVER CROPS

Part of the crops discussed under this heading are legumes and part cereals. They have all been grown to determine their value as green manures for increasing the humus content of the soil and for the purpose of protecting the land from the effects of wind and the intense heat of summer. Such crops as milo, kaffir corn, and sorghum have all been used to determine their value as quick growing temporary wind breaks and for the benefit to the soil that results from the addition of the large root system they produce. This work has not been conducted as a regular experiment, the crops having been grown largely on ground occupied by experiments previously explained.

Experiment 1 Canadian Field Peas.—There has been considerable need for a quick growing leguminous crop that can either be incorporated in the soil while green or left in a dry state to shade the ground during the summer. To determine what a crop of field peas would do, it has been planted three times, twice in the spring and once in July. Fall planting is not advisable on account of the low winter temperatures of this district. The crops grew nicely until warm weather came on when growth was immediately arrested and the plants soon withered and died. This condition came on, one year when the plants were but a few inches tall, another season when they were in full bloom, and another when some seed had been formed. If planted as soon as danger of frost is over in the spring, Canadian field peas would have sufficient time to develop before the warm weather sets in.

This crop can be used to advantage for two purposes; one to grow and work into the soil in the spring for which but a short time is required, the other to allow the crops to remain on the ground during the summer, thereby shad-

ing it and preventing more or less of evaporation, and minimizing also the amount of organic matter burned out of the soil. It has been noticed that field peas, like most other crops, do much better where some fertility has been added to the land. The growth is not only stronger but the effects of summer heat are withstood for a greater length of time.

Experiment 2. Vetch.—On account of its extreme hardiness and ability to withstand both summer drouth and cold weather in winter, the hairy vetch (**Vicia villosa**) when sown in early fall on irrigated ground, makes a good growth and comes on rapidly the next spring. It has been used several times under different conditions of soil and seasons of planting. The first planting, made in the middle of July, resulted in a fair crop. The last two seedings have been in the fall, one early and the other late. The early seeding has given much the better results. This crop does not succeed so well when sown in the spring, and should be confined altogether to growing in the winter. Inoculation would evidently be of advantage to vetch when it is being grown for the first time on new land. Observations have shown that when put on new ground only an occasional plant will thrive during the first few months. Upon investigation the larger plants are found to carry a great many nodules of which the weaker ones are devoid.

At the present time seed is very hard to get and is too expensive to be used advantageously. To overcome this difficulty a good method is to produce the seed on the ground. This can be done each year by leaving between the trees a narrow strip of plants to go to seed. In the fall they can be scattered about and worked into the ground. This method does not permit an orchardist to keep his tract looking very neat but by its use there is considerable to be gained.

It is a bad practice to plow a heavy crop of vetch or other green manures directly into the ground. The mass is oftentimes sufficient to prevent proper capillary action in the soil, and should be cut up with a disk harrow before plowing. The orchardist who desires to practice clean culture during the summer time can maintain the fertility of his land by growing on it an occasional crop of this nature. On account of its hardiness and luxuriant habit of growth, this variety of vetch is one of the best cover crops that can be had.

Spring Vetch. (**Vicia sativa**).—This crop has been tried three successive years, once seeded in the summer and twice in the fall. Neither attempt has been successful, from the fact that the plants freeze out in winter. Some

effort is being made to get a variety of vetch that is as hardy as **Vicia villosa** and will produce seed abundantly in this district. If it can be procured, the great expense of buying imported seed each year at a high price can be avoided.

Experiment 3. Espercett.—This leguminous crop was sown in 1910 to determine its value. It grew nicely, spread out well over the ground and held the soil unusually well. It stands the winter climate, but is slow to develop and is fully as difficult to start as the clovers, which are superior to it in many ways.

