REPORT

of

HOP BREEDING PROJECT

Sept. 3, 1930, to Dec. 31, 1931.

By

E. N. Bressman,

Associate Agronomist,
Oregon Experiment Station,
and
Agent,
Division of Drug
and Related Plants,
U. S. D. A.

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See Project file

OREGON STATE AGRICULTURAL COLLEGE

SCHOOL OF AGRICULTURE AND EXPERIMENT STATION

CORVALLIS

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February 19/32.

Director Wm. A. Schoenfeld,

Campus, O. S. C.

Dear Director Schoenfeld:

I am transmitting herewith the report on the hop project as presented by Dr. E. N. Bressman. This is the only copy here provided with photographs, so I suggest that it be maintained on file in your office on a complete basis and without removal of any of the pictures.

Very truly,

OREGON EXPERIMENT STATION.

G. R. Hyslop,
Agronomist.

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Female plants in field.

HOP BREEDING

by

Dr. E. N. Bressman, Associate Professor of Farm Crops, Oregon State Agricultural College and Agent, Division of Drug and Related Plants, United States Department of Agriculture.

INTRODUCTION

The first work on the hop breeding project was initiated on September 3, 1930, by the writer when he began a study of the downy mildew disease in the various yards in the vicinity of Corvallis, Oregon. This work was done entirely under the direction of the Oregon Agricultural College on September 16, 1930; the writer was appointed to the position of collaborator, without compensation, in the Bureau of Plant Industry. This appointment terminated October 31, 1930. After that period the writer continued some studies with hop seedlings under the direction of the Oregon Agricultural College.

On April 16, 1931 the writer was again appointed to the position of collaborator, without compensation, in the Bureau of Plant Industry. This appointment continued until July 31, 1931, when it was terminated.

August 1, 1931 the writer was appointed agent in the Bureau of Plant Industry, to conduct hop breeding work, and to devote about one-half time to this activity.

A preliminary report was submitted to the Director of the Oregon Experiment Station last winter. This gives the details of the initial work, and the results of interviews with a large number of growers. As a matter of record, much of this report is included here.

Of course, it must be remembered that this report is preliminary and covers chiefly a survey of the situation. Of necessity, a breeding program must be a long one and this is particularly true of a perennial crop like hops.

In the first place, there are many things beside resistance to downy mildew that must be considered. A desirable hop must have ability to yield and be of the quality desired by buyers. All of this information must be garnered before a breeding program can begin. The writer attempted to get this information by contacts with a large number of growers in all of the important hop growing sections of the Pacific Northwest. This necessitated visits to many yards both in the fall of 1930 and the season of 1931.

The general plan of this hop breeding project is to grow seedlings from superior plants noted in various yards, seedlings from hybrids between various varieties which show indications of either mildew resistance or yield and quality, make selections of superior plants, and obtain introductions from foreign sources. In the preliminary and beginning work all of these things have been accomplished. Many seedlings from seed obtained in growers' yards have been grown. Hybrids between Fuggles and the ordinary Late Cluster variety have been obtained and the M45 variety which is the best downy mildew resistant variety from England has been secured.

GREENHOUSE RESULTS IN 1930-31

The results of the work in the greenhouse with seedlings are summed up in the following article, which was submitted to Science on April 4, 1931 and published August 21, 1931, Vol. 74, No. 1912, pages 202 and 203. These hops were continued to full maturity and during the summer of 1931 many seeds were collected off of these plants. In addition, specific crosses were made between individual male and female plants. All of this seed was saved for growing in the greenhouse during the following fall.

Male plant in field.

DEVELOPING NEW VARIETIES OF HOPS

April 4, 1931.

Last fall work was initiated to develop new varieties of hops. Because of an attack of downy mildew, Pseudoperonospora humuli (Miy. et tak.) Wils., it was desired to obtain new varieties which were not only resistant to this disease, but also superior in yield and quality. The variety Fuggles has been reported as resistant to this disease. This variety, however, under most Oregon conditions, is considered low in yielding ability and of a quality that is desired only by a certain trade.

Naturally fertilized seeds of this crop were collected in the growers' yards. Preliminary trials showed that the seed was dormant and would not grow under ordinary germinating conditions. The seed, therefore, was chilled for about ten days at freezing temperatures and then scarified by rubbing on coarse emery paper. This seed was planted in the greenhouse on October 9 in flats and the seedlings were transplanted to a bed after they had made a growth of about 12 inches. Artificial lights (three 500-watt Mazda lamps for 100 plants) were turned on from 5 to 12 P. M. each night. Plants 20 feet in length were developed by March 29, and two of the plants came into burr (blossom) at this date. A growth of 12 inches was recorded in one day. This development of a hop plant from seed to blossom in less than six months' time indicates the possibilities of rapid development of new varieties. Professor E. S. Salmon, in England, stated that the "work of raising new varieties of hops is an arduous and expensive one and is necessarily very slow, since the seedling plants do not bear a crop until the third year, and cannot be judged for character such as aroma, richness in resins, and cropping powers until the fifth year, at the earliest."

The use of chilling and scarification of seed, the greenhouse, and the lights are of great assistance in speeding up a program of breeding with a crop of this type. The striking variability of seedlings indicates a great difference in the value of the different plants. Of course, it will take additional time to test out not only their disease resistance, but also their yielding ability and quality. Also, some time will be required to increase their vegetative parts for planting stock.

This procedure not only speeds up the breeding program, but also gives available plants for testing in the spring when inoculum of the downy mildew disease, which is a true parasite, is plentiful.

Seedlings in Greenhouse
Corvallis -- 1931
Fall planted -- Illus.-- March
Note lights

FIELD SURVEY IN 1930

The writer visited the Ireland Hop Yard, East of Corvallis, Oregon, on September 3, to search for downy mildew and get acquainted with symptoms of the disease. No mildew was found. The manager, G. W. Butler, reported that all spikes had been removed early in the season, but the yard was not sprayed. Apparently the disease did not spread. The next work was done on September 6, when the Ireland Yard was again visited and some of the outstanding plants were staked. Picking had progressed for two days, and the hops were yielding about a ton per acre. All of the hops in this yard are English Clusters.

On September 9, the writer visited Independence and interviewed Dean Walker, of the First National Bank. Mr. Walker is an extensive hop grower in the Independence district. He is also associated with Mr. Seavey in other yards. An appointment for the following day was made with Mr. Walker, as he was busy on the day he was interviewed. Mr. Walker stated that he had a thousand pickers working in his yards. The McLoughlin Yard, consisting of 400 acres, was then visited. This yard is owned by Louis Lachmund of Salem. The foreman said, "Mildew shows up when heavy late fogs are present. Rain is usually followed by the wind, so it does not necessarily bring on mildew." Seed was collected from English Clusters. Seed was also collected from several yards of early hops which had been picked. I was unable to get the variety names. Picking was in progress in these yards, and the foreman said there were about twelve hundred pickers at work. He also stated that on the Horst Ranch there were 2000 pickers at work.

The Gilbert and Patterson place at Eola was next visited. They grew forty-two acres of hops, which yielded rather poorly because the vines were not trained up until late in the season. The foreman stated that they were using sulphur for bleaching, at the rate of a quarter of a pound per box, which is about a half a pound of sulphur for a hundred pounds of hops. They were running their kilns at a temperature of 140 to 150 degrees F. They carry about twenty-one inches of hops on the floor and dry for twenty-one hours. He stated that they liked to "ease" their hops; that is, dry them in the warehouse for several days before baling, as they go through a "sweat" and make a better quality. Hop bales weigh 200 pounds net, allowing five pounds for the sack, and they are baled with a baler which has about 20 tons pressure. Considerable seed from last year's crop was collected at the Patterson place. It was stated that the price for hops had been poor for the last three years, and that the market now was from 12¢ to 14¢ per pound with no buyers. He stated that some quotations were as low as 7¢ per pound.

September 10 was spent in the vicinity of Independence. Most of the morning was spent with Mr. Dean Walker, collecting seed and noting various plants. Mr. Walker stated that there are three main varieties of hops grown in Oregon: First the English Clusters, or late hop; Second, the Early Clusters, which were originated by a grower near Albany; Third, Fuggles, an early hop which is resistant to Mildew. All thru the yards, particularly of late hops, one finds some red vine hops. These vines are well known by the pickers, as they are very difficult to pick, the cones being scattered thru the leaves. A large quantity of seed was obtained of the Fuggles and Early Clusters from yards which had already been picked. Mr. Walker, however, was familiar with these yards and was certain of the varieties. Then, the writer, accompanied by Mr. Walker, collected seeds of various plants which the latter had noticed in the fields of English Clusters. Some of the plants bear cones which do not

Family group picking hops.
East Corvallis, Oregon.

close; others bear extremely small cones; then considerable of the male hops containing cones were observed. These hermaphrodite plants were fairly common in the Independence district.

Pickers were receiving $1.00 per hundred pounds in almost every case. In some instances, however, growers were paying 85¢ per hundred pounds with a bonus of 15¢ per hundred if the pickers stayed thruout the season. This is in contrast with the $1.25 per hundred paid last year, with a 10¢ bonus. Most of the yards in this district are strung on high trellises. The string wires are No. 6, and the large cross wires are 00. Poles are in every fifth or in every seventh row, depending upon the yard.

Mr. Walker stated that there was an old gentleman by the name of Smeed at Eugene, who was supposed to have brought in about forty varieties of hops several years ago. He did not know Mr. Smeed's initials, and was of the opinion that he was not living. The writer got in touch with O. S. Fletcher, County Agent at Eugene. Fletcher stated that the person's name was Stephen Smeed, of Springfield, Oregon. He stated that he was unable to get in touch with Mr. Smeed, but he was sure that they were still growing hops.

On October 11, the Ireland Yard was again visited and the manager, Mr. Butler, was interviewed. Mr. Butler said that part of the yard was planted in 1890; another part in 1916; and the last part in 1920. The yard is owned by Dr. Ireland, of Portland, and leased by Mr. Seavey. One of the weighers who had removed spikes early in the season reported that he had seen some mildew in the yard, but the writer was unable to locate it. In this yard they use three strings and four vines per hill, stringing two vines on the center string. They grow male hops every ten hills square, and in the hill is placed a large stake, so that in the spring they can distinguish the males from the females. Ordinarily they seed in vetch with a one-horse drill early in the fall. This not only adds fertility but gives sheep pasture in the

spring. They allow sheep to clean up the old vines and to eat the lower leaves of the hop plants after they have been trained. Several desirable hop plants were staked in the yard on this date.

The entire day of September 12 was spent in the vicinity of McMinnville and Newberg. The yard of W. C. Miller at McMinnville was visited. He is growing twenty-five acres at McMinnville, and thirty acres of hops at Yamhill. All of them are English Clusters. He stated that he and his brother have a yard at Forest Grove in which they are growing what is known as a Hungarian hop, which has a heart shape. He stated that several years ago they got about fifteen roots. All of them died except one, which they have increased until they now picked from it this year 200 pounds of hops. It is extremely early and was picked on August 5. He stated that T. A. Livesly had offered them $50 for 50 roots of this hop. The writer attempted to get some of this hop from Mr. Miller, but he did not seem very anxious to part with any of them. Mr. Miller stated that the sulphur contained arsenic and so the English buyers do not like hops that are bleached. He also stated that they liked to get hops that were rather green in color and picked early. Part of his crop had been contracted to English buyers.

Next the yard of Henry L. Kent, of Star Route, Newberg, was visited. He has four yards. This one contained 62 acres, all English Clusters. Seed of both dry and green hops were obtained in this yard; also some seed from red vines were obtained. Several of the smaller yards in the vicinity of St. Paul were visited. Most of these yards are rather small and apparently are operated by independent growers. A visit was then made to the Independence district. Some time was spent at the McLoughlin baler, where 100 bales are baled a day. The wheelers were paid 4¢ per bale, and it was stated that all working on baling were paid by the bale.

E. N. Bressman and Hungarian (Mildew Res.) Hop.
(26 Hills)
Note arms on Late Clusters.
Frank Miller Yard,
Forest Grove,
Oregon.

Previously in the day, Mr. Miller had stated that there was considerable frost damage in his yard last fall and that the frosted plants bore no cones. At the bent ranch the foreman stated that they called the red vine hop Welsh hops.

In thrashing out of the seed, it was noted that the Early clusters have extremely large seed, the seeds of this variety being nearly twice the size of other varieties. No differences were noted in the other seed.

The first seeds were planted in pots in the greenhouse on September 9. A week later none of them had sprouted. At the same time seeds were placed in blotters in the germinator, and these also appeared to be dormant. They were neither sprouted nor moulded.

On September 11 considerable seed was placed in the Dairy Department cold room at a temperature of zero degrees F. It was thot that this chilling of the seed may overcome its dormant habit. The seed was allowed to remain until this date, or for four days at this temperature. Some of the seed was then placed in the germinator to see if it would sprout.

On September 16th the writer went to Eugene and got in touch with Stephen Smeed and found that he had quit growing hops and had retired. However, his son, Herbert Smeed, is planning to re-enter the hop growing field. Stephen Smeed is 89 years of age. He came to this country at the age of 25 from Sussex, Kent, England. He grew hops for a few years in Wisconsin and then came to Oregon. He has grown six varieties - English Clusters, Prolific, German Grape, Jones and Cobbs. He said that the English Clusters and Fuggles were the best. The German Grape was fair. He finally discarded all varieties except the English Clusters and Fuggles. He stated that Fuggles do well on long poles, and that they get from 2000 to 3000 pounds per acre.

I next visited the hop yard of Herschel Anderson. It is across the

river and south of Eugene, Oregon, adjoining the Chase's garden. Mr. Andersen has 80 acres of hops - 60 acres of English Clusters and 20 of Red Vine. He states that he contracted his crop for 22 cents per pound and figures that he will have nearly 120,000 pounds. He had some mildew this spring, but pulled the spikes and none was present this fall. He had a very peculiar long, pencil-shaped hop which did not seem to fatten up. He thought maybe this was caused by disease. In the last few days it has started to increase in size, particularly at the end. He stated that the year before had had two plants which bore no hops, but this year they bore a crop. He stated that the English people do not mind a little reddish discoloration on the hops, and that they do not like green hops. This is contrary to the statement made by Mr. Miller.

The hop ranch of Murphy Brothers at Harrisburg, Oregon was visited. They are growing both English Clusters and Fuggles. Also they have a planting of Early Clusters which should bear next year. Mr. C. W. Murphy stated that they had no mildew. He also stated that the Fuggles dried out about 30 pounds to the hundred, where the English Clusters dried out 24 pounds to the hundred. However, the Fuggles do not yield as many pounds in the field. They are also rather rooty and hard to train.

Next visited J. R. Cartwright at Harrisburg. He has 130 acres of hops, mostly English Clusters. They did not take care of the yards this year, and consequently picked only about 25,000 pounds off of the 130 acres. He was very familiar with Mr. Smeed, and knew of the varieties which Mr. Smeed grew. In the order of the earliness he listed them Hobbs, Prolific, Fuggles, German Grape, Jones Cluster and English Clusters. He says that the German Grape and the early Clusters are identical. He also stated that the Wells Seedling, or Red Vine, was the first hop grown in this country. He called attention to small hops, which they call peanut hops. He said that they had sold roots for as high as $20 per thousand, 3 inch roots with two eyes. He stated

Letting the wire down.
Seavey Yard -- East Corvallis, Oregon.

that he liked these roots better than the long ones. Roots usually sell for $8 per thousand. It costs about $5 per thousand to dig them.

On September 18 I visited the Horst Ranch, at Independence, together with Professor C. E. Owens, to inspect the hop mildew experiment he has been carrying on. The work was carried on in a yard which was not being harvested this season. As a rule, it was stated, the Horst Ranch leaves some of their yards each year. It is the custom to plant corn between the rows in these yards which are not trained. The corn was making a very nice growth and maturing ears. Many hops were being produced where the vines were climbing on corn plants. No males were visible, and so a large quantity of hops was picked to use in grading work. These were of the variety of the English Cluster. Similar hops of this variety adjoining males were also picked for comparison.

