

Contents

Ρ	a	g	e
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Letter of transmittal	3
58th year of service	4
Director's report	5
Agriculture Division	8
Agronomy	8
Animal Investigations	11
Botany and Plant Pathology	14
Chemistry	15
Entomology	16
Forestry	19
Home Economics	20
Horticulture	20
Poultry	24
Range and Pasture Management	26
Rural Economics and Sociology	30
Seed Laboratory	32
Veterinary Pathology and Bacteriology	32
Engineering Division	37
Civil Engineering	37
Mechanical Engineering	40
Substations	42
Editorial Service	43
Personnel	49
Board, officers, and staff of Station	50
Financial report	52

Letter of Transmittal

Fifty-Eighth Annual Report **Colorado Agricultural Experiment Station**

Hon. John C. Vivian Governor of Colorado Denver, Colorado

Sir:

In compliance with the law, I herewith present the Fifty-Eighth Annual Report of the Colorado Agricultural Experiment Station for the fiscal year of July 1, 1944 to June 30, 1945, inclusive.

Hover & Henney Director

Fort Collins, Colorado July 1, 1945



58th Year of Service

Here are a few of the many research findings which were published for general distribution during the 58th year of service of the Colorado Agricultural Experiment Station:

- Good to choice beef can be produced by feeding only a small amount of grain with Colorado roughages, alfalfa hay, and no protein supplement.
- Calves fed cottonseed cake during their wintering period gained 1 pound extra per day. Without the cake the calves continued to gain 1/3 pound more per day during the grazing period.
- Seed of blue grama grass obtained from Arizona produced 1 1/2 tons more forage than a Montana strain. Southern strains of smooth bromegrass have produced both more forage and seed.
- Corn hybrids in Colorado produced up to 20 bushels more per acre than a standard open-pollinated variety.
- Seven years of testing shows Ladak alfalfa to be the best strain for high altitudes.
- A machine that can be built on the farm does the work of 6 to 10 men in loading manure, bucking hay.
- Coe's sorghum produces up to 60 percent more grain than corn in the dryland area, but the crop should be up early.
- Waste pinto beans when cooked are a good protein supplement for hogs.
- Over-irrigation of potatoes may aggravate potato rot.
- Midwest markets prefer Colorado peaches, but fruit should be more attractively packaged.
- Thatcher, one of the newer spring wheats, has stem rust resistance, and is recommended for growing on irrigated land.
- Damage to wheat by wireworms may be controlled by rotating wheat with row crops or by allowing land to lie fallow.
- Eggs sealed in a moisture-proof package with a small amount of solidacid substance and soda to release carbon dioxide retain the qualities of fresh eggs.

Director's Annual Report

Fifty-Eighth Fiscal Year 1944-45 Colorado Agricultural Experiment Station

To The President and State Board of Agriculture:

The Experiment Station program for the past year was an attempt to study only those problems which would aid materially in bringing the war to an immediate close. With the exception of a few formal projects such as improved varieties of crops and plants and the breeding of disease-resistant varieties, which must be continued once they are started, considering the replacement cost involved, practically all projects gave some results which can be applied in benefiting the 1945 and '46 crop seasons.

Briefly, the trend toward mechanization, labor-saving, and preservation of food and feeds gained impetus during the year when one considers all projects from the standpoint of pressure groups, demands by farmers, and financial assistance to the Station from state, federal, and commercial interests.

What Was Accomplished

Some of the more important studies and accomplishments are listed:

The black stem rust disaster for the 1944 winter wheat crop resulted in appropriation of additional funds by the Legislature so as to speed up a rust-resistant winter wheat for Colorado. Dr. D. W. Robertson, agronomist, thinks he has a promising hybrid which might be speeded up by cooperating with some other stations which have better greenhouse facilities so that Colorado may have a wheat resistant to rust.

The problem of how to produce more beef and lamb without concentrates was partly answered by results from an experiment completed. Carcasses from beef which had received only a small amount of grain with Colorado roughages, alfalfa hay, and no protein supplement graded good to choice. The grain fed was worth 38 percent more than grain fed in larger amounts.

A survey of Colorado dairy herds indicates that one out of three dairy cows is infected with some strain of mastitis. It will take 2 to 5 years to complete the control methods. That predisposition to mastitis is transmitted genetically is a possibility. Preliminary results from another experiment indicate the possibility that cow feces are a new and cheaper source for sex hormonal substances. Comb weights of pullets and cockerels fed 10 percent of the feces increased by 12 times. It was also learned that abcesses of cattle develop both on the range and in fattening pens.

In the feed preservation program it appears that corn silage, as put up today, loses 20 to 30 percent of its nutrient value, and that alfalfa and grasses preserve their nutriments better when put up as silage than when air-dried for hay. Experiments with feeding potatoes in at least seven different forms indicate that they are often as good as corn and mix well into most stock rations.

The high protein content of the shrub, winterfat, makes it excellent fall and winter pasturage. Another forage experiment showed that a good mixture of palatable perennial grasses, weeds, and browse gives a more balanced ration than a singlevariety grass stand.

A photographic method of determining snow cover forecast a flow of 172,000 acre-feet for the Cache la Poudre River last year. The actual flow was 187,000 acre-feet. A riffle-deflector type of sand trap was laboratory tested and found to capture 85 to 90 percent of the moving silt load. Irrigation water is frequently wasted.

A peach mosaic study indicates that a plant louse transmits the disease. An experiment with DDT emphasizes its effectiveness. A laboratory test showed that it is effective against adults and nymphs of the potato psyllid. A method of cutting seed potatoes which is 25 percent faster than the best methods used in Weld County was developed. Tests on the mechanical thinning of sugar beets showed no significant differences in yield as compared with hand-thinned beets.

Two of the Station's corn hybrids show promise of being equal or superior to some developed by the commercial corn breeders. Results from the inoculations of 4,000 barley plants with certain forms of barley smut fungus are indicative of resistance and are encouraging.

The 10-year research program for the substations calls for the State to be divided into nine substation areas. An advisory committee around the substation in each of these areas is being developed.

Recommendations for Improvement

In order to speed up research work and make more effective the time of research men, more money should be spent on pickup trucks, improved farm machinery, and labor-saving equipment during the next 5 years.

Salaries and competition for staff members has forced the Station into paying the better men much higher salaries than was true in the pre-war period. In the post-war period, efficiency of the Station as well as effectiveness of the research work could be improved if there were a policy whereby every Station man, Extension worker, or College professor was put half and half on two phases of the work. If each Extension man spent one or two quarters per year on a research project in his field and if about half the Station workers spent one or two quarters per year in Extension work the coordination of all effort would be much improved. The younger research men would be put on research and teaching until they matured for the Extension-type work.

The longer-time program demands more farm land around the main Station. An acreage for horticultural experiments is most needed. A ranch of 10 to 20 sections where grazing experiments on competitive use of grazing by cattle and sheep could be conducted, as well as progeny tests made for beef cattle, should be obtained before the end of the 10-year period.

The substation program is being speeded up and should increase the value to Colorado residents of the over-all College-Station-Extension program. Increased emphasis on publicity, radio, and press on what is being accomplished is very desirable.

Estimated Costs

The improvement programs suggested would cost for physical facilities between 100 and 150 thousand dollars. This could be spread over a 5-year period. Additional operating costs should not exceed \$50,000 annually, half of which would be salaries and the rest expenses. The completion of this program would run the Station budget from around \$300,000 to something less than \$500,000.

The land and other physical facilities should come by direct appropriation of the State Legislature if federal lands cannot be allocated to the Station for such use. Operating expenses could for the first few years be handled in such a way that receipts from sale of cattle and crops would take care of most of them. This same might hold true of all the substation areas.

AGRICULTURE DIVISION

Agronomy

Disease Resistance of Small Grains (Botany and Plant Pathology Section cooperating.)

Wheat. Out of about 7,000 strains in the nursery about 35 have shown promise of being rust-resistant. All stem and leaf rust material has been eliminated from advanced generation stocks. Some rust-free F_3 material is available for use as breeding stock. Smut resistance was carried to F_4 and F_5 generations.

Barley. Progress toward obtaining a Lico-type barley resistant to loose smut (U. nuda) looks very good. Inoculations of 4,000 barley plants were made with certain forms of barley smut fungus.

Oats. Desirable lines were advanced into farmer tests and continued in the regional uniform test of the U.S.D.A. Selections of smut-resistant stocks still show commercial possibilities.

Winter Hardiness and Disease Resistance in Alfalfa (Home Economics Section cooperating.)

Increased yield and resistance to wilt are indicated in the selections from the first generation maternal line selections. Samples were taken for vitamin analysis.

Barley Genetics (Botany and Plant Pathology Section cooperating.)

This program is yielding new fundamental data on the location of genes on the chromosomes in linkage groups.

Hybrid Corn (Office of Dry Land Agriculture, U.S.D.A., Rocky Ford Substation, and the Extension Service cooperating.)

Hybrid trials were conducted at Fort Collins, Rocky Ford, Haxtun, Wray, and Akron. The hybrids for irrigated conditions in northern Colorado were 12 to 25 percent better than the standard open-pollinated variety; in the Arkansas Valley, 30 to 50 percent better. Inbred lines and single cross stocks were supplied to producers of registered hybrid corn seed. It is estimated that 85 percent of the irrigated corn acreage and 30 percent of the dryland corn acreage is planted to hybrid corn. Improved Seed (Office of Dry Land Agriculture, U.S.D.A., Bureau of Plant Industry; Office of Cereal Crops and Diseases; and the Fort Lewis and Rocky Ford Substations cooperating.)

Wheat, barley, oats, soybeans, sorghums, and dry beans were tested for irrigated and dryland conditions. Some foundation stocks were increased and released to farmers. A new barley, Blackhull 1180 (renamed Munsing), has been the highestyielding barley in the Great Plains uniform barley test for the past 4 years.

Longevity of Farm Seeds (Seed Laboratory cooperating.)

Studies were continued on the length of retention of viability of farm seeds stored in an unheated, dry room. The first seed samples were stored in 1920. Germination tests are made yearly. Results prove that good seed can be stored in a dry atmosphere for several years with only a slight loss in viability. The milling, baking, and vitamin B_1 studies showed that storage has no consistent effect on the protein content of the grain.

Dry-Land Farming (Office of Dry Land Agriculture, U.S.D.A., cooperating.)

The results of 30 years of tillage methods and crop sequence studies were published in U.S.D.A. Circular No. 700, "Dry Land Rotation and Tillage Experiments at the Akron (Colorado) Field Station." Work done includes rotation, cultural methods, rates and dates of seeding, breeding and testing new crops, and distribution of improved new varieties or hybrids.

Value of Trashy Fallow (Entomology and Range Management Sections and the Soil Conservation Service cooperating.)

This study is to determine the damage to yield and quality of wheat in stripland farming due to the type of trashy fallow practiced on seeded strips and to insect propagation in the uncropped strips. The results to date indicate that the chief benefit of trashy fallow is that it will give a large measure of protection against wind and water erosion. Grain grown on one trashy fallow was inferior to that grown on clean fallow. A great amount of the grain was destroyed by a grubworm (*phyllophora*).

High Altitude Agricultural Crops (Fort Lewis Substation cooperating.)

Variety tests were conducted for winter and spring wheat and barley and oats under irrigation; for forage grasses under dryland and irrigated conditions; and for alfalfa under high altitude conditions. Some of the results were published in Experiment Station Bulletin No. 487, "Spring Wheat Production in Colorado."

Availability of Soil Mineral Nutrients

The primary benefits of alfalfa to following crops comes from the increased nitrogen and not from an increase in availability of mineral nutrients. Nitrogen fertilizers gave a 30 to 50 percent increase in sugar beets. Peaches gave a very pronounced response to nitrogen fertilizers. The statistical study indicates that the soil tests now in use are not a reliable index of the probable crop yields or probable mineral content of crops.

Classification and Reclamation of Saline Soils (Not an official Experiment Station project.)

This project is of vital concern to the entire Western Slope and the San Luis Valley as well as many other parts of the State. Methods which long have been needed to determine the structural and chemical suitability of saline and alkaline soils for irrigation have been developed.

Land Use and Soil Survey (Soil Conservation Service and Bureau of Plant Industry, Soils, and Agricultural Engineering cooperating.)

An Experiment Station bulletin No. 486, "Land Types in Eastern Colorado—Their Influence on Crop Yields and Land Use in the Various Climatic Zones of the Area (Dry Land)" was published. A general land-type map of Colorado in color and a map giving the climatic zones are included. The study on land use classification standards continues.

Top Soil Study

The Soil Conservation Districts located in irrigation sections are undertaking rather large land-leveling programs. Information is needed on what those land-levelling operations will do to productivity when topsoils are removed and subsoils exposed. Accordingly, definite experiments have been set up attacking this problem.

Animal Investigations

Cattle Experimental Work

Utilizing Short-Grass Range and Sorghums for Wartime Beef Production

A three-phase (wintering, grazing, and fattening) experiment with steer calves has been completed. This experiment showed that 1 pound of cottonseed cake added to each of the calves' wintering ration increased their rate of gain, not only during the wintering period, but much of this gain was held while on pasture the following summer and in the feedlot the next fall and winter. Another project showed that for fattening steers, ground coes sorghum in combination with either wheat or corn is satisfactory.

Ammoniated Dried Beet Pulp and Urea as Protein Sources for Fattening Cattle (Great Western Sugar Company and Quaker Oats Company cooperating.)

Results showed that ammoniated dried beet pulp held no advantage over good quality alfalfa hay as a source of protein. The steers fed urea made slightly lower gains.

Fort Collins Summer Cattle Feeding Experiment (Mechanical Engineering Section cooperating.)

Heifers were fed rations containing potatoes stored in various forms. Dehydrated potato pulp gave excellent results. Raw potatoes chopped and combined with dry corn fodder or alfalfa hay made high quality silage that compared favorably with corn silage. Heifers fed cooked potato silage made good gains. Yearling heifers, fattened in a short feeding period, dressed a high percentage of good carcasses, showing that good beef can be produced quickly with these rations.

Utilization of Roughages in Wartime Cattle Fattening Rations (Mechanical Engineering Section cooperating).

This steer-feeding experiment compared roughages in fattening rations, primarily testing alfalfa silage put up alone and with corn and phosphoric acid as preservatives. Alfalfa silages put up with preservative gave good results compared with corn silage. The alfalfa silage put up without preservative was not as good quality as the other two alfalfa silages. Potato-roughage silage gave the best gains.

Nutritional Control of Mastitis

Five cows in the dairy herd which were found positive for mastitis have been isolated since November 1944. These cows will be treated by means of chemical infusions and by fasting for a period of 5 days. Four of the cows are direct descendants in one family, indicating that mastitis may be inherited.

Irrigated Pastures for Dairy Cattle (Agronomy Section cooperating.)

During the summer of 1944 dairy heifers were placed on three types of pastures: (1) barley; (2) strawberry clover, brome grass, and Kentucky bluegrass; and (3) brome grass, Kentucky bluegrass, quack grass, and orchard grass. At intervals through the test of the bodyweight of the heifers was recorded and the grasses were sampled for yields and analyzed for protein and moisture contents. Results have not yet been completely tabulated.

Nutrient Utilization by Steers of Different Body Types

It appears that the main difference between animals of standard and compact types is in length of time such animals must remain in the feedlot to reach slaughter condition. The compact type reaches full slaughter condition much earlier than does the standard type.

A Rickets-like Condition in Heavily Fed Cattle Receiving Adequate Calcium, Phosphorus, and Vitamin D

Through frequent observations of animals and feed mixtures, calcium, phosphorus, or vitamin D deficiency has been ruled out as a cause of the rickets-like condition. An experiment has been started in which grain mixtures and milk, similar to rations fed to cattle, will be fed to rats.

Feed Preservation (Mechanical Engineering Section cooperating.)

Experimental work on the preservation, utilization and chemical analyses of various feeds was continued and enlarged during the year. Potatoes were stored and fed as cooked potato silage, potato-corn fodder silage, potato-alfalfa hay silage, and raw. Green alfalfa was harvested and ensiled with and without preservatives, and mature sweet clover was also harvested and ensiled.

Sheep Experimental Work

Utilizing Grain and Roughages in Wartime Lamb Fattering Rations

The lot of lambs receiving wet beet pulp produced the heaviest gains. There was little or no significant difference in gains by the other lots. In connection with this test, and in cooperation with the Pathology and Bacteriology Section, a study was made of the fringed tapeworm in sheep.

Shrinkage Studies of Commercial Wool Clips

This work has been in progress since 1939. In 1944 a total of 51 bands of sheep, representing approximately 60,000 animals, were sampled. The use of individual mesh sacks in scouring and the use of numbered sacks have greatly speeded up the actual shrinkage operation.

Cooperative Wool Studies

This work has been enlarged by 50 percent. It consists of physical measurements of wool samples from three portions of the animal. Reports of fineness, variability, black fiber occurrence, incidence of medullation, and length of staple are submitted to the grower. Two complete years of work on one band and 5 year's work on another band are ready for statistical treatment and publication.

Effect of Iodinated Casein on Wool Production

Metabolism trials have been conducted with ewes fed different levels of iodinated casein. Fiber length, diameter, and grease and salt content of fleece have been measured. The effect of feeding varying levels of thyroid-activating principals on wool and lamb production is being studied.

Swine Experimental Work

Pinto Beans for Fattening Pigs

This experiment tested the feeding value of waste pinto beans in a hog-feeding ration. Cooked pinto beans were palatable and good gains were obtained, but the gains were not as great as from corn. Raw pinto bean meal is not palatable to pigs. During the feeding period only two pigs fed raw pinto bean meal were fat enough to market, while from five to seven pigs were marketed from the other lots.

Potatoes for Fattening Pigs (Mechanical Engineering Section cooperating.)

Results indicate that cooked potatoes are more efficient than raw potatoes for fattening pigs, but neither are as efficient as corn. Dehydrated potatoes were not as palatable as corn and did not produce as good gains.

Botany and Plant Pathology

Potato Diseases (Tuber Rot and Net Necrosis)

Two species of phytophthora have been found associated with tuber rotting, resulting in a type of "leak". Completion of the identification of these fungi and the study of their pathogenicity is in progress.

Net necrosis of a new type has been found. Greenhouse tests indicate that the disease is not of a virus nature. Field trials are being conducted with copper sulphate in irrigation water for the control of late blight of potatoes.

Increasing Yield and Nutrition Value of Pod Peas by Control of Disease and by Cultural Practices (Horticulture Section cooperating.)

Isolations from diseased peas indicate Fusarium solani var. Martii, Rhizoctonia solani, Ascochyta pinodela, and Pythium sp. are causing rot.

Seed treatments have proved effective in decreasing the amount of seed rotting and seedling blights. Sulfates of copper, iron, zinc and manganese seem to increase the general vigor of the plants, but results were not consistent.

Laboratory and greenhouse tests showed that there are several strains of *Fusarium solani* var. *Martii* associated with pea rots. These strains differ in their cultural characters and their pathogenicity on peas.

Greenhouse tests show that the chemicals used in seed treatments vary in their effectiveness against different fungi and that different results can be expected in different soils and with different pea varieties. Two varieties of peas of the many tested showed resistance to root rot.

Scientific Series Paper 183, "Experiments with Pea Seed Treatments in Colorado," was published.

Sugar Beet Studies (U.S.D.A. cooperating.)

Cross inoculations with *Verticillium albo-atrum* (wilt fungus) have been made on both potatoes and sugar beets. A controlled soil temperature study of the reaction of sugar beets to *V. albo-atrum* is now in progress. Addition of fume phosphate to sugar beet seed without fungicide has proved detrimental.

Virus Diseases of Stone Fruits

Between the years 1934 and 1944, 86,209 diseased peach trees were removed in Palisade district by the State Bureau of Plant and Insect Control. Replants have followed eradication and now 60 percent of replants are in bearing. Despite the vast eradication program the seasons of '43 and '44 have produced the largest crop on record in Mesa County.

Two new peach diseases have been found: The bark cracking disease and the calico virus. The first of these has proved very destructive in California. The X-disease of peach has been found and is on the increase. Trees located have been destroyed.

Chemistry

Mineralization Changes in the Ground and Surface Waters of the South Platte Irrigation District of Colorado (Civil Engineering Section cooperating.)

Irrigation can in time salinize Colorado ground waters to such an extent as to render them unfit as well water for general farm home use or even for pumping irrigation. The absence of any intimate chemical data upon the ground and stream waters of the South Platte Valley was the reason for undertaking this study.

For 2 consecutive years, 1943-44 and 1944-45, about 70 samples of waters have been taken at 6-month intervals from the South Platte and its tributaries, as well as from farm water wells at specific locations; these were analyzed for mineral content.

Marked changes have been shown in stream waters as between November and May. Some wells show similar changes while others remain almost uniform. The information now gathered may prove important as years of irrigation farming go by.

Occurrence, Mineral Composition and Nutritive Values of the Forage Plants of Middle Park (Range Management Section cooperating.)

This project is now being brought to a close after 3 years study of 14 mountain meadows of the Middle Park region and also many individual plant species in the vicinity of Kremmling. The soils of part of the region carry selenium and molybdenum and it was desirable to learn whether or not meadow plants absorbed these elements in quantities toxic to livestock. Meadow and plant species were sampled each year at haying time and were subjected to thorough chemical analysis. Analytical work on this project is being completed. The major results appear to be that under irrigation selenium and molybdenum seldom appear in plants in definitely harmful quantities; certain dryland roadside weeds and herbs often take up large quantities.

Vitamin Synthesis in the Rumen (Animal Investigations Section cooperating.)

Investigation is in progress to isolate and identify the specific organisms normally present in the rumen contents of cattle and to study the ability of each type of organism to synthesize the various components of the vitamin B complex. Partial isolation of groups of organisms has been accomplished with rough quantitative indications of their ability to synthesize certain Bcomplex vitamins.

Relation of Certain Phases of Nutrition to Reproduction in Hereford Cattle

The work on carotene and its relation to reproduction is in its third year of study. Only progress reports have been written. A paper on the blood levels of calcium and inorganic phosphorus in Hereford cattle is being published.

DDT

Experiments are being conducted to determine the value of DDT dust in the control of grubs in cattle. Experiments will also be conducted in season to determine the value of DDT sprays for the control of hornflies on cattle.

Entomology

General Insects Investigations (Extension Service cooperating.)

In general, the insect problem was about the same as for the last few years. The oriental fruit moth made its appearance in the peach-growing district of Mesa county in the fall of 1944. This pest, if not checked, will prove a worse enemy to the peach industry than peach mosaic. The russet mite, a destructive pest of tomatoes, was found in Mesa County and spread rapidly. In California this is one of the worst tomato pests.

Control of Insects on War-Important Field Crops (Mesa County Research Committee cooperating.)

Experiments on the bean cutworm were carried out at Grand Junction, Fruita, Palisade, and Mack. DDT dusts and sprays, available for only a small acreage, appeared to be the most promising control. Cryolite and basic copper arsenate were second and third.

Two sprays of zinc arsenite did not give a complete control for Mexican bean beetles, which were numerous. The spread of the tomato russet mite is well under way, the mite being found at Clifton, Orchard Mesa, and Mack. This pest appears to winter over in Mesa County. Using a 3-percent DDT dust and $7\frac{1}{2}$ -percent thiocyanate dust around canneries controls drosophila.

Control of the Mexican Bean Beetle

The work in 1944-45 involved 294 plots. Basic copper arsenate, cryolite, rotenone, and zinc arsenite as sprays gave equally effective controls, although the yield from the zinc arsenite plots was reduced because of spray injury. Basic copper arsenate and rotenone as dusts gave yields equal to the most effective sprays, even though the rotenone dust plots showed considerable foliage injury from larvae. Cryolite dusts in 20, 30, 40, 50, and 60 percent concentrations failed to give satisfactory controls. Cryolite (40 percent) was used with five different carriers without significant difference in effectiveness. One pound of DDT to 100 gallons of water and DDT in dusts of 1, 2, $2\frac{1}{2}$ and 3 percent concentrations failed to give satisfactory control. Thiocyanate added to five concentrations of rotenone dust failed to increase the effectiveness of the rotenone.

Control of Potato Insects

Laboratory tests made during the winter indicated that DDT is quite effective against the adults and nymphs of the psyllid. No plant injury was noticeable with concentrations as high as 5 pounds per 100 gallons of water. In a field-plot test DDT was the most effective treatment. DDT-treated plants produced at the rate of 104.27 bushels more per acre than did the plants sprayed with liquid lime sulfur, the standard treatment most generally used throughout the State. The concentration used was 1 pound of pure DDT to 100 gallons of water. The most effective treatment for flea beetles was 1 pound of DDT to 100 gallons of spray.



Making analyses of DDT residue on pears in the chemistry laboratory.

Control of Codling Moth (State Bureau of Plant and Insect Control cooperating.)

DDT used at the rate of 0.4 pound per 100 gallons of water in the first two applications and 0.6 pound in the seven later applications gave results significantly better than were obtained with fixed nicotine, which was the next most effective material. The difference between results obtained with the DDTtreatment and eight treatments involving arsenate of lead and various combinations of soaps and oils as spreaders and ovicides was very highly significant. A split schedule consisting of arsenate of lead on the first brood of worms and DDT on the second brood gave results about equal to those from the fixed nicotine schedules but significantly better than with arsenate of lead throughout the season.

The standard hydrochloric acid wash was not effective in removing DDT residue. (Analysis of DDT residue made by the Chemistry Section.)

Aphid Yellows of Celery

It was demonstrated that plants will recover from this disease condition following destruction of the plant lice, *Aphis helianthi* Mondell, thus indicating the cause is a toxin rather than a virus. The insect spends the winter on dogwood and the summer on a considerable number of plants. It appears to come to the celery largely from sunflowers. In the greenhouse it will breed continuously on celery.

Effects of Sulphur Spray Residues Upon the Keeping Qualities of Canned Tomato Products

Periodic examination of samples has now been continued 31/2 years. Higher storage temperatures continue to affect can vacuum more than sulphur from sprays.

Improvement of Dusting Methods and Machinery for Greater Potato Production

Tests were carried out at the Colorado Potato Station at Greeley, in cooperation with the U.S.D.A. Results have not been reported.

Psyllid Resistance (U.S.D.A., Colorado Potato Station, Greeley, cooperating.)

Psyllid-resistant potato strains developed are still showing great promise.

Insect Vectors of Peach Mosaic

Further tests wih Myzus persicae Sulzer have been carried on and this pest has been definitely proved a vector. Bark from seedlings on which this plant louse was allowed to feed, was grafted into healthy June-budded Elbertas and the mosaic disease was transmitted to these trees in 39 out of 115 instances. A study of the various strains of mosaic is under way at the Whitewater, Mesa county, laboratory to determine the relationship between the presence of morning glory and the peach disease.

Forestry

Fence-Post Farm

The program is to establish a fence-post farm in which various tree species may be treated with different preservatives and tested under varying soil conditions.

The species used are western red cedar, lodgepole pine, and aspen. Creosoted, untreated, resin-impregnated and two treated with commercial preparations were used. Additional Colorado species, preservatives, and sites are to be included in the test.

Akron Shelterbelt (Agronomy Section cooperating.)

The program is to allow the shelterbelt area to lie fallow and then to plant it to trees. Records of grain yield for calibration purposes were collected by the Agronomy Section. It is planned to carry out the tree planting in the spring of 1946.

Home Economics

Properties of Colorado Fruits and Vegetables and Other Factors Which Affect Their Processing, Preserving, and Culinary Qualities (Chemistry, Horticulture, Pathology and Bacteriology, and Mechanical Engineering Sections cooperating.)

The fruits investigated included apples, peaches, pears, plums, and raspberries. Vegetables investigated included beets, greens, corn, peas, snap beans, asparagus, carrots, and tomatoes. Results clearly show the effects of variety, stage of maturity, and method of handling after harvest. The methods of preservation included canning, dehydration (except with asparagus), and freezing (except with plums). Cool storage investigations were made for products adaptable to this practice.

Significant ascorbic acid losses were general with cooking and holding vegetables. The results with carotene, riboflavin, niacin, and pantothenic acid varied with the commodity from significant losses to significant gains. In some cases no significant differences occurred.

The Baking of Flour Mixtures at High Altitudes (Chemistry Section cooperating.)

To date more than 50,000 individuals have received help as a result of the baking project. In addition, much fundamental information has been obtained. This forms a sound basis for future work. A bulletin on high altitude cookery is being published.

Horticulture

Effect of Soil Treatment on Color and Quality of Red McClure and Bliss Triumph Potatoes

Past results have shown that minor elements when applied alone are less effective in improving yield and quality of Red McClure and Bliss Triumph potatoes than when applied in combination. The combination of copper, iron, and manganese increased the skin color of tubers and, when added with fertilizers, increased yield.

This year cobalt and nickel were added to the minor element treatments. Differences in response to treatments were obtained again between the Bliss Triumph and Red McClure varieties of potatoes, indicating that varieties of potatoes will respond in a different way to fertilizer or minor elements. While these tests will have to be repeated for several years, the increases in yield and in quality may lead to improvement of soil fertility practices which will affect the yield of general farm crops as well as potatoes in the San Luis Valley.

Potato Breeding and Cultural Investigations (U.S.D.A. Bureau of Plant Industry cooperating.)

New seedlings were included in comparative trials in northern Colorado, the San Luis Valley, and Western Slope. The test is to determine the relative disease resistance of the new types and their commercial adaptation. Hybrid 6341 shows high scab resistance and high yielding ability. Two seedlings show tolerance to psyllid insect injury.

Ultraviolet Light Studies for Potato Virus Determination (Botany and Plant Pathology Section cooperating.)

Twelve authentic viruses were received for comparative studies and identification by ultraviolet light. They were found to fit closely the description given for the correlation of fluorescence and specific viruses in the Bliss Triumph variety of potatoes. Work was initiated to determine the possibility and accuracy of using the ultraviolet light fluorescence as a means of identifying viruses in other potato varieties. Seedling plants were used so that the healthy potato virus X was absent in making comparative readings.

Bacterial Wilt and Ring Rot of Potatoes (Botany and Plant Pathology Section cooperating.)

This is a dangerous disease of potatoes which can be spread very rapidly. Tests this year included a study of different chemicals as knife disinfectants in preventing the transmission of bacteria from infected tubers to healthy tubers at seed cutting time. Previous results indicate that the boiling-water method of disinfecting a rotary cutting knife is very effective. Mercuric chloride disinfectant used on the cutting knife was shown to be satisfactory. However, 5 gallons of the solution will safely allow cutting only 20 sacks of potato seed before it becomes of little value as a disinfectant. Only five sacks of potato seed can be cut without changing the solution if a 1-gallon tank of mercuric chloride is used to disinfect the rotary cutting knife. Transmission of the disease takes place after the fifth sack is cut. Two new widely advertised and sold chemical disinfectants for sterilizing rotary cutting knives were found to be of no value as a disinfectant.

Studies are being continued on resistance to symptom expression (or masking of symptoms by varieties or types.) There is a correlation of the relative numbers of bacteria present with the degree of symptom expression.

Types of Fertilizers and Rate of Application of Sulphur in San Luis Valley

Test plots were arranged so that comparisons could be made between a plot receiving no fertilizer and plots receiving nitrogen, potash, and phosphorus in the following ratios: 10-20-0, 10-18-5, and 5-31.5-2.5. The effect of adding sulphur to each of the fertilizer applications at the rate of 300, 600, and 900 pounds per acre was also observed. With the Red McClure variety a complete fertilizer with 300 pounds of sulphur gave the highest yields. However, with the Triumph variety, a 10-20-0 fertilizer with 900 pounds of sulphur gave the best response. With the Red McClure variety any complete fertilizer treatment which received less than 900 pounds of sulphur gave higher yields than either the unfertilized control or any treatment of 10-20-0 at any rate of sulphur addition. The 10-18-5 fertilizer combined with 300 pounds of sulphur gave favorable response.

In 1944 a plot was arranged which contained an unfertilized control, and a 10-20-0, a 10-18-5, and a 5-31.5-2.5 fertilizer plot. Each fertilizer was applied at 100, 200, and 500 pounds per acre. A complete fertilizer gave the best results with a differential variety response obtained on the Triumphs and Red McClure varieties.

Development of Disease and Insect Resistant Varieties of Onions (U.S.D.A. Bureau of Plant Industry cooperating.)

The development of F_1 hybrids of the Sweet Spanish and Danver types is being emphasized. By making use of the mode of inheritance of male sterility, it is possible to produce F_1 hybrids. This new method in plant breeding may open an entirely new field, making it possible to produce many hybrids with other open-pollinated crops.

Comparative yield tests of F_1 hybrids, determination of parents which produce F_1 sterile hybrids, and ability of parents to combine are being conducted this season.

Commercial Fertilizer Tests on Pod Peas in the San Luis Valley (Botany and Plant Pathology Section cooperating.)

While seed treatment and commercial fertilizers are helpful in reducing losses in pod peas, they do not control the trouble. Any condition such as unbalanced fertility levels or any cultural practice that weakens growth, predisposes the plant to root-rot attacks. Commercial fertilizer tests indicate that a combination of phosphorus and potash without nitrogen in the combination, or phosphorus alone, will extend the picking period of peas grown in the rocky, gravelly, sub-irrigated soil of the San Luis Valley.

Minor elements, such as copper, manganese, iron, and zinc were applied to the soil singly and in various combinations. No significant differences in stand or yield were obtained because of the high variability of the soil in which the tests were conducted. The results indicate that stand and yields are improved and less root rot will occur in soils where plants are not weakened by improper nutrient balances, unavailability, or other factors affecting nutrition of the plant.

Tomato Fruit Rot (Botany and Plant Pathology Section cooperating.)

The study of chemical spray and dust controls for tomato fruit rot were continued with the application of copper sulfate in the irrigation water being tested. While the method of application used needs considerable refinement, it shows some promise in the control of this water mold. The development and testing of tomato types and varieties for fruit rot resistance included 27 F_2 and 56 F_1 lines grown in the field in quantity. These were tested for fruit rot resistance in the laboratory under standard conditions.

Fruit Production

Variety testing, soil fertility projects, and pruning, thinning, harvesting, and storage tests were continued at the Fruit Substation at Austin. Two early varieties of peaches, Fisher and Viceroy, may extend the harvest period for high quality fruit in this area. Studies on chlorosis and on mineral deficiencies and excesses were continued and were expanded to the Mesa County area this season.

The commercial fertilizer trials in Mesa County orchards this year confirmed previous findings. On the basis of actual cost of material and application, the most economical yield increases have come from a nitrogen-bearing fertilizer, ammonium sulfate, used alone.

Testing New Crop Plants — New Vegetable Types in Colorado (U.S.D.A. and all state substations cooperating.)

The testing of major vegetable crops was conducted on all the substations in Colorado. The object was to determine the adaptability of varieties to specific growing conditions for irrigated valleys, for high altitude districts, and for the dryland sections of Colorado. Results show that certain varieties are adapted only to certain districts and for specific uses in the State.

The Bounty variety of tomatoes was found to be a continual good producer under dryland and mountain conditions where earliness is a factor. The Perfected Detroit variety of garden beet continually performed well as a bunching type, and Tendergreen or the Improved Stringless Green Pod bean has continually produced good yields of quality beans.

Rust Resistant Pinto Bean Tests (U.S.D.A., Agronomy Section, and all substations cooperating.)

Rust resistant pinto beans have been on trial to determine their comparative resistance to rust, and their commercial characteristics or yielding ability under irrigated growing conditions. Results show that three lines are high yielding, comparatively resistant to rust, and show promise as being adapted to production under irrigated conditions.

Poultry

Carotene and Riboflavin Content of Alfalfa and of Sprouted Grains for Poultry (Agronomy and Home Economics Sections cooperating.)

Carotene and riboflavin assays of different cuttings and varieties were made for the third consecutive year.

Limitations in the Use of Soybean Products in Poultry Feeding (Pathology and Bacteriology and Home Economics Sections cooperating.)

COLORADO AGRICULTURAL RESEARCH FOUNDATION PROJECT: This project attempts to determine the cause of poor reproduction encountered in feeding high soybean rations to poultry and whether the goitrogenic factor of soybeans is identical to the hatchability factor. The goitrogenic factor is not present in soybean ash and is not extractable from the meal by chloroform or ether; it is not destroyed by heating or autoclaving at 250° F. for $2\frac{1}{2}$ hours; it is similar to thiourea in one respect only, in that it produces intrafollicular hemorrhages. Cyanide does not seem to be responsible for the goitrogenic effect. A lifespan experiment was started in which birds were fed rations containing varying amounts of soybean oil meal throughout the life cycle. In contrast to previous results, chicks fed soybean oil meal as the only protein supplement made as satisfactory early growth as those fed a meat-scrap-supplemented ration. Birds fed a ration containing soybean oil meal as the sole protein supplement were slightly later maturing than those fed rations containing meat scrap. Hatchability in the experiment decreased consistently from 75 percent to 27 percent as the amount of soybean oil meal increased from 50 percent to 100 percent of the supplementary protein.

A hatchability experiment was conducted testing the effect of various substances upon hatchability of eggs from hens fed high levels of soybeans. A liver preparation fed at 0.25 percent of the ration increased hatchability from 41 percent to 75 percent. Casein feeding resulted in only a slight increase in hatchability. Iodinated casein fed at a level of 0.2 percent caused a market drop in egg production.

Cyanogenic substances may be removed from linseed meal by treatment with 50 percent ethanol. This residue supplements soybean protein for growth when fed in proportions of soybean 1, linseed 1 and soybean 2, linseed 1.

Poultry Laying Houses for Colorado (Mechanical Engineering and Home Economics Sections cooperating.)

Three laying houses are being tested for their adaptability for use in this climate. The six-month mortality for birds housed in September 1944 has ranged from 21.4 percent to 26.7 percent. Production has been slightly better in the Cornell house than in the Wyoming or Colorado type houses. The daily temperature range during February and March in the Colorado and Cornell type houses was approximately 10° F. greater than in the Wyoming house. The daily relative humidity range during February and March in the Cornell and Colorado type houses was approximately 50 percent greater than in the Wyoming type house.

Factors Affecting the Cooking and Nutritional Quality of Eggs (Home Economics Section cooperating.)

The various factors affecting egg quality in two groups of birds selected for high and low egg quality are being studied. A flock of 65 New Hampshire pullets was divided into flocks of high and low egg quality on the basis of egg measurements made by the Home Economics Section. Some hens were found which consistently laid strong eggs. Results indicate that the odors of eggs which are traceable to hereditary factors is at least partially, if not wholly, due to volatile organic bases. This odor is largely, if not entirely, lost during the cooking of the egg. It is not related to the diet of the hen producing these strong-odored eggs. Progress in the investigation of storage methods was limited by the type of plastic films available for container wrapping. So far the study has been confined to cellophane and waxed paper wraps.

Range and Pasture Management

Induced Revegetation of Depleted Range and Abandoned Cropland

Russian intermediate wheatgrass exceeds standard reseeding grasses in seedling vigor, ability to compete in mixtures, and depth from which seedlings emerge. Southern strains of bromegrass outyield northern strains; Fairway crested wheatgrass yields less than the standard strain, and blue grama grown from Flagstaff, Ariz., seed very significantly outyields all other sources. Intermediate wheatgrass mixtures continued to outyield brome-crested wheatgrass while Russian wild rye mixtures yield less. No new grasses appear too promising; however, a hybrid pasture type alfalfa appears promising.

Winterfat and four-wing saltbush (prominent range plants) germinate satisfactorily and show promise of field reseeding. Winterfat germinates more readily than other shrubs. It germinates best when planted in late fall or early spring, and retains its germinative ability only one season. Fall-collected seed germinates better than spring-collected seed. Late fall seeding appears superior to early spring seeding. Late spring seeding resulted in failures.

Crested wheatgrass and western wheatgrass in mixture gave better stands than grama grass mixtures on sandy land. Seeding depleted rangeland infested with snakeweed, a worthless half-shrub, gave very poor stands. A poor to fair stand of crested wheatgrass was established on abandoned cropland on a shale ridge.

Revegetation of Abandoned Croplands and Their Management (Cheyenne Wells Substation cooperating.)

Stand counts and observations reveal the following preliminary accomplishments, which may be changed by drought, grazing, or some other factor in the future: (1) To date no consistent differences due to date of seeding are apparent, except that June seedings have been unsuccessful. (2) Crested wheatgrass, intermediate wheatgrass, tall wheatgrass, bromegrass, Russian wild rye, and green needlegrass stands have been established on bottomland fallowed areas. Their use will greatly extend the grazing season because of early and late seasonal growing habits of these grasses. (3) Rhizomatous crested wheatgrass made a better first year stand than other strains; Springerville, Arizona, blue grama seed made a better stand and more growth than local seed; hulled buffalo grass seed germinated better than unhulled seed in the field.

Nutritive Value of Native Forage Plants (Chemistry Section and Rocky Mountain Forest and Range Experiment Station cooperating).

Monthly range forage samples of blue grama, buffalo grass, western wheatgrass, green needlegrass, prairie sage, wormwood, and winterfat (an important shrub) were again collected on the experimental college range pastures, as well as from the Nunn Experimental Range and from Manitou (Colorado Springs) for chemical analyses from early spring to late fall and late winter (February). Records of growth, yield, and utilization of these forage species and precipitation are obtained throughout the period of study.

Complete fodder and mineral analyses of at least 170 samples of forage have been made annually by the Chemistry Section. Fodder and mineral analyses made of the monthly forage samples have established the following facts concerning these principal forage plants of our foothill ranges:

(1) Young growth of grasses and weeds in spring and early summer rank comparatively high in protein but decline rapidly as the forage matures. This results in a protein deficiency during the fall and winter in these plants. The winterfat, however, retains a high protein level throughout the fall and winter. The extra value of palatable shrubs can effect either an increase in livestock production in the fall or a reduced need for winter protein supplements by reserving such feed for fall or winter use.

(2) There is a phosphorus deficiency in all forage species from late summer throughout the winter. The decline to a deficiency level coincides with seed stalk heading time; however, certain late-maturing weeds retain adequate phosphorus later in the season than other plants.

(3) There is an adequate calcium content in all forage plants throughout the year, but weeds and palatable shrubs are significantly higher in this mineral than grasses. The practical significance of these studies is that a good mixture of palatable perennial grasses, weeds, and browse provides a more balanced ration and is therefore more conducive to maximum range livestock production than a pure stand of a single-grass species.

Improving Sagebrush Lands for Increased Livestock Production (Soil Conservation Service cooperating.)

Livestock men in the Western Slope area of Colorado are much concerned over the vast areas of sagebrush land that have very limited forage production. The results of 2-year studies near Craig show that cattle make substantial gains in weight on sagebrush-grass ranges. In 1944 with a substantial amount of feed remaining on October 1, the cattle were still in excellent condition. Indications are that improved sagebrush range is satisfactory range for summer grazing of cattle. It is planned to continue the cattle grazing for at least 3 more years, to be followed by sheep grazing on a spring-fall basis.

Two-year nursery tests of introduced and native grasses indicate the care needed in selecting grasses for reseeding on different types of soil and slope. The standard crested wheatgrass grows excellently under all conditions; bromegrass, slender wheatgrass, and one introduced strain of erect brome (Russian) show considerable promise on the cooler sites. Grasses fully utilized in grazing tests in September included bromegrass, Russian wild rye and Russian erect brome, Mecca rye (a strain of slender wheatgrass developed in Canada), and beardless blue bunch (a native). Crested wheatgrass and its allied strains showed practically no use. Such information indicates grasses that are valuable for summer grazing in the sagebrush types.

It may take 2 or 3 years for a seeded grass stand to become fully established as shown by 1941 crested wheatgrass seedings at Great Divide.

Occurrence, Mineral Composition and Nutritive Values of the Forage Plants of Middle Park (Chemistry Section cooperating.)

For the fourth year, composite mountain meadow hay samples were collected prior to hay harvest on 14 ranch meadows in Middle Park. At each sampling point the species composition, hay yield, and character of meadow management practice were recorded.

Some of the important findings already discovered: (1) The mountain meadows varied in character from the meadow having only 14 percent of seeded tame species to the meadow at the

other extreme with almost 66 percent of the stand composed of seeded tame forage plants. (2) Great variation in the abundance of clovers and legumes is apparent. The degree of abundance of alsike clover is reflected in the protein and calcium content of the hays; the greater the amount of clover the higher the protein and calcium but not phosphorus. (3) High yield of meadow hay and quality of meadow hay are not necessarily always related. A meadow that ranked highest in quality (protein, calcium, and phosphorus) was lowest in yield. The increase in quality appears largely due to the high proportion of dandelion in the stand. The 1943 mineral analyses reveal that dandelion was highest in phosphorus, which mineral seems to be deficient in Middle Park havs. It also ranks next to the clovers and alfalfa in protein content. (4) Hay from upland meadows ranks higher in protein, calcium, and phosphorus than lowland meadows. Although hay yield is less, because of insufficient irrigation water, the quality compensates for lower yields. Better management of the upland meadow also is a factor in the improved quality of hay. Upland meadows were more recently seeded as meadows: therefore with a minor stand of water-loving vegetation present, it was possible to reseed them to tame grasses and alsike clover. (5) It is probable that there exists a phosphorus deficiency, at least for growing livestock on certain meadows. Many of the meadows approached the deficiency level in 1 or more of the 3 years. Inspection of two phosphate-fertilized meadows appeared to show a response in increased yields. (6) Clovers and legumes rank highest in crude protein, followed by sedges and rushes, with the grasses as a group at the bottom.

Improved Range Practices to Increase Livestock Production (Animal Investigations Section cooperating.)

The experimental program consisted of a grazing trial from June 1 to September 30 in which deferred-rotation grazing of 20 purebred cows and their calves in two pastures was compared with conservative season-long grazing of 10 purebred cows and their calves. In addition, 10 head of dry cows were left on the pastures after September 30 for 20 days to observe any shrinkage in weight.

Results obtained: (1) Forage development was better for blue grama and buffalo grass (warm season grasses) because of better mid-summer precipitation. (2) Livestock gains were less than for 1942 and 1943. (3) Cattle pastured conservatively for the season produced 18.65 pounds of gain per acre as compared with 14.55 pounds gain for those pastured on the deferred-rotation pastures. (4) Critical analysis of gains on each pasture reveals that the deferred pasture has produced more beef per acre than the conservatively grazed pasture during the last half of the grazing period. This indicates that cows with calf may be expected to produce more beef when rotated to fresh pasture in mid-season. (5) Dry cows merely maintained their weight when held on pasture from October 1 to October 20.

Evaluation Surveys of Colorado's Native Vegetation to Determine Range and Production Capacities

Field work in this project was very limited during the past year. The extremely wet spring in 1944 was an important factor in maintaining the high density of the shortgrasses (blue grama and buffalo grass) in the Great Plains.

The land resource data from the Elbert County range resource survey was compiled and forwarded to the Elbert County Planning Committee. It was needed to make postwar plans for Federal aid on farm and ranch highways.

Rural Economics and Sociology

Farm Business Analysis Studies as Affected by World War II

Detailed financial data has been obtained from (a) representative irrigated farms in the Fort Collins-Greeley area, (b) representative dryland farms located in the northeastern corner of Colorado, and (c) winter feedlot operators in the Fort Collins-Greeley area. By analyzing these data and making comparisons with data for earlier years, general counsel and advice has been given in regard to farm problems in the area. These data likewise contributed to the reports made to the War Food Administration.

Effect of Recent Changes upon the Economic Relationships Between Colorado Ranch and Range Properties

The program continues to determine the changes in ranch organization, management expense