Experiment 4 Red Clover.—Both Red and Mammoth Red clover have been used in this work. The value of the clovers is not altogether in their ability to build up the soil; for often a crop of hay can be taken off to advantage before the field is plowed. The chief objection to this crop is the difficulty of getting it started on land that is exposed to the wind. It is necessary to sow at the rate of 12 to 16 lbs. in rye stubble or during the fall between rows of corn. The latter method is generally preferable, from the fact that early fall-sown clover is usually as good the next spring as if it were a year old. The spring-sown crops are of some value for shading the ground during the summer, but require a great deal of water to keep them up. Fall sown crops can be plowed in the next fall, but spring-sown crops must be left on the ground at least a year and a half. One and two year old crops of clover, upon being plowed in, show a marked change in the condition of the soil upon which they were grown.

In no case should clover be left over two years in an orchard. Its requirements of irrigation are very different from those of the trees, and its shading keeps the moisture close to the surface. This condition causes a development of the root system of the trees near the surface of the ground and when the crop is plowed the trees are seriously injured.

Experiment 5 Sweet Clover.—This crop is not generally favored for green manure or cover crop purposes from the fact that many people consider it an obnoxious weed. It has only been grown on the farm once but has proved to be of great value. The seeding was done May 15, 1911, and by Sept. 30 it had reached a height ranging from 1 to 2½ feet, a height which is much greater than any other leguminous crop attained during the summer. It could have been plowed under to good advantage in the fall, but as the ground was not in need of it, the crop was mowed and left

lying in the field. The following May the clover had again reached the height of 2 feet before being plowed up. As soon as this material had sufficient time to decay, the exact location of the land upon which it was grown could be determined from the outward sign of the crop then growing upon it. It needs to be sown the same as red clover or alfalfa, using 16 to 20 pounds of seed per acre. It might be put in at any time during the growing season. The chief difficulty with it is in its being rather hard to get started if planted in an exposed place. The seed is at present rather high in price but as it is fairly easy to produce, the price might be expected to decline somewhat. On account of its more vigorous growth this crop makes a better green manure than alfalfa. The United States Department of Agriculture, in Farmers' bulletin No. 485, recommends its use for forage and hay. Its rapid and vigorous habit of growth makes it of some value for forage purposes while being grown to enrich the soil. Stock do not take readily to it, but can be trained to like it in a little while, and once having acquired a taste for it will thrive on either the hay or green forage.

In some ways sweet clover and the alfalfa crops are better for fertilizing the land than is red clover. They are stronger in growth and more permanent. On account of their deep rooting habit they can often be maintained to better advantage with a small quantity of water than the shallower rooted clover.

Experiment 6 Alfalfa.—The operation of eradicating alfalfa is many times quite difficult, for the loose nature of the soil does not permit of good plowing. To plow to best advantage the ground should be irrigated to make it more firm. In this condition the plow holds its place better and cuts the roots more effectively. When only a small portion of the root system of a plant is left in the ground it usually keeps alive and may, after some time, make its reappearance and involve replowing.

Alfalfa has an economic value in addition to the increase in soil fertility, in that four crops of hay can be grown in a year. This means much to the beginner in a new country. Alfalfa is used quite generally in some districts where a sufficient amount of water is available, by being sown in strips between the tree rows. The strips are diminished in width each year as the trees grow, so the root system can spread properly. If there is any question concerning the possibility of ample water, such a crop should not be grown: for the trees are liable to injury from drouth. In no case should

an attempt be made to grow trees in a heavy planting of alfalfa. The root system of the forage plants so thoroughly permeate the soil that the trees have but a very poor chance to survive.

Alfalfa is seeded either in the spring or early fall by using 16 to 20 pounds of seed to the acre. It should be put in with a drill in order that all the seed will be deep enough in the ground to insure even germination. The young plants are very tender and for their protection some covering of the ground is usually necessary.

Experiment 7. Crimson Clover.—The success of this crop in some fruit districts has been very great. If sown in the fall, as is usual, a luxuriant growth of vegetation can be worked into the ground the ensuing spring. In order to determine what it would do in this district, it has been sown three times. twice in the fall and once in the spring. The results of the work have been very unsatisfactory. Conditions of seed bed and moisture have been very good in every instance, but the action of the plants has shown that the crop is not adapted to this coarse open soil. The largest plants obtained did not exceed 8 inches in height, whereas they grow at least 1½ or 2 feet tall. The fall sown plants largely killed out during the winter. Some made a slight growth in the spring but withered when warm weather came on in June.

Experiment 8. Kaffir Corn, Milo and Sorghum.—A quick growing low annual windbreak for use in gardens, clover fields, etc., is frequently needed. To determine what crop could be used to best advantage for this purpose, several experiments are being carried on. Two varieties of kaffir corn have been grown, but between the two no marked difference could be determined excepting that the black hulled variety produced the greatest amount of seed. This crop can be grown by planting at any time during the summer, but will not mature seed if planted later than July 1st.

Milo has also been grown in this determination. It does not produce as much fodder as kaffir corn or sorghum but yields seed abundantly. This crop can be used to advantage following early maturing vegetables, etc., for the production of grain to use on the farm.

Sorghum makes a slower growth than either of the above mentioned plants, produces only a small amount of seed, and has a tendency to spread out more when grown in single rows. It is not desirable for a low windbreak unless planted early and in several rows together.

Besides the fact that these cane crops are of value for

a quick growing low windbreak and for the seed produced the stubble left after removing the row or broadcasted crops affords a good protection for young alfalfa or clover. When the cane crop is in rows alfalfa or clover can be planted to good advantage while the cane crop is still standing. The root system moreover is very large and when left in the soil adds a great deal of fiber and considerable plant food to it.

Experiment 9. Millett.—Millett grows fairly well but has no special value. At the Station it has been used in limited quantities to determine its power to prevent wind action on the soil. For this purpose it does not equal rye, and when once introduced on a place becomes an obnoxious weed. It spreads rapidly along ditches and fence rows and is very hard to eradicate. It has no properties of sufficient value to justify its being grown.

Experiment 10. Field Corn.—Field corn, besides being of some economic value for fodder and grain, makes an excellent windbreak and is being used by some farmers for the protection of young alfalfa. Hardy varieties only should be grown on new land. Corn requires less moisture than many other crops and for this reason can quite frequently be used to advantage where the weaker crops would perish. On prepared soil corn frequently grows to twice the size of that planted on new ground and makes a correspondingly greater yield of grain.

COOPERATIVE COVER CROP EXPERIMENTS.

For the purpose of determining how the more desirable cover crops will grow on other soils in the district, several cooperative experiments have been undertaken near Stanfield. The tendency at this place is to neglect soil fertility: hence by growing some of these crops in the district as a demonstration, it is hoped that the people will adopt their use to build up the soil. The ground has only recently been put under irrigation, and like most other soils is very deficient in humus and nitrogen. Arrangements were made with three farmers to plant seeds furnished by the Experiment Station. In the fall of 1912 two varieties of vetch, **Vicia villosa** and **Sativa** were used, and in the spring of 1913 Canadian field pea seed will be furnished them to plant. The experiments have been located where they can be readily seen by any one interested in them.

IRRIGATION

Experiment 1.—To compare the result of moderate vs excessive irrigation on the growth, productivity, and longevity of fruit trees where drainage is practiced.

For this experiment a special selection of land was made and a piece one acre in extent was chosen upon which no water could be gotten excepting through the regular distribution system. The land was divided into equal parts, and carefully constructed weirs were plaecd so as to measure the exact amount of water applied to each. The Winesap variety of apple has been chosen on account of its hardiness and the vigorous growth of the tree.

The irrigation of this land during the first year was very unsatisfactory. Frequently during the season it was impossible to get water to the experiment when it was needed. As a result of this uneven irrigation, no results were obtained and the growth of the trees was very unsatisfactory. In 1912 the first plat was irrigated every 7 days and the second plat every 14 days. The growth this year has been very good, but there is practically no difference in the appearance of the trees at the present time. This work is to be carried on for an indefinite period, because it is expected that the principal determinations will be made after the trees reach maturity.

Soil Moisture Determination.

The physical composition of the soils of the lower Umatilla River country puts them under two classes, namely, sand and sandy loam or silt. The silt soils can be irrigated with a minimum of loss but the sandy areas are very difficult to irrigate without losing large quantities of water. This loss of moisture is due to rapid percolation during the operation of irrigating, and to evaporation afterwards. Definite knowledge of the action of irrigation water in this character of soil is needed in order to plan experiments by which the best means of overcoming the difficulty can be determined. For this purpose, some soil moisture determinations were made this year and will be repeated next season to verify the results that have been obtained.

Experiment 2.—The purpose of this experiment is to find what conditions of soil moisture exist in strips of alfalfa between the tree rows in an orchard. The principal objects sought are the percentage amount of water held by the soil from each irrigation, the rate of loss through respiration, evaporation, and percolation, and the amount of moisture present when the alfalfa plants begin showing signs of distress.

Experiment 3.—An attempt to determine the value of cultivation on the coarse sandy soils.

For this purpose two plats of equal size were used, to which equal quantities of water were applied. One of

the areas was systematically cultivated at frequent intervals and the other had no cultivation. It is expected that the soil moisture determinations from these plats will show some difference in the power of the soil, under the different treatments, to hold moisture. On account of the open texture of the soil and the loose condition of the surface upon drying it is possible that the cultivation will make little if any difference in the amount of evaporation.

Experiment 4.—A third line of work was pursued in an endeavor to determine the percentage loss of moisture through the agencies of evaporation and percolation. An area of land was given a known amount of water, then securely covered with an oiled canvas which was made practically air tight by having the edges buried in the soil. Assuming that this canvas was air tight the principal loss sustained from the covered soil must be through percolation since the action of capillarity in a horizontal direction is very slight, and no samples were taken near the edge of the plat. The samples were taken at frequent intervals to a depth of 6 ft. to determine the rate of loss of moisture; and to determine also the amount of moisture contained in this soil at different depths as compared with that contained in the cultivated and uncultivated plats. By comparing the data gathered from experiments two and three with experiment four we expect to find the percentage of loss that is sustained through percolation, also what is lost by evaporation from the first two experiments.

WINDBREAKS AND ORNAMENTALS.

Windbreaks in some form are almost indispensable for protection to soil and crops in this district. The heavy winds which usually occur during the spring, prevail from the southwest, making protection necessary along the west and south of the farm units. A dense windbreak will afford protection to the land and crops for a distance ranging from 5 to 10 times the height of the trees.

The form of protection that can be used to best advantage will vary considerably with the size of field and the kind of crop that is being grown, and also with the area that can be devoted to growing the trees. Where the land can be spared, a wide strip of trees, or a shelter belt, is very desirable, but can not be used to advantage on the small farm units of this district. A shelter belt is made most effective by planting trees of several kinds, which differ in habit of growth. Some low spreading tree such as Russian oleaster **(eleagnus augustifolia)** Golden Willow or Russian mul-

berry, should be put on the exposed side, and next to it something taller like mulberry, maple or locust, and beyond that the locust, poplar, or Scotch or Western Yellow pine.

For a windbreak to be grown on a small farm where it will occupy the least possible space, a double row of Black locust or Carolina poplar is very desirable. The trees should be set so as to alternate in the rows, as this renders the shelter more effective. Where but a single row is to be used the Black locust is a very good tree to plant. It is better than any of the poplars because it spreads out more and does not bend so easily. To give the best results locusts should be planted from 5 to 8 feet apart and poplars 3 to 5 feet.

For a permanent low shelter, the Russian oleaster, Russian Golden Willow, or Russian Mulberry are very desirable, although the mulberry frequently grows to be 20 to 30 feet tall. These trees have a spreading habit of growth and should be planted from 4 to 6 feet apart.

In ordering trees for windbreak purposes or for shelter belts, small young stock is preferable, as it usually grows better and can be bought at a much lower price than the larger stock.

A number of ornamental plants were tried from which to select some things that can be used to advantage for lawns and hedges. From this work, which has only been followed for one year, indications are that **Berberis Bulgaris**, B. **thunbergi**, **Eleagnus longipes**, mock orange, snow berry, **Tamarisk Africana** T. **hispida**, T. **Chinensis**, Red cedar, **Ibota privet**, and California privet can be depended upon for ornamental planting. The California privet makes a very nice hedge.

FORESTRY PLANTING.

A large collection of trees was received from the U. S. Forest Service in 1911 and were planted in nursery rows as a preliminary test. Some kinds have grown nicely and others have not. Trees of this lot that are showing up best for windbreak purposes are Scotch and Western Yellow pine, boxelder, Diamond and Golden Willow, Sugar maple, Cork and American Elm.

Green and white ash, Hardy Catalpa, Sycamore, Norway spruce, Colorado Blue Spruce and Rocy Mountain Silver cedar are giving promise of value for ornamental purposes.

METEOROLOGICAL OBSERVATIONS.

Observations of temperatures, humidity, evaporation; and wind velocity are being made to determine the influence

of these factors upon crop growth and also upon the losses of soil moisture. During the frost periods of spring and fall the maximum and minimum temperatures are being taken on the highest part of the place in addition to those taken at the buildings. The difference in altitude of the two instruments is 52 feet and in nights of sharp frost the minimum temperature recorded on the higher land has been as much as 70 above that recorded at the lower place.

COMMUNITY BREEDING

The lighter soils of the Columbia River Valley are quite difficult and slow to subdue and to bring into profitable crop production. The principal source of difficulty is the lack of humus and nitrogen. This shortage can best be overcome by one of two methods. One is to grow repeatedly, such hardy crops as can be produced, and to plow them in until enough material is added to make the soil productive. Such an operation is slow and expensive, for money and labor are being expended, and nothing is being received in return as the work progresses. This condition confronts almost every land holder in the country. The people need returns before their orchards and vineyards come into bearing and must look to some more economical methods of procedure.

The second method of procedure is that of feeding to dairy cattle, all the forage that can be raised. In this way the greater part of the plant material will be returned to the soil to assist in supplying the elements of fertility which it needs and at the same time the owner is realizing a neat profit from the butter fat and milk which the cows produce.

By the application of a small amount of capital, and the exercise of some energy in addition to what is already being done, a fair income can be derived from the operation of transforming the comparatively unproductive desert land into a highly fertilized soil with greatly increased possibilities of crop production. In a new country the securing of profitable dairy stock is a difficult matter. Milch cows are hard to get, and the better classes of them are rarely to be had even though high prices might be offered. The only practical solution of the matter is the importation of the best "grade" cows obtainable, and from these to improve the class of stock by the use of pure bred sires.

Recognizing the needs of the people of the Umatilla Project and neighboring districts in this matter, the Oregon Experiment Station has furnished a valuable Jersey sire to be used by local breeders for an indefinite period. This animal is being kept at the Experiment Farm at no expense

to the peaple except a small charge to cover the cost of maintaining him. This is the only instance of help being afforded people in the state in any such manner, and its practicability has yet to be determined. The need of such assistance has been keenly felt by the farmers of the district, and this attempt to help them is being greatly appreciated.

EXTENSION WORK

Besides the regular work of the Station, considerable work is being done through the eastern part of the state in the way of lecturing and demonstrations to fruit growers on topics of horticulture and irrigation. In the vicinity of the Experiment Station frequent trips are made, upon request, to analyze perplexing problems for the residents of the district, demonstrations are also held, at such times and places as will best suit the line of work considered. As the Station force is increased, it is intended to get out among the people more, to assist them to carry out their work to the best advantage.

SUMMARY

The clearing and grading of this sandy land requires careful and thorough work. If the soil is allowed to blow at any time, regrading becomes necessary.

Flumes should be used instead of ditches for carrying the water wherever possible, to prevent excessive loss.

The furrow system of irrigating is the method best adapted to use upon light soils. Steep land can be irrigated to best advantage by contour furrows when clean culture is practiced.

The fertility of this new land is increased most effectively by the growth of crops and incorporation of vegetable matter into it. Hairy vetch (**Vicia villosa**) Canadian field peas, red clover, and sweet clover are green manure crops especially adapted to this soil. The repeated use of such crops causes a rapid change in the character of the land, making it more productive, less subject to blowing and washing, and increasing its water holding capacity.

Apples are making a strong growth and appear to be better adapted to the sandy soil than any of the other tree fruits. Pears do best on damp soil, which indicates that they might be used to advantage on subirrigated land, provided the water table is not too high.

Prunes and cherries are difficult to get started. Peaches do not grow well on some land but thrive in fertile and moist locations. One year old trees of small size (3 to 4.5 ft.) give better results than older and larger stock.

American grapes grow fairly well and begin bearing early. The fruit is very sweet and should demand the highest price. Vinifera grapes make a very strong growth and produce abundantly. They freeze back in winter if not covered and are badly affected by crown gall. Viticulture promises to be one of the leading industries of the sandy districts under irrigation in the Columbia River Valley.

Gooseberries, dewberries, loganberries, and evergreen blackberries are the most hardy cane fruits so far tried.

Strawberries should not be planted on new land. When grown on well fertilized land, an excellent quality of fruit is produced.

Vegetable growing can be successfully followed by properly enriching the land. Asparagus, potatoes, egg plant, and onions give promise as commercial crops, and indications are that the production of peanuts can be made profitable. A superior quality of egg plant is grown here and large yields secured. This crop should be grown and shipped in large quantities to points in the northwest now being supplied by California growers.

Watermelons of good quality are being produced, and the production should be increased until several car loads are marketed each year.

Windbreaks are very essential to protect the soil and crops and should be more generally used. Black locust and Carolina poplar are the best quick growing trees for this purpose.

Talent, Oregon. Nov. 9, 1912.

Report of the Southern Oregon Experiment Station.

Prof. C. I. Lewis,

Corvallis, Oregon.

Dear Sir:

I am submitting herewith the first report of the Southern Oregon Experiment Station, covering the period from August 15, 1911 to November 1, 1912.

LOCATING THE EXPERIMENT STATION

As we could not obtain possession of the original site selected for the Experiment Station at Tolo, Oregon, it was necessary to find another location. I therefore spent four months making a careful study of the different localities in the valley, and discussed the matter thoroughly with many of the fruit growers. As soon as the fruit growers understood the objects and purposes of the Station, many of them offered land for a site. I then made a careful study of the various tracts of land offered. The soil on the most suit-

able tracts was thoroughly examined to a depth of six feet, the object being to ascertain the character of the soil for uniformity and depth.

The committee from the Agricultural College finally selected the site and tract of land offered by the County Court of Jackson County. The tract has many features to recommend it for such an Experiment Station. It is located one-half mile north of the town of Talent, Oregon, on the leading road in the county, and is situated near the center of the fruit industry of the valley. The soil consists of two distinct types: a heavy loam bordering on the sticky, and a fine loam, commonly known as Bear Creek Bottom. The original tract consisted of fifteen acres. On Oct. 2, 1912, the County Court gave us an additional tract of five acres, which consists of a strip along the north side of the original tract.

Preliminary Work at the Station.

There were no buildings on this tract of land, hence the County Court also gave us $2500.00 for the construction of the necessary buildings. These buildings were constructed during the spring of the present year. It became necessary for me to superintend the construction of these buildings; hence considerable time had to be devoted to that feature of the work.

The entire tract of land was in alfalfa, most of which had become thoroughly established. This heavy alfalfa sod had to be ploughed up and the alfalfa killed. This has taken a large amount of time and work.

The Bear Creek bottom which constitutes about seventy-five per cent of the Station land, had never been leveled or graded. A large portion of this was very rough and rolling. At various times in the past Bear Creek has overflowed this land and has cut deep gulches through it. We have spent four months leveling and grading this land so that it will be as uniform as possible, and so that in the future it can be readily irrigated.

Part of the heavy upland is very wet and poorly drained. In places the water level during the driest part of the year was only a foot below the surface of the ground. This is now being thoroughly drained with the tile drains laid at a depth of four feet.

This preparatory work, which was absolutely necessary has prevented us from doing any experimental work on the Station grounds during the past season.

Cooperative Experiments.

We have a great variety of soils in this valley; according to the government soil survey there are at least fifty types. It is possible to get only a small number of these types on any one tract of land. Hence we have many local problems which must be solved experimentally on the different soil types where they occur. To solve some of these problems this Station has inaugurated a number of experiments in various orchards in the valley, as follows:

Fertilizer Experiments.

Experiments to determine the effect of the fertilizing elements Nitrogen, Potassium, Phosphorous, Magnesium and Iron on:

A. The yield of Yellow Newtown and Spitzenburg apples when grown on the various types of soil.
B. The yield of pears on the various types of soil.
C. The bearing age of Yellow Newtown apple trees on heavy rich soil.
D. The color of Spitzenburg apples. This experiment is being conducted in an orchard where the fruit of this variety does not color well.
E. The trouble known as "Little Leaf" of the apple, the object being to determine whether this trouble is due to a lack of some plant food or some other cause.
F. The dropping of the fruit of the Muir peach; to determine whether this can be prevented by proper fertilizing.

Cover Crop Work.

Experiments to test the practicability of growing cover crops in the orchards of this valley; to determine:

A. Whether the cover crop will make sufficient growth to be of value where irrigation is not practiced.
B. The most suitable cover crops for this valley.
C. Best time to do the seeding.
D. Effect of the cover crop on the physical condition of our very heavy soils.
E. Effect on the yield and size of fruit.

This work is being conducted in young pear orchards, bearing pear orchard, and mature bearing Yellow Newtown and Spitzenburg apple orchards.

Orchard On Hard-Pan Soil.

An experiment to determine the best soil treatment for an orchard on hard-pan soil: by dynamiting the soil, deep

ploughing, thorough cultivation, cover crops, manuring, fertilizing, and irrigation.

Pruning Experiments.

An experiment to determine the effect of the various methods of pruning on the bearing age of pear and apple trees.

A. Winter Pruning:

In this experiment we are comparing the effect of severe cutting back and moderate cutting back of the branches in winter, with no cutting back. The work is being done on heavy, red, sticky soil. The varieties are Comice and Howell pear trees six years old.

B. Summer Pruning:

In this experiment we wish to determine the effect of severe cutting back, moderate cutting back, and no cutting back on the bearing age of the trees; to determine also the effect of such cutting back when done during spring, early summer, mid-summer, late summer, and fall. The work is being conducted on heavy black soil. The trees are Yellow Newtown apples eleven years old.

Experiment on Girdling Fruit Trees.

An experiment to determine the effect of various methods of ringing, notching, girdling, stripping, and wiring on the bearing age of apple trees. The work is being done with Yellow Newtown apple trees eleven years old. The trees are growing on heavy black soil and have produced very little fruit. Untreated trees are left as checks for comparison.

Experimental Work at the Station.

Some of the cooperative experiments will be duplicated at the Station; the object being to make the results as conclusive as possible.

Pruning Experiment on Pears.

This is a very extensive experiment to determine the effects of various amounts of thinning and cutting back of the branches during the winter and at various times throughout the summer on the following:

1. Precocity.
2. Fruit buds.
3. Checking growth of trees.
4. Vigor of tree.
5. Regularity of bearing.
6. Amount of fruit.

7. Size of fruit.
8. Color of fruit.
9. Framework of tree.

Variety Testing.

An extensive test orchard of promising European and American varieties of pear will be planted. This is to determine which of these varieties are suited to our local conditions of climate and soil; their resistance to disease; keeping and shipping qualities; flavor of fruit.

Also an extensive plantation for testing small fruits, as strawberries, raspberries, dewberries, loganberries, etc.

An Experiment With Pear Stocks.

An experiment to determine the most suitable stocks for pears, as to soil adaptation, vigor, bearing age, disease resistance.

Orchard Tillage Experiment

An experiment to determine the effect of intercropping as compared with clean cultivation in an orchard.

Vegetable Gardening Work.

Extensive work with the leading vegetables, to determine the best varieties, proper season of planting, best methods of irrigation, value of manures and commercial fertilizers.

New Problems.

Ample provision will be made to take up other lines of work as new problems present themselves.