The only place new infections of downy mildew were observed were in cases where Professor Owens had covered the hills with a tent made of burlap sacks and wet down the tent thoroly with water from a hose for forty-eight hours. Infected spikes were rubbed over these hills and spikes left in the hills. A good many leaves showing recent infections were found in these hills. In practically all other cases the mildew had not spread, even the infected spikes were rubbed over the leaves and infected spikes were left in the hills. It indicates that the dry weather during August did not permit the spread of the disease.

On September 19 the greater part of the day was spent at the Linn & Linn ranch, near Albany. Seed and roots were collected. They have forty-six acres of hops of all four varieties, English Cluster, Fuggles, Late Clusters, and Canadian Reds. Mr. James Linn, owner of the Marion Hotel, stated that he was responsible for the Early Cluster variety. He says

that he found two plants in 1908 growing in the English Cluster variety. The roots of these plants were dug and planted on the ranch of Mr. McKee, at Jefferson. The same variety was also grown by Mr. Magness. This variety has long and numerous roots which are difficult to handle. He stated that they get sometimes as high as 120 roots to a plant in the Early Cluster variety. The variety apparently is also quite susceptible to both mildew and aphis. These growers, however, are very enthusiastic about the Early Cluster variety, stating that it yields more than the Fuggles and makes a hop which is in a little more demand than the Fuggles, which is bought only by English buyers for making stout. They stated that they were going to quit growing the Fuggles variety because it yields so little, not one-half of the yield of other varieties. These growers like the Canadian Red variety. They state that it is high yielding, comes later than the English Cluster, and makes a fair quality hop, althe the oder is a little strong. Apparently the chief objection to this variety is that it is hard to pick and is very susceptible to red spider. The spider seems to work on Red Vine more than any of the others. These growers stated that they would like to have a variety which has the good characteristics of both the Canadian Reds and the Early Clusters, without the poor characteristics of these varieties.

Linn & Linn are very emphatic in their statements against the spray for downy mildew. They claim that the spray reduces yields and that there is no difference noted in the spread of the disease. They said that they have noted only one spiked hop this fall, and it was in the Red Vines. In the months of May and June, when the mildew was present, they removed the spikes but did not take them away from the field. The spikes were cut off and dropped in the rows.

These growers called attention to a variety known as the Bavarian Hop,

which was growing on the adjoining place, now owned by the First National Bank of Oregon. It was stated that Ezra Meeker brought these hops to Oregon from Puyallup, Washington. It produces rather a small cone and is just between the Early Clusters and the Late Clusters in maturity. They state that they practically always begin picking Early Clusters on August 24, the Bavarians on August 28, and the late hops on September 3. Their cost of production is 13 cents per pound.

Some mold was found in the Red Vines. These molded hops were found only on the tops of the wires, not down on the sides. It was stated that this was the first mold which had appeared this year. Hops with cones which are molded appear a little drier on the outside. When the cone is broken open longitudinally, the entire center has turned black, and this blackish mold has almost entirely ruined the hop. A small green grub had worked on the lower end of many of the hops; that is, cut off the feed supply and the lower end of the hop had turned brown. A few hops which they call "stinkers", which are rather fluffy hops which do not close, were observed in the field. A large number of these were observed in an adjoining field owned by Mr. Irvine.

The Irvine ranch was also visited. They are completing their picking on this date. The Wigrich ranch in the vicinity of Independence was also visited. They had completed their picking. This ranch has about four hundred acres and is owned by English hop importers.

On September 26 I visited the Hurst Ranch at Independence and conferred with the manager, Mr. Kennedy, about the condition found in hop yards this year known as "Sleepers". This condition appears to be fairly common in

many of the yards and is characterized by hills which give no growth or only a few weak arms, not sufficient for training. Mr. Kennedy was of the opinion that these sleepers were plants that were dying or already dead. He stated that they planned to grub out those hills. The Horst Ranch produced 2800 bales on about 275 acres. They had 300 acres of hops in corn, making a total of about 575 acres of hops on this ranch. The downymildew plots were noted and it appears that the downy mildew is spreading from one hill to another around the hill which had considerable infection. An adjoining yard showed an enormous amount of "mold", and in fact quite a bit of the hops in this yard were left in the field because of "mold".

I then visited the Frank DuBois Hop Yard at West Woodburn, Oregon. This three year old yard of English Clusters consists of 26 acres. Nearly two acres in one corner of the field contained, with few exceptions, nothing but "Sleepers". Mr. DuBois had written in regard to information on this condition. Many of the hills were dug and they appeared to be dying or already dead. A few of the hills, however, were sending out fairly good arms that appeared to be in good condition. From all appearances this condition was caused by some organism, maybe verticillium or fusarium. Specimens were brought in but it was found that there was no one available to work on them. Roots of healthy and diseased plants, also diseased crowns, were planted in the greenhouse for further study. Mr. DuBois was advised to grub out the hills which were apparently gone out nearly dying. In handling the hills that were making some growth, he planned to grown part of them this fall and the others in the spring. A large number of plants were staked in the corner of this yard. It appears that this condition is causing as much trouble as downy mildew and it should be thoroughly investigated. It may be that this trouble is responsible for the large number of missing hills found in many of the hop yards.

General View -- Seavey Yard
East Corvallis, Oregon

1931 SHORT COURSE

The following letter was sent to a list of nearly 600 hop growers: -

January 17, 1931.

Dear Sir:

The Farm Science Short Course on the campus of the Oregon Agricultural College at Corvallis, will devote Monday afternoon, January 26, from 1 to 6, to a discussion of some of the problems of the hop growers. This special conference on hop problems will include the following:

1:00 P.M. - Hop Varieties and Unproductive Plants in the Hop Yards - - - - - - - - - - - Dr. E. N. Bressman.
2:00 P.M. - Conditions Causing Downy Mildew of Hops and Methods of Control - - - - - - Prof. H. P. Barss.
3:00 P.M. - Hop Insects and their Control - Dr. D. C. Mote.
4:00 P.M. - Preliminary Results of Hop Economic Survey - Prof. G. L. Sulerud.
5:00 P.M. - Conference of Hop Growers.

We hope that a large number of interested growers will be present to participate in this program. There is much that is new in the hop situation and a conference on the industry at this time should be particularly valuable.

We wish to call your attention to the inclosed program for the entire Farm Science Short Course. There are conferences on soil fertility, corn, alfalfa, irrigation, seed production, and other topics of interest to hop growers.

Remember the date, bring your neighbor along, and spend Monday, January 26, and as much of the week, January 26 to 31, as you can, with us.

Yours truly,

(Signed) E. N. Bressman,
E. N. Bressman,
Associate Professor of Farm Crops.

ENB E
S230

Large Unproductive Plant (Bastard)

which produces no flowers.

Experimental Yard. Corvallis. 1931.

About 125 hop growers, representing most of the acreage attended the short course. Practically all of the prominent growers were present. At the end of the meeting the growers voluntarily passed a resolution thanking the Oregon Agricultural College for its interest and help in the problems of the hop growers.

As a matter of record the writer's talk which was later published in the Journal of the Institute of Brewing Vol. XXXVII No. 7 (Vol. XXVIII, New Series), July 1931 is included. It follows:

UNPRODUCTIVE HOP PLANTS AND VARIETIES IN OREGON

The hop (Humulus lupulus) is a perennial climbing plant which grows from a root stock or underground stem. The yards are set out from these underground stems which form roots and stems. Most growers refer to these underground stems, from which new plants are set out, as "roots". The above ground stems or vines die back each year and arise each spring from the below ground portion. The above ground stem or vine when vertical turns and grows clockwise in direction which is different from most of our plants.

The hop is one of the few crop plants which are diecsious in nature. It carries its male flowers on separate plants from the female flowers. Sometimes one sees plants which have both male and female flowers on the same plant. These are known as hermaphrodites.

These hermaphrodites make up the first group of unproductive or freak plants which are discussed herein. They are of comparatively little value and should be dug up and completely grubbed out. Their roots come true and produce this same type of hermaphrodite plant. Many of the growers are of the opinion that they are of this nature because of some injury. Considerable work has been done, however, to show that injury does not cause this condition and neither does disease. It is a true hereditary character of the plant, and for that reason these plants should be completely dug out. When new roots are obtained they should not come from these hills. This hermaphrodite type of plant was very common in many of the yards this past season. I noted that very few of the pickers took any cones from these hills and so they were a total loss. These unproductive hermaphrodite plants are occupying approximately one per cent of the space of our yards and they should be removed.

The "hops" which are picked are in reality the female inflorescences. Botanically these hop cones are strobiles or burrs. They develop in the axils of the leaf independently of the male plant, and contrary to the opinion of many growers, there is not a great deal of relation between the development of this female inflorescence and the male plant. It is not essential that the male plant be present for this flower to develop.

The male plant carries the male flower on an altogether different appearing inflorescence from the female and contributes the pollen which is necessary for the development of the seed. Of course, the seed adds weight to the hop flower and in that way may be of value. On the other hand, buyers discriminate against hops which are seedy and carry a large amount of seed. Still growers are of the opinion that they do not receive a premium for hops which are not seedy. They take no chances therefore, and have several male plants distributed around the yards to add weight to the "hops".

More than 600 growers of hops in Oregon raise about 80,000 bales worth $3,000,000 on some 18,000 acres each year (see Fig. 5). Nearly two-thirds of the hops in the United States are found in Western Oregon in a relatively small area of the Willamette Valley. There is much that is new in the hop growing industry. First there was prohibition, later there were outbreaks of aphis and red spider. Lately there have been the dreaded downy mildew disease, low prices, tariffs, poor stands and unproductive plants to harass the industry.

A common unproductive plant and maybe the most outstanding one in our yards is the one which grows enormously large, is dark green in color and bears no flowers, either male or female. This unproductive plant is referred to by many writers as a bastard plant, although this term is used in describing the hermaphrodite plants, previously discussed. It is difficult to say what causes this condition. Some are of the opinion that these plants change from productive to unproductive with the different seasons. That is, one year an unproductive plant may be productive and the next year unproductive. Some are of the opinion that this is a disease condition and maybe caused by one of the viruses. Virus diseases of hops are known in England but I have no reports of them here. There is a similar condition in potatoes known as Giant Hill where the potato plant grows to an enormous size and produces small or no tubers.

One 40 acre yard in Oregon which was set out several years ago contained 6,000 of these unproductive plants. These plants were staked this year and will be grubbed out. Without a doubt it will be a considerable task to get rid of all of the roots of these plants after this length of time. These 6,000 plants occupied about 25 per cent of this yard. On the average there is nearly four or five per cent of the plants of this nature. Similar to the hermaphrodite plants these unproductive plants should be grubbed out and removed. They add absolutely nothing to the yield but take more than their share of moisture and plant food.

Another plant, which causes considerable worry amongst the hop growers, is known as a "sleeper". This plant is fairly common and is characterized by a hill which makes no growth or sends out just a few short arms, not sufficient for training. Mr. Kennedy, Manager of the Horst Ranch at Independence, Oregon states that they plan to grub out all of these "sleepers". The writer's attention was called to the condition of a yard near Woodburn, Oregon. This three-year old yard of English Clusters consisted of 26 acres. Nearly two acres in one corner of the field contained, with few exceptions, nothing but "sleepers". The owner stated that this was considered the most fertile and best part of the yard before the hops were planted. However, no crop was obtained. From all appearances this condition was caused by

some organism, maybe verticillium or fusarium wilt.

Specimens of this trouble were planted in the greenhouse and some of them are growing. One in particular made a growth of several leaves and is quite husky. This, however, was a plant that appeared fairly healthy in the field. The British Columbia workers have been unable to get any roots to grow in the fall and winter in the greenhouse. We have had several plants come from roots in the fall under greenhouse conditions.

W. W. Steckberger of the U. S. Department of Agriculture states that this condition is what he has called "winter-kill". He says: "I have always held the view, although I readily admit without definite proof, that the common methods of pruning are largely responsible for this trouble. In many instances pruning is effected without suitable consideration of the condition of the hills as considered individually. There is evidence that following a heavy crop the plants are somewhat weakened and if they are then heavily pruned and meet with unfavorable weather conditions, the chances are very great that they will not survive. In many of these hills, decay appears to start in the center of the crown and, as you suggest, may be caused by some harmful organism. I trust that in time, we will be able to culture some of this material in order to determine whether we are dealing with a pathological or physiological condition."

These three plants known as hermaphrodites, bastards, and "sleepers" appear to be the most common unproductive plants in our hop yards. There are, however, many minor difficulties. One of the common ones was observed in a yard not far from Corvallis, Oregon. There the owner called attention to the hop cones which were falling off because the small stem which attaches them to the vines was rotted. He thought that maybe this had some connection with downy mildew. Recently, however, I discovered that this condition has all of the symptoms of a comparatively new disease which Professor E. S. Salmon, of Wye, England, calls hop-drop. In England this disease was first met with in 1922. It caused many of the hop cones to fall to the ground shortly before they were ready for picking. The fungus Macrosporium was constantly associated with the disease, and Professor Salmon suggests that it is the cause of the trouble. He offers no remedy or control method but states that it is his opinion that the trouble comes when the plants are in a state of physiological weakness brought about in his particular case by cold wet weather and cold winds that occurred in September.

One of the chief causes of low yields in all cultivated crops is a poor or imperfect stand. This is particularly true of crops grown in rows such as corn and potatoes and applies just as rigidly to hops. Stands in hop yards vary all the way from 75 to nearly 100 per cent. On the average it appears that there is not much over a 90 per cent stand in the yards. The stand will fluctuate from year to year as unproductive plants are usually considered along with missing ones for they do not produce anything. A 10 per cent decrease in stand will mean a loss of about $40 per acre depending, of course, upon the price and yield of hops.

A satisfactory method of overcoming a poor stand is to stake all unproductive hills during the growing season. After harvest, it is desirable to dig out these hills completely and put in fresh earth before new plants are set out. Replanting should be done early when there is still considerable moisture in the ground and not late in the season after the soil has

dried out. In this connection it is necessary to emphasize the importance of strong, vigorous cuttings taken from high yielding hills. Most hop growers buy their cuttings by the sack from fields where the hills have been pruned heavily or plowed out. They do not definitely know whether they are getting "roots" of male or female plants, or whether the "roots" are from unproductive or productive hills. With all of the emphasis placed upon selection in livestock, selection in corn and other crops, it seems that the hop growers have been rather slow to take up the idea of careful selection. I know of no crop where selection is of more importance. Hop yards stay down for many years and it is extremely important that the roots set out are of the very highest quality, free of disease and from high producing hills.

The four varieties of hops grown on a commercial scale in Oregon are English Clusters, Early Clusters, Fuggles and Canadian Red Vines. The first mentioned variety is the most common one and is the general late hop (see Fig. 6). It appears to have a special demand in foreign markets and is classed by Professor Salmon as a different species of hops than those grown in England. He bases his classification on differences not only in odor but in shape of leaf and other botanical structures. The Early Cluster variety is supposed to have originated about twenty years ago as a mutant in a field of the English Clusters. This variety is particularly outstanding in earliness and size of both hop cone and seed. It is also distinguished by its long and vigorous roots which are sometimes rather difficult to handle. One grower stated that he gets as high as 120 "roots" to a single plant of this variety. It has been mentioned by various growers that Early Clusters are more susceptible to downy mildew and aphis damage than any of the other varieties.

The Fuggles variety is resistant to downy mildew as far as the cones are concerned, according to Professor Salmon. It has been commonly stated that Fuggles are resistant to mildew, but some of the growers have noted that there has been mildew on it. I believe that the statement should be confined to the cone rather than the plant. The chief difficulties with this variety are its low yield and rather restricted use for brewing purposes.

A fourth variety is known as Canadian Red Vine. It is later and higher yielding than the English Clusters and makes a fair quality of hops although the odor is rather strong. The chief objections to this variety are that it is rather hard to pick, and it is susceptible to the red spider. One grower stated that the variety of hops that he would like to have is one that has the good characteristics of both the Canadian Red Vines and the Early Clusters without the poor characters of either.

Professor Barss' discussion on mildew is included in the mimeographed circular issued by the Oregon Experiment Station in the spring of 1931. Professor Sulerud's discussion is elaborated in Oregon Station Bulletin No. 288 issued in June, 1931, "An Economic Study of the Hop Industry in Oregon." Professor B. G. Thompson's discussion of hop insects is included as a matter of record. It follows:

HOP INSECTS IN OREGON

by

Professor B. G. Thompson.

HOP APHIS

This is a pale, yellowish-green louse in the wingless form and green and black in the winged form. It spends the winter chiefly in the egg stage on plum and prune trees. Occasionally eggs winter over on alder, apple, peach and cherry. The spring forms may be present in sufficient numbers to entirely cover the under surfaces of the leaves. As soon as winged forms appear in the early summer, they migrate to the hops which appear to be the chief summer host, although at times it attacks cultivated sunflower throughout the summer.

In some localities the aphis may pass the entire summer on plums and prunes, and it may also pass the winter as living forms in the crowns of the male hop plants in the fields. They transfer from the plum to the hops in the spring and back to the plums in the fall in the usual procedure, however.

These insects, like all other aphids, have sucking mouth parts. They insert their beaks into the soft tissues of the plant and suck the plant juices from within. Where the infestation is heavy, injury is quite serious. Cool, moist summers seem to be favorable for aphid development.

Control:

Due to the fact that aphids suck the juices from within the plant, poison sprays as applied for chewing insects are not effective. Therefore, some spray must be used that will kill by contact.

The standard control for aphids of all kinds is nicotine sulphate. This is sold under the trade name of Black Leaf-40. Ordinarily a dilution of 1 to 800 is satisfactory. Nicotine sulphate is most effective when temperatures are fairly high -- 70° F. or above is satisfactory.

Another insecticide used for aphids and especially on hops is quassia extract. The active ingredient, quassiin, is obtained by soaking quassia chips in water. This material seems to be more effective when used in combination with soap. Various formulas with different amounts of quassia chips and soap have been used. The following formula gives a fairly strong spray solution:

Quassia chips	5 lbs.
Fish oil soap	10 lbs.
Water	100 gals.

The soap is first dissolved in a little hot water and poured into the mixing tank. The quassia chips are placed in a cloth bag and submerged in the soapy solution for 24 hours. The soap aids in the extracting of the quassiin. In order to extract a large percentage of the quassiin, the full amount of water indicated in the formula should be used.

Quassia is one of our oldest aphid insecticides, but it is little used now except perhaps on hops. It has been found that for most aphids, nicotine sulphate is just as effective and comes ready to place in the spray tank. This eliminates a tremendous amount of labor . Quassia chips are not always readily obtainable and the homemade extract, owing to its variable strength, is not always dependable.

Another insecticide which has recently come into use for aphid control is pyrethrum extract. Several brands of this material are now on the market. Evergreen and Red Arrow insect spray are two brands that can be purchased in Oregon. As with the quassia, best results seem to be obtained with this material when used in connection with soap.

As stated before, aphids are killed by contact. Every aphid must be wet with the spray to obtain perfect control. Thoroughness of application is, therefore, absolutely necessary if satisfactory control is to be obtained.

RED SPIDER MITE

Another pest of hops, although not an insect, but one that is usually placed in the same category with insects, is the common red spider mite, Tetranychus telarius.

This pest has a long history, having been known to science since 1781. In Europe this mite was undoubtedly a serious pest on hops for many years before its habits were well known. The characteristic mite injury was long known as "fire blast", a trouble supposed to be caused by heat and drouth, conditions which greatly favor the multiplication and vigor of the mites. It was during the unusually hot summer of 1868 that the mite did untold damage in English and German hop plantations. The leaves of the hops turned brown in color, then shrivelled and finally fell. Thousands of acres of hop fields produced no hops. Since that time it has continued its ravages in Europe.

This mite was found doing damage in the New England states as early as 1889. It was found attacking greenhouse plants, flowers, cotton and other plants. The opening up of the far west caused this pest to assume an importance never before attained in this country. The hot, dry climate of the southwest and the mild climate of the Pacific Coast is especially favorable to its multiplication and spread.

The development of the hop industry in this country, taking with it this old hop pest of Europe, has caused this species to assume great importance wherever hops are grown. Although this mite attacks more than a hundred different plants on the Pacific Coast, it is known as a worse pest to hops than to any other plants, being second in importance as a pest only to the hop aphis.

The adult mite is quite small, being about 1/600 of an inch long. They vary in color from pale yellow to orange, red and green. The eggs are globular and transparently pale yellow. The young mites are of a white or yellowish color. This mite is a profuse web spinner and infested plants are often covered with webs. The mites spend the winter mostly as adults in the soil in cold regions and in cracks and crevices of trees, in trash and on weeds and winter growing plants in the warmer regions. Adults usually appear in May or June and although few in numbers at first, soon become numerous enough to do damage as reproduction is rapid. Each female lays from 60 to 80 eggs in a period of a week or ten days. The eggs ordinarily hatch in about three days. The young reach maturity in about twelve days, so a new generation is appearing about every twenty days throughout the summer.

Control:

Low temperatures and moisture are very detrimental to red spiders. Ordinarily they occur in very small numbers during the spring or until higher temperatures prevail and rains are less frequent. High temperatures and drouth are ideal for development of red spiders and in seasons of prolonged drouth accompanied by high temperatures, the hop red spider may be expected to develop in abnormal numbers. Sulphur in some form is the standard control for red spider mites. Sulphur dust mixture is sometimes used. This consists of dry sulphur 90% and fine hydrated lime 10%. Usually three dustings are adequate. A power duster is necessary and weather conditions must be ideal to insure success with dusting.

In general, a liquid spray is used for this mite, especially on hops. This consists of a lime sulfur, sulfur mixture. The formula usually used on hops is as follows:

Commercial lime sulfur (32 Baume test) ...	2 gals.
Calcium caseinate	½ lb.
Dusting sulfur or wettable sulfur	5 lbs.
Water to make	100 gals.

The calcium caseinate and powdered sulfur are thoroughly mixed. The water is added slowly, while working the mixture into a thin paste. The commercial lime sulfur and the water are placed in the spray tank. As the tank is filling the sulfur paste is added, pouring it through a strainer to remove lumps.

Skim milk has been successfully substituted for the calcium caseinate spreader, thus reducing the cost of the spray. As with the aphids, thoroughness of application is necessary if good control is to be had.

12-SPOTTED LEAF BEETLE

Although aphids and spider mites are the two major pests of hops, other pests become numerous at times to cause injury. A few years ago the spotted cucumber beetle (Diabrotica soror) became so numerous as to cause considerable damage to the early hops in certain sections of the Willamette Valley. This beetle is quite an omnivorous feeder, attacking cucumbers, melons, squash, beans, clover and many other plants, including hops.

This insect has chewing mouth parts and feeds on the leaves and young hops, eating them full of holes, causing them to dry up and in some cases to drop. Although a chewing insect, this beetle is rather hard to control with poisons, due to the fact that it avoids sprayed foliage. This beetle is about ½ inch long, yellowish green in color with twelve black spots on the wing covers. In general appearance it somewhat resembles a ladybird beetle, but it is no relation to this beneficial insect as it belongs to an entirely different family of beetles.

The life history of this insect is not entirely known, but is about as follows: The female passes the winter in the adult stage. But few, or none, of the males survive the winter. During the first warm days of spring the females become active, feeding at this time on clover, alfalfa and other plants. At this time they are also quite destructive to young clover. During the past two or three years thousands of acres of clover planted in February have been destroyed by this beetle. The wild gourd or "man in the ground" is a favorite food of the overwintering adults. They may be found on this plant during the early spring in great numbers. They skeletonize the leaves, leaving only a gauze-like vein structure.

As the days become warmer, eggs are deposited by the beetles. They are layed on a number of plants including grasses, clover, corn and various grains. On hatching, the young larva works into the ground and feeds on the roots of plants. In this stage, however, they are not nearly so destructive as in the adult stage. During June the larva pupates and the new generation of adults emerges in late June and early July. It is at this time that the beetles are especially destructive because the favorite host plants, including "man in the ground" are now dried up and gone. They gather in large numbers and migrate to gardens and hop yards where they continue to work until cold weather sets in during late fall. They then seek out some sheltered place, usually a fence row or other place where vegetation is dense and spend the winter.

Control:

The control of this pest is rather difficult. Poison sprays are usually ineffective because the beetles avoid sprayed foliage. Because of this habit plants can often be protected by a spray or dust applied as a repellant. Lead arsenate applied at the rate of four pounds to 100 gallons of water has proven effective as a repellant. However, this is out of the question on hops due to the arsenical residue problem. Hydrated lime dusted on the plants has also been used with some success as a repellant. Frequent applications are necessary to insure success.

The Experiment Station, in tests conducted last year, found that pyrethrum was quite effective in killing this beetle. Two pyrethrums, Red Arrow insect spray and Evergreen, were used and both proved effective. To be effective the spray must actually come in contact with the insect. The spray is best applied during early morning before the beetles become active. If a rather large area is to be covered, it is advisable to dust a majority of the plants with hydrated lime, forcing them to congregate on the undusted plants. These are then sprayed with the pyrethrum solution.

THE HOP BUTTERFLY

This is one of our larger butterflies having a wing expanse of about two inches. The upper surface of the wings is of a reddish-orange or amber brown color with a distinct dark brown border along the margins. The undersides of the wings are marbled with various shades of brown. The caterpillars are almost black, covered with coarse spines. They normally feed on nettles but have been recorded as occasionally doing serious damage to hop fields.

Control:

The ordinary control recommended for this caterpillar is lead arsenate spray used at the rate of 4 pounds of lead arsenate to 100 gallons of water. To avoid an arsenical residue one of the fluosilicates might be substituted for the lead arsenate. The pyrethrums have also been used successfully on certain caterpillars and might prove effective on this one.

Another insect, which at times has proven injurious to hops in some sections, is the hop flea beetle.

This beetle is a very small one, black or dull green in color, and hops like a flea when disturbed. It is particularly injurious to hops but feeds on beets, nettle, chickweed, dock and other plants.

The larva, or grub of the beetle, feeds on the roots of hops. Where this insect becomes numerous enough to warrant control measures, the same control as recommended for the 12-spotted leaf beetle is suggested.

Good roots -- Spring 1931

Undesirable Roots -- Spring 1931
Typical of many being planted.
Collected from growers
setting out yards.

WORK IN 1931

The Seavey hop ranch south of Corvallis was visited on March 13. In this yard they were pruning for the first time in five years. Also, they were grubbing out dead and weak hills and replacing with new cuttings. The foreman, Mr. Butler, was of the opinion that a good hop cutting should be six inches in length and have two or three pairs of eyes. The cut at the top of the root should be at a slant and be about a quarter of an inch above the top pair of eyes. The bottom of the roots should be cut off just beneath the lowest pair of eyes. He is of the opinion that it is not necessary to have a root cutting large in diameter, in fact he says the diameter makes no difference, but it is desirable to have a good length of six inches rather than three or four inches.

This yard was using a commercial fertilizer known as Red Steer No. 5 Tankage Fertilizer, which analyzed 6-8-0. This fertilizer is the one that Swift and Company are recommending for hops. It contains no potash. They were using nearly a pound of this commercial fertilizer in each hill. After the old hill was grubbed out, the ground was spaded thoroughly and the fertilizer mixed in the soil. The roots were then set upright in the center of this reworked hill. Mr. Butler stated that in former years when roots were set out in this way they bore a fairly good crop the first year.

Because the yard had not been pruned for several years, they were pruning very heavily. The entire top portion of the crown was removed as well as all superfluous roots.

On Tuesday, March 24, a trial of dusting hills to control downy mildew was put out on the Ross Wood yard near Dayton, Oregon. This 100-acre yard is owned by Mr. Wood and Mr. Hugh Nelson, a hop buyer of Portland, Oregon, who represents Strauss and Son, of England. Most of the yard was

Crown Gall Disease of Hops.
Benedict Yard, Albany, Oregon.

put out in 1920, and some of it was put out four years ago. The yard has all three varieties; that is, late clusters, early clusters, and Fuggles. There was rather a severe outbreak of downy mildew last year in the early clusters in the spring, but the yard was thoroughly sprayed once and spikes removed. They picked better than a half a crop off of the early clusters. The yard is low and rather damp as it is almost entirely surrounded by the river. The trial was placed in a portion of the yard where the mildew was practically a hundred per cent. Before the hills were treated they were pruned and covered and the treatment put on top of the earth. The dust treatment covered the hills very well, but the liquid treatment washed away the dirt over the crown and left it exposed. The foreman called attention to the discoloration of many of the pruned roots. They were of the opinion that this was not downy mildew, and it appears much as what Dr. Salmon speaks of as occurring in infested hills in England. Many of these roots were collected and planted in the greenhouse to see if they would propagate the disease.

Mr. Wood requested a fertiliser trial and so the following trial was laid out. This trial will adjoin the hill treatment work and will be on early clusters which were heavily infected with mildew last year.

On March 27 Mr. F. E. Needham, a hop grower of Salem, was visited. Mr. Needham originated the spreader which many of the growers are using in the bordeaux spray. He stated that because of the depression the spreader would not be manufactured this year, but any growers wishing to use it were free to do so and that we could publish the formula in a small mimeograph which is being prepared at this time. Mr. Needham suggested that it would be well to state that the amount of spreader should be reduced if it caused foaming.

Mr. DuBois of Woodburn was visited. Because of the wet condition we did not go down to the hop yard. He stated, however, that the yard was making a good growth and he was beginning to train up some of the hops. Also, he was of the opinion that the yard that was so heavily infected with "sleepers" last year was making good growth now and appeared to be recovered from this condition. He suggested a fertilizer trial on these hills to see if the fertilizer would help to put more vigor in them. This was arranged for and as the yard is plowed, pruned and in condition for fertilizer applications, it will be done as soon as weather permits.

Two of the hop seedlings which were developed from seed planted on October 9 in the greenhouse came into burr on Sunday, March 29. One appears to be a male and the other a female, although it is rather early to distinguish the flowers. This is a rather rapid production of hops from seed, particularly as compared with the five year program as stated by Dr. Salmon. The red spider was attacking some of the hop plants in the greenhouse. The spider causes the leaves to take on rather a white shine on the upper surface and is rather easily seen. Also, the webs of the spider are a good clue as to the cause of the trouble. Several of these infected leaves were removed and the hops were sprayed with a pyrethrum extract. In addition, the leaves will be speckled with a fine spray from the hose as the spider does not like moisture and will leave if this application is followed.

April 1931
Seavey Yard (East Corvallis), Oregon.
Planting Hops -- Iron rod to mark place
of planting while spading
ground around hill.

April 1931
Planting Roots -- Seavey Yard (So. Corvallis), Oregon.

The first mildew of the season began to show in very small quantities on March 28, 1931. In just about two weeks, however, it began to show in quantity, and many spikes were noted after the very rainy spell which we had at that time.

The one year old rooted cuttings of the M-45 variety of hop which were received from Professor F. S. Salmon of Wye College of England were planted in the hop yard on April 13. They appeared to be in fairly good condition except that they had very long white shoots which were removed before planting. Four rows of 12 hills each were planted before the yard was gotten in readiness.

One of the seedlings in the greenhouse appeared extremely mottled and had a typical mosaic color. With the assistance of T. P. Dykstra, leaf inoculations with the juice of this plant were made on several healthy plants. Several leaves and some water were thoroughly worked up with a mortar and pestle. This material was then put in a small cheesecloth bag and several leaves of healthy plants were inoculated by rubbing. The backs of the leaves were rubbed and symptoms were expected, if it was a virus disease, in two or three weeks. No symptoms, however, appeared.

In a trip on April 16 to Independence, Dayton, Woodburn, Silverton and other places, large quantities of mildew were observed, in several different yards. Spikes were very common.

On April 17 the first work in laying out the one acre yard was started. Prices were obtained on wire and poles from various sources. Bids for the poles were received and opened on April 25. The prices varied all the way from 45¢ to 95¢ each. The bid was awarded to Swartley

Bros. of Corvallis, Oregon, who furnished excellent 20 foot cedar poles at a price of 45¢ delivered.

On April 26 the entire hop yard was surveyed with the assistance of Mr. Earl Price, Agricultural Engineer. Three varieties of hops were planted from root cuttings in duplicate plots. Each plot consisted of three rows of 16 hills, making a total of 48 hills. The varieties planted in duplicate were Late Clusters, Early Clusters and Fuggles. Male plants were placed in the 1st and the 18th rows in the yard.

On April 29 many seedlings were transplanted from the greenhouse, and arrangements were made with Mr. Dean Walker of Independence to furnish root cuttings from unproductive plants, those large plants which produce no hops. Roots of typical Red Vines were obtained from the Linn and Linn hop yard and roots from the Bavarian variety were obtained from Mr. Benedict, both of Albany, Oregon.

On April 30, the entire one acre yard was completed and each hill had been planted with either root cuttings or seedlings.

The following radio talk on hops was given:

EARLY SUMMER CARE OF HOPS

After one of the most adverse early spring seasons with which growers have had to contend, most of the hopyards are now beginning to show a promise of their usual excellent appearance during the growing season. Several growers have stated that they have never had so much difficulty in getting the yards in good shape for summer care.

The season started with unusually warm and fine working conditions in February. Many growers did much of their hoeing, pruning, and re-setting at that time. Then followed the heavy rains and floods which covered nearly all of the yards on the river bottoms with anywhere from one to eight or ten feet of water. Following the flooded condition we had drying winds, which baked the soil and left it in a very poor physical condition. Growers have reported broken implements and other difficulties.

In some sections there have been practically no rains as far as doing the crop much value for the last two months. In the lower Willamette Valley there have been some rains which have helped the growing of the crop.

Right now the vines are in various stages of growth, all the way from those just emerging from the ground up to vines which have been trained on the wire. In other words, there are plants all the way from a few inches to six or eight feet in length. There is considerable difference in growth within a yard, but the chief difference is in yards which were worked in February and those which were not worked until the last few weeks. Any effects of this time of working on our various insect and disease pests, as well as in yields, should be rather striking this year. Growers in general are of the opinion that the difference in growth will not make very much difference in yields, and practically no difference in time of picking. Without a doubt the time of developing of seed-bearing parts in practically all crops is regulated pretty much by the length of day.

It has been suggested that the yards which have made the most advanced growth to date will be more subject than others to insect and disease as well as suffering more from lack of moisture if the reduced moisture conditions continue. This remains to be seen.

Many of the yards are training their hops at this time. I have noticed one report of wages at $1.50 per day for laborers doing this work. Mr. W. W. Stockberger, in U.S.D.A. Bulletin No. 304 makes the following suggestion in regard to training: "As a general rule in all light producing sections it is advisable to train the first runner. In the heavy producing sections the second runner should be chosen. Two runners are usually trained to each string, care being taken to twine them from left to right about the string." He is also of the opinion that under certain conditions the yield per hill is directly proportional to the number of vines trained. He is of the opinion, therefore, that except on very heavy cropping land, better results should follow when six vines to each hill are trained rather than with a smaller number. There is surely no uniformity of practice in the training of vines in this section.

Many growers are interested in the subject of cultivation of hops. It is a costly practice and one which should receive considerable attention. In general, most hop growers do an excellent job of cultivation, in fact here may be one place where they are able to reduce costs. Cultivation work with other crops shows that the weed factor is the important one, and that cultivation should be so designed to rid the yards of all growth except the crop being grown. Unless there is a rather special soil condition, additional working of the yard after weeds are suppressed does not appear to be of great importance, in fact cultivation can do damage by root pruning and become a costly practice rather than one that is of benefit.

Methods now used for cultivation are leading to some of the common difficulties in the yards. I have noted in some yards where the cultivators have laid open any number of hills, and where the discs have cut crowns squarely in two and left the cut plant exposed to the many rotting organisms which are so common in our soils. One of the most common questions which we are getting at this time is in regard to these rotted crowns. Some yards report anywhere from 10% to 30% of the hills rotted. Some of this condition

may be due perhaps to careless cultivation practices. Of course growers cannot watch all of their help and helpers cannot be expected to take the care that the owner of a yard or foreman would ordinarily take. Tractor men operating at high speed invariably injure some plants, particularly in yards where they are not planted very straight. Also, ununiform conditions in the field will throw tractors out of line and are responsible for some of the difficulty.

Cultivation, therefore, should be designed to kill weeds and to refrain from damaging the hop plant in any way. Any cuts or tears in the crown may lead to rotting. The work should also be designed to carry on these operations at the least cost and the operations should be timely.

There is just one other point which I care to touch on at this time, and that is in regard to stripping and spraying. Most yards strip the lower leaves from the hops after they have reached the wire. This operation should be carried on with the least possible damage to the plants. The chief value of stripping seems to be in reducing the amount of leaf area that must be sprayed for the various insects and diseases. From that standpoint it may be very much worth while, but injury to the vines is, of course, to be avoided.

The importance of spraying is recognized by all growers. The details of the spray program must be left to the entomologist and plant pathologist, but there is no doubt that spraying, when well managed, is profitable, but that when managed poorly, it may be costly and yet not give the results desired.

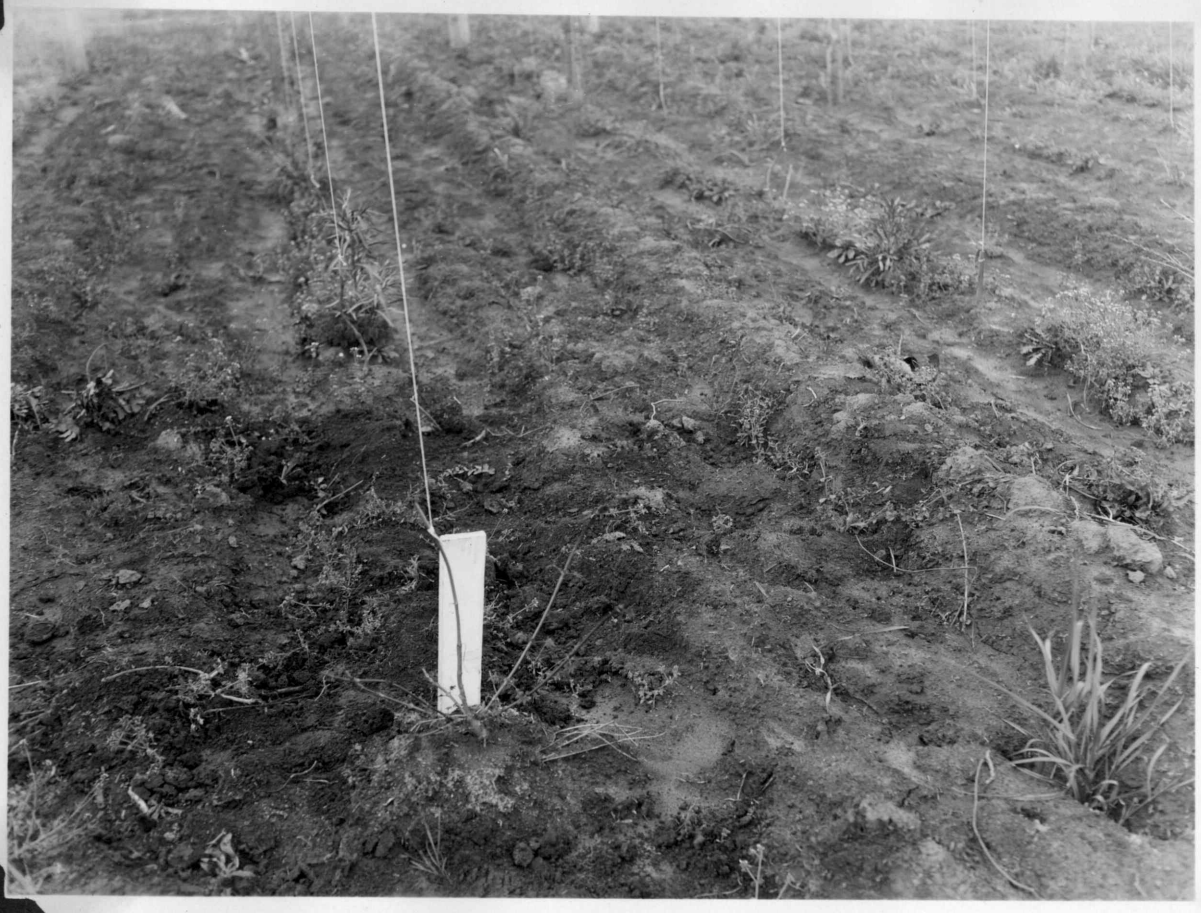
With the assistance of Dr. A. E. Longley, chromosomes from the seedling hops were counted. One hop showed a very characteristic chromosome number of eleven and another showed a count of ten chromosomes. Other material was "fixed" for making counts at a later date. Practically all of the published work shows that hops contain ten chromosomes in the haploid or reduced number.

The period from May 3 to May 6 was spent in surveying the hop fields in western Washington for the downy mildew disease. The disease was extremely prevalent at this time and was doing considerable damage. Many of the growers were discouraged and it appeared that most of them were going to do little if anything in regard to the disease. A meeting of growers was held during this visit and the writer talked on hop breeding for disease resistant varieties.

Hoeing
Seavey Yard -- February 1931
South Corvallis, Oregon.

February 1931
Seavey Yard -- South Corvallis, Oregon.
Hoed hill -- before pruning.

February 1931
Seavey Yard -- South Corvallis, Oregon.
Hoed and Crowned Hill -- after pruning.



Method of tying string to stub of old vine.
Frank Du Bois Yard
South Woodburn, Oregon.

A hop growers' meeting was held at Oregon City at 8 p.m. on the evening of May 19 and a discussion of hop breeding, varieties, agronomic practices was given by the writer. There was a large amount of interest in not only the downy mildew disease, but many other troubles such as "sleepers" and virus diseased plants.

June 1 was spent at Forest Grove, Portland, and Newberg studying the mildew disease and particularly resistant plants. The resistant variety grown by Mr. Miller of Forest Grove was observed and it showed extreme resistance to the disease, while surrounding plants of the Late Cluster variety were badly diseased.

June 24 was spent at Salem, Woodburn and vicinity, and June 27 was spent at Independence, Newberg and vicinity studying the downy mildew disease.

July 2 was spent in the vicinity of Springfield, Eugene and Cottage Grove, Oregon, where some badly damaged fields were observed. Mr. I. Anderson of Springfield had a large amount of leaf infection and "spikes" of downy mildew which he had not observed in his Early Cluster variety. He was advised to do some picking of spikes and to spray. The John Seavey yard of Cottage Grove consisting in part of 60 acres of Late Clusters was practically ruined with the mildew disease. Practically every plant showed heavy infection both on the leaves and spikes. This grower was not at home, but from other sources it was understood that the infection appeared very quickly and that on the previous Sunday the yard appeared to be in good condition. This yard had already reached the wire and gave every prospect of a good crop. The infection was too great to do anything at this time, and as I understand it, no hops were picked. On this date considerable damage

Leavey Yard of Early Clusters ruined

by Downy Mildew Disease.

Goshen, Oregon. 1931.

to the Fuggles variety by the red spider was observed in the Harrisburg section.

On July 3d I visited the yard at Champoeg and found that there was still an enormous amount of mildew present. At the Ross Wood yard at Dayton, Mr. Noakes, representative of the Ray Hop Company, stated that they were planning to spray for mildew at the Ross Wood yard. There was still considerable mildew in waste places in the Ross Wood yard, but he had picked most of the spikes in the main field. Mr. Noakes reported considerable damage to their Rickreall yard from thrips. The entomologist at this Station, D. C. Mote, advised the use of a nicotine spray, 1 to 800.

On July 6th Mr. Butler of the yard south of Corvallis called and advised there was considerable mildew in his yard. An investigation showed that there were many spikes, both basal and terminal. There was some little leaf infection which he called blight. He was advised to clean up the spikes and not to spray. The Wolf yard at Brownsville was visited that afternoon. The yard was in very bad condition, due to downy mildew. There was considerable leaf infection, a s well as spikes. The Early Clusters were by far the worst of any of the three varieties present, although there was considerable infection in both the Late Clusters and Red Vines.

On July 7th the Haner yard near Independence was visited with Dean Walker. Thrips were doing considerable injury and he was advised to spray with nicotine 1 to 800. The Hurst yard had considerable mildew in some portions, and they were beginning to spray. I was advised that they did not spray the Ross Wood yard on account of too much wind.

July 8th and 9th were spent in the Yakima section. We visited the McDonald pole yard at Donald, Washington. His 25 acres of Late Clusters

Basal spike in front of pole.
(Note normal vines)
Puyallup, Washington.

Spikes in hill (Note normal vine).
Puyallup Section, Washington
James Coplan, Orting, Washington.

Spikes from field.
Puyallup, Washington.

showed some chlorotic trouble. The symptoms were chiefly patches that were light in color near the edge of the leaves. It was difficult to tell whether it was due to drying or possibly a virus disease. He advised that they were getting about 1 1/2 tons per acre. There were many aphids present, but he stated that he could keep the water off at a temperature of 95° for two or three days, or one day at 104° and eliminate all the aphid trouble. Most of July 9th was spent in the Moxee district. There were some traces of mosaic. Mr. McGrath at the bank at Moxee seemed to be acquainted with most of the hop growers' difficulties. He stated that there had been some rumors of mildew being present, but none were confirmed. No mildew was observed by the writer in the Yakima section. Mr. McGrath stated that the Moxee hops were dark green and that they brought 2 cents per pound less than the Yakimas.

July 10 was spent in the Western Washington hop growing section. Most of the yards in the vicinity of Tacoma were still showing considerable mildew. The Klaber yard at Klaber, Washington, also showed considerable infection. Practically nothing was being done in the way of spraying or dusting. The manager of the Klaber yard reported that he had 1,364 bales of both his 1929 and 1930 crop still on hand.

Many grafts were made in the hopyard on July 11. The grafts were made at the suggestion of Prof. E. S. Salmon. His letter follows:

"Many thanks for your letter with its interesting information. I look forward to receiving many reports in due course from you in which your experiments will teach us here many new things. Now to return to the subject of the variety M45 being tested in Oregon. There are certain considerations which I want you (and your virologists!) to think over.

M45 is a proved 'carrier' of mosaic disease (see our paper in Annals of Applied Biology, Vol. XVI, pp. 368, 374).

"Now all American varieties are resistant to mosaic disease and when grown at Wye (see page 364) proved to be 'carriers' of it. If you are growing any English Golding variety in the United States, it must be remembered that all Golding varieties are susceptible to mosaic disease and if plants of M45 were planted adjoining them, the Goldings would almost certainly be attacked and killed, - the virus being transmitted either by the knife in cutting the hills or by insects. There is a further point to be considered. It is not probable that American varieties in their native home are not 'carriers' of mosaic but will become so when M45 is grown adjacent to them, - in which case the possibility exists that it might in the future be impossible to grow English Golding varieties adjoining American varieties, as the latter would all be turned into 'carriers'! Of course, your American varieties may be 'carriers' now, in which case you would have nothing to fear from M45. It would be extremely interesting if some one would graft healthy scions of any English Golding variety (growing in the United States) on to any American variety and observe whether they contract mosaic disease or not. The variety Fuggles is resistant to mosaic disease and is, or may become, a 'carrier' of it. From your point of view, therefore, the case of Fuggles may be considered to be the same as that of your American varieties.

If on thinking over these considerations you wish me to send plants of M45, I could, I now find, send you more than 30 roots - probably 60. That would allow of the variety being tested at two centres. What would be the best month to send them, so that they could be planted on arrival? I think it would be best to send them packed in soil, so that they would

Wm. Cyrus and Hungarian (Mildew Res.) Hop.
Frank Miller Yard,
Forest Grove, Oregon.

not dry out.

"Yours sincerely,

"Prof. E. S. Salmon."

On July 15 mildew was found on the cones of Early Cluster in the Linn and Linn yard. Several outstanding Bavarian female plants were staked in the Benedict yard at Albany. These were at the right of the road and drier. The flowers were in brush on this date. No males could be found in this yard. Observation at the Ross Wood yard fertilizer trials showed that plots 3 and 12 were outstanding. They appeared to be darker green and had more arms.

On July 15 the grafts that were made a few days previously were doing well. Weed killer was placed on morning glory in the Butler hopyard on this date. Sodium chlorate, Atlacide, and Vegetal were put on in spots in order from the north to the south.

A hop growers' meeting was held at Salem, Oregon, on July 17 at noon. A talk was given by the writer on the hop breeding work. The Magness yard near Wheatland was visited and considerable cone infection on the Early Cluster variety was observed. The fruiting bodies of the downy mildew disease gave a whitish appearance to the cone and many cones were small and hard.

The period during the week-end of July 18th was so hot and dry that many of the seedlings and grafts were lost. They were lost even in spite of furnishing shade and watering.

On July 23rd a visit was made to Mr. Miller at Forest Grove, and seed of his downy mildew resistant variety was obtained. This seed, however, had been through the drier and subsequent trials showed that it would not germinate. Peculiar plants in the yard of Emil Raestte at Fargo, Oregon, were noted. These plants had white heads in sharp contrast to the green

tips of normal plants.

The period from July 24th to July 27th was spent in conference with Dr. W. W. Stockberger. Field trips to the hop yard and various growers' yards were also made.

The first hops that were picked in Western Oregon were from a yard of Fuggles which was badly injured with red spider. This yard was picked on July 31st.

On August 1st notice was given of the arrival of a Ford car for use in connection with hop breeding work. It was a Model A De Luxe delivery car, motor No. A-4664313. The car was delivered Tuesday, August 4th.

Most of the time in the fall was spent in harvesting the yard at Corvallis, harvesting fertilizer trials, and collecting seed. The sources of the seed collected this year are given in Table No.

The Ross Wood fertilizer trials were picked on August 31st. It required about all day for two pickers per row to pick the 50 hills. In his yard he picked in three sections. Each section was 50 rows and there are two pickers to a row or a total of 100 pickers to a section. He uses five kilns, and fills them in less than a day. Each kiln is dried for 15 hours. In each section, in addition to the pickers, he uses a weigher who carries the tripod for weighing the hops picked, a checker who records sack number, picker's number and the weight of the sack, a wire-down who lets the wires down for the pickers, a vine cutter, who cuts the vines after they have been picked, and a sack boy who gets the sacks ready. In addition, there is a foreman in charge of the three sections. There are three fireman, one on each shift, and a drier man who is in charge of the drying. The drier man is usually an experienced hop drier, and receives about $12 per day.

The hop floors in the Ross Wood yard are 52 feet by 32 feet. The hops are laid 24 inches deep, and there are 10 bales of 200 to 215 pounds to a kiln. Two hundred pounds of dry hops equal about 25 hills, or 8 pounds per hill. There are about 150 sacks at 50 pounds each to a kiln, and the 50 pound sack dries down to about 15 pounds.

The period from September 15th to 22nd was spent at the Dominion Laboratory of Plant Pathology at Saanichton, British Columbia, and in the hop yards of British Columbia. A conference was held with Mr. Walter Jones of the Dominion Laboratory, who is working on the downy mildew disease of hops. In the laboratory he showed that it was very easy to inoculate cotyledons of seedlings and produce both conidia and oospores. In each cotyledon he gets anywhere from 150 to 200 oospores. He says that 68° F. and 90% relative humidity give the optimum conditions for mildew infection. Their laboratory work with the downy mildew disease was rather limited, but nevertheless some very nice results have been obtained.

The hop fields on the mainland showed considerable infection of downy mildew just coming on. This was due, more than likely, to the heavy rains which had just occurred. Mr. Jones had visited the yards a few days before and found no mildew, but considerable infection was showing in several of the yards which had not been picked at this time. One of the largest yards had just completed picking, and the foreman reported some exceptionally fine results from their crown treatment trials, using copper lime dust.

There are about 1,000 acres of the hops in British Columbia. These are in a few large yards. The largest yard located at Sumisan is operated by Mr. T. A. Livesley of Salem, Oregon. Other yards are in the vicinity of Agassis and Sardis. The Hulbert Hop Company of Sardis, British Columbia, is growing a variety known as East Kent Goldings, which they

Spring 1931
Horst Yard -- Independence, Oregon.
Crown Treatment -- Copper-lime Dust
Applied by hitting hill with
"gunny" sack containing dust.

Corn planted in hops not trained.

claim is very resistant to the mildew disease. It appears to be a hop similar in some respects to the Fuggles but of different quality. Seed of this variety was obtained in the fields of the Hulbert Hop Company. As far as could be found, this is the only variety that has shown much resistance to the disease. Mr. Hulbert is enthusiastic about the variety, and believes it has considerable promise both from the standpoint of disease resistance and quality.

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HOP GRAFTING TRIALS

Beginning on the July 11 after the hop plants had made sufficient growth, several attempts were made to graft one variety on another. This work was initiated at the suggestion of Professor E. S. Salmon, of Wye, England. In the following letter, he suggests the reason for making these grafts:

"I am very glad to hear that the "M45" arrived safely, and look forward to hearing more in the future.

"I should like to point out an interesting and important piece of work which requires to be done in your country now.

"As you know, I think M45 is a proved "carrier" of the "mosaic disease" and we have found that all American varieties (Oregon and California clusters, New York) after having been grown in our hop garden here for several years, are also "carriers" of mosaic disease. It is not known whether your American varieties as they are growing now in the U.S.A. are "carriers" of "mosaic". Before there is any chance of "M45" operating, it is very desirable that grafting experiments are made to ascertain the point.

"May I suggest that the following experiments are carried out this season:

"1. The grafting on M45 of scions of any mosaic-susceptible variety. The variety Bramling, or Canterbury Golding, or any Golding would be suitable, but the English variety Fuggles is not suitable, as this variety never takes the mosaic disease but may be a carrier of it. If you cannot obtain a susceptible English variety (but I do hope such will be available), scions from <u>male</u> hops in yards of American varieties should be used, as I have found some to be susceptible to the mosaic disease. If positive results are obtained (as they certainly will be if an English mosaic-susceptible variety is used on M45), it will familiarise you with the symptoms of mosaic disease.

"2. Mosaic-susceptible scions of English varieties should be grafted on American varieties in American hopyards, so as to ascertain whether <u>now</u> these varieties are "carriers" or not.

"3. By use as "scions" and also as "stocks" <u>male</u> American hops should be tested to find out whether they are "carriers" or not.

Grafting hop varieties

in Experimental Yard.

Corvallis, 1931.

"4. The English variety Fuggles, which has now been grown for many years in the U.S.A., should be tested to find out whether it is a "carrier" or not.

"The operation of grafting hops is very simple. It is described in the enclosed article. We use rubber tape, a sample of which I enclose, to bind the stock and scion, and rubber solution to hold the ends of the tape, to save the trouble of tying.

"You will forgive, I am sure, my suggesting this line of work to you, but I know of no one else interested in hops to whom I could write. If you cannot find time for the work, could you possibly send a copy of this letter to anyone who has the facilities for the work?

"You see, the matter has an historical side, - if it is not ascertained now whether your American varieties (and the English variety Fuggles) are "carriers" of mosaic or not, we shall not know in future years what part "M45" has played."

The method used is given in the small circular entitled "Virus Diseases and the Grafting of the Hop," reprinted from "The Gardeners' Chronicle," of May, 1925. For the rubber to cover the grafts, dental dam was used. In all, about 25 grafts were made, and several of them appeared to grow for a week or more. However, no positive results were obtained, even though shade was supplied to the plants grafted. Shade in the form of small white cloth covers in the form of tents was supplied.

The hop weather and dryness at this time of the year without a doubt was the chief reason for failure. Temperatures of over 100 degrees Fahrenheit were common at this time of the year. Similar work will be done in the greenhouse during the following spring season. It appears that this work cannot be done out of doors as the weather conditions are very unsuitable at the time the hops are ready for making grafts.

M45 Variety from England.

Corvallis, 1931.

FERTILIZER TRIALS ON MILDEW INFECTED HOPS

It is common knowledge that fertilizers have an effect on both the susceptibility and resistance of plants to disease. Trials, therefore, were designed to get the effect of the different fertilizers on the downy mildew disease. Three trials were laid out, and each of them included the important fertilizers, nitrogen, phosphorus, and potash, alone and in various combinations. Sulphur was also included, both alone and in combination with the above ingredients. Landplaster was also used because of its rather common usage in this section.

The first trial was put in the Frank Dubois yard, at Woodburn, Oregon. These trials were laid out in single three-row plats. Each plat contained forty-five hills of hops. The second trial was put out on April 24, on the Ross Wood yard. These were single-row plats of fifty hills each. The following week a trial was placed on the Seavey yard, just east of Corvallis.

In every case the fertilizer was very carefully measured out and applications were made to the individual hill in equal amounts. The fertilizer was put in a circle about the hill and far enough away from the sprouting hops to avoid damage. In no case was any damage obtained.

At no time during the trials were there any marked differences between the various applications. It must be remembered that after the applications it became very dry, particularly during the month of May. Good rains, however, came in June, but no response was noted. It is reported that similar results were obtained in most fertilizer trials in this section during the past year. In cases where excellent repponse was obtained in former years, very little response was obtained this year. More than likely the failure of fertilizer itself was due to environmental conditions this year.

The results of the fertilizer trials are given in the following tables. Only two of the trials were harvested. The third trial at the Seavey yard at Corvallis was not harvested, and observations only were made at this yard.

From the standpoint of getting the effect of these fertilizers on downy mildew, the trial was not successful, as the growers picked spikes and infected leaves, and in that way kept down the mildew. Work of this type must be carried in yards which are under the experimenter's control, so that the effect of the disease can be obtained. The following year it is hoped that this trial can be carried on in the Horst field, which is set aside for downy mildew work. Results from the 1931 applications, however, may be obtained in the spring of 1932, and these plots will be carefully observed for differences in amounts of mildew.

Of course, the trials would have given better results if the plats would have been replicated. Lack of time and land, however, made replications impossible. The differences in yields are not very great, and none of them are significant. In the trials at the Ross Wood yard, the probable error of a single determination of a check plot is ±.12 tons. It is impossible to obtain a probable error of the difference in yields of any of the treatments because none of the treatments were replicated, but none of the differences in yields are equal to three times the probable error of a single determination. And none of the differences are three times as great as the probable error of the mean of the check yields. Only three of the checks in this trial were used in determining probable errors, as Plot 17 was very weedy. The weeds could not be removed from this plot on account of the "A" frame which came at this point. The yield of this plot is reported but the low yield is due entirely to the weeds.

ahle error of the mean of the check yields is ± .067 tons. The probable error of a single determination is ± .15 tons per acre. None of the differences in yield is as great as three times the probable error of a single determination. Plots 12 and 13, however, do show a slight significance when compared to the probable error of the mean.

If one assumes that the P. E. based on the check is a generalized P. E. then the P. E. of the difference for the Ross Wood yard is ± .169 and the Dubois yard ± .184.

In general, none of these trials have showed any marked increases in either yield or susceptibility or resistance to the downy mildew disease. It must be remembered, however, that the extremely dry conditions in May may have resulted in a poor response to these fertilizer applications.

April 9, 1931
Fertilizer Trial
Frank Dubois, South Woodburn, Oregon.
Date of Application.

Table No.
FERTILIZER TREATMENTS - 1931
Downy Mildew Infected Yards

Plat No.	Percentage Composition	Rate per acre	Pounds per acre of fertilizer
1	Check	--	No treatment
2	0-0-12	500#	120# Muriate of Potash
3	0-6-6	500#	66# Treble phosphate 60# Muriate of Potash
4	0-12-0	500#	133# Treble Phosphate
5	4-6-0	500#	133# Na Nitrate 66# Treble Phosphate
6	Check	--	No treatment
7	8-0-0	500#	266# Na Nitrate
8	4-0-6	500#	133# Na Nitrate 60# Muriate of Potash
9	8-12-12	500#	266# Na Nitrate 120# Muriate of Potash 133# Treble Phosphate
10	----	100#	100# sulfur
11	Check	--	No treatment
12	0-0-12	500# 100#	120# Muriate of Potash 100# Sulfur
13	0-12-10	500# 100#	133# Treble Phosphate 100# Sulfur
14	8-0-0	500# 100#	266# Na Nitrate Sulfur
15	8-12-12	500# 100#	266# Na Nitrate 120# Muriate of Potash 133# Treble Phosphate Sulfur
*16	Check	--	No treatment
17	Land plaster	200#	200# Land plaster

* Plots 16 and 17 reversed in Ross Weed Yard

Table No. ____
FERTILIZER TRIAL - LATE CLUSTER HOPS
Downy Mildew Infected
Ross Wood Yard - Dayton, Oregon
Single Row 1/16 Acre Plats - 1931

Plat No.	Treatment	Green Weights	Green Weights Lbs.	Green Weights Tons per A.	Est. Dry Wt. Tons per A.
1	Check	43-31-46-38-23-47-43-50-44-42-26-53	486	3.888	1.296
2	0-0-12	44-41-43-44-46-52-25-48-48-41-41-48	521	4.168	1.389
3	0-6-6	39-47-48-33-45-38-38-30-52-53-25-15	463	3.704	1.237
4	0-12-0	44-46-44-48-46-47-47-31-48-54	455	3.640	1.220
5	4-6-0	50-52-56-43-50-50-43-20-55-28-43	490	3.920	1.306
6	Check	42-50-39-47-43-31-44-46-50-47-27-45-27	538	4.304	1.435
7	8-0-0	40-49-51-43-36-39-22-52-57-47-44-24-27	531	4.243	1.414
8	4-0-6	45-43-40-47-42-48-49-30-33-36-16-25	464	3.714	1.238
9	8-12-12	48-44-45-47-40-25-25-48-28-15-53	417	3.336	1.112
10	Sulfur	47-49-44-47-45-48-14-47-43-47-23-23	477	3.811	1.270
11	Check	44-42-43-43-42-50-30-45-39-27	405	3.240	1.080
12	0-0-12	44-47-45-40-45-52-49-35-53-15	425	3.400	1.133
13	0-12-0	50-51-59-53-60-12-13-10-60	368	2.944	0.981
14	8-0-0	48-47-50-48-50-49-37-40-55-49	471	3.768	1.256
15	8-12-12	45-48-63-57-41-48-27-34-7-4	374	2.992	0.997
16	Landplaster	47-40-49-35-47-27-55-9-11	320	2.560	0.853
17	Check	50-42-52-36-51-38-13	282	2.256	0.752

Table No.
FERTILIZER TRIAL - LATE CLUSTER HOPS
Downy Mildew Infected
Frank Dubois Yard - Woodburn, Oregon
Three-Row 1/20 Acre Plats - 1931

Plat No.	Treatment	Green Weights	Green Weight Lbs. per A.	Green Weight Tons	Dry Weight Tons Per A.
1.	Check	47-51-56-57-34	245	2.45	.816
2	0-0-12	57-60-38-57-48	260	2.60	.866
3	0-6-6	43-60-33-29-61-44	270	2.70	.900
4	0-12-0	45-24-61-54-55-29	268	2.68	.893
5	4-6-0	53-60-38-44-44-42	281	2.81	.936
6	Check	56-58-12-21-50-46-68	311	3.11	1.036
7	8-0-0	56-56-60-33-29-18-54-17	323	3.23	1.076
8	4-0-6	64-37-48-45-48-48-12-14	311	3.11	1.036
9	8-12-12	57-54-27-43-83	264	2.64	.880
10	Sulfur	58-60-37-44-56-50-51-30	384	3.84	1.280
11	Check	51-53-66-54-30-66-45-30	395	3.95	1.316
12	0-0-12	14-55-54-56-52-60-56-56-43-47	453	4.53	1.510
13	0-12-0	26-42-50-54-56-34-58-20-61-56	457	4.57	1.523
14	8-0-0	55-16-52-58-32-45-62	320	3.20	1.066
15	8-12-12	40-57-62-49-40-55-56-40	399	3.99	1.330
16	Check	56-58-46-18-37-20-33-48	314	3.14	1.046
17	Landplaster	35-61-62-44-68	270	2.70	.900

Co-Op. Book Store

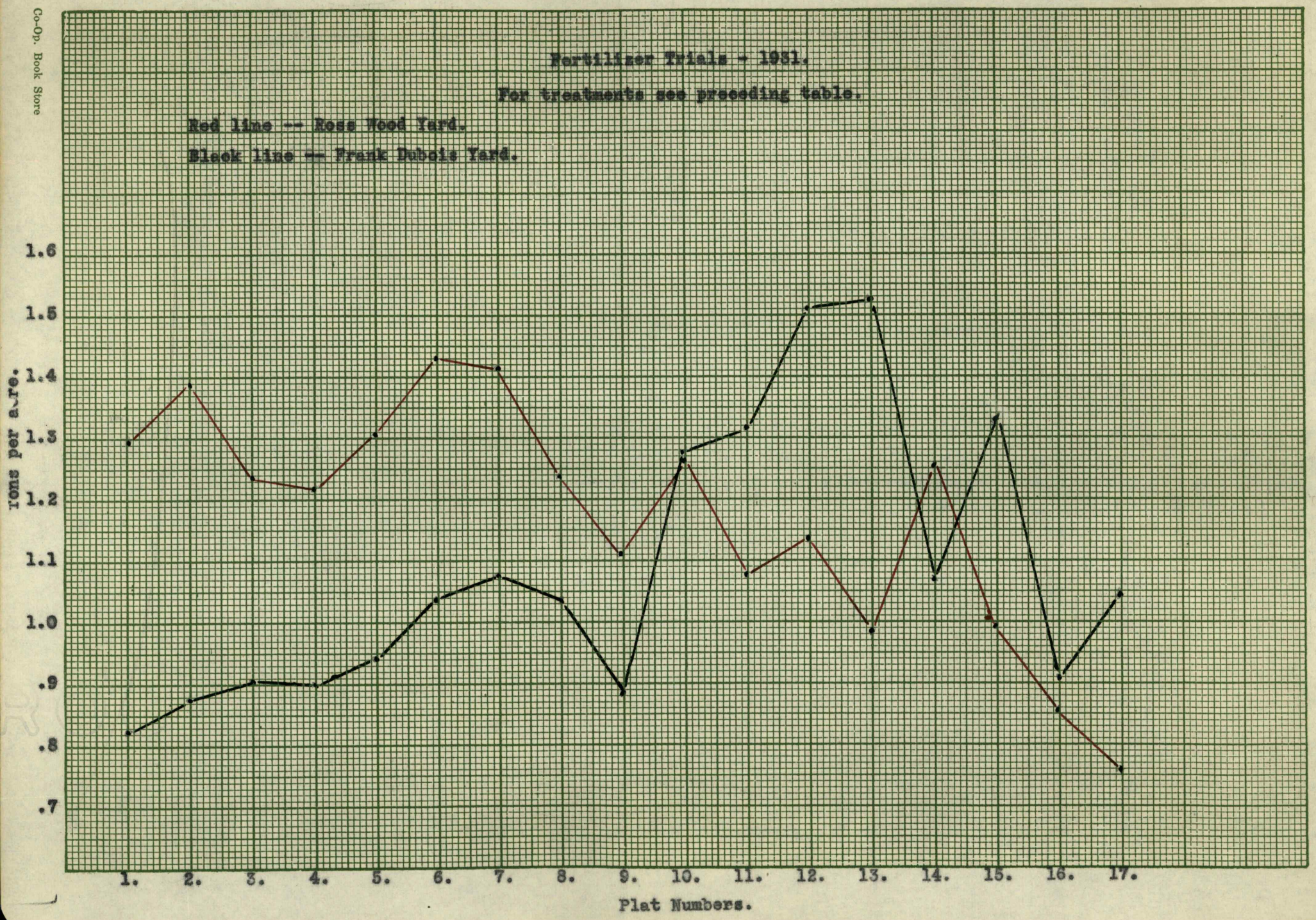


Table No.
MISSING HILLS IN FERTILIZER TRIALS
Ross Wood Yard - Dayton, Oregon - 1931

Plat No.	Missing Hills	Males	Babies	Remarks
1	1	0	1	
2	0	0	0	
3	0	0	0	
4	0	0	0	
5	1	0	1	
6	0	0	0	
7	0	0	1	
8	0	0	0	
9	2	0	0	
10	0	0	1	
11	0	0	0	
12	0	0	0	
13	1	0	1	
14	0	0	0	
15	0	0	0	
16	1	0	1	
17	2	0	1	Weedy

Table No.

MISSING HILLS IN FERTILIZER TRIALS

Frank Dubois Yard - Woodburn, Oregon - 1931

Plat No.	Missing Hills	Males	Babies	Remarks
1	3	0	13	
2	5	0	3	
3	3	0	2	
4	2	2	0	
5	0	0	2	
6	2	0	0	1 Bastard
7	2	0	0	
8	4	2	0	1 Bastard
9	2	2	1	
10	4	1	2	
11	2	0	3	
12	1	1	6	
13	6	0	2	
14	3	1	3	
15	2	1	0	1 Bastard
16	0	0	2	
17	2	2	0	

General View of

Experimental Yard.

Corvallis, 1931.

Table No.

EXPERIMENTAL HOP YARD

Corvallis, 1931

1/1 - M45	1/18 - L.C.	2/5 - M45
1/2 - E.C. (Wood)	1/19 - L.C.	2/6 - H.neo-mex. Male
1/3 - Fuggles Seedling	1/20 - L.C.	2/7 - H.neo-mex Male
1/4 - M45	1/21 - L.C.	2/8 - M45
1/5 - L.C. Male	1/22 - L.C.	2/9 - E.C. Root
1/6 - M45	1/23 - L.C.	2/10 - L.C. Sel.
1/7 - L.C. Sel.	1/24 - L.C.	2/11 - L.C. Sel.
1/8 - H.neo-mex. Male	1/25 - L.C.	2/12 - F.C.Seed 3/13
1/9 - M45	1/26 - L.C.	2/13 - Male
1/10 - L.C.	1/27 - L.C.	2/14 - L.C.
1/11 - M45	1/28 - L.C.	2/15 - L.C.
1/12 - M45	1/29 - R.V.Seed	2/16 - L.C.
1/13 - Male	1/30 - Male	2/ - L.C.
	1/31 - #301 F. Seed	
	1/32 - #302 F. Seed	
	1/33 - #303 F. Seed	

1/14 - L.C.

1/15 - L.C.

1/16 - L.C.

1/17 - L.C.

2/22 - L.C.

2/23 - L.C.

2/24 - L.C.

2/25 - L.C.

2/26 - L.C.

2/27 - L.C.

2/28 -

2/29 - L.C.

2/30 - L.C. Seed (New)

2/31 - #304 F. Seed

2/32 - #305 F. Male - Seed

2/33 - #306 F. Seed

2/1 - M45

2/2 - M45

2/3 - M45

2/4 - M45

3/10 - L.C.

3/11 - L.C. 6/19

3/12 - M45

3/13 - M

3/14 - L.C.

3/15 - L.C.

3/16 - L.C.

3/17 - L.C.

3/18 - L.C.

2/18 - L.C.

2/19 - L.C.

2/20 - L.C.

2/21 - L.C.

3/28 -

3/29 - L.C.

3/30 - F. Seed (Old)

3/31 - #307 F. Seed

3/32 - #308 F. Seed

3/33 - #309 F. Seed

4/1 - Puggles Seed

4/2 - R. V. Seedling

4/3 - L.C. 3/13

4/4 - H.neo mex. Male

4/5 - R.V. Seed

4/6 - L.C.

3/1 - L.C.

3/2 - M45

3/3 - H.neo-mex. Male

3/4 - H.neo-mex. Male L.C.

3/5 - Fuggles Seed

3/6 - M45

3/7 - H.neo.mex. Male

3/8 - L.C. Sel.

3/9 - Fuggles Seed

4/16 - E.C.

4/17 - E.C.

4/18 - E.C.

4/19 - E.C.

4/20 - E.C.

4/21 - E.C.

4/22 - E.C.

4/23 - E.C.

4/24 - E.C.

4/25 - E.C.

3/19 - L.C.

3/20 - L.C.

3/21 - L.C.

3/22 - L.C.

3/23 - L.C.

3/24 - L.C.

3/25 - L.C.

3/26 - L.C.

3/27 - L.C.

5/3 - E.C.

5/4 - H.neo-mex.

5/5 - L.C.

5/6 - L.C.

5/7 - L.C.

5/8 - L.C.

5/9 - L.C.

5/10 - L.C.

5/11 - L.C.

5/12 - L.C.

4/7 - Fuggles Seed

4/8 - Fuggles Seed

4/9 - M45

4/10 - Fuggles Seed

4/11 - E.C. Seed 3/13

4/12 - M45

4/13 - Male

4/14 - Bast.-Horst

4/15 - E.C.

5/20 - E.C.

5/21 - E.C.

5/22 - E.C.

5/23 - E.C.

5/24 - E.C.

5/25 - E.C.

5/26 - E.C.

5/27 - E.C.

5/28 - E.C.

5/29 - Bast.-Horst.

4 - F. Seed 26	5 - Male 13	5 - Male 30
		5 - #3013 F. Seed 31
		5 - #3013 F. Dis. Seed 32
		5 - #3014 F. Seed 33
4 - E.C. 27	5 - E.C. 14	6 - Male 1
4 - E.C. 28	5 - 15	6 - L.C. 2
4 - E.C. 29	5 - E.C. 16	6 - L.C. 3
4 - Male 30	5 - E.C. 17	6 - L.C. 4
4 - #3010 F. male seed 31		
4 - #3011 F. Seed 32		
4 - #3012 F. Seed 33		
5 - E. C. 1	5 - E.C. 18	6 - E.neo-max. 5
5 - E.C. Greenhouse 2	5 - E.C. 19	6 - E.C. 6
6 - L.C. 7	5 - E.C. 25	7 - Male 13
6 - L.C. Seed 8	5 - E.C. 26	7 - Fuggles 14
6 - L.C. Seed 9	5 - E.C. 27	7 - Fuggles 15
6 - L.C. 10	5 - E.C. 28	7 - Fuggles 16
6 - L.C. 11	6 - E.C. 29	7 - Fuggles 17

6 - L.C.
12

6 - Male
30

6 - #3015 F. Seed
31

6 - #3016 F. Seed
32

6 - #3017 F. Seed
33

6 - Male
13

6 - E.C.
14

6 - E.C.
15

6 - E.C.
16

6 - E.C.
17

6 - E.C.
18

6 - E.C.
19

6 - E.C.
20

6 - E.C.
21

6 - E.C.
22

6 - E.C.
23

6 - E.C.
24

7 - Male
1

7 - L.C.
2

7 - L.C.
3

7 - L.C.
4

7 - L.C.
5

7 - L.C.
6

7 - L.C.
7

7 - L.C.
8

7 - L.C.
9

7 - L.C.
10

7 - L.C.
11

7 - Bast. - Horst
12

7 - Fuggles
18

7 - Fuggles
19

7 - Fuggles
20

7 - Fuggles
21

7 - Fuggles
22

7 - Fuggles
23

7 - Fuggles
24

7 - Fuggles
25

7 - Fuggles
26

7 - Fuggles
27

7 - Fuggles
28

7 - Fuggles
29

7 - Male
30

7 - #3018 F. Seed
31

7 - #3019 F. Dis. Seed
32

7 - #3020 F. Male Seed
33

8/1 - Male

8/2 - L.C. 3/20

8/3 - L.C. 3/20

8/4 - L.C. 3/20

8/5 - L.C. 3/20

8/6 -L.C. 3/20

8/7 - L.C. Seed

8/8 - L.C. 6/19

8/9 - F. C.

8/10 - F. C. Seed

8/11 - L. C.

8/12 - F.C. Seed

8/13 - Male

8/14 - Bast. - Horst

8/15 - Fuggles

8/19 - Fuggles

8/20 - Fuggles

8/21 - Fuggles

8/22 - Fuggles

8/23 - Fuggles

8/24 - Fuggles

8/25 - Fuggles

8/26 - Fuggles

8/27 - Fuggles

8/28 - Fuggles

8/29 - L.C. Seed (Old)

8/30 - Male

8/31 - #3021 F. Seed

8/32 - #3022 F. Dis. Seed

8/33 - #3023 F. Seed.

9/1 - M 12/20

9/2 - L. C.

9/3 - H. neo-mex.

9/7 - L.C. 6/20

9/8 - L.C. 2/18

9/9 - L.C. Seed

9/10 - .C. 8/20

9/11 - L.C. 8/20

9/12 - L. C. Seed

9/13 - Male

9/14 - Fuggles

9/15 - Fuggles

9/16 - Fuggles

9/17 - Fuggles

9/18 -

9/19 - Fuggles

9/20 - Fuggles

9/21 - Fuggles

8/16 - Fuggles

8/17 - Fuggles

8/18 - Fuggles

9/25 - Fuggles

9/26 - Fuggles

9/27 - Fuggles

9/28 - Fuggles

9/29 - Fuggles

9/30 - F. Seed (old)

9/31 - #3024 F. Seed

9/32 - #3025 F. Seed

9/33 - #3026 F. Male Seed

10/1 - Male 2/20

10/2 - L.C.

10/3 - L.C.

10/4 - L.C.

10/5 - L. C.

10/6 - L.C.

10/7 - L.C.

9/4 - L.C. 6/19

9/5 - L.C. 6/20

9/6 - L.C.

10/13 - Male

10/14 - L. C.

10/15 - L.C.

10/16 - L. C.

10/17 - L.C.

10/18 - L.C.

10/19 - L. C.

10/20 - L.C.

10/21 - L.C.

10/22 - L.C.

10/23 - L.C.

10/24 - L.C.

10/25 - L.C.

9/22 - Fuggles

9/23 - Fuggles

9/24 - Fuggles

11/1 - Male 12/20

11/2 - F

11/3 - F. Seed

11/4 - F

11/5 - F

11/6 - F. Seed

11/7 - F

11/8 - F.

11/9 - F

11/10 - E.C.

11/11 - E.C.

11/12 - E.C.

11/13 - L.C. Female

10/8 - L.C.

10/9 - L.C.

10/10 - L.C.

10/11 - L.C.

10/12 - L.C. 2/18

11/19 -

11/20 - L.C.

11/21 - L.C.

11/22 - L.C.

11/23 - L.C.

11/24 - L.C.

11/25 - L.C.

11/26 - L.C.

10/26 - L.C.

10/27 - L.C.

10/28 - L.C.

10/29 - L.C.

10/30 - L.C. Seed (Old)

10/31 - #3027 F. Seed

10/32 - #3028 F. Seed

10/33 - #3029 F. Seed

12/6 - N.neo-mex.

12/7 - N. neo-mex.

12/8 - F.

12/9 - F.

12/10 - F.

12/11 - F.

12/12 - F.

12/13 - M.

11/14 - L.C.

11/15 - L.C.

11/16 - L.C.

11/17 - L.C.

11/18 - L.C.

12/23 - L.C.

12/24 - L.C.

12/25 - L.C.

12/26 - L.C.

12/27 - L.C.

12/28 - F. Seed (old)

12/29 - L.C.Seed (old)

12/30 - F. Seed (old)

12/31 - #3033 F. Seed

12/32 - #3034 F. Seed

12/33 - #3035 F. Seed

$\frac{11}{27}$ - L.C.

$\frac{11}{28}$ - L.C.

$\frac{11}{29}$ - L.C.

$\frac{11}{30}$ - F. Seed (Old)

$\frac{11}{31}$ - #3030 F. Seed

$\frac{11}{32}$ - #3031 F. Seed

$\frac{11}{33}$ - #3032 F. Seed

$\frac{12}{1}$ - H. neo-mex

$\frac{12}{2}$ - Fuggles - Seavey

$\frac{12}{3}$ - F.

$\frac{12}{4}$ - F.

$\frac{12}{5}$ - F.

$\frac{13}{10}$ - F

$\frac{13}{11}$ - Bast - Horst

$\frac{13}{12}$ - Bast - Horst

$\frac{13}{13}$ - Bast - Horst

$\frac{12}{14}$ - L.C.

$\frac{12}{15}$ - L.C.

$\frac{12}{16}$ - L.C.

$\frac{12}{17}$ - L.C.

$\frac{12}{18}$ - L.C.

$\frac{12}{19}$ - L. C.

$\frac{12}{20}$ - L. C.

$\frac{12}{21}$ - L.C.

$\frac{12}{22}$ - L.C.

$\frac{13}{28}$ - E. C.

$\frac{13}{29}$ - F. Seed (old)

$\frac{13}{30}$ - Mole

$\frac{13}{31}$ - #3036 F. Seed

$\frac{13}{32}$ - #3037 F. Seed

$\frac{13}{33}$ - #3038 F. Seed

$\frac{14}{1}$ - H.neo-mex.

$\frac{13}{1}$ - M 12/20

$\frac{13}{2}$ - Fuggles Seed

$\frac{13}{3}$ - H.neo-mex

$\frac{13}{4}$ - F.

$\frac{13}{5}$ - F.

$\frac{13}{6}$ - F.

$\frac{13}{7}$ - F.

$\frac{13}{8}$ - F.

$\frac{13}{9}$ - F.

$\frac{14}{16}$ - E.C.

$\frac{14}{17}$ - E.C.

$\frac{14}{18}$ - E.C.

$\frac{14}{19}$ - E.C.

13/14 - E.C.
13/15 - E.C.
13/16 - E.C.
13/17 - E.C.
13/18 - E.C.
13/19 - E.C.
13/20 - E.C.
13/21 - E.C.
13/22 - E.C.
13/23 - E.C.
13/24 - E.C.
13/25 - E. C.
13/26 - E.C.
13/27 - E.C.
15/4 - R. V.

14/2 - Red Vine
14/3 - R.V.
14/4 - R.V.
14/5 - R.V.
14/6 - R.V.
14/7 - R V.
14/8 - R.V.
14/9 - R.V.
14/10 - R.V.
14/11 - R.V.
14/12 - R.V.
14/13 - M
14/14 - E.C.
14/15 - E.C.
15/22 - E.C.

14/20 - E.C.
14/21 - E.C.
14/22 - E.C.
14/23 - E.C.
14/24 - E.C.
14/25 - E.C.
14/26 - F. Seed (old)
14/27 - E.C.
14/28 - E.C.
14/29 - E.C.
14/30 - F. Seed (old)
14/31 - #3039 F. Seed
14/32 - #3040 F. Seed
14/33 - #3041 F. Seed
15/1 - M 12/20
15/2 - Red Vine
15/3 - R.V.
16/10 - Bavarian

15/5 - H. neo-mex.

15/6 - R.V.

15/7 - R.V.

15/8 - R.V.

15/9 - R.V.

15/10 - H.neo-mex.

15/11 - R.V.

15/12 - R.V.

15/13 - M.

15/14 - E. C.

15/15 - E.C.

15/16 - E.C.

15/17 - E.C.

15/18 - E.C.

15/19 - E.C.

15/20 - E.C.

15/23 - E.C.

15/24 - E.C.

15/25 - E.C.

15/26 - E.C.

15/27 - F. Seed (old)

15/28 - E.C.

15/29 - E.C.

15/30 - F. Seed (old)

15/31 - #3042 F. Seed

15/32 - #3043 F. Seed

15/33 - #3044 F. Seed

16/1 - M 12/20

16/2 - Bavarian

16/3 - Bavarian

16/4 - Bavarian

16/5 - Bavarian

16/6 - Bavarian

16/7 - H.neo-mex.

16/8 - H.neo-mex.

16/11 - Bavarian

16/12 - Bavarian

16/13 - Male [illegible]

16/14 - Fuggles

16/15 - Fuggles

16/16 - Fuggles

16/17 - Fuggles

16/18 - Fuggles

16/19 - Fuggles

16/20 - Fuggles

16/21 - Fuggles

16/22 - Fuggles

16/23 - Fuggles

16/24 - Fuggles

16/25 - Fuggles

16/26 - Fuggles

15/21 - E.C.

16/28 - Fuggles

16/29 - Fuggles

16/30 - Male

16/31 - #3045 F. Seed

16/32 - #3046 F. Seed

16/33 - #3047 F. Seed

17/1 - Male

17/2 - Bavarian

17/3 - Bavarian

17/4 - Bavarian

17/5 - Bavarian

17/6 - Bavarian

17/7 - Bavarian

17/8 - Bavarian

17/9 - Bavarian

17/10 - Bavarian

17/11 - Bavarian

17/12 - Bavarian

16/9 - B

17/16 - Fuggles

17/17 - Fuggles

17/18 - Fuggles

17/19 - Fuggles

17/20 - Fuggles

17/21 - Fuggles

17/22 - Fuggles

17/23 - Fuggles

17/24 - Fuggles

17/25 - Fuggles

17/26 - Fuggles

17/27 - Fuggles

17/28 - Fuggles

17/29 - Fuggles

17/30 - Male

16/27 - Fuggles

18/4 - Bastard-Walker

18/5 - Bavarian

18/6 - H.neo-mex.

18/7 - Bastard-Walker

18/8 - Bastard-Walker

18/9 - Bastard-Walker

18/10 - Bastard-Walker

18/11 - Bastard-Walker

18/12 - Bastard-Walker

18/13 - Bast. Horst

18/14 - Fuggles

18/15 - Fuggles

18/16 - Fuggles

18/17 - Fuggles

18/18 - Fuggles

17/31 - #3048 F. Seed

17/32 - #3049 F. Seed

17/33 - #3050 F. Seed

17/13 - Bast. - Horst

17/14 - Fuggles

17/15 - Fuggles

18/22 - Fuggles

18/23 - Fuggles

18/24 - L.S. (female) Root

18/25 - Fuggles

18/26 - Fuggles

18/27 - Fuggles

18/28 - Fuggles

18/29 - R.V. Seed (old)

18/30 - F. Seed (old)

18/31 - #3051 F. Seed

18/32 - #3052 F. Seed

18/33 - #3053 F. Seed

18/1 - Bast.

18/2 - H.neo-mex.

18/3 - H.neo-mex.

18/19 - Fuggles

18/20 -

18/21 - Fuggles

Picking hops in

Experimental Yard, Corvallis, 1931.

VARIETAL TRIALS WITH HOPS

The trial to determine the yielding ability of the three leading varieties of hops Late Clusters, Early Clusters and Fuggles was conducted at the experimental yard. These three varieties were planted from root cuttings in duplicate plots. Each plot consisted of three rows of 15 hills in each row. Plots, therefore, contained 45 hills of hops. Because of the extremely dry weather, the stand of hops was variable. The missing hills, however, were replanted with seedlings because roots of the variety were not available late in the season. The stand varied all the way from 55 to 95 per cent. The missing hills, however, being planted with hops did not affect the growth of adjoining hills. The yields were determined on the actual hills picked.

The highest yielding variety was Early Clusters. This variety was followed fairly closely with the Lake Clusters and the lowest yielding variety was Fuggles. Both of the Cluster varieties yielded over a bale of dried hops per acre. This is considered a very good yield for the first year's growth. The yield of Fuggles was low, as expected, and indicates that this variety is not worth training the first season.

The center row of each plot received a little different treatment than the two outside rows. The roots which were used to plant this center row were rolled in landplaster. It was hoped that some information could be obtained on both the effect of landplaster on yield and the effect on disease, if any, in these roots. The results show that the landplaster had no affect on yield and that it more than likely is not worth while. In fact, the roots which were rolled in landplaster showed great difficulty in sprouting, and many of them had to be taken up and dipped in water to remove

the landplaster in order to get them to sprout. Of course, these results may be due to the abnormally dry conditions at planting. It must be borne in mind that some yards set out at this time were entirely destroyed by the dry weather and no crop was obtained. In moist years landplaster on the roots, the same as landplaster applied to other things in this locality may be stimulated, but neither these results nor observations showed any particular value for this treatment.

TABLE NO.

HOP VARIETAL TRIAL
Corvallis, 1931.

Plot	Row	No. of Hills Picked	Green Wt. lbs.	Dry Wt. lbs.	Dry Wt. Less Seed Pounds.	Treatment of vines after harvesting
I. L.C.	1	14	17	4	3.86	Vines left on wire
"	2	13	15.9	4	3.86	Vines cut from wire
"	3	9	11.2	3	2.89	Vines cut off at ground
II. E. C.	1	10	16.4	3.5	3.38	Vines left on wire
"	2	11	11	2.8	2.71	Vines cut from wire
"	3	13	17.6	4.4	4.25	Vines cut off at ground
III. F.	1	14	1.7	.4	.39	Vines left on wire
"	2	13	.9	.2	.19	Vines cut from wire
"	3	9	1.1	.3	.29	Vines cut off at ground
IV. L. C.	1	15	11.5	2.6	2.51	Vines left on wire
"	2	14	15	3.7	3.57	Vines cut from wire
"	3	13	12	2.9	2.79	Vines cut off at ground
V. L. C.	1	7	6.3	1.6	1.54	Vines left on wire
"	2	13	17	4.6	4.44	Vines cut from wire
"	3	7	10.4	2.6	2.51	Vines cut off at ground
VI. F.	1	12	2.4	.6	.59*	Vines left on wire.
"	2	11	2.2	.5	.49*	Vines cut from wire
"	3	8	.9	.2	.19*	Vines cut off at ground

The Late Clusters grew to an average of 15-1/2 feet.
The Early Clusters grew to an average of 14-1/2 feet.
The Fuggles grew to an average of 10 feet.

* Estimated.

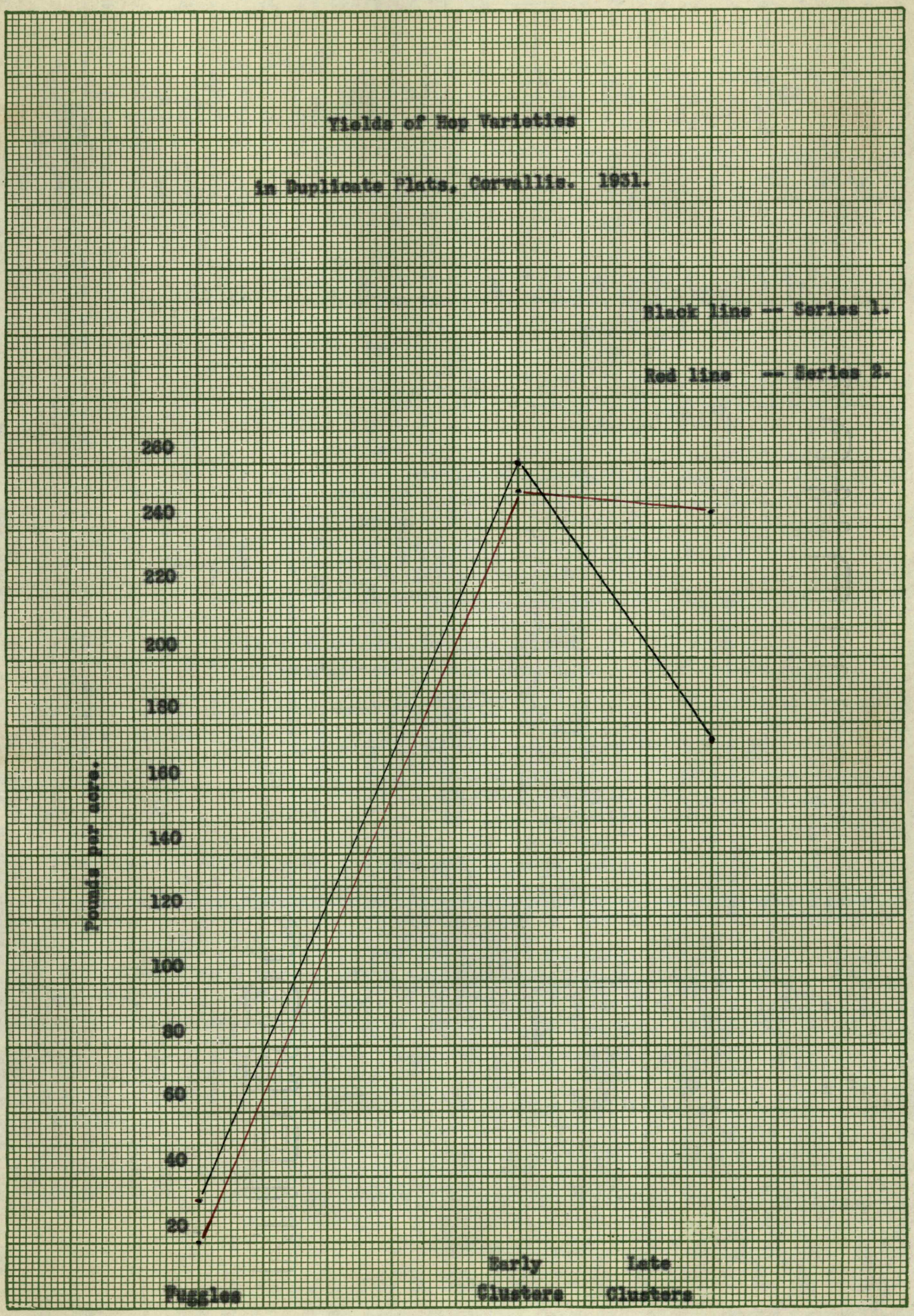
Table No.

Yields Per Acre of Hop Varieties

in Trials at Experimental Yard

Corvallis, 1931

Plot No.	Variety	Number of Hills	Pounds Dry Weight	Pounds Per Acre	Average yield per Acre
1	L.C.	36	11	244.8	--
2	E.C.	34	10.7	251.2	--
3	F.	36	.9	20.	[illegible]
4	L.C.	42	9.2	175.2	210.0
5	E.C.	27	8.8	260.	255.6
6	F.	31	1.5	33.5	26.75



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Weighing hops in

Experimental Yard, Corvallis, 1931.

Seedling

in Experimental Yard.

Corvallis, 1931.

TABLE NO.

WEIGHTS OF INDIVIDUAL PLANTS (YIELD)
FROM O.S.C. HOP YARD, 1931.

Plant Row	Hill	Variety	Green Wt. lbs.	Dry Wt. lbs.
6	3	L. C.	6.9	1.6
6	4	L. C.	5.0	1.3
6	8	L. C. - Seed	4.8	1.2
6	9	L. C. - Seed	4.5	1.0
7	9	L. C.	6.2	1.3
8	11	L. C.	3.8	.9
8	4	L. C.	3.7	.9
8	9	E. C.	1.5	.4
8	10	E. C. - Seed	3.8	.9
8	12	E. C. - Seed	1.1	.25
11	3	F. - Seed	.3	.05
11	6	F. - Seed	.2	.05
11	8	F.	.6	.1
12	2	F.	.5	.1
12	4	F.	.3	.05
14	4	R. V.	3.4	.8
14	6	R. V.	.9	.25
15	3	R. V.	.8	.2
15	6	R. V.	1.9	.5
15	7	R. V.	.9	.2
16	2	Bav.	1.4	.6
16	6	Bav.	3.6	.9
17	7	Bav.	5.2	1.3
17	8	Bav.	5.2	1.2
17	9	Bav.	2.6	.7

Table No.

HOP SEED COLLECTED IN 1931

No.	Grower	Variety
1.	C. Murphy, Harrisburg	Fuggles
2.	Ross Wood, Dayton	Fuggles
3.	Ross Wood, Newberg	Fuggles
4.	McLaughlin, Independence	Fuggles & L.C.
5.	Bensen Yard, Silverton	Fuggles
6.	John Morley, Silverton	Fuggles
7.	Romeo Gouley, Albany	Fuggles & Unknown
8.	Linn and Linn, Albany	Early Clusters & R.V.
9.	L. D. Patten, Independence	
10.	O. N. Love, Forest Grove	Late Clusters
11.	J. Nichol, Forest Grove	" "
12.	J. F. Miller, Forest Grove	" "
13.	J. F. Miller, Forest Grove	Mildew Resistant
14.	La Fallet, Forest Grove	Late Clusters
15.	L. S. Christofferson, Eugene	" "
16.	Anderson Brothers, Eugene, M. R. B.	" "
17.	Waine & E. W. McBee, Eugene, Route 2	" "
18.	J. H. Seavy, Eugene, Route 2	" "
19.	W. M. Winn, Albany, Route 4	" "
20.	A. W. Crooker, Albany	" " & E. C.
21.	S. F. Irvine, Albany	" "
22.	L. W. Porterfield, Independence	" "
23.	L. H. Ward, Independence	" "
24.	Downing & Eoff Yard, Independence (Loyde Hunnicut)	" " & R.V.

No.	Grower	Variety
25.	Sloper Brothers, Independence, Route 2	Late Clusters
26.	Sloper & Patton	Early Clusters
27.	Charles Livesly, Independence	F. in L.C. yard & L.C.
28.	Hugh Smith, Dallas	Late Clusters
29.	Werline Hop Yards, Independence	Late Clusters & R.V.
30.	E. E. Jain, Dallas, Route 2	Lates
31.	Chas. N. Plaster, Dallas	
32.	Otis Foster, Dallas, Route 2	Late Clusters
33.	Sam J. Hoover, Independence	" "
34.	Hugh Hanna, Independence	
35.	P. L. Hedges, Independence	" "
36.	Homer Gouley, Gervais	" "
37.	A. W. Nusom, Jr., Gervais	
38.	A. M. Jerman, Salem, Route 8	Early Clusters - L.C.
39.	L. Lachmond, Independence	Fuggles
40.	Mat Suda, Independence	Fuggles
41.	Prater Yard, Independence	
42.	Horst Yard, Salem	Late Clusters
43.	Plaster Yard, Dallas	" "
44.	C. N. Bilyeu, Dallas	" "
45.	R. E. Williams & Thacker, Salem	" "
46.	Homer Woods, Independence	Early Clusters
47.	Lake Brook Ranch, Salem	Late Clusters
48.	E. P. McCarthy, Independence	Early Clusters - L.C.
49.	David Jackson, Jefferson	Early Clusters & L.C.
50.	Newton, G. E., Independence	" " " "
51.	A. C. Locke, Jefferson	Late Clusters

No.	Grower	Variety
52.	Dean Walker's Yard across from Independence	Fuggles
53.	Frank Needham, Box 116, Salem	Fuggles & E.C.
54.	California (Horst)	Late Clusters (?)
55.	Bob Austin, Route 1, Jefferson	" "
56.	John J. Roberts, Salem	" " & E.C.
57.	F. B. Gwin, Independence	" "
58.	Mrs. John Krebbes, Route 1, Jefferson	R. V.
59.	A. M. Jerman & D. Chittenden, Independence	Late Clusters
60.	P. M. Leeper, Albany	Early Clusters
61.	G. P Locke, Route 1, Jefferson	Late Clusters & R.V.
62.	J. Nichols, Forest Grove	Late Clusters
63.	P. L. La Follett, Cornelius	Early Clusters
64.	Hyzler Bros., Gales Creek	Late Clusters
65.	D. C. Minto, Salem	Fuggles
66.	Nick Purfield, Puyallup, Washington	Fuggles
67.	O.S.C. Greenhouse	Seedlings
68.	O.S.C. Hop Yard	Bav. - L.C. - E.C. - F. M 45 & Hybrids
69.	B. C. Hulbert, Sardis, B. C.	East Kent Goldings

Males Produce Female Flowers

All of the male plants grown in the experimental yard during the season of 1931 were from the Late Cluster variety. Practically all of the roots growing these male plants were from selected hills marked the previous fall. These hills were marked because of the outstanding vigor and growth of the male plants. None of the males showed any tendency to develop female flowers.

It was surprising, therefore, to note during the season 1931 the great tendency of the males grown in the yard to produce female flowers. Only one male plant showed no female flowers. The others showed all the way from a small percentage up to as high as 75% of the flowers as females. It is rather hard to account for the tendency of these males to throw female flowers. This is particularly true when all of them were from selected plants of the previous season.

The following table gives the tendencies of these various male plants to become monoecious; that is, produce both flowers on the same plant. These male plants, of course, will be observed during the following season.

Roots from plants which produced no flowers the previous season were obtained from two sources, the Walker Yard and the Horst Yard. These roots produced large, vigorous plants and none of them produced any flowers. This indicates that roots from these so-called bastard plants come true and produce the same type of plant. With this one year's results as to their performance, it is hoped to attempt to change their conditions by various fertilizer treatment during the coming season.

It may be that these plants are the result of a virus disease. At any rate, they will be watched closely and an attempt will be made to account for them. As previously stated, this type of plant is very common in some yards and one of the common unproductive plants which is found here.

Estimated Percentage of Female Tendencies of Male Plants in Experimental Yard, Corvallis, 1931.

Plant No.	Female tendency.
1 - 5	10
6 - 1	0
13 - 1	50
15 - 1	3
16 - 1	65
17 - 1	5
18 - 1	7
15 -13	70
14 -13	75
12 -13	5
10 -13	40
9 -13	60
7 -13	75
6 -13	15
5 -13	75
4 -13	1
3 -13	No bloom.
2 -13	" "
1 -13	" "
1 -30	50
4 -30	60
5 -30	50
6 -30	75

2.

7 -30	50
8 -30	30
13 -30	No bloom.
15 -30	50
16 -30	75
17 -30	75

GREEN MANURE TRIALS

This fall the portion of the experimental hop yard which was in crop during the 1931 season was planted to a green manure trial. This portion of the yard consists of about one acre and the one acre was divided into five plots as follows:

Table No.	Green Manure Plot
1	Barley
2	Hungarian vetch
3	Hairy vetch
4	Common vetch
5	Austrian winter field peas

This green manure crop will serve a double purpose. In the first place, it will keep the soil from washing in case of extremely high water. In the second place, it will add organic matter to the soil. In the spring these various green manures will be observed for winter killing, amount of growth, and other factors. They will then be turned under and differences in growth of plants in the various plots will be recorded.

Hop growers are greatly interested in green manure crops and particularly so in the new Austrian winter field pea, which is available at this time. Much seed of this crop was offered to hop growers last fall and it was recommended because of the value it had shown in other trials here at the Experiment Station. This trial will be expanded in the fall of 1932 to include the entire experimental yard. The rest of the yard, which was just laid out this fall, is in red clover and so the entire yard is protected from washing and will receive the advantage of the green manure crop turned under in the spring.

TESTS FOR QUALITY IN HOPS

One of the important factors in the development of a new variety of hops is quality. This rather intangible thing has received an enormous amount of attention abroad but very little has been done about it here. In the development of a new disease resistant variety of hops, it is necessary not only to have yielding ability but a type of hop which has the qualities desired by the buyer.

The opportunity of obtaining a graduate student to work on this problem presented itself this fall, and so C. F. Whitaker, an experienced chemist, began work October 1, 1931. He is devoting half-time to this problem, the results of which he will use as a thesis for the Master's degree.

The first work done was a complete review of the literature on this subject, which is rather voluminous and not very definite. Then he attempted to determine the resin content of samples which were collected last fall.

The samples saved last fall included some 25 individual hills grown in our experimental hop yard. These were both seedlings and selections. In addition, samples were saved from all of the fertilizer trials to see what effect, if any, fertilizers had on quality.

The method used was first suggested by Ford and Tait, in the Journal of the Institute of Brewing. It was later modified by Dr. T. K. Walker, and again by Hastings and Walker, in the same journal.

Mr. Whitaker states that the publications omitted a number of important details and precautions, so that he had to do considerable preliminary work to obtain proper methods. The first of the work done during 1931 was mainly to develop proper procedure for the methods suggested by the English workers. The chemical tests being conducted by Mr. Whitaker are well under way and will soon be completed.

Later, he proposes to make several tests of the various collections of hops from the bacterial standpoint. This method of getting the bacteriacide value of hops is favored by some workers.

Seed Treatment to Induce Germination

Because of the poor germination of hop seeds, many methods of inducing germination were attempted. Final results have not been obtained on these various methods but some preliminary information indicates that good germination may be obtained if the proper procedure is followed.

The following treatments have been employed:

1. Chilling at 0° Centigrade.
2. Scarifying.
3. Alternating temperatures.
4. Using light.
5. Various temperatures of seed beds.
6. Exposure to X-ray.
7. Chemical treatments:
   - Trichloroethylene, 3 hours in a 6 per cent solution.
   - Ethylene chloride, 3 hours in a 1 per cent solution.
   - Ethylene chlorhydrin, 3 hours in an 8 per cent solution.
   - Ethyl bromide, 3 hours in a 6 per cent solution.
   - Ammonium thiocyanate, 3 hours in a 3 per cent solution.
   - Potassium thiocyanate, 3 hours in a 1 per cent solution.

Dr. William Crocker, Director of the Boyce Thompson Institute for Plant Research at Yonkers, New York, was asked for assistance in this germination problem. Lately he has been furnished with a thousand seeds of the Fuggles variety obtained from the Ross Wood Yard and he is conducting a thorough test on these seeds. Previously, however, he wrote the following letter:

> "I have your letter of December 2 regarding the germination of hop seeds. Of the fruits you sent 186 were empty as shown by slight pressure between the thumb and finger; 93 appeared to have good seeds. These we are running through various tests to find out what conditions will favor germination. If you would care to send forward 1000 or more fruits we could make more thorough tests and report the results back to you, as it is a matter of routine with us to carry various seeds through a great variety of conditions to find out the best condition for germination.
>
> "I note from the little article that you enclosed that you got favorable results by keeping the seeds for a period in a low

temperature germinator. I am wondering whether it would not pay you to run these low germinators for a much longer period, say for 1, 2, and 3 months, though judging from your results perhaps one month would be sufficient. Where low temperature stratification benefits seeds we find that 1° C. is most favorable for certain seeds as the European mountain ash; 5° C. is most favorable for others including many of the roses, the apple, peach, etc. In some cases 10° C. proves very favorable. This is especially true of the more southerly forms. In the case of persimmon 15° C. is a very favorable temperature. We generally follow these low temperature treatments with a higher temperature such as 20°. I am sending forward under separate cover three articles that deal with this matter of stratification.

"In many seeds alternating temperatures prove very favorable and in general daily alternation is as good as longer alternation periods. In these alternating temperatures we generally run the cooler period for the longer time. For instance, if you use 10° C. and 30° C. it would be well to run the 10° for 18 hours of the day and the 30° for 6 hours of the day. In many seeds the broader range of alternation is best, such as 5°-30°, or 10°-30°, but in some seeds even 20°-30° is very favorable.

"Light also favors germination in many seeds. This you can easily test out by Petri dish tests in your laboratory."

Right now best results are obtained by scarifying the seed, chilling them for a period of ten days or longer at 0° Centigrade and then planting in flats and covering the seed with peat moss. These flats are placed on the steam pipes under the benches in the greenhouse. The temperatures obtained in the flats are quite high, mostly above 90° Fahrenheit. Under these conditions, the seeds germinate fairly well. The seedlings, however, must be removed shortly after germination so that they do not become too spindly. It may be that Dr. Crocker will give us information which will lead to a better technique. Also, the seeds may germinate better as the season progresses. In general, however, a very low percentage of germination is obtained. Very significant differences in ability of different lots of seed to germinate have been noted. Seed obtained from seedlings grown in the greenhouse the previous year and

from the variety Fuggles germinate very readily, as do seed of the variety Red Vine. The seed obtained in California also germinates readily. On the other hand, some lots of Fuggles, particularly those from the Ross Weed Yard at Dayton, Oregon, germinate very slowly and poorly.

Seedlings Infected with Downy Mildew

In cooperation with G. R. Hoerner flats of seedlings were infected with conidia of the downy mildew organism. These seedlings were grown in flats by the writer, and the inoculations were made by Mr. Hoerner. The following table gives a list of the varieties and the various collections of each variety which were inoculated with the organism.

Variety and Source of Seedlings Inoculated with Downy Mildew.*

FUGGLES

- Benson, G.
- Gouley, R.
- Jacobson, B.
- Matsuda
- Minto, D. C.
- Morley, J.
- Murphy
- McLarop
- McLaughlin--New Yard
- McLaughlin--Old Yard
- Needham
- Pratten
- Turner
- Walker, Dean
- Wood, R.

EARLY CLUSTERS

- Gouley, H.
- Hartley
- Jerman, A. M.
- Linn & Linn
- Livesley
- Loper
- Matsuda
- Turner

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* Data furnished by G. R. Hoerner

LATE CLUSTERS

Bilyeu, C. N.
Crocker, A. W.
Derin, S. C.
Foster, Otis
Hanna, Hugh
Hedges, P. L.
Hurst, E. C. (California)
Hunnicut, L.
Linn & Linn
McBee
McCarthy, E. P.
Porterfield, L. W.
Seavey, J. H.
Smith, Hugh
Ward, L. H.
Wesline
Winn, W. M.

RED VINE

Krebles
Locke, G. P.
Wesline

It was surprising that all collections of seedlings were susceptible to this organism. Even all of the collections of the variety Fuggles were susceptible. This variety, as is well known, is quite resistant to the downy mildew under field conditions. From these results it appears that seedlings infected in the cotyledon stage are susceptible, and that if varieties are resistant later, this resistance must be built up and be expressed in later stages. Just what this stage is has not been determined as yet. Of course, the cotyledon tissue is different from the other plant tissue, and so infection at this stage may not have any great importance in determining resistant plants.

All of this, however, makes the breeding for disease resistant plants more difficult. It was hoped that seedlings in this early stage could be inoculated and the resistant ones separated from those that were susceptible. It appears that the seedling must be grown to a greater height before it is inoculated.

This method of inoculating cotyledons of seedlings was suggested by Mr. Walter Jones of the British Columbia Experiment Station. He found that the cotyledons were quite susceptible, and that a large number of oospores were developed in the cotyledons.

The Needham Drier, which

reduces the drying period of hops.

Salem, Oregon. 1931.

SEEDLINGS GROWN IN FALL OF 1931

More than 100 flats of seeds were started in the fall of 1931. Many of these were used in the inoculation trials described in the preceding pages. Others were used for growing larger seedlings. The various methods of inducing germination are described in the preceding pages, also.

On December 31, 1931 there were nearly 1000 seedlings which had been transferred from the flats to beds in the greenhouse. These seedlings are being grown in pairs so that two canbe set out in the field in each hill. These pairs are from the same collections of seed. At this time many of these seedlings are about one foot in height, but the majority of them are only six or seven inches tall.

In addition to these seedlings several others were grown early. These reached the height of eight or ten feet. Most of these have been cut down and allowed to more or less mature. Recently they were set out in the experimental field. These plants will be observed to see if they will make as much growth during the 1932 season as seedlings which are set out and not cut back. Most of the seedlings will be set out after all danger of frost is over, but it is hoped to get some information as to the best way of taking them to the field. That is, should they be cut back to the surface of the ground or should they be allowed to make a growth of 12 inches or two feet, or even more? Results in 1931 indicate that the hop seedling should have a growth of three or four feet in the spring if it was to bloom during the same season.

"Boxes" of hops being pulled into drying kilns.
Seavey Yard -- East Corvallis, Oregon.