

*Oregon's*  
**AGRICULTURAL PROGRESS**  
*Through Research*



**STATION  
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*1951 Annual Report*  
OF THE  
**OREGON AGRICULTURAL EXPERIMENT STATION**

## Foreword

American agriculture is today in the midst of a vast revolution. New and improved products and practices have been appearing on the agricultural scene during the past decade at an unprecedented rate. Out of this progress has come more and better food and fiber for our people—and at a lesser expenditure of resources.

A key spoke in this wheel of progress is the work of the state Agricultural Experiment Stations. These Stations conduct research, both fundamental and applied, to safeguard and advance the agriculture of their state. This report, *Oregon's Agricultural Progress Through Research*, presents key examples of the Oregon Station's program of research during the past year.

A handwritten signature in cursive script, reading "F. E. Price". The signature is written in dark ink and is positioned above the printed name and title.

Dean and Director

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July 1, 1950 to June 30, 1951

**T**HIS report has been organized on a commodity basis for the convenience of the reader. In each division progress is reported on some of the representative problems in the particular field. Since the complete program of the Experiment Station involves research on some 400 agricultural problems, a full report on each was not practical. Instead, a few have been selected from each field in an attempt to present the over-all picture of agricultural research in Oregon. The report was prepared by Norville R. Gish, Assistant Experiment Station Editor.

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# Field, Forage, and Seed

**I**NCREASING emphasis is being given by the Experiment Station to research on improvement of Oregon's range, pasture and other forage producing crops. Studies reported in this section reflect this trend.

In addition, major work is under way with breeding and production problems, including disease control on small grains, corn, flax, hops, and grasses and legumes grown for forage or seed. Cultural problems in sugar beet seed production are under investigation along with mint diseases and insects.

A program for lowering processing costs for fiber flax includes a key federal-state cooperative study on developing improved processing machinery as well as bacteriological and chemical tests on improved retting methods.

Other important projects include control of gorse; quality, germination, and purity studies with seed; hay and corn drying; mint distillation; and development of farm machinery.

*Ammonium Sulfate Raises***Grass Seed Yields**

H. H. White

Alta fescue and Harding grass seed production experiments were conducted this year at the Southern Oregon Branch Station with particular emphasis on the effect of ammonium sulfate fertilizer on seed yield, the relative value of row and solid plantings, and the effect of row spacing on seed production.

Results of the trials show that income per acre from both alta fescue and Harding grass was more than doubled by experimental applications of ammonium sulfate fertilizer.

Good yield increases were produced on alta fescue with applications of 200 and 400 pounds of ammonium sulfate per acre, but 600 pounds resulted in a net loss. There were indications, however, that more soil moisture might make 600 pounds per acre profitable.

With alta fescue seed calculated at a conservative value of 35 cents per pound, test plot results showed a net income of only \$207 per acre for unfertilized alta fescue. With 400 pounds of fertilizer



Harding grass grew nearly six feet tall and income from seed was doubled by ammonium sulfate fertilizer applied at the rate of 600 pounds an acre on Southern Oregon Branch Experiment Station test plots.

added, the seed production was 1,045 pounds per acre, which represented a net income of \$353 per acre.

Results were similar with Harding grass fertilization trials, except that 600 pounds of ammonium sulfate fertilizer produced good yield increases over 400-pound applications.

Tests with row and solid planting produced evidence that row planting holds an advantage over solid planting for both alta fescue and Harding grass in southern Oregon. Before the decision is made whether to plant these crops solid or in rows, consideration must be given to other factors such as machinery and time available for cultivation, general farm organization, and the need for pasture.

Spacing tests between rows indicated that closer spacing will give higher yields of both crops. Alta fescue planted in rows with 28-inch spacing produced 1,091 pounds of seed per acre. Thirty-inch spacing between alta fescue rows yielded 918 pounds of seed per acre, while 36-inch spacing reduced the yield to 858 pounds per acre.

The same tests with Harding grass gave a yield of 363 pounds of seed per acre for 28-inch spacing, 297 pounds for 30-inch spacing, and 211 pounds for 36-inch spacing.

Results of the investigations indicate that Harding grass production may be profitable in the Rogue River Valley.

Future plans call for continuation of the experiments to obtain data over a longer period of time.

### *Station Releases Two*

## **New Crop Varieties**

A. E. Gross

H. A. Schoth

A promising new oat variety and an outstanding new forage legume were released for use in Oregon this year by the Experiment Station.

The new oat was Shasta, a spring variety which had been under test at the Klamath Experimental Area for several years. It was developed by the U. S. Department of Agriculture from a cross between Markton and Victory varieties, combining the smut resistance of Markton with the yielding ability of Victory.

A tall, late-maturing, high-yielding spring oat, Shasta was tested and found adapted for use in the irrigated areas of the Klam-



Granger lotus, a forage legume with outstanding prospects, was one of two new crop varieties released this year by the Experiment Station. Above is an experimental planting of Granger at the Central Station.

ath Basin and central Oregon. Its late maturity has made it occasionally susceptible to late spring frosts.

In nursery trials at the Klamath Experimental Area, Shasta outyielded both Markton and Kanota, common varieties in that area. In central Oregon trials, Shasta outyielded Victory, the most common central Oregon variety.

The outstanding new forage legume was Granger Lotus, developed at the Experiment Station and released jointly with the U. S. Department of Agriculture, following 14 years of testing at the Central Station, the John Jacob Astor Branch Station, the Southern Oregon Branch Station, and the Klamath Experimental Area.

Granger has shown early indications of someday becoming an important forage crop throughout the Northwest and perhaps the entire nation. It is adapted to coastal, southern, and Willamette Valley conditions and has been placed under test in eastern Oregon and in various points throughout the United States.

Under experimental conditions, Granger produced the highest long-term forage yield of all varieties and strains of lotus tested by

the Experiment Station. It has compared favorably in forage production with the best Ladino clover.

The original seed from which Granger was developed was obtained from England by the U. S. Department of Agriculture. The new variety is a broad-leafed strain of *Lotus corniculatus*. It grows upright, is leafy, and is extremely long-lived. The forage is palatable and nutritious. It is a good seed producer, also.

Two outstanding features of Granger are its vigorous seedling development which reduces plant loss during the establishment period of the crop and its rapid comeback after harvesting.

Foundation seed distributed to farmers this year will be used to increase seed supplies for the future and make the new crop available to all who want to use it.

## *Progress Made on Control of* **Potato Diseases**

J. A. Milbrath

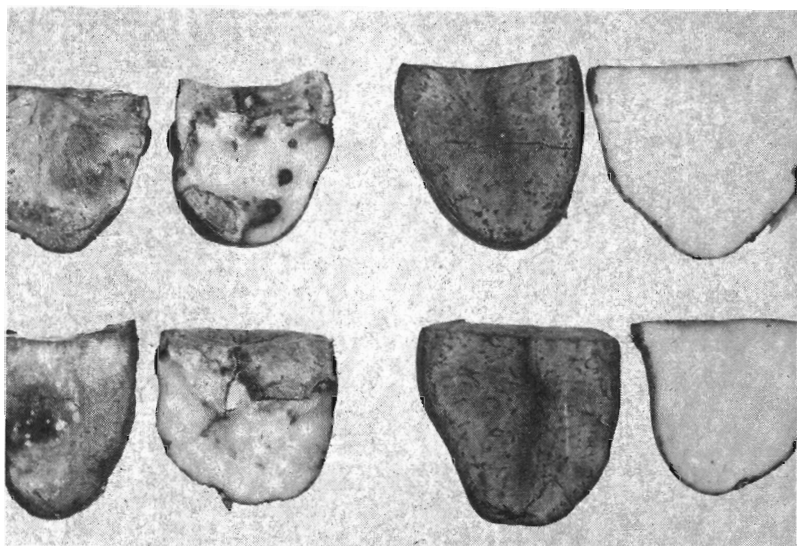
Roy A. Young

Clark Amen

Emphasis was placed on vector control and seed-piece treatment for the control of seed-piece decay in the potato disease research program this year. Good vector control resulted in a marked reduction in leaf-roll but failed to control mosaic. Treatment of cut potato seed-pieces with Phygon and Semesan Bel gave increases in stand and yield.

Main objective of the vector control tests was to determine whether spread of virus diseases could be prevented by controlling the vectors responsible for their spread. The main objective of the seed-piece treatment tests was to evaluate various fungicides for effectiveness in prevention of seed-piece decay and the resulting poor stands and yields.

Vector control trials in Multnomah County demonstrated that proper application of insecticides reduced the spread of the leaf-roll virus but failed to stop the mosaic virus. When four applications of dusts were used, aphid populations were reduced 99 per cent by parathion plus DDT, 90 per cent by parathion alone, and 81 per cent by DDT plus sulfur. Comparable samples of tubers taken from the various plots at the end of the growing season gave disease readings of 2.2 per cent leaf-roll and 8.9 per cent mosaic in the plots treated



The value of treating seed-pieces to prevent decay is shown by these potato seed-pieces photographed five weeks after cutting. Four pieces on left were untreated while others were treated with Phygon.

with parathion alone. There was 3.6 per cent leaf-roll and 10.3 per cent mosaic in plots treated with DDT-sulfur. In check plots where no dusts were applied for the control of aphids there was 16.1 per cent leaf-roll and 14 per cent mosaic.

Potato seed-piece decay, caused by seed-borne and soil-inhabiting fungi, annually results in reduction in stand ranging from a trace to losses that make replanting necessary. Poor stands frequently occur in fields planted with tuber unit potato planters on which potatoes are cut and planted immediately.

To prevent such losses, a satisfactory method of treating seed-pieces in the interval between cutting and planting is needed. Excellent results were obtained in preliminary trials with a tuber unit planter which cut seed-pieces with a vertical rotating wheel of knives and passed them through a fungicide bath before planting.

Treatment with Phygon at the rate of 1 pound to 10 gallons of water and Semesan Bel at 1 pound to 7½ gallons of water resulted in marked yield increases. Excellent results were obtained with Phygon in all seed-piece treatment trials. Phygon favors tuberization and provides protection against seed-piece decay fungi. Mercury compounds appear promising for treatment of cut seed-pieces if



injury can be avoided by planting soon after treating. A tuber unit potato planter adapted for seed-piece treatment will facilitate the use of mercury compounds on cut potato seed-pieces and should be an asset to seed potato growers.

Vector control trials will be continued and correlated with studies on the effects of different methods of roguing on spread of potato virus diseases. New materials that show possibilities as aphicides will be tested.

Seed-piece treatment trials will be continued and plots will be established in all major potato-growing sections of the state. Emphasis will be placed on trials with a tuber unit planter equipped for fungicide treatment. Several new chemicals will be screened in plots at Corvallis in an effort to secure chemicals more effective in preventing seed-piece decay.

Other research included a program on blackleg disease, observations of certain disease-resistant potato varieties, and preliminary storage house disinfection studies using chloropicrin and steam. More than 30 different chemicals were tested for use in chemical roguing of virus-diseased plants. The more promising of these will be tested further. The nature of several potato virus diseases are being determined and studies are being made on the virus-vector relationship. Studies of the overwintering habits of the aphid vectors are being included in these investigations.

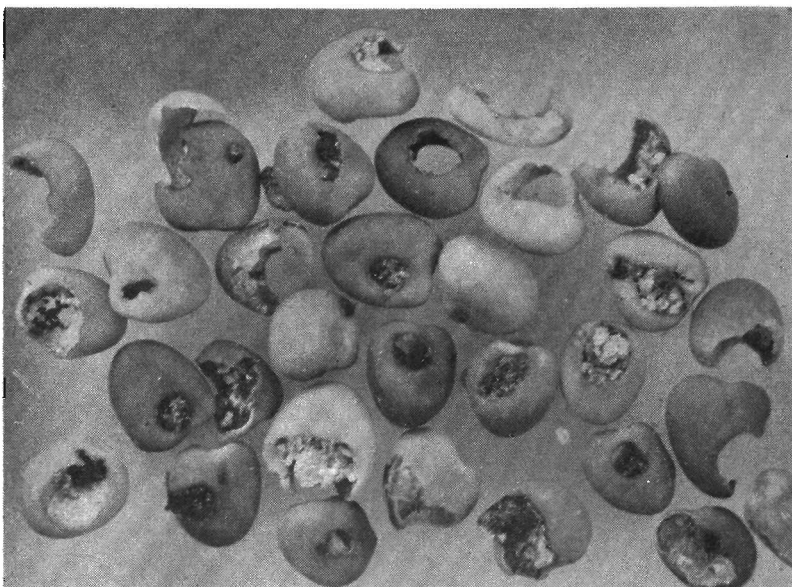
### *Controls Sought for Damaging*

## **Insect Pests**

E. A. Dickason

Some insect pests in Oregon are definite limiting factors in seed and forage production. Research was begun in 1949 on some of the more important pests. Main objectives have been to determine the effects of these insects on production and establish a control when needed, taking into consideration the toxic residue on forage and the protection of honey bees and other pollinating insects essential to seed production. This limits the materials that may be used, and emphasizes the necessity for careful timing and minimum rates of application.

Preliminary work on Ladino clover has demonstrated that lygus bugs, by sucking plant juices from the productive portions of plants, prevent seed formation and increase the percentage of shriveled



A close-up photograph of damaged seeds shows type of injury caused by the clover seed weevil when it attacks certain legume seed crops.

seed. Information is incomplete on all phases of control, especially time of application and the number of lygus bugs necessary to cause economic damage. The present practice of applying 30 pounds of 5 per cent DDT per acre when there is an average of one bug per sweep is giving a satisfactory control in most cases.

Severe damage can result to Ladino, white, or alsike clover from the clover seed weevil larvae. It was found that the clover seed weevil lays its eggs when the blooms begin to ripen, and since the insecticide has no effect on the eggs or larvae protected in the pod, application must be made before the adults have an opportunity to lay eggs. The most effective time to treat for the weevil is before 20 per cent of the heads in the field have browned.

A small, black, shiny beetle, the nitidulid, has attracted considerable attention on red clover in the Willamette Valley. Studies of life history and habits indicated both the adults and larvae were primarily pollen feeders, and it was not understood how they could cause damage. Definite evidence of damage was obtained for the first time this year. Apparently when the new adults emerge in high numbers in July in the red clover fields, there are not enough mature florets with ripe pollen to provide adequate food for these extremely

active insects. The new adults attack developing florets and buds, perhaps seeking pollen, and feed on and partially destroy the tender, immature floral parts. This causes the bloom to appear brown and blasted. The loss in seed yields is most likely a combination of injured floral parts and browned flowers that are not attractive to pollinating insects. No satisfactory chemical control has been found.

### *Fertilizers Improve*

## **Pasture Yields**

D. W. Hedrick

The effects of five different fertilizers on forage yields were tested this year as one phase of pasture research in western Oregon. Responses indicate that fertilizers paid dividends.

The work was undertaken because of a need for basic information on the effect of fertilizing hill pastures. The experiment was conducted on a well-drained site of Olympic clay soil, which is fairly typical of a large area of western Oregon. All applications of fertilizers—two levels of nitrogen and one level each of phosphorus,



Workers begin harvesting forage from experimental plots used to test value of various fertilizers for use on western Oregon pastures.

potassium, lime, and sulfur—were made in the fall except that of nitrogen. One-fourth of the nitrogen was put on in the fall and the remaining three-fourths in the spring.

Nitrogen fertilizer gave the greatest response where grass predominated in the plant cover. Smaller responses were obtained from applications of phosphorus and lime. When sulfur was combined with applications of lime and phosphorus, the yield was not increased.

An application of 571 pounds of ammonium nitrate per acre increased hay yield from 1.81 tons to 4.29 tons per acre. Increasing the amount of fertilizer material to 875 pounds only increased the yield to 4.50 tons. An application rate somewhat lower than that used in this experiment probably will be most profitable.

Treble superphosphate at the rate of 1,200 pounds per acre increased the yield from 3.36 to 3.67 tons per acre and 4 tons of limestone raised the production from 3.32 to 3.70 tons per acre. A combination of sulfur and phosphorus yielded 3.58 tons while sulfur and lime combined produced 3.57 tons.

Results of the study emphasize the need for further data on rate and time of application of nitrogen fertilizer and the response of pasture yields to phosphorus where legumes are present. Current research is being directed toward an answer to the following questions: How much and at what time should nitrogen fertilizer be applied to western Oregon hill pastures for maximum return? What proportion of the forage should be made up of legumes before a profitable response to phosphorus fertilizer can be expected? What extension in the length of the green feed or good grazing period can be expected from a fertilization program?

*Good Seed Crops Result from*

## **Pollination by Bees**

H. A. Scullen

Movement of bees from one section to another for the purpose of pollinating certain fruit and seed crops has increased immensely in recent years. About 30,000 colonies are moved for this purpose in Oregon, many coming in from adjoining states. Colonies kept in permanent locations are also serving an important function in pollinating surrounding crops.

Experimental work with bees has been aimed primarily at determining the number of bees necessary to secure maximum produc-



Pollination by bees has proved essential for production of a paying crop of Ladino clover and lotus seed. Preliminary work shows that seed set may be increased still further by a higher bee population.

tion of seed crops and to devise a practical method for the farmer to use in deciding whether he has an adequate number of bees in the field. Other problems relating to the pollination of legume seed crops by honeybees and wild bees also are under investigation. These include studies of nectar produced by a pollinated crop, management of bees for maximum pollination, and pollination by native wild bees.

Research has not advanced to the point where final conclusions can be drawn, but Experiment Station studies so far indicate that a higher bee population than the usual aim of one to two colonies per acre should give a greater seed set.

It has been definitely demonstrated that bees are essential for the production of Ladino clover and lotus seed. In the case of hairy vetch, only about a 50 per cent crop is obtained without bees. It has been demonstrated that wind will not pollinate Ladino clover to any appreciable extent.

In some limited areas bumblebees may be pollinating as much as a third of the bloom on Ladino clover. No other wild native bees

have been found to be doing a measurable amount of pollinating. Bumblebees are more common in red clover, but honeybees, working the bloom for pollen, do most of the pollinating. Bumblebees for undetermined reasons have recently become very scarce in Jefferson County and the Grants Pass area, two important seed producing areas.

Even with only one colony per acre, there is not sufficient nectar in Ladino clover to produce a surplus of nectar beyond the immediate needs of the colony so that no surplus of honey is ordinarily produced. Bees kept in a section the year around, where only Ladino clover and red clover are available, will have difficulty securing enough nectar to maintain colony strength or even survive the winter.

Although investigations have been limited to Ladino clover and red clover with some attention to hairy vetch and lotus, several other seed crops in various parts of the state need attention as well as fruit and berry crops.

### *New Chemicals Aid*

## **Weed Control**

Virgil Freed

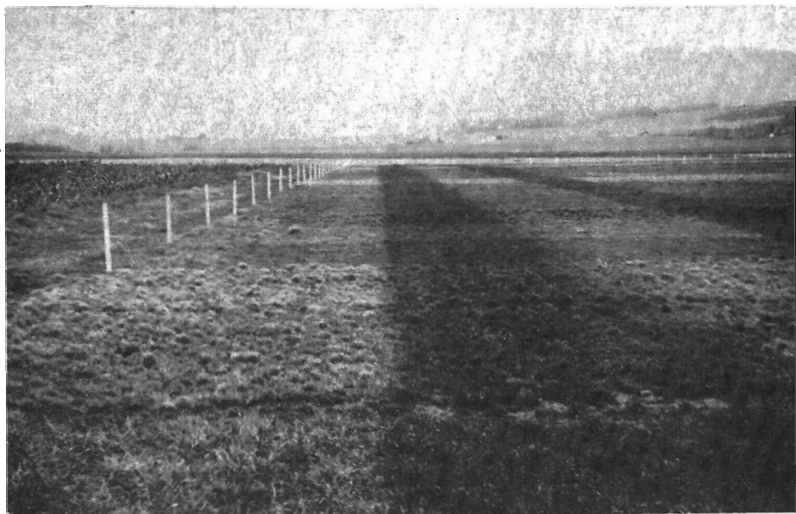
Weeds are causing an annual loss in Oregon of some 40 to 50 million dollars, more than one-tenth of the annual farm income. It is little wonder that a problem which exacts this annual loss is called the second largest problem in agriculture today.

Research has demonstrated, however, that these losses may be materially reduced. For example, the saving from the use of 2,4-D on cereal crops in Oregon enriches its agriculture by an estimated \$5 to \$8 million a year.

The effect of weeds on agriculture, while not as spectacular as other pests and problems, is none the less serious because of the competition these plants give crops for moisture and nutrients, thereby reducing crop yield. Seed producing areas of Oregon, on the other hand, are vitally concerned with the reduction of crop quality caused by weeds. The livestock industry is particularly concerned with losses resulting from poison plants.

Until a few years ago, investigations on weed control were concerned largely with cultivation and only to a limited extent with the use of chemicals. The development of new and effective chemicals has resulted in tremendous interest in this phase of weed control





Good response was obtained when alta fescue was treated in the fall with 3 pounds of IPC and 480 pounds of cyanamid per acre to control weedy annual grasses. The dark strips above are the treated areas.

work. Since 1945, when 2,4-D was introduced, there has been material gain on the weed problem through chemicals.

Interest in chemical weed control has prompted increased attention to weed control research, leading to some important new developments in the field.

As a result of these investigations, the Experiment Station developed recommendations for using IPC to control weedy annual grasses in alta fescue and other perennial grass seed crops. This program shows indications of greatly improving Oregon's position as a seed producing area.

Effective as IPC has been for many grassy weed problems, it still is not a solution for some of the summer annual grasses. Considerable attention has been devoted to the development of more effective materials to supplement present herbicides.

A new chemical, Chloro IPC, has emerged from recent investigations as one of the promising new materials. It has proven effective for many troublesome weeds.

The herbicides, 2,4-D and 2,4,5-T, though widely used and very effective as weed killers, do have their limitations, particularly for selective weed control in legumes and for the control of Canada thistle. MCP, a chemical relative of these herbicides, has undergone

extensive testing by the Experiment Station over a five-year period. As a result of favorable reports on this chemical, it is now becoming available commercially in the United States.

Climatic conditions in western Oregon provide an ideal situation for the growth of brushy plants. Attention has been devoted to the chemical control of such plants as blackberries, poison oak, and maple. It has been found that application of 2,4-D and 2,4,5-T in oil to the trunks of these plants in the winter will give control. The Experiment Station also has worked out a formula involving the use of 2,4-D and 2,4,5-T with TCA for the control of brushy plants by foliage application.

However impressive the list of accomplishments, there are still many problems remaining unsolved. Painstaking research will be required to find solutions to such problems as the infestations of cheat grass on eastern Oregon wheat lands and the weedy annual grasses in such crops as rye grass. In addition, hundreds of chemicals remain to be evaluated for control of weeds, any of which may prove to be far superior to those being used today.



# Horticulture

**I**NVESTIGATIONS in the horticultural field center around production problems of vegetable, tree fruit, nut, small fruit, nursery and ornamental crops as well as processing problems of fruit and vegetable crops.

Progress on certain projects is reported in this section, but other important studies are under way. Among these are the disease, insect, and weed control programs; introduction, breeding, and testing of new varieties of tree fruits, nuts, vegetable crops, and berries; pollination studies; and storage problems.

Processing studies with horticultural crops involve work of a fundamental nature as well as practical canning, freezing, and dehydrating tests.

A study of costs and efficiency in the production of apples and pears is under way and a similar study with walnuts and filberts was completed this year.

*Nutrition May Prove Key to***Croft Lily Scorch**

A. N. Roberts  
S. E. Wadsworth  
W. B. Mellenthin

Information on the cause and control of the physiological disease of Croft Easter lilies, "scorch," is necessary for the continued production of a high quality florist product by Oregon's bulb growers.

While the cause of this disorder has not been fully determined, nutritional studies in the past two years have provided information on ways to prevent its occurrence. Several thousand bulbs have been used in these studies both under field conditions and in greenhouse forcing.

Results indicate that this leaf scorching, which may occur on the plants growing in the field and especially on plants being forced, is associated with nutrition of the plant. The field-history of the bulb also has a direct bearing on the incidence of scorch when it is



Liberal applications of lime to soils have helped control Croft lily scorch. These plants show growth differences resulting from various fertilizer trials. Treatments (*left to right*) were: no lime, 8 tons of lime an acre, and a complete fertilizer plus 8 tons of lime an acre.

forced in the greenhouse. For this reason, it is a problem that must be corrected by both bulb grower and florist.

Studies recently completed by the Experiment Station show that scorch is more likely to occur on plants grown under acid soil conditions, where the content of soluble aluminum and manganese are relatively high. Additions of these elements to soil in which Croft lilies are grown have increased the incidence of scorch. Complete fertilizers applied to Croft lily plants during forcing increase the incidence of scorch, unless liberal amounts of lime also are applied to the soil. A combination of such a complete fertilizer with lime has produced the highest quality of Croft lily foliage without scorch or other leaf disorders. This type of fertilization also has increased materially the bud-count of the potted plant.

The results of these studies indicate that lilies grown in Oregon coastal soils of high acidity would respond favorably to rather liberal applications of lime.

### *New Machine Eases Job of*

## **Grading Lily Bulbs**

J. B. Rodgers

A new machine which will grade Croft lily bulbs nearly eight times faster than the old hand-grading method has been developed by the Experiment Station and the Agricultural Engineering Research Foundation. Tests in the field have been successful.

Although Oregon's Croft lily bulb industry is valued at nearly \$3 million annually, grading of these bulbs for many years has been a slow, laborious hand process. The circumference of each bulb was measured with a tape, with the average output for a worker reaching only about 225 bulbs per hour.

The experimental grading machine has an average output of 30 bulbs per minute or about 1,800 per hour. Maximum rate of grading is expected to reach 45 bulbs per minute, depending on the skill of the operator.

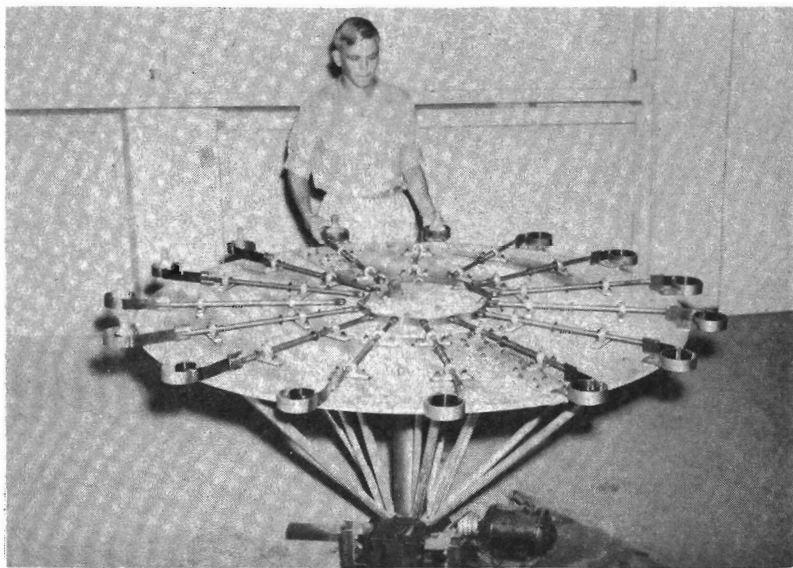
The possibility of developing a grader to segregate bulbs on the basis of weight was considered. Since screens and shakers cannot be used because the bulbs are highly susceptible to breakage, it was decided that circumference should be the basis for grading rather than weight because variation in root length and soil clinging to the bulbs would have affected accurate weight selection. Consumer

opposition to change of grading method was also a factor in favor of continuing to use circumference as the basis of selection.

Oregon grading standards state that circumference shall be taken at the greatest diameter of the bulb at right angles to a line from the top to the base of the bulb. Commercial sizes range from 5 inches through 12 inches.

The grader developed utilizes an expanding and contracting spring steel band held in the form of a loop. The expansion is positive and is accomplished with a cam. The contraction is accomplished with a coil spring.

The size of the bulb held in the loop at the instant of contraction regulates the amount of contraction and the position of the cam follower. As the outer rim of the grading table rotates around the stationary cam, the cam follower again engages the cam, forcing the loop open and dropping the bulb. The lobes on the cam increase in increments of 1 inch in a counter clockwise direction. As a result, the larger the bulb, the further around the table it is carried before being dropped. The grader is driven by a  $\frac{1}{4}$ -horsepower electric motor through a reduction gear.



Eight times faster than hand grading methods, this new lily bulb grading machine uses expanding and contracting steel bands to hold the bulbs and drop them in boxes according to size as the table turns.



*Progress Made Toward Better***Vegetable Crops**

W. A. Frazier

S. B. Apple

Breeding, production, and nutritional studies with vegetables produced substantial results this year in field trials aimed at selecting vegetable varieties well adapted to Oregon conditions and at improving yields through better fertilizer practices.

Two new bush beans, Top Crop and Contender, showed definite promise for home and market gardens. White-seed breeding lines from seedsmen and the U. S. Department of Agriculture Vegetable Breeding Laboratory were tested to keep abreast of the most recent developments in types which might be used for harvesting with the mechanical bean picker. Crosses have been made between Blue Lake pole and bush beans to secure higher quality bush types.

Several promising sweet corn varieties for home and market gardeners were observed. These included F. M. Cross, Golden Jewel, Wisconsin hybrids 800 and 804, and Oto. No variety earlier than Golden Cross Bantam was found with acceptable processing quality.

An English tomato variety named Puck was found to have unusual fruit-setting ability at low temperatures in the field in the spring. Since this character is needed in American tomatoes, crosses were made with a number of varieties. Growth regulators were used successfully to increase the set of fruit on tomatoes.

In cucumber tests, Yorkstate and MR 17 pickling varieties were observed to be promising for general horticultural characters and will be tested further.

Bean virus trials have shown that the FM 65 bean, used in recent years for a substantial part of Oregon's bean processing acreage, is susceptible to common bean mosaic. Heavy ultimate losses occurred in some fields where no diseased seedlings could be found, so that a question remains as to the source of the virus in such cases. Best insurance against loss from the disease is through use of resistant strains of Blue Lake. This virus may be transmitted through seed.

Cantaloupe varieties, Golden Gopher and Iroquois, have been promising especially in areas of Oregon with moderately long growing seasons. Granite State variety, an early cantaloupe, has shown distinct promise for western Oregon. Oro Blanco, a small fruited



Pole beans were tested this year to determine their reaction to fertilizers. Combined nitrogen and phosphorus fertilization produced the large growth increase in row at right. Left row got nitrogen alone.

honey dew type, is early, has high sugar content, and can be grown in the Willamette Valley. The most promising new watermelon variety is the New Hampshire Midget, a very early small type.

In squash tests, Uconn, a new bush type Acorn, proved especially promising for home gardeners. Caserta, a new early Zucchini type, gave an excellent performance in 1950.

About 145 onion lines were planted for testing, but none proved to be resistant to pink root in tests at Lake Labish. Asgrow B46 hybrid proved to be a good brown-type onion with above average keeping quality.

In the studies of the effect of various fertility levels on the behavior of vegetable crops, it was noted that the most important factor influencing yield of pole beans was time of application of fertilizer. Side dressing of complete fertilizer, practiced by many growers, was inferior to application at planting. A combination of nitrogen and phosphorus appeared to be the primary need. None of the minor elements were effective in influencing yield at the rates applied. Nonfertilized beans were slightly later in maturing than those receiving a complete fertilizer.

Beets responded with increased yield when nitrogen was applied in combination with phosphorus. Calcium nitrate used as 50 per

cent of the source of nitrogen in a mixed complete fertilizer gave a significant yield increase over ammonium sulfate used as 100 per cent of the source of nitrogen. Canker was controlled on beets with 40 pounds of borax per acre applied in a band with fertilizer. A fertilized plot without boron showed 85 per cent canker.

In an exploratory test with paper mulch and plastic caps on watermelons and cantaloupes, yield increases were unexpectedly high, especially from paper mulch. Plastic caps aided greatly in the early stages of plant growth, but were less effective than paper mulch for increasing final plant size and yield. Principal value of the caps would be in protection from late frost.

### *Growth Regulator*

## **Speeds Fruit Maturity**

Elmer Hansen

A. N. Roberts

E. J. Kraus

Lack of red color at time of harvest on certain varieties of apples, especially red and striped Delicious, is a serious problem in the apple producing sections of Oregon. A practical method of increasing red color without detracting from the keeping quality of the fruit would be of considerable economic value.

With this in mind, experiments were conducted this year to determine the effect of 2,4,5 trichlorophenoxyacetic acid on the maturation of apples, pears, and peaches, with emphasis on rate of ripening and development of color.

It is apparent from the results obtained that 2,4,5-T sprays accelerate the maturation of peaches, apples, and pears, depending upon type and variety of fruit and concentration and time of application. Red color was increased on some varieties of apples and peaches but was an indirect result of more rapid maturation.

Early maturing varieties of fruits were most responsive to treatment. The red varieties of summer apples, Red June and Early McIntosh, were sprayed with solutions containing 50 and 75 parts per million of 2,4,5-T three to four weeks prior to normal harvest date. They developed red color and were fully ripe within 10 days following treatment. The unsprayed fruit developed approximately the same amount of color when fully ripe. Delicious apples in the Hood River district matured more rapidly as a result of treatment, but no differences in color were apparent.

Peaches, including Red Haven, Oriole, and July Elberta, were sprayed with 40 parts per million of 2,4,5-T. They ripened several days to a week ahead of untreated fruit. No effects were noted on J. H. Hales.

Bartlett and Anjou pears at Medford were sprayed four and two weeks before normal harvest with solutions containing 10, 20, and 40 parts per million of 2,4,5-T. They showed no response in relation to color and size. Treated fruits matured more rapidly and had lower pressure tests at time of harvest. Both varieties softened more rapidly during cold storage at 30° F.

It is apparent from preliminary results that 2,4,5-T cannot be used specifically for the development of red color on fruits without affecting maturation and keeping quality in storage. Tests with other chemicals with greater specificity on anthocyanin formation are needed. Sprays containing 2,4,5-T may be useful for accelerating maturation and ripening of summer varieties of apples and peaches for early market use.

### *New Uses Found for*

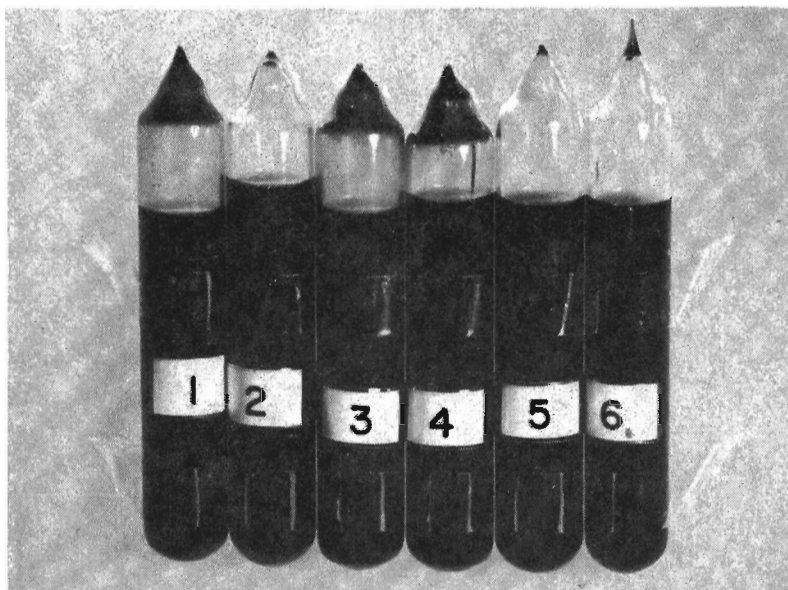
## **Tasty Small Fruits**

W. F. Filz

Preservation of fruit and vegetable pulps and juices has been an important phase of Experiment Station research aimed at developing new food products. Efforts this year were concentrated on small fruits and produced a number of promising new products.

A clear, beautifully-colored prune jelly, a tangy cranberry cocktail, and new fruit base for cranberry marble ice cream stand out among the new products. Fresh juice and juice concentrates, rich in natural color and flavor, also are ready for market testing. An entirely new carbonated beverage, using either cranberry concentrate alone or concentrate plus other natural fruit flavors, promises an addition to the soft drink industry. Another new product is the cranberry popsicle. Other new uses for whole cranberry pulp include candied cranberries, fruit base, cranberry sherbet, and a frozen cranberry dessert.

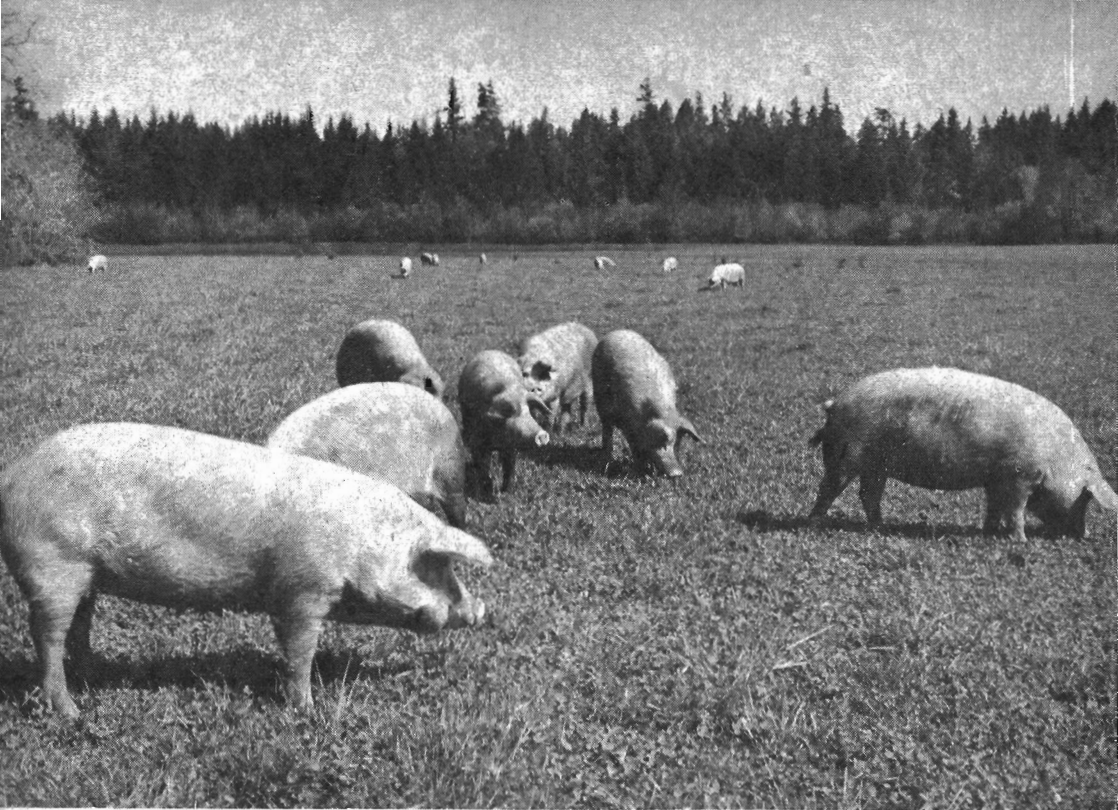
New strawberry-cranberry and raspberry-cranberry jams containing 20 per cent ground cranberries have been produced for use in the preserving industry. Tests have shown that the addition of cranberries improves the flavor of mildly acid fruits and helps maintain a better colored product during storage.



Sediment forming in storage has been a problem faced in production of cranberry cocktail. Tubes here were stored and inverted before being photographed. Old-type cranberry cocktail formed sediment in tubes 1, 3, and 4 while improved version left little trace in others.

Fresh and concentrated prune and cranberry juices were studied to determine characteristics and possible commercial adaptability. Storage tests, experiments with suitable containers, and taste improvement trials with fresh juices were conducted throughout this year.

Among problems needing a solution for economical production of cranberry cocktail were the low yields of juice obtained by ordinary extraction methods and the large amounts of sediment which formed in the product while stored. Research has cleared up these obstacles and developed a product apparently readily acceptable in several branches of the food industry.



# Livestock

**R**ESearch on livestock problems has been expanding at a fast rate. High prices of meat products and wool, expanding west coast population, and emphasis on production of soil-conserving forage crops have created keen interest in livestock production.

A progressive research program is essential to aid this development, to increase constantly the efficiency of the industry, and to protect it from loss.

Besides the projects outlined in the following section, studies are under way in marketing of livestock and wool including consumer demands for meat and meat products in diseases of sheep and swine, in control of pests (arthropods) affecting livestock, in fertility of livestock, in breeding and testing of sheep, in role of minor elements and fundamental biochemical factors in animal nutrition, and in work on quality and palatability of meat.



*Iron Salts in Sow Rations***Reduce Pig Anemia**

J. E. Oldfield

The role of certain minor mineral elements in the nutrition of swine was investigated this year at the Central Station. The problem of iron-deficiency anemia, which has been recognized as an important cause contributing to mortality in swine during the preweaning period, was a focal point of studies. At present, some 30 per cent of young pigs across the country die between birth and weaning, causing serious economic loss.

In the past, methods of treating iron-deficiency anemia have involved supplying young pigs with iron shortly after birth by dosing them individually with solutions of iron salts. The solutions were painted on the sows' udders, or the young animals were allowed access to the soil. These methods have proved effective, but have been tedious in practice, which limits their usefulness. For this reason, it was decided to determine whether mixtures of iron salts in the sows' rations during the gestation period would result in iron storage in the young pigs at birth to such an extent that the occurrence of anemia would be prevented.

The experiments involved the addition of iron salts to the rations of pregnant sows in amounts to supply 100 and 250 milligrams of iron daily throughout gestation. Hemoglobin determinations made on the blood of the young pigs born to these sows showed that they did not drop to anemia levels during the first three weeks after birth, as did those born to control animals.

Further investigations were made in an effort to determine the nature of iron storage in the young pigs. Analysis of livers from the young animals indicated that iron storage in this organ was not extensive enough to account for any significant improvement in blood hemoglobin level. It was concluded that the additional iron must have been stored elsewhere. This work is being continued in order to clarify present knowledge of the manner in which iron may be stored and used by swine.

Considerable interest has been shown in the possible addition of certain minor mineral elements to swine rations in order to speed rate of growth. Encouraging results obtained elsewhere prompted an investigation of the effects of adding trace minerals to an otherwise balanced ration for growing swine. The mineral elements used



Pig anemia, a cause of serious losses between birth and weaning, has been reduced by adding iron salts to the rations of pregnant sows.

included copper, iron, cobalt, and manganese, all of which were added in the form of sulphates to iodized salt used in the ration.

Just after weaning the pigs receiving the trace-mineralized ration gained somewhat more than those on the control ration. This suggests that these elements may be valuable to young pigs just after they have come off the sow. Once the young animals became fully accustomed to their grain ration, the advantage to the addition of trace-mineralized salt quickly disappeared.

The rations used in these trials were composed of Oregon-grown grains, mainly barley, with tankage and soybean meal as protein supplements. It seems evident that the addition of trace minerals to balanced rations composed of locally grown grains for swine is neither beneficial nor necessary for increasing rate and economy of gain. It is possible that the use of some of these minerals might be effective in certain localized areas where deficiencies exist in the crops produced. Such deficiencies should be confirmed by chemical analysis of the products in question before the use of minor or trace mineral supplements is undertaken.

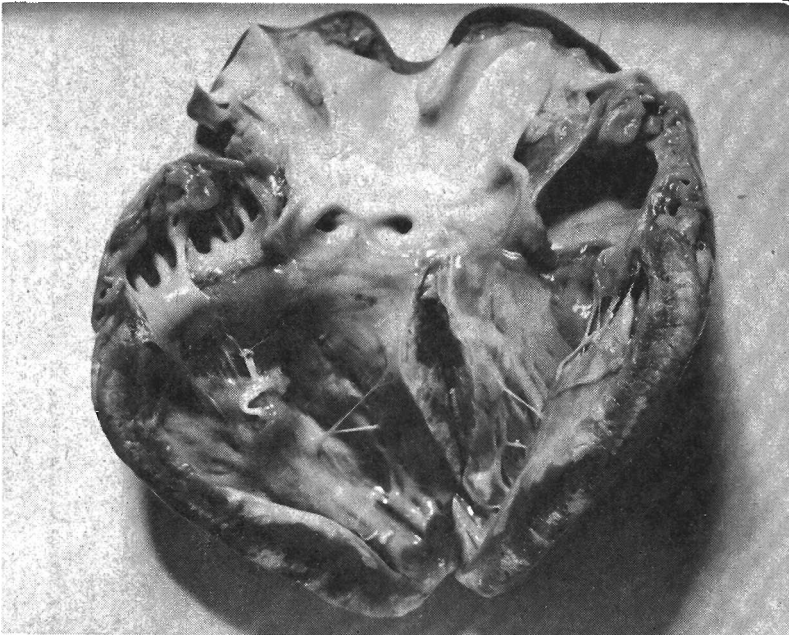
Further work has been proposed regarding the place of minor elements in rations of varying composition, both for swine and for other domestic animals.

*Controls Needed for***Beef Cattle Diseases**

J. N. Shaw

Investigations of diseases of beef cattle for the year were concerned with some of the diseases that constitute serious problems for beef producers. These studies are particularly important to the Oregon producers because of the remote location of much of the state's beef husbandry and the lack of local assistance in many instances. The absence of significant parasite populations and results of chemical analysis of feedstuffs from peat land pastures indicate that scours in beef cattle on these pastures may be due to a lack of balance among trace elements.

Delayed calving so that cows calve on pastures and avoidance of legumes in winter feeding of cows reduced the problem of white muscle disease in calves.



Among disease problems needing a solution in Oregon is white muscle disease in calves. Shown is a calf heart affected by the disease.

Heated drinking water for weaner steers during the winter months on one ranch proved to be a promising approach to prevention of urinary calculi. Increasing the water intake by this method may be a practical solution to this problem.

Field investigations indicate that anaplasmosis is becoming more prevalent and emphasize the necessity for disposing of known carriers and avoiding the addition of infected animals to herds.

Antibiotics used in advanced actinomycosis (lumpy jaw) infections were successful in slowing the processes. The breeding life of valuable animals with the infection may be extended by such treatment.

Anaerobic infections occurring in western Oregon have frequently been found to be the result of infection by an organism closely related to the blackleg organism. Blackleg-malignant oedema vaccine gave good protection against this infection.

Since disease is an outstanding limiting factor in the economy of beef production, it is essential that every effort be made to keep it at a minimum. Causes are sometimes quite complex and require study over a considerable period under different conditions before a practical solution to the problem can be reached. Progress has been made in solving a number of disease problems. Continued effort along this line will prove a practical advantage to beef producers.

### *Tests Point Way to*

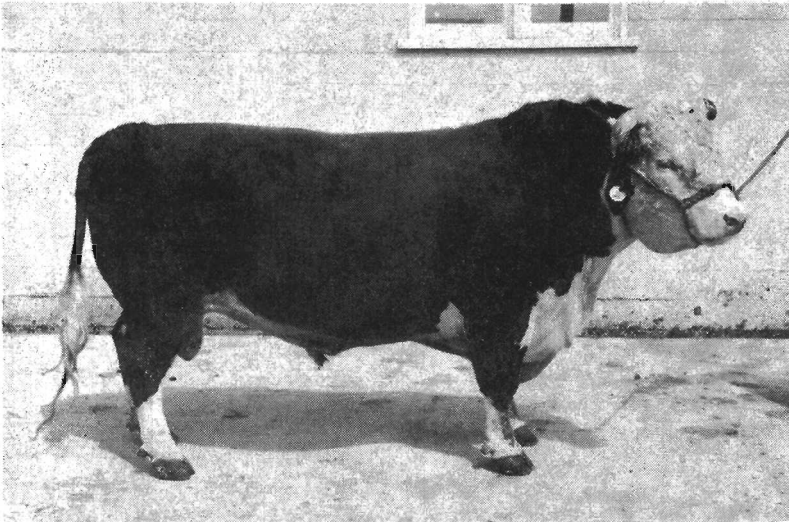
## **More Beef With Less Feed**

Ralph Bogart

Beef cattle research this year centered around a statewide improvement program based on selection of animals for rate and economy of gain. Outstanding practical results in feeding trials and widespread acceptance of the principle by Oregon cattle producers combined to make the Experiment Station a leader in beef cattle improvement research.

Main objective of the program was to find a means of early appraisal of beef calves that will provide an accurate forecast of their ability to produce in the beef herd. Feeding tests and breeding work at the Central Station and four branch stations have provided evidence that cattlemen can get more beef from their herds with less feed by selecting their animals on rate of gain.

Tests at the Central Station and Eastern Oregon Livestock Branch Experiment Station proved conclusively that bulls gain faster



Top gainer among bulls fed to determine rate and economy of gain was Oregon David Domino. He averaged 3.41 pounds a day for 88 days.

and require less feed than heifers. Trials at the Squaw Butte-Harney Cooperative Range and Livestock Station proved that cow size is an important factor affecting the weaning weight of calves.

Heritability of rate and economy of gain was shown to be relatively high, and in general, the results indicate that the fastest gaining cattle are also the most economical users of feed.

In feeding trials at the Central Station, bulls and heifers were placed on test at 500 pounds and removed at 800 pounds. The best gaining bull calf produced a gain of 3.41 pounds per day and required 1,155 pounds of hay and 489 pounds of grain to add 300 pounds of body weight. The slowest gainer among the bulls, on the other hand, added only 1.84 pounds per day and ate 2,235 pounds of hay and 780 pounds of grain in acquiring 300 pounds weight.

With heifers, rate of gain was slower and feed costs relatively higher. The fastest gaining heifer added 2.32 pounds per day while consuming 1,729 pounds of hay and 855 pounds of grain. The slowest gainer among heifers on test gained at the rate of 1.33 pounds per day while eating 2,727 pounds of hay and 1,320 pounds of grain.

At the Squaw Butte-Harney station, data collected on the relationship of cow size to the weaning weight of calves show that the size of the cow is important in this respect. For each 100 pounds

difference in weight of cows at the same age, there is a difference of 15 pounds in the weaning weight of their calves.

Evidence accumulated shows that rate of gain and economy of gain are not related closely to body conformation, but the fact that rapid gaining calves usually make the best use of their feed suggests that good results can be obtained if selection is based on rate of gain alone.

Trials with different feeds based on research at the Malheur Experimental Area showed that corn and barley are about equal in value as grains for putting weight on yearling steers. There are, however, more hazards in feeding barley than corn because of bloat.

Extensive breeding and feeding trials will be continued next year. Three sub-lines of Herefords and one line of Angus cattle are being established at the Central Station. A fourth line of Herefords is being established at the Eastern Oregon station. Sires with desirable characteristics are being used.

Factors affecting rate and economy of gain will be analyzed to discover what is responsible for the wide differences in animals. Among other problems due for consideration are a study of the relationship of feedlot performance to pasture performance, an investigation of the ability of fast and efficient gainers to produce calves, and an analysis of the effect of certain sex hormones on rate and efficiency of gain.



# Dairy

**A** QUITE diversified research program is under way in the field of dairy production and processing. In addition to progress reported on certain projects in the following section, investigations were conducted in the following fields:

- Reproduction of dairy cattle, with particular emphasis on fertility problems.

- Development of new types and better practices in cheese manufacturing.

- Fundamental studies on the physical, chemical, and biochemical properties of milk and milk products.

- Growth, lactation, and management studies with dairy cattle.

- Diseases of dairy cattle.

- Improvement of dairy sanitation procedures.

- Costs of distributing milk in the Portland market and costs of producing Grade A milk in the state as a whole.

- Improvement of dairy farm structures and equipment.



*Tests Show Differences in***Composition of Milk**

G. A. Richardson

An expanded milk composition study this year was aimed at determining variations between areas and between breeds. A total of 2,284 samples of milk were analyzed, including 1,106 Holstein, 546 Guernsey, and 632 Jersey milks. Except for some random sampling of herds in the vicinity of Corvallis, these represent one-day composites for an entire year of the individual cows in 3 Holstein, 2 Guernsey, and 3 Jersey herds in the Bend-Redmond and Tillamook districts.

Sampling was personally supervised, and at each sampling the cows were screened for udder normalcy by tests on the foremilk from individual quarters. The milks were analyzed for fat, solids-not-fat, protein, and, to a limited extent, milk sugar and riboflavin. Breeding records and milk yields were obtained.

The data show the composition of the milks in these two important dairy districts. When combined with the data from the Corvallis-Eugene areas, they provide information on the milks from an important segment of Oregon. This information is valuable to the producer in determining feed requirements, to the processor in calculating yields of products, and to the consumer and nutritionist in estimating the food values of various milks. It also can serve as a basis for calculating prices at the producer and consumer levels.

The average composition of the milks from the breeds studied was as follows:

Breed	Average yield per cow per day	Fat	Solids-not-fat	Protein
	<i>Pounds</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
Holstein .....	41.11	3.61	8.76	3.06
Guernsey .....	28.24	4.89	9.44	3.59
Jersey .....	25.74	5.89	9.74	3.91

When these data are combined with the 1949 data from Oregon, the average composition of the milks is as follows:

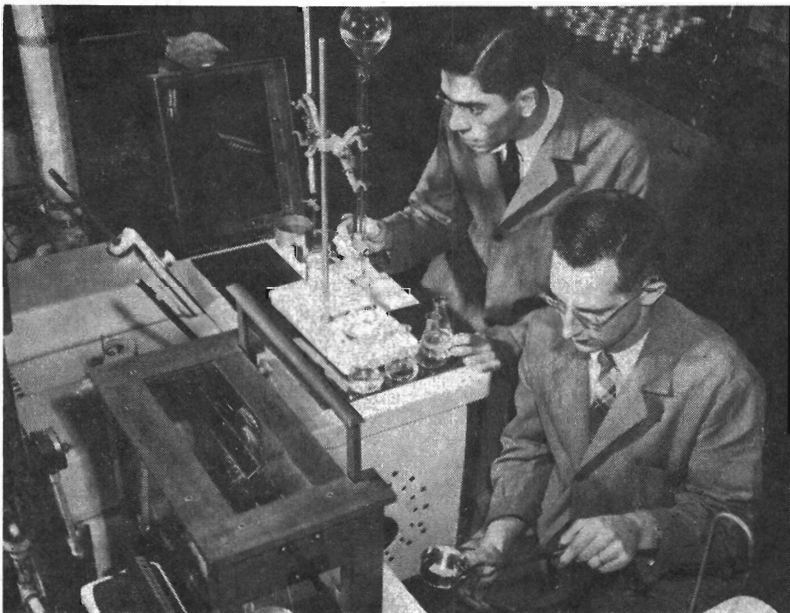
Breed	Samples	Fat	Solids-not-fat	Protein
		<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
Holstein .....	1,371	3.60	8.74	3.11
Guernsey .....	1,298	4.92	9.45	3.58
Jersey .....	1,108	5.81	9.75	3.92

Combining these results with those similarly obtained in Illinois, Arizona and California, the average composition for milks of these breeds is as follows:

Breed	Samples	Fat	Solids-not-fat	Protein
		<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
Holstein .....	2,577	3.57	8.67	3.14
Guernsey .....	1,878	4.92	9.44	3.73
Jersey .....	1,851	5.58	9.65	3.86

Some of the herds were found to be low in udder abnormality. In others, as high as 50 per cent of the cows had been or were currently affected by mastitis. Monthly reports of all tests made on the milk and the foremilk from each quarter were sent to the owners. In most cases, these reports were used in the interest of improved management.

The riboflavin or vitamin B<sub>2</sub> content of milk was found to vary from 0.8 milligrams per liter in mastitic milk to 2.82 milligrams per liter of normal milk. As much as 0.5 milligrams per liter variation



In milk composition tests, samples are collected from dairy herds and analyzed in Experiment Station laboratories to determine percentages of fat, solids-not-fat, protein, milk sugar, and riboflavin.

occurs in milks from the abnormal and normal quarters of the same cow.

Feed costs, which comprise about one-half the cost of producing milk, are dependent upon the size of the cow and the yield and feed energy content of the milk. The latter is determined by the fat, protein, and milk sugar content of the milk. Analysis of the data shows that no definite general relationship exists between the fat and solids-not-fat percentages, except for milks from the same breed. A direct relationship does exist between the fat percentage and the energy value of the milk regardless of breed. The data obtained to date suggest that this relationship can be expressed by the equation:

$$E = 56.4f + 114.2 \text{ (where } f \text{ equals fat per cent and } E \text{ equals calories per pound of milk).}$$

Similarly, a relationship between fat percentage and the nutrient or food energy value of milk has been found which may be expressed by the equation:

$$E_1 = 50.6f + 107.26 \text{ (where } f \text{ equals fat per cent and } E_1 \text{ equals units of nutritive energy per pound of milk).}$$

Use of these relationships makes it possible to price milk equitably to producers on an energy basis by either the point fat system or by the fat-hundredweight basis. Likewise, it is possible to price milk to the consumer on its nutritive energy value.

The project will be continued to include herds from four additional areas of the state. Ultimately, when the large amount of data has been analyzed, coded and appraised, it is expected that relationships between the major components of Oregon's milk supply will be established which may be used to evaluate production costs and usage and food energy values from simple, practical laboratory tests.

### *Bacteria Cause Slimy Curd*

## **Cottage Cheese Defect**

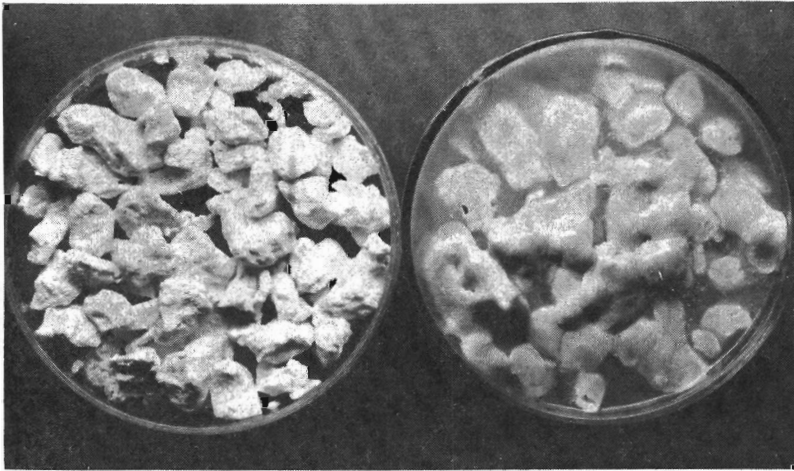
P. R. Elliker

Continued investigations on the gelatinous or slimy curd defect of cottage cheese have established that this is one of the most important problems encountered by cottage cheese manufacturers in marketing their product in this country.

The gelatinous or slimy defect usually is preceded by various off-flavors—such as fruity, bitter, rancid, rotten, or flat. Bacterial species associated with this group of defects have been identified as

*Pseudomonas viscosa*, *Pseudomonas fragi*, and *Alcaligenes metalcaligenes*.

Observations under commercial conditions and laboratory tests indicate that the defect occurs more readily in creamed than in uncreamed curd, because the creaming operation tends to raise the pH of the exterior of the curd particle. Maintaining a pH value of 5 or less in the creamed curd will reduce incidence of spoilage when causative bacteria are present but does not always prevent the defect. Raising the salt content of creamed cottage cheese cannot be em-



Damage caused by bacteria which produce the slimy curd defect in cottage cheese is apparent when normal uncreamed cottage cheese, left, is compared with that spoiled by the *Pseudomonas viscosa* species.

ployed to prevent the defect because salt levels required to prevent spoilage are higher than the consumer will tolerate.

One or more species of the spoilage bacteria have been isolated from plant water supplies, cheesemaking and packaging equipment, creaming mixtures, and defective cheese. On the basis of this study, routine chlorination of water used to wash and chill the curd has been recommended for all cottage cheese plants. Special cleaning and sanitizing methods are advisable for plants experiencing difficulty with this defect. Observations under practical conditions have demonstrated that the only sure means of consistently avoiding difficulty with this type of spoilage is to eliminate the causative bacteria from the plant and product. The resulting higher quality of product and longer marketing period are well worth the added effort.

Studies in the Experiment Station laboratories have established that the cottage cheese spoilage bacteria are destroyed under normal water conditions by exposure to 5 parts per million of chlorine for 15 seconds. In a comparison of various germicides, a representative commercial hypochlorite destroyed the three species of spoilage bacteria more rapidly than did a number of quaternary ammonium germicides. This information is of significance in considering sanitizing agents for destruction of the bacteria on cottage cheese manufacturing equipment.

Further studies are under way to establish relationship between the three cottage cheese spoilage bacteria which have been isolated and sudden losses in typical, desirable butter culture aroma in commercial cottage cheese.

### *Economical Sizes Charted for*

## **Butter - Powder Plants**

Glen T. Nelson

Dairy plant managers constantly are adjusting their operations to conform with changes in the utilization of milk. An important question to managers of small plants is whether they should consolidate their operations and enjoy the economies of large scale production. Managers of larger plants are interested in the combination of processing facilities that will maximize their net returns.

In newly developed irrigated regions, the problem is to determine the most economical size plant to build. Facts pertaining to the physical input-output relationship of various sized plants are being assembled to aid management in making these important decisions.

Initial work was with butter and powder plants, varying in daily volume from 10,000 pounds of milk to approximately 300,000 pounds. Representatives from Idaho, Oregon, and the Farm Credit Administration cooperated on the project.

Physical inputs—such as hours of labor, amount of supplies, gallons of fuel oil, kilowatt hours of electricity, and cubic feet of water—were determined for each of the 12 plants participating in the study. By expressing this information in physical units, it does not readily become out of date, because uniform costs and prices can be applied for each year's operation to make direct comparison of plants in different areas. As technology changes, adjustments in physical units can be made before uniform prices and costs are used to compare different plants.

Interplant comparisons were made to show differences in resource use as affected by volume, rates, institutional factors, and the balance of labor and capital. Differences will be shown in costs of the physical requirements to operate plants in different areas of the Pacific Northwest.

Basic information obtained from the 12 plants served as a guide in setting up buildings, equipment, labor forces, and supplies to show efficient combinations of facilities for plants varying in size from a daily volume of 37,500 pounds of milk to 324,000 pounds. Comparisons of these hypothetical plants, when completed, will show how costs change with increases in plant size.

It is anticipated that the plant studies will be expanded to include other manufactured dairy products as well as Grade A milk. The over-all plant study will show the input-output relationships for all dairy products. Comparisons can then be made of various sizes of specialized and flexible plants.

### *Dried Beet Pulp Saves*

## **Silage Juices**

I. R. Jones

J. H. Byers

Loss of plant juices during the ensiling process with corn or other materials always has been a problem unless harvesting is delayed until the plants ensiled reach an advanced stage of maturity. This loss of juice has increased in importance with the advent of grass ensilage.

Studies of the juices lost in experimental silos filled with corn showed a reduction of 4 per cent of the total dry matter ensiled. In an experimental silo containing 70 tons of ensiled corn, the loss in the protein alone was equal to the protein in two tons of corn grain.

Successful curing of grass silage has depended to a considerable extent upon the addition of carbohydrates to insure proper fermentation. Molasses has been most generally recommended, but usually a large loss of valuable nutrients in the form of excess juices resulted. Experiments using molasses beet pulp instead of molasses not only saved a considerable amount of nutrients through absorption of these juices but improved the quality of the ensilage.

Two experimental silos, each holding approximately 70 tons, were filled with grass silage. Molasses was added to one at the rate of 60 pounds per ton. Dried molasses beet pulp was added to the

other at the rate of 60 pounds per ton. The silage resulting from the dried molasses beet pulp mixture showed more natural grass color and had a better aroma than the silage made with the addition of molasses.

Chemical analysis showed dried molasses beet pulp silage to be higher in dry matter, crude protein, and carotene. There appeared to be no difference in palatability. Cows ate as much as 75 pounds of either per day.

Each pound of beet pulp absorbed about 2 pounds of plant juices containing 8 to 10 per cent dry matter. In terms of dry matter, beet pulp added to the 70 tons of ensilage absorbed about 870 pounds. If this dry matter were valued the same as the dry matter in barley (at \$75 per ton), the saving would be about \$36.

Since the juices tend to settle to the bottom of the silo, it was found advisable to add a greater amount per ton of grass at the bottom of the silo than at the top of the silo. Mixing was most satisfactory by spreading the beet pulp over the top of the loads as they came to the silo for unloading.

This work will be continued to determine the most satisfactory amount of dried molasses beet pulp to add with different kinds of forage and with varying moisture contents.





# Soil and Water

**M**AJOR effort in the soil and water field is aimed at providing the know-how to aid in better maintenance of the soils of the state.

Optimum use of fertilizers—including type, rate, and time of application—is another closely related program receiving considerable attention. Two of the progress reports that follow deal with research in these fields.

With the expansion of supplemental irrigation, added emphasis has been given to the problem of obtaining highest efficiency in the use of water. Tests on this problem are under way at the Central Station and in Malheur, Jefferson, Crook, Deschutes, and Umatilla counties.

Other research includes: soil surveys; minor element studies; testing effects of herbicides, insecticides, and fungicides on soil microorganisms and crop production; and an economic study of soil erosion control practices.

*Experiments Prove Value of***Wood Waste Mulch**

W. B. Bollen

Attempts to utilize the vast quantities of wood wastes available in Oregon for agricultural purposes have been encouraging and have met with increasing popular appeal.

Investigations of the use of sawdust and other wood wastes as mulches and soil amendments have led to a better understanding of the problems involved and the benefits to be derived.

Waste products of the lumber industry, where locally available at low cost, can effectively replace the relatively expensive peat moss for many purposes. These products have little or no fertilizing value, but when properly used and supplemented with available nitrogen they have proved beneficial to intensive farming in many ways.

As mulches, sawdust and other wood wastes are clean to handle, easy to apply, long lasting and efficient in conserving moisture. Plants grow well under such mulches, provided nitrogenous fertilizer is added to balance the excess of carbonaceous matter and meet the requirements of microorganisms that slowly decompose the woody material. As a soil conditioner, sawdust is particularly useful when incorporated with heavy soils. Up to 200 tons per acre have been employed for this purpose, resulting in marked improvement in physical condition of the soil. After decomposition has proceeded several years, the resulting increase in humus-like organic matter gives the soil an improved porous sponge structure, greater usable moisture capacity, and better aeration.

One hundred forty cubic yards of sawdust are needed to cover one acre one inch deep. This is equivalent to approximately 20 tons of dry sawdust or 50 tons of fresh sawdust. Wood contains practically no nitrogen but is high in cellulose and lignin, which are attacked by certain soil microorganisms and eventually transformed to humus. These microorganisms, like higher plants, require nitrogenous food. Not finding it in the sawdust they must absorb it from the soil and thus compete with plant roots. Sooner or later the microorganisms die and release their nitrogen. As long as the decomposition is active, growing plants will suffer a deficiency. Although temporary nitrogen starvation is more pronounced when the sawdust is mixed with the soil, mulches also should be treated with supplemental nitrogen.

While recommendations vary for different crops and soil conditions, as a general rule when sawdust is applied during or immediately before the growing season, about 25 pounds of ammonium sulfate or its equivalent in nitrogen should be added to each ton of sawdust the first year. This treatment may be divided: one half the amount of fertilizer being added with the sawdust and the other half being broadcast later and irrigated in. Treatment should be repeated the second year, after which the decomposition becomes stabilized and requires no more additional nitrogen. Where great amounts of sawdust are incorporated, instead of using a correspondingly heavy dosage of nitrogen fertilizer, one may use a series of small applications sufficient to avoid starvation symptoms during the growing season. Heavy incorporations of sawdust also promote rapid aeration and drying so that moisture must be maintained by additional irrigation. When used as a mulch, however, moisture is conserved.

Sawdust has been found especially well adapted for use on blueberries, strawberries, ornamental trees and shrubs, and vegetables such as cabbage and tomatoes as well as in nurseries. As a mulch on strawberries, it has consistently increased yields and quality and is effective in preventing soil from splashing on the fruit and reducing market quality.



Sawdust, used as a mulch on strawberries, has consistently resulted in higher yield and increased quality in Experiment Station tests.

Although most attention has been given to Douglas-fir sawdust, the value of other wood wastes for mulching has been demonstrated. Cedar tow, Douglas-fir bark, pine shavings and alder sawdust serve as excellent mulches for blueberries, giving results equal or superior to peat moss. On potato and tomato plants, these materials were comparable in effect to Douglas-fir sawdust.

Under laboratory conditions it has been found that alder and yellow pine sawdust decompose in soil twice as rapidly as Douglas-fir. Cedar sawdust is slightly more resistant than fir. It is evident that alder and pine are preferable where a more rapid build-up of humus is desired. Supplemental nitrogen demand also must be applied more rapidly.

Studies are under way in the laboratory to determine the fundamental effects of wood waste on soils and crops. Long-time effects are being observed on older field plots. Correlation of these data should provide a sound basis for specific recommendations whenever questions arise concerning particular wood wastes, crops, and soils.

### *Malheur Tests Yield Data on*

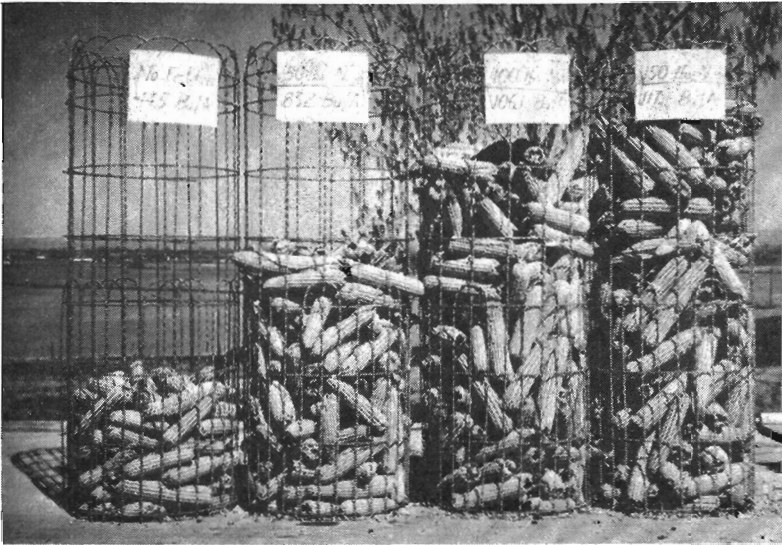
## **Soil Fertility**

Albert S. Hunter

Increased crop yields and greater economy of crop production are expected to result from an extensive soil fertility research program begun in 1950 in Malheur County. Work included field plot studies of the fertilizer responses of sugar beets, corn, potatoes, and grain on a large number of cooperating farms widely distributed over the irrigated soils of the country. Soil samples were taken from all experimental sites and tested in the laboratory for available nutrients and other characteristics related to soil fertility.

Studies were designed to produce information upon which sound recommendations for fertilizer use on Malheur County soils and crops can be based. A second aim was to promote a basis for the correlation of laboratory soil tests with field responses to fertilizers.

Tests have shown that nitrogen is the main limiting fertility factor in crop production on the irrigated soils of Malheur County and is needed far more generally than phosphate. Many of the soils have enough phosphate for present needs except where high rates of nitrogen are applied. Practically all of them are well supplied with available potash and do not need more.



Marked yield increases were obtained in Malheur County tests by fertilizing corn with nitrogen. Wire baskets, from left, show results when no fertilizer, 50 pounds N, 100 pounds N, and 150 pounds N were added per acre. Yields varied from 44.5 bushels to 117.1 bushels.

Ten sugar beet experiments in 1950 gave average yields of 19.4 tons per acre without nitrogen fertilizer, 21.2 tons with 50 pounds of nitrogen, 22.2 tons with 100 pounds, and 23.0 tons with 150 pounds. Six of these ten farms gave outstanding responses to nitrogen. Without nitrogen, an average yield of 16.7 tons of beets per acre was obtained. The yield was increased 2.3, 4, and 5.2 tons per acre, respectively, by 50, 100, and 150 pounds of nitrogen on these six farms.

In two corn experiments, an average yield of 45 bushels per acre was produced without nitrogen. With 50 pounds of nitrogen the yield was 75 bushels, and with 100 pounds it was 88 bushels. Further significant increase did not occur with 150 pounds of nitrogen. The protein content of the corn was increased from 6.15 per cent without nitrogen to 6.95 per cent, 8.02 per cent, and 9.12 per cent, respectively, for 50, 100, and 150 pounds of nitrogen per acre. In three experiments where potatoes were grown after alfalfa, the average yield without nitrogen was 139 100-pound bags of No. 1 potatoes per acre. The application of 50 pounds of nitrogen per acre gave an additional 43 bags, 100 pounds increased the yield by

62 bags, and 150 pounds boosted yield by 68 bags. Corresponding increases in total yield of potatoes of all grades were 58, 85, and 88 bags.

Phosphate responses were relatively small in comparison with nitrogen responses and usually were not obtained except where phosphate was applied in combination with high rates of nitrogen. A significant yield increase from phosphate applied alone was obtained on only one farm, where no commercial fertilizer had ever been applied. Radioactive phosphate was used in this experiment. By means of radioactivity measurements and chemical analyses, the amounts of phosphate taken up by the plants from the native soil phosphate and the fertilizer were calculated.

On this one farm, yield of sugar beets was increased from 13.3 tons without phosphate to 19.6 tons per acre where 80 pounds of  $P_2O_5$  were applied. The tops and roots of 19.6 tons of beets contained 29 pounds of  $P_2O_5$ . Nineteen pounds were derived from native phosphate originally present in the soil, and only 10 pounds were absorbed from the 80 pounds applied as fertilizer. The remainder of the 80 pounds was residual in the soil. It seems probable that the small response to phosphate on other farms is due in large part to residual effects of phosphate fertilizers applied in previous years.

Future plans call for the inclusion of other crops in the research program. Further studies will be made of the effects of variations in soil moisture level and plant density upon crop yield and efficiency of fertilizer use. Investigations will be made of the effects of differences in time and method of application of fertilizers. Studies in progress will provide information on the availability of residual phosphate fertilizer to crops grown following the year of application.

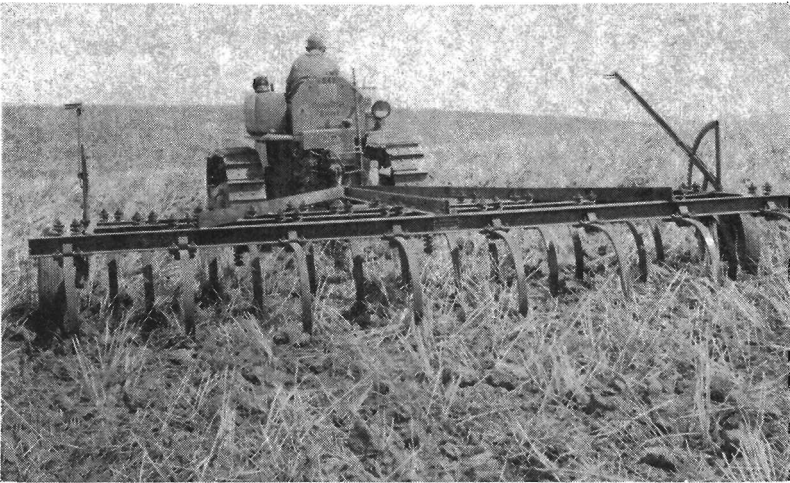
### *Umatilla Tests Seek Ways to*

## **Stop Soil Erosion**

M. M. Oveson

Soil erosion in the Pacific Northwest intermountain wheat producing area is generally ranked as the number one problem facing wheat farmers in that region.

The seriousness of the situation has resulted in the establishment of the Columbia Basin soil erosion project in Umatilla County with headquarters at the Pendleton Branch Experiment Station. Work has been jointly supervised by the Experiment Station and the Soil Conservation Service.



Here is one type of initial tillage being tested for use in the Columbia Basin. The method leaves all wheat straw on the surface and provides added protection to the land against wind and water erosion.

Main objective in establishing the project was to develop a practical conservation farming program for the Columbia River Basin which would provide necessary protection from erosion, be economical to follow, and produce high yields. Another goal was to determine relative effectiveness of farming practices and combinations of practices in controlling erosion. The tests also sought methods of preserving light stubble in low producing areas to offer protection against wind and water erosion and methods of handling heavy stubble so that adequate tillage operations could be performed while protecting against erosion. Still other trials were aimed at testing farm implements for use in applying conservation methods to farming.

The project was located in Umatilla County because it has wide variations in soil, climate, elevation, topography, and general farming conditions.

Pilot farms near the Pendleton Branch Experiment Station were leased from farmers, including one in the 12- to 14-inch rainfall belt, represented by the Walla Walla-Ritzville soil series, and another in the 20-inch rainfall belt where annual cropping is the common farming practice on Athena-Palouse soil series. The Pendleton station represented the area between these two extremes, being located in a 15-inch rainfall belt on the Walla Walla soil series. Tillage prac-



tices were established on these pilot farms so stubble could be utilized and tests could be made on the adaptability of various implements. Fertilizer trials were established, testing the value of fertilizer in wheat and pea production. Experiments on the seeding of wheat at different dates in the fall with various rates of seeding were set up, along with a comparison of varying types of drills.

All types of tillage tools now on the market were obtained by lease through the cooperation of machinery companies in the Pacific Northwest. This tillage equipment included machines such as the moldboard plow which completely buries the stubble, the off-set disk which mixes it with the surface soil, and the sweep which leaves it entirely on top of the land.

Valuations were determined through the measurement of yield and quality of grain and peas produced, through studying changes in the physical condition of the soil, and through measured results on the organic matter and fertility of the soil and its ability to absorb moisture.

Limited results have been obtained in the two years since the project began. Findings have indicated that nitrogen fertilizers up to 40 pounds per acre will give economical increases in wheat yields at all three rainfall levels when grown on summer fallow or following peas. Additional fertilizer levels gave increased yields when wheat was grown after wheat. The addition of fertilizers to peas grown in the higher rainfall area did not give significantly higher yields when used as a top dressing before seeding or when applied and plowed under at the time of plowing. Three types of drills used in seeding both spring and winter wheat showed no significant difference in yield from either type.

In a rate of seeding experiment, 45 pounds of wheat per acre seeded October 1 or October 15 gave yields just as high as when the seeding rate was 75 pounds per acre. In the high rainfall area 60 pounds of wheat seeded October 20 produced yields as high as those from 90 pounds of seeded wheat.

Stubble mulch summer-fallow produced high wheat yields in the lower rainfall area but depressed yields in the higher rainfall areas.

Sweet clover stands were successfully established with spring barley, spring wheat and peas as companion crops.

Successful seedings of sod-waterways were made on two of the pilot farms. Crested wheatgrass was used in the lower rainfall area and intermediate wheatgrass in the higher rainfall area. Both grasses were seeded in the spring.

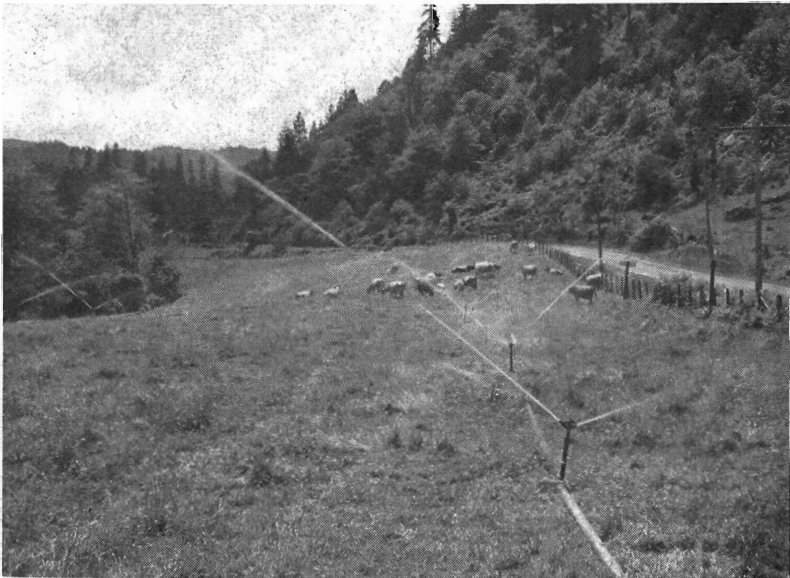
## *Capacity Affects Efficiency in* **Sprinkler Irrigation**

M. H. Becker

Economic research in sprinkler irrigation was directed this year towards costs and evaluation of irrigation systems being used by farmers in the Willamette Valley in 1950. The study provided economic information helpful to both irrigators and others working in the general field of irrigation.

Main objective of the study was to determine costs of applying water by sprinkler irrigation and to point out ways of reducing these costs. Information gathered in the field has provided evidence that many systems could be operated more efficiently by alteration in design.

The average cost of applying water by sprinkler irrigation on 111 farms in the Willamette Valley in 1950 was \$1.99 per acre inch. The average acreage irrigated per farm was 33.4 acres. A total of 18.1 acre inches of water was applied in 6.5 applications during the season.



Cost studies on the efficiency of sprinkler irrigation systems in Oregon show that lowest costs occur when systems operate at capacity.

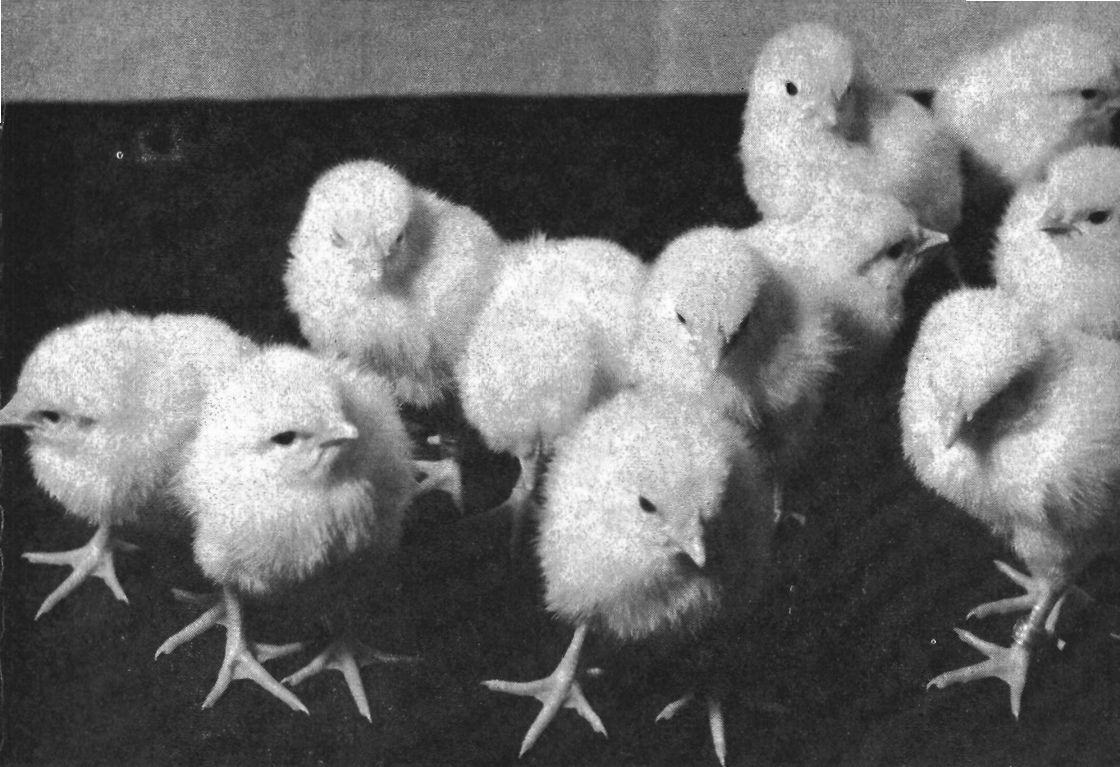
Costs ranged from a low of \$0.38 to a high of \$7.74 per acre inch. Approximately 42 per cent of the cost was an overhead charge for interest and depreciation. Labor costs amounted to 30 per cent of the total while power costs were 24 per cent. The remaining 4 per cent of the total charge included miscellaneous charges for repairs, water charge, and use of farm machinery in moving the system. The original investment in irrigation equipment ranged from \$30 to \$504 per acre, with an average of \$116 per acre.

Low application costs were found where systems were operating at or near capacity during the critical irrigation period. For the group of farms using their systems at 23 per cent of capacity during the critical month of operation, the average cost per acre inch was \$3.11. Those using their systems at 50 per cent capacity spent \$1.84 per acre inch, while irrigators using their systems at 91 per cent capacity had costs of only \$1.03 per acre inch.

Of the 111 systems studied, 49 had excess capacity, 45 had the recommended capacity, and 17 were too small to give adequate coverage to the acreage that was irrigated. Of the 45 systems that had adequate capacity to cover the acreage, only 14 were properly designed in respect to the proper combination and size of motor, pump, pipe and sprinklers desirable to give even distribution of water at the lowest total cost.

Additional information was gathered concerning length and frequency of applications, quantity of water per irrigation, and total water applied during the season for various crops.

Factors affecting the costs and practices of applying water will be further analyzed to provide a better basis for irrigators to re-evaluate their systems and increase efficiency.



# Poultry

**P**OULTRY research is in process this year on most of the major problems affecting chicken and turkey production in Oregon. The following section includes complete progress reports on the production and marketing programs now under way with turkeys, a report on methods of drying wet poultry litter, and a summary of the poultry disease-control program.

In the turkey field, other studies were conducted this year on cost of producing turkey market birds and turkey hatching eggs.

Chicken studies, in addition to those covered by progress reports in this section, include investigations of nutrition, breeding, and economic problems of the chicken industry.

Specifically, experiments are under way on nutrition as related to egg production, reproduction, and body weight; factors related to fertility and hatchability of eggs; breeding improvement; and the economics of poultry farming in western Oregon.

*Proper Ventilation Dries***Wet Poultry Litter**

M. G. Cropsey

Proper ventilation apparently is the solution to the problem of wet poultry litter which has plagued many poultrymen for years. Experiment Station tests of two different systems indicate good prospects for obtaining dry litter at an economical cost.

A condensing wall with proper ventilation and a controlled ventilation system combined with insulation were investigated. Both proved economical in operating costs and were relatively simple to install. In experiments lasting from November 1950 to March 1951 the use of both produced dry litter in a 20 by 20 pen of a continuous poultry house. The pen contained 125 birds at the beginning of the season.

The principle involved was the control of the relative humidity by means of a galvanized iron condensing wall. The amount of intake air also was controlled, and the air was circulated within the house. The condensing wall collected moisture on the inside when-



Two different systems employing good ventilation were successful this year in tests for practical methods of drying wet poultry litter.

ever the inside air approached a high level of moisture. Provision was made to collect excess water in a trough in front of the iron wall, but this did not prove necessary. A small fan calibrated by an air meter controlled the amount of intake air. The quantity of incoming air was calculated to secure the lowest possible relative humidity inside the building when the outside atmosphere was 100 per cent relative humidity at 40° F. A centrally located fan drew the warm air off the ceiling and directed it down on the floor. Electrical consumption was 63 kilowatt hours per month.

A second method consisted of controlling the relative humidity within the poultry house by regulating the intake of air and insulating the house. A small fan introduced a controlled amount of ventilation. Dry litter was obtained from November 1950 to March 1951, for 14.7 kilowatt hours per month for operating the fan. No stirring of litter or liming was required. The small amount of electricity used resulted in a very low operating cost. Insulation costs, on the other hand, would be high for 4 inches in the ceiling and under the floor. This method could be used to assist in securing dry litter while using less insulation. For example, with deep litter and lime, dry litter should result without stirring the litter or adding lime.

Both of these methods are simple and practical to use, but more experimenting is required to put the systems into practical use for poultrymen.

### *West Must Alter Plans for*

## **Marketing Turkeys**

Charles Fischer

The West is faced with a gradually shrinking market on the East Coast for its turkeys. This was the conclusion reached in a study of turkey production and consumption in the United States for the period 1929 to 1949.

Twenty years ago, the North Atlantic, East North Central, and South Atlantic regions produced slightly more than one-fourth of their requirements for turkey meat. In 1949, these regions were producing up to half of their requirements. With the western growers exporting over half of the annual turkey production, the western region is in a position where it has been forced to make a critical appraisal of its position in the production of market turkeys.

Several factors were found to have contributed to this change in the market position for the western turkey grower. Turkey pro-



Studies show western turkey growers may be forced to alter present market procedure. Shrinking eastern market for western turkeys presents problem that may be solved by developing new marketing ideas.

duction in areas close to the large consuming centers of the eastern states has increased rapidly during the past 20 years. The increase in per capita production in these areas has been more rapid than the increase in per capita consumption.

The western turkey industry has several alternatives ahead in adjusting to this new production-consumption relationship. The industry could curtail production. This might come about through the elimination of less efficient producers. Another alternative is to expand the market for western turkeys. There appear to be several possibilities. Efficiencies in production and marketing may enable western growers to market turkeys at reasonable prices and still make a satisfactory profit margin. As turkeys become "good buys" for the consumer, it is possible that the average per capita consumption of the West may be increased. Another possibility lies in the shift from the production of large turkeys to the production and marketing of a smaller variety of turkeys. This would include the "family size turkey" and the turkey broiler which has been introduced only recently. Another way of improving the market is to institute better methods of marketing the large turkeys now produced in the western region. Many steps have been taken in this direction



through the merchandising of turkey halves and quarters and turkey pieces.

Commercialization in the turkey industry has proceeded at a rapid pace during the 20-year period. There has been a reduction in the number of farms reporting turkeys grown and an increase in the number of turkeys raised per farm. It is important to note that the rate of commercialization appears to be more rapid in the regions adjacent to the eastern consumption centers. This is added evidence that western growers face increased competition in selling turkeys in eastern markets.

### *Service Program Conducted on*

## **Poultry Diseases**

E. M. Dickinson

In addition to research, there is in the poultry field a service program which has proved valuable to individual producers and to the industry as a whole.

The service program is closely associated with current research in providing an up-to-date picture of poultry disease problems throughout the state and keeping the Experiment Station abreast of the ever changing disease picture. Statistics are collected on common disease problems, new diseases are detected, clinical data are gathered, and disease surveys are made as an aid in planning and adjusting poultry research projects.

This year 3,134 specimens were examined from 1,204 different cases. These included 2,097 chickens, 856 turkeys, and 181 other birds and miscellaneous specimens. Since bacteriological studies were often necessary for accurate diagnosis, 1,247 specimens were cultured.

Four chicken diseases most often diagnosed were: coccidiosis, 283 cases; leukosis, 260; encephalitis, 247; and pullorum, 101. Seventeen per cent were given an undetermined diagnosis, emphasizing the importance and need for additional research work on both known diseases of importance and diseases of undetermined cause.

With turkeys the four diseases most often diagnosed were: salmonellosis (paratyphoid infection), 148 cases; omphalitis, 122; blackhead, 69; and erysipelas, 60. Eighty-two cases were undetermined.

Another important service is agglutination testing for pullorum disease. A comprehensive program of pullorum disease eradication,

first developed for Oregon by the Experiment Station, is now being conducted in cooperation with the national poultry improvement program. Last year more than 480,000 chicken and turkey blood samples were tested.

Another important part of the service program has been the survey and epidemiological studies on Newcastle disease. More than 500 different poultry flocks were subjected to the hemagglutination-inhibition test last year in a survey to detect the incidence and distribution of this disease over the state.

Research and the service program work together on other diseases such as salmonellosis, erysipelas, and undetermined diseases. It is axiomatic that an accurate diagnosis is essential to successful disease control.

### *Research Yields Answers to*

## **Turkey Problems**

J. A. Harper

Breeding, management and nutritional experiments with turkeys this year were aimed at finding answers to problems encountered by Oregon flock owners in economical production and reproduction of turkeys.

Fertility during the early season was increased in Oregon Broad Breasted Bronze breeding flocks where a one tom to five hen ratio was used. Other trials indicated possibilities for improving egg production without trapnesting by selecting hens that start to lay earliest following artificial lighting. A plan for a low-cost pole shelter for breeding flocks was devised to help save feed and labor. Brooding and nutritional experiments provided information adapted to immediate use by the turkey industry.

One objective of the program was to determine causes of low fertility in breeding flocks of Broad Breasted Bronze turkeys. Tests showed that increased relative number of toms to hens, staggered time for lighting hens, and artificial insemination are management methods of immediate commercial advantage in improving fertility. Results also indicate that the problem is also hereditary, and improvement may be made by progeny testing since family differences have been found to exist in both fertility and duration of fertility of Broad Breasted Bronze turkey hens.

The two-year average fertility of turkeys mated with a 1 tom to 10 hen ratio was 75.9 per cent. When staggered lighting was



Among experiments with turkeys this year was test using infrared lights for heat. Photo taken in test pen indicates the young turkeys prefer the infrared pyrex light, left, to the soft infrared light.

practiced so that groups of hens were lighted at five-day intervals and mated with the same ratio, fertility was 81 per cent. When the ratio was reduced to 1 to 5, fertility went up to 84.2 per cent. Artificial insemination alone produced 87.7 per cent fertility over a three-year period. Used at the beginning of the season to supplement natural mating, artificial insemination raised fertility from 66.6 per cent to an average of 90 per cent for four weeks.

Floor space requirements of poults during the brooding period were studied this year with electric and hot water radiant heating, electric hovers, and wire floor pens with forced hot air. Observations were made allowing  $\frac{1}{2}$ ,  $\frac{3}{4}$ , and 1 square foot per poult from 1 day to 8 weeks of age. Differences to 4 weeks of age with respect to body weight or mortality in all treatments were small. At 8 weeks of age poults brooded on wire floors with  $\frac{1}{2}$ ,  $\frac{3}{4}$ , and 1 square foot of floor space weighed 3.8, 3.9, and 4.2 pounds, respectively. With electric hovers the 8-week weights were 3.2, 3.4, and 3.6 pounds, while for hot water radiant heating they were 3.1, 3.3, and 3.7 pounds respectively. Poult feathering was good with all methods of brooding where 1 square foot of floor space was provided.

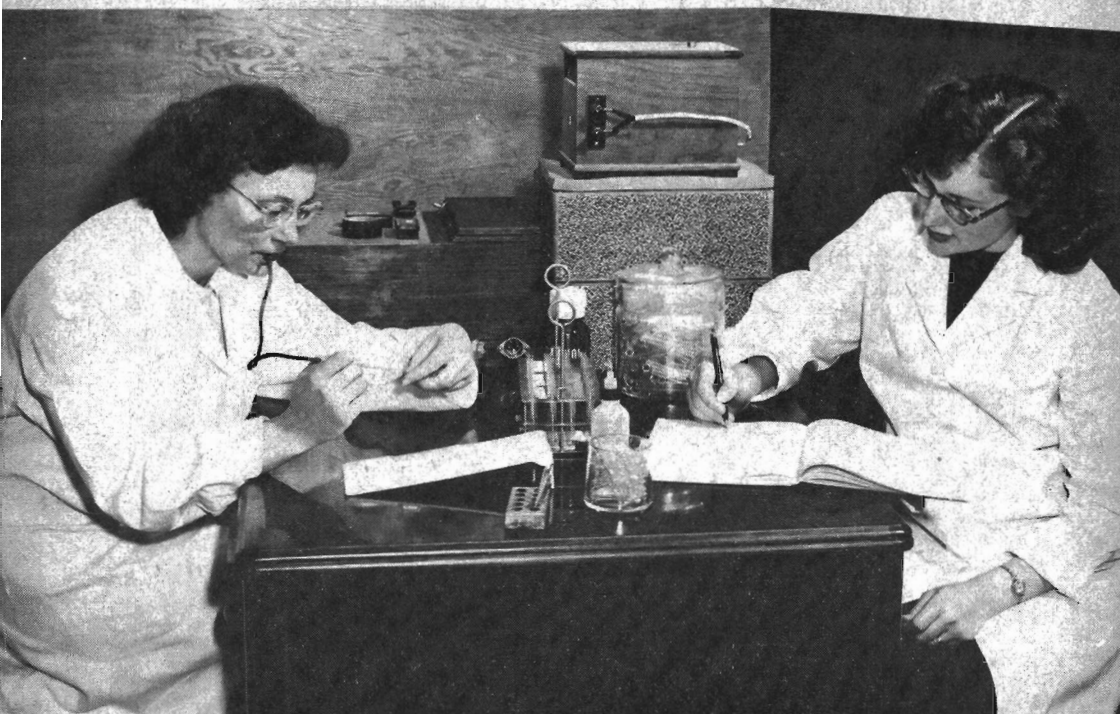
In a nutritional experiment the value of a high efficiency-high protein ration from day old to maturity was compared with 20 per cent protein developing rations fed beyond 8 weeks. All lots were allowed free choice of grain at 8 weeks. A supplement containing aureomycin and Vitamin B<sub>12</sub> was included in two of the rations.

The male turkeys fed the high efficiency ration throughout the growing period averaged 1.3 pounds heavier at maturity than those changed to a lower protein mash at 8 weeks. There was no advantage in feeding the high efficiency ration to the hens.

Lowest growth rate occurred on an all-vegetable protein ration. When this ration was supplemented with an aureomycin-Vitamin B<sub>12</sub> supplement the toms were 2.1 and hens 1.4 pounds heavier. Turkeys fed 3 per cent fish meal plus the aureomycin B<sub>12</sub> supplement in the diet were as heavy as those receiving 5 per cent fish meal plus 5 per cent meat meal.

Mortality during the first 8 weeks averaged 15.1 per cent for lots not receiving the aureomycin-Vitamin B<sub>12</sub> supplement. It was less than 1 per cent for lots fed the supplemented rations. The majority of the mortality occurred the first two weeks and was attributed to omphalitis. Since the only difference common to all rations was the aureomycin-Vitamin B<sub>12</sub> supplement, there appeared to be a disease preventing substance present. Additional work is under way to determine whether Vitamin B<sub>12</sub> or aureomycin reduced the mortality.

At the Umatilla Branch Station, data showed that individual hens differ in time of lay following artificial lighting, just as do turkey breeding flocks coming into lay under natural light. Identification of such hens was accomplished by examination of the oviduct when a flock average of 10 per cent lay was reached. A difference of 9.4 eggs for the season in favor of the earliest hens to lay was observed. Breeding improvement for egg production through early sexual maturity might be obtained by saving potential breeding stock from the fast responding hens. This possibility is being tested.



# Home Economics

**T**HE research program in the field of home economics includes studies of human nutrition, foods, housing, textiles, and clothing design.

Besides the vitamin requirement project reported in the following section, a study of factors related to tooth decay is under way in the human nutrition field.

Foods research has centered around evaluation of food quality and the influence of various production and processing factors on behavior of fats and oils in food products.

Housing investigations have been chiefly concerned with studies of housing requirements in rural areas.

Efforts in the textile field have been concentrated on development of designs and methods for weaving flax yarns into drapery and upholstery fabrics.

Clothing work was concerned with designing improved patterns for work dresses for rural women.

*Progress Made on Study of***Vitamin Needs**

Clara A. Storvick

Major attention in the field of human nutrition was focused this year on the human requirements for Vitamin B<sub>1</sub> (thiamine) and Vitamin B<sub>2</sub> (riboflavin). Tests were made since the requirements of vitamins are needed before recommendations regarding the level of intake of these nutrients can be made. In addition, blood thiamine and serum riboflavin values of normal subjects maintained on known thiamine and riboflavin intakes must be obtained before the significance of such tests for assessing nutritional status can be evaluated.

In order to carry out studies on human requirements of these nutrients it was essential to maintain normal subjects on controlled and weighed diets for periods of at least 30 days. The basal diet was constant throughout and adequate in all nutrients except for thiamine. A supplement of pure thiamine was given daily to bring the intake of that nutrient up to the desired level.

Four women served as subjects during a 30-day experimental period. Analyses were made daily to determine total and free serum riboflavin, urinary riboflavin, blood thiamine, and urinary thiamine.

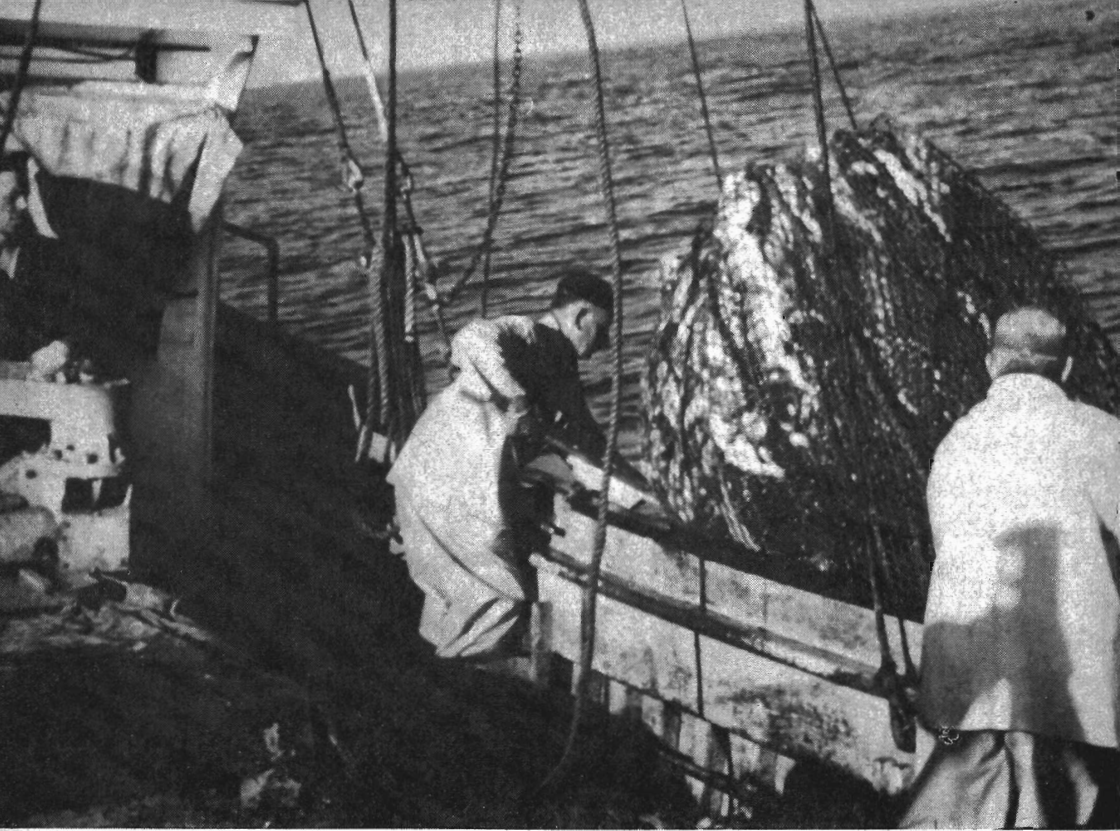
On an intake of 1,200 micrograms of riboflavin per day, which was the amount recommended by the National Research Council in 1945, the urinary excretion of riboflavin for the subjects decreased during the 30-day experimental period. This indicated that their intake of riboflavin was even more liberal before the experiment. The concentration of free riboflavin in the serum ranged from 0.21 to 2.15 micrograms per 100 milliliters. The values for total riboflavin in the serum ranged from 1.73 to 3.94 micrograms per 100 milliliters.

The 30-day study was divided into two 15-day periods as far as the level of thiamine intake was concerned. During the first period, when the subjects received a total of 1,000 micrograms of thiamine per day, the excretion of thiamine was about four times more than it was during the last 15-day period when the thiamine intake was decreased to 600 micrograms per day. Blood thiamine values appeared to be somewhat lower during the second period when the thiamine intake was restricted to 600 micrograms per day, but the change in intake was more clearly reflected by the change in urinary thiamine excretion than by the concentration of thiamine in the blood.

These are the first studies which have involved the daily determination of thiamine and riboflavin in blood samples throughout the experimental period. The daily fluctuation in the concentration of these nutrients in the blood of subjects maintained on comparatively liberal intakes of thiamine and riboflavin is wide and suggests that a single determination of blood thiamine or serum riboflavin would be of limited value.

It seems desirable at this point to determine the serum riboflavin and the blood thiamine of a representative group of normal subjects in order to determine the ranges for blood thiamine and serum riboflavin for healthy people.

Values for blood thiamine and serum riboflavin and for urinary thiamine and riboflavin obtained for the four subjects yielded ranges of normalcy and tested the validity of the National Research Council's recommended allowances for these nutrients.



# Wildlife and Marine

**R**ESearch on wildlife and game fish problems centers in the Cooperative Wildlife Unit operated by the Experiment Station and the U. S. Fish and Wildlife Service. Wildlife studies are focused on game birds and deer. A new program of research on game fish problems was started last year.

Programs in the marine field include: development of new and improved food products from fish and seafoods; utilization of fishery byproducts, little-used fish, and fish wastes; determination of methods to replenish depleted oyster beds; study of effects of pollution on marine life; and study of classification, distribution, and biology of Oregon fish. The first two of these programs are carried out at the Seafoods Laboratory at Astoria. The third and fourth programs have headquarters at the Yaquina Marine Laboratory.

Progress of one of the Station's fur-farming programs is reported in the following section.



*Wide Differences Found in***Pheasant Survival**

Arthur S. Einarsen

Although millions of dollars have been spent in the artificial propagation of pheasants throughout the habitat tier stretching across the northern part of the United States, there have been few systematic attempts to measure the efficiency of the program or adjust the program to the most productive level.

The Oregon Cooperative Wildlife Research Unit has been active in the search for these facts during the past ten years, making control studies each year to measure the survival rate of both adult and immature pheasants.

An exacting series of experiments have proved conclusively that there is a wide difference in the survival rate of adult hen and cock pheasants. The data accumulated through the experimental studies gives convincing proof that over a given period of time only about 40 per cent of the hens survive compared to 70 per cent of the cocks. There is ample evidence to support the claim that both game farm and wild-reared pheasant hens are less capable of surviving than cocks of similar origin.

In the light of this experience, it has proved far more economical in the Northwest to make the releases of game farm hens in March or April since their low survival rate precludes the possibility of using them as game birds and allowing them to be taken even in small numbers in the daily bag. Their value lies in producing a good brood of young pheasants. It has been found that spring release results in normal clutches of eggs which are dependent on local conditions for an effective yield of chicks.

The liberation of game farm hens in the hope that each hen will add some young stock to the field population after producing eggs at the game farm has proved ineffective as a management technique. The average clutch nested and incubated under these conditions is about 5 eggs. The survival rate is 1 chick. In order for hens so liberated to be effective they should have a normal nesting season. This cannot be expected until the succeeding year. The findings of the research unit show conclusively that the chance of a single hen surviving into the following nesting season is small, thus the practice is inefficient. The number of eggs produced in a normal nesting season averages approximately 11 per hen under good condi-

tions. The survival rate, as determined through experiments, is about 4 young.

These facts prove that it is necessary in carrying on successful management of pheasants to take periodic inventories to determine the prevailing sex ratios, the relative abundance of hens and the harvestable crop which reflects the success or failure of the nesting season for the year. Because of the greater ability of the cock pheasant to survive, it can be shot during long open seasons if the hen pheasant can be adequately protected.

The research studies also have revealed that the pheasant can be established in many areas now ignored as pheasant ground. It has been found that the pheasant is a bird that depends to a large extent on green vegetable matter and needs high protein foods only during the critical winter period. In many areas in the Northwest it can live on green foods throughout the year. Experiments with pen birds have revealed that pheasants have passed through the winter in good shape and gained considerable weight living entirely on green matter. This is important in the mild climatic belts of British Columbia, Washington, Oregon and northern California where pheasants do not occupy all the habitat available to them.

Research still under way has been planned to measure several methods of artificial propagation and the survival of the liberated chicks under the usual methods followed at the game farm. In the initial tests in 1951, eight different groups of pheasant juveniles were studied. Survival and growth were excellent in the older age classes liberated. Over a 5-month study period, about 75 per cent of the group released at 6 weeks of age were lost.

### *Mink Diet Affects*

## **Fur Production**

**Phyllis Watt**

Research at the Experimental Fur Farm has shown that two seldom-utilized marine fishes, the arrow-toothed flounder and the black rockfish, have great value as feed for mink. Pacific hake demonstrated little practical value at the levels at which it was fed.

Since these experimental studies were the first of this nature to be undertaken in this country, interest and support of the project have been widespread throughout the industry.

For many years the principal marine fishing has been centered upon a few select species of flatfishes and rockfishes suitable for



Fur farming research has been concentrated on feed requirements for mink this year. Mink are weighed regularly to determine progress.

human food consumption and for mink food. There has been some evidence of depletions of certain of these fish. An important objective of the experiments was to attempt to relieve the emphasis upon these few species.

One hundred sixty-five animals were carried on 13 diets from July 28 to November 15, 1950, and the following observations were made:

Pacific hake, when included in the rations of mink, did not produce growth nor were the pelts of these animals considered of high value. It was concluded that Pacific hake did not provide for the needs of mink when included in the diet.

Mink receiving diets containing arrow-toothed flounder were of exceptional size and rated higher in growth rate than did the control group considered to be normal. These mink, however, had unsatisfactory fur color, which was attributed directly to the diet.

Diets containing black rockfish did not produce satisfactory growth but did produce animals whose fur color was very dark and of high value.

Food consumption rates were computed for each ration. Those mink receiving Pacific hake consumed the greatest volume, while those receiving arrow-toothed flounder consumed the least.

It was also found that apparently the daily temperature affected to some extent the amount of feed consumed by the mink. In general, food consumption was heavy in cool weather and light in warmer weather.

Continued studies of diets containing arrow-toothed flounder and black rockfish, high amounts of mixed fish, antibiotics, amino acids, and certain vitamins are planned.

## *Fish Waste May Be Source of* **Salmon Hatchery Food**

R. O. Sinnhuber

Construction of dams, intensive fishing, pollution, and destruction of spawning areas are contributing to a gradual decrease in the number of salmon in the Columbia River.

A stream management program involving adequate fish-ways over dams, pollution abatement, screening of diversion ditches, removal of barriers, protection of adequate breeding stocks for natural spawning, the use of sanctuary spawning streams, and artificial propagation will assist and may be the answer to the maintenance and preservation of this important natural resource.

Artificial propagation or the raising of salmon in hatcheries probably is destined to play an important role in the maintenance of the salmon runs of the Northwest. The value of finding a nutritional and economical diet requires emphasis.

Artificial propagation, however, involves a need for tremendous quantities of food for the hatchery salmon. It has been estimated that 25,000,000 pounds of food will be needed annually to raise salmon and trout in hatcheries, as the proposed government dam building and hatchery program goes into effect during the next four years.

At present, suitable food is scarce and food costs are high even for existing hatcheries. In addition, little success has been achieved in providing a nutritionally adequate diet for raising spring Chinook salmon under artificial conditions.

Faced with this problem, the Experiment Station and the Oregon Fish Commission have turned to fish waste as a possible answer. If suitably combined, the enormous amount of fish waste which is

available could solve the fish food problem from both the nutritional and economic standpoints.

The Seafoods Laboratory at Astoria, in conjunction with the Fish Commission, currently is engaged in a series of experiments on this problem. Food is prepared and compounded at the laboratory and feeding experiments are conducted at Bonneville Dam. The tests have demonstrated that spring Chinook salmon can be raised successfully through the winter and that salt or a mixture of mineral salts is important in the growth of young Chinook salmon. Successful feeding has been recorded with high fat diets despite the general belief that low fat diets are most desirable for raising fish.

Chinook salmon have been raised with fair growth on diets composed of synthetic or highly purified materials. This so-called synthetic diet has served as a useful tool in testing other diet components. Material or food to be tested may be added to the diet at a predetermined level and compared with similar foods.

Beef liver, probably one of the most desirable components of the fish diet, is restricted in its use by cost and availability. As a result, substitutes for beef liver are being sought.

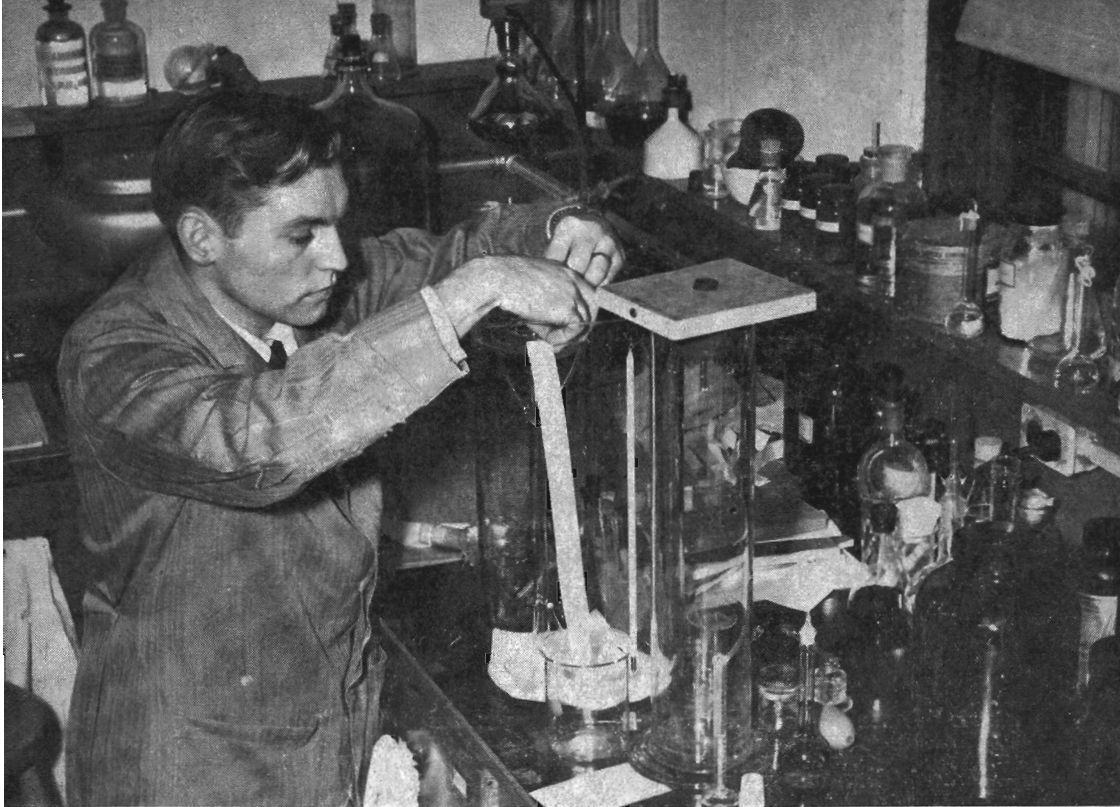
Tests showed that tuna liver in the synthetic diet was not an equivalent substitute for beef liver. Salmon livers and salmon eggs, although described as equal to beef liver in earlier reports, were found to be definitely inferior to beef liver at the same level.

No substitute has yet been found for beef liver, but the level of use in the diet has been reduced to a low percentage.

Previous research has indicated that a substance called "Factor H" is necessary for adequate growth in trout. Experiments at Bonneville Dam using the synthetic diet technique have verified that such a factor exists for salmon. An additional growth response was produced by adding 10 per cent fresh or frozen beef liver (on a dry basis) to a diet containing all known vitamins, including antibiotics and Vitamin B<sub>12</sub>.

Apparently this material is adversely affected by heat since drum-dried beef liver gave a somewhat smaller weight gain than fresh or frozen liver. Beef liver meal dried at high temperatures gave even less growth response or approximately the same as the straight synthetic diet.

A new series of experiments will undertake investigation of several other protein waste materials in order to learn more about "Factor H" and its contribution to maximum growth. "Factor H" apparently is present in salmon fish meal, turbot meal, and other fish meals as well as in grasshoppers, salmon viscera, and condensed fish solubles.



## General Research

SOME of the investigations conducted by the Experiment Station cannot be classified under a specific commodity heading in this report. A number of projects of a general or fundamental nature are in process. In many cases these studies provide necessary background data for later, more specific experiments in the various commodity fields.

Outstanding in this category this year were projects in the fields of biochemistry and plant and animal physiology.

Another general study concerned the problem of waste fumes released by industrial plants and the damage these fumes caused to adjacent farm crops. Controls were tested for certain harmful aquatic weeds in Oregon's coastal lakes.

Efforts were continued on the project aimed at developing plans and specifications for better farm structures and equipment.

*Isotopes Used to Find Out***How 2,4-D Works**

J. S. Butts

In the field of plant growth regulators, 2,4-D has received the most attention. As a weed killer it has proved of great value to agriculture. It is not the whole answer, however, and other weed killers are badly needed. It has been felt that if the method of action of 2,4-D on the plant can be determined, there is a strong possibility that other compounds may be found which have similar action.

With the advent of isotopes—atoms which act chemically in an identical manner but which can be “traced” when mixed with non-isotopic atoms—a tool was made available to study the changes that occur in the plant.

Investigations have revealed that 2,4-D can be detected in the plant two hours after application to the leaf. The concentration increases in various parts of the plant during the next six days, with the majority of the radioactivity centered in the stem. The absorption and translocation of the 2,4-D indicated that young plants are much more susceptible to it than older ones.

When increasing amounts of 2,4-D were applied, it was found that above a certain point there was little additional response.

The plant metabolized the 2,4-D in such a manner that 10 to 20 per cent of the radioactivity was recovered as carbon dioxide.

After application to the plant, some of the 2,4-D was identified as such, but there were two other major radioactive substances which developed as the 2,4-D disappeared. It appeared that the growth regulator was being metabolized and other compounds were being synthesized at the expense of the carbon in the 2,4-D. One of these compounds has been identified tentatively as a glucoside, a complex of sugar and 2,4-D. The second major compound is unknown. Evidence indicates that the 2,4-D interferes with carbohydrate metabolism.

Studies will be continued for there is much more information needed. For instance, a vigorously growing plant responds to 2,4-D much more readily than one in poor nutritional condition. The relationship of nitrogen and phosphorus application to 2,4-D response will be studied in detail during the next year in an attempt to shed more light on the subject. Isotopic phosphorus, P-32, will be used in the work.

# Publications and Papers

July 1, 1950 to June 30, 1951

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- 481—A Pumping Manual for Irrigation and Drainage. John W. Wolfe.
- 482—A Guide for the Kitchen Planner. Maud Wilson.
- 483—IPC, A New Weed Killer. Virgil H. Freed, H. E. Bierman.
- 484—The Economics of Grass Seed Production in the Willamette Valley, Oregon. E. A. Hyer, M. H. Becker, D. C. Mumford.
- 485—Development of Blight Resistant French Pear Rootstocks. F. C. Reimer.
- 486—Cost of Producing Grade A Milk, Willamette Valley Section, Portland, Oregon, Milkshed. Grant E. Blanch, D. C. Mumford, Wray Lawrence.
- 487—Commercial Preservation of Apple Juice. Ernest H. Wiegand, H. Y. Yang.
- 488—More Beef with Less Feed. Ralph Bogart, Robert L. Blackwell.
- 489—Importance of Ram Breed in Fat Lamb Production. O. M. Nelson, A. W. Oliver, G. B. McLeroy, Ralph Bogart.
- 490—Manufacture of Jellies and Preserves. Earl M. Litwiller.
- 491—Annual Report of Oregon Agricultural Experiment Station. Oregon's Agricultural Progress Through Research. Director, Oregon Agricultural Experiment Station.
- 492—Drainage Practices for Oregon. W. L. Powers, A. S. King.
- 493—Weed Spraying Equipment. G. E. Page.
- 494—Freezing Cooked and Prepared Foods. Ruth C. Miller, Agnes M. Kolshorn, E. H. Wiegand.
- 495—Significance of Quality Loss in Marketing Early Idaho-Oregon Potatoes. Gerald E. Korzan, George B. Davis.
- 496—Transportation Rates on Livestock and Meat Products in Western States. W. H. Dreesen.
- 497—Home Preparation of Maraschino Cherries. William F. Filz, Edward N. Henney.
- 498—Chicken Hatching Egg Production in Oregon. J. E. Parker.
- 499—Growing Blueberries in Oregon. C. A. Boller.
- 455—Holly Production in Oregon. A. N. Roberts, C. A. Boller.

## CIRCULARS OF INFORMATION

- 487—Climate and Its Relation to Agriculture (Corvallis Area 1889-1950). W. L. Powers.
- 488—Cost of Producing Turkey Hatching Eggs, Western Oregon, 1949. D. Curtis Mumford.
- 489—A Tilting-Bed Implement Trailer. R. N. Lunde, D. E. Kirk.
- 490—Irrigated Ladino Pasture for Hogs. A. W. Oliver.
- 491—Bacterial Ring Rot of Potatoes. Roy A. Young, J. A. Milbrath.
- 492—Life History and Control of the Cottoncater Webworm. R. G. Rosenstiel.
- 493—Cost of Raising Market Turkeys in Western Oregon, 1949. Edgar A. Hyer.



- 494—Cost of Producing Apples and Pears in the Hood River Valley, Oregon. Progress Report IV. Gustav W. Kuhlman, Arthur E. Irish.
- 495—Pear Scab and Its Control in Oregon. J. R. Kienholz, Leroy Childs.
- 496—Dried Molasses Beet Pulp as Grass Silage Preservative. Progress Report. J. H. Byers, I. R. Jones.
- 497—Cost Guides for Range Reseeding. C. V. Plath.
- 498—A Hoof-Trimming Chute for Cattle. H. B. Howell, W. E. Dent, H. D. Dorman.
- 499—Cost of Producing Filberts and Walnuts in Oregon. Gustav W. Kuhlman.

## TECHNICAL PAPERS PUBLISHED IN JOURNALS

- 630—A Method for the Determination of Worm and Insect Fragments in Food Products. Published as "Get Quicker Insect Counts on Raw Foods." Phillip E. Gilbert, Wm. F. Filz. Food Industries.
- 631—Immunization of Turkeys Against Erysipelothrix Rhusiopathiae with Avirulent Live Culture. J. W. Osebold, E. M. Dickinson, W. E. Babcock. Cornell Veterinarian.
- 632—A Measure of Losses in the Making of Grass and Corn Silage. John H. Byers, I. R. Jones. Proceedings of the Western Division of the American Dairy Science Association.
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- 637—DDT-Resistant Flies in Oregon. A. R. Roth, Don C. Mote. Journal of Economic Entomology.
- 638—Space Spraying for Fly Control in Dairy Barns. H. E. Morrison, R. W. Lauderdale, H. H. Crowell, Don C. Mote. Journal of Economic Entomology.
- 639—Quality of Frozen-Defrosted Pork from Protamone-Fed and Thiouracil-Fed Hogs. A. A. Rasheed, Thomas B. Niven, Ralph Bogart. Food Technology.
- 640—Rotation-Deferred Grazing as Compared to Season-Long Grazing on Sagebrush-Bunchgrass Ranges in Oregon. D. N. Hyder, W. A. Sawyer. Journal of the Society of Range Management.
- 641—The Problems of Bacteriophage in the Dairy Industry. P. R. Elliker. Journal of Milk and Food Technology.
- 642—A Method for Determination of Concentration of Quaternary Ammonium Compounds in Milk and in Detergent Sanitizers. D. D. Miller, P. R. Elliker. Dairy Science.
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- 646—Species of *Selenophoma* on North American Grasses. Roderick Sprague, A. G. Johnson. *Oregon State Monographs*.
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- 648—Studies for Improving Storage Quality of Emperor and Almeria Grapes: Part I. J. App, G. J. Loran, E. H. Wiegand. *Food Technology*.
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- 650—A Method for Maintaining Free Sulfur Dioxide Content in Wine. H. Y. Yang, E. H. Wiegand. *Food Technology*.
- 651—The Separation of Rusty Mottle of Cherry from a Ringspot-Rusty Mottle Complex. J. A. Milbrath. *Science*.
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- 663—The Keeping Quality of Berry Wines. H. Y. Yang, E. H. Wiegand. *Wines and Vines*.
- 664—Harvesting Seasons and Characteristics of Small Fruits in Oregon. George F. Waldo. *Proceedings, Oregon State Horticultural Society*.
- 665—Pre-Packaging Studies on Several Fruits and Vegetables. George J. Lorant, Jean App. *Pre-Package Age*.

- 666—The Effect of Nitrogen Fertilizer Sprays on Pears. E. S. Degman. Proceedings, Oregon State Horticultural Society. 42nd Annual Report, 1950.
- 667—Seasonal Variation in the Vitamin A Potency of Oregon Produced Blue Vein Cheese. P. H. Weswig, J. R. Haag, R. T. Pierce. Journal of Dairy Science.
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- 679—Functional House Dresses. Mrs. Clara Edaburn. Journal of Home Economics.
- 680—Effects of 2,4,5-T on the Maturation of Italian and Stanley Prunes. Quentin B. Zielinski, Paul C. Marth, V. E. Prince. Proceedings, Society of Horticultural Science.
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 IAY B. LONG, M.S., Associate Biologist.  
 CARL E. BOND, M.S., Assistant Biologist.  
 EUGENE HAYDU, M.S., Assistant Biologist.  
 I. W. KUHN, M.S., Assistant Biologist.  
 PHYLLIS R. WATT, M.S., Research Assistant.  
 WILLIAM D. BARRON, B.S., Graduate Research Assistant.  
 WAYNE H. BOHL, B.S., Graduate Research Assistant.  
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 GENE DESCHAMPS, B.S., Graduate Research Assistant.  
 DOUGLAS K. HILLIARD, B.S., Graduate Research Assistant.

HARRY D. HARTWELL, B.S., Graduate Research Assistant.  
 WALTER JONES, B.S., Graduate Research Assistant.  
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 WILLIAM O. SALTZMAN, B.S., Graduate Research Assistant.  
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## FOOD TECHNOLOGY

- \*E. H. WIEGAND, B.S.A., Food Technologist in Charge.  
 EARL M. LITWILLER, Ph.D., Food Technologist.  
 E. W. HARVEY, Ph.D., Associate Food Technologist, Seafoods Laboratory, Astoria.  
 R. O. SINNHUBER, M.S., Associate Biochemist, Seafoods Laboratory, Astoria.  
 O. J. WORTHINGTON, Ph.D., Associate Food Technologist.  
 HO-YA YANG, Ph.D., Associate Food Technologist.  
 EDWARD C. BUBL, Ph.D., Assistant Food Technologist.  
 W. F. FILZ, M.S., Assistant Food Technologist (resigned).  
 RUTH MILLER, B.S., Assistant Food Technologist.  
 THOMAS B. NIVEN, Ph.D., Assistant Food Technologist.  
 CLIFFORD E. SAMUELS, B.S., Assistant Food Technologist.  
 CURTIS WILDER, M.S., Assistant Food Technologist (leave of absence).  
 D. K. LAW, B.S., Research Assistant, Seafoods Laboratory, Astoria.  
 LYNNE A. PETTIT, B.S., Research Assistant.  
 MARGARET JO SCHWAB, Ed.M., Research Assistant.  
 WILLIAM K. HIGBY, B.S., Graduate Research Assistant.  
 S. C. MOYE, B.S., Graduate Research Assistant.  
 J. N. SHAH, B.S., Graduate Research Assistant.  
 ROBERT C. WILEY, B.S., Graduate Research Assistant.

## HOME ECONOMICS

- MAUD M. WILSON, A.M., Home Economist Emeritus.  
 CLARA A. STORVICK, Ph.D., Nutritionist, Acting in Charge.  
 ANDREA J. MACKEY, Ph.D., Home Economist.  
 JOAN PATTERSON, B.Arch., Textiles Specialist.  
 CLARA EDABURN, M.A., Associate Home Economist.  
 MARGARET EDWARDS, B.S., Research Assistant.  
 ELIZABETH JOHNSON, Ph.D., Research Assistant.

## HORTICULTURE

- HENRY HARTMAN, M.S., Horticulturist in Charge.  
 E. J. KRAUS, Ph.D., Visiting Professor of Horticulture.  
 W. A. FRAZIER, Ph.D., Horticulturist (Vegetable Crops).  
 ELMER HANSEN, Ph.D., Horticulturist (Pomology).  
 \*J. H. PAINTER, M.S., Horticulturist (Nut Crops).  
 \*GEORGE F. WALDO, M.S., Horticulturist.  
 SPENCER B. APPLE, M.S., Associate Horticulturist (Vegetable Crops).  
 O. C. COMPTON, Ph.D., Associate Horticulturist.  
 A. N. ROBERTS, M.S., Associate Horticulturist (leave of absence).  
 STANLEY E. WADSWORTH, B.S., Associate Horticulturist (Floriculture).  
 QUENTIN B. ZIELINSKI, Ph.D., Associate Horticulturist.  
 C. A. BOLLER, M.S., Assistant Horticulturist.  
 LAWRENCE T. BLANEY, M.S., Research Assistant (leave of absence).  
 RALPH GARREN, JR., M.S., Research Assistant.  
 LEWIS A. HAMMERS, M.S., Research Assistant.  
 W. M. MELLENTHIN, M.S., Research Assistant.  
 JOHN R. STEGMULLER, B.S., Research Assistant.  
 C. J. ANNEN, B.S., Graduate Research Assistant.  
 LYSLE H. PARSONS, B.S., Graduate Research Assistant.

## POULTRY HUSBANDRY

- J. E. PARKER, Ph.D., Poultry Husbandman in Charge.  
 PAUL E. BERNIER, Ph.D., Associate Poultry Husbandman.  
 WILBUR T. COONEY, M.S., Associate Poultry Husbandman.  
 \*J. A. HARPER, M.S., Assistant Poultry Husbandman.  
 C. L. ANDERSON, B.S., Graduate Research Assistant.

## PUBLICATIONS

- SAM H. BAILEY, M.S., Experiment Station Editor (military leave of absence).  
 NORVILLE R. GISH, B.S., Assistant Experiment Station Editor.  
 FRED M. SHIDELER, M.S., Director of News Bureau.  
 DELMER M. GOODE, M.A., Director of Publications.  
 RALPH W. SALISBURY, B.S., Assistant Editor, Publications.

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## SOIL SCIENCE

W. L. POWERS, Ph.D., Soil Scientist in Charge (leave of absence).  
 C. V. RUZEK, M.S., Soil Scientist, Acting in Charge.  
 R. E. STEPHENSON, Ph.D., Soil Scientist.  
 \*A. S. HUNTER, Ph.D., Soil Scientist.  
 RAY A. PENDLETON, Ph.D., Agronomist.  
 ALBERT W. MARSH, Ph.D., Associate Soil Scientist.

E. W. DULL, B.S., Research Assistant.  
 RICHARD K. KIRSCH, B.S., Graduate Research Assistant.  
 ALEXANDER POPE, M.S., Graduate Research Fellow.  
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## VETERINARY MEDICINE

J. N. SHAW, D.V.M., B.S., Veterinarian in Charge.  
 L. R. VAWTER, D.V.M., M.S., Veterinarian in Charge, Animal Diagnostic Service.  
 E. M. DICKINSON, D.V.M., M.S., Veterinarian.  
 O. H. MUTH, D.V.M., M.S., Veterinarian.  
 J. O. SCHNAUTZ, D.V.M., A.B., Associate Veterinarian.

W. E. BARCOCK, D.V.M., M.S., Assistant Veterinarian.  
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 J. F. SULLIVAN, D.V.M., Research Assistant.  
 JOHN L. WEIBEL, D.V.M., B.S., Research Assistant.  
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## Branch Stations and Experimental Areas

## CENTRAL OREGON EXPERIMENTAL PROJECT, REDMOND

MALCOLM J. JOHNSON, M.S., Project Supervisor.

JOHN A. CURRIE, B.S., Research Assistant.

## EASTERN OREGON LIVESTOCK BRANCH EXPERIMENT STATION, UNION

\*H. G. AVERY, B.S., Superintendent.

CECIL D. PIERCE, B.S., Research Assistant.

## HOOD RIVER BRANCH EXPERIMENT STATION, HOOD RIVER

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 \*J. R. KIENHOLZ, Ph.D., Pathologist.

W. H. MEVLE, B.S., Research Assistant.  
 V. W. OLNEY, B.S., Research Assistant.

## JOHN JACOB ASTOR BRANCH EXPERIMENT STATION, ASTORIA

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## KLAMATH EXPERIMENTAL AREA, KLAMATH FALLS

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 A. R. HALVORSON, Ph.D., Assistant Superintendent in Charge of Soils Research.

PAUL E. STEVENS, B.S., Research Assistant.

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 H. M. WADDUPS, M.S., Research Assistant.

## RED SOILS EXPERIMENTAL AREA, OREGON CITY

J. T. McDERMID, B.S., Superintendent.

## SHERMAN BRANCH EXPERIMENT STATION, MORO

\*G. A. MITCHELL, B.S., Superintendent.

W. E. HALL, B.S., Research Assistant.

## SOUTHERN OREGON BRANCH EXPERIMENT STATION, MEDFORD

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 \*R. A. WORK, B.S., Project Supervisor, Irrigation Water Forecasting.  
 \*W. T. FROST, A.B., Associate Hydraulic Engineer, Irrigation Water Forecasting.

H. H. WHITE, M.S., Associate Agronomist.  
 R. T. BEAUMONT, B.S., Assistant Water Forecaster, Irrigation Water Forecasting (leave of absence).  
 MANES BARTON, B.S., Research Assistant.

## SQUAW BUTTE-HARNEY BRANCH EXPERIMENT STATION, BURNS

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## THE DALLES EXPERIMENTAL AREA, THE DALLES

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## UMATILLA BRANCH EXPERIMENT STATION, HERMISTON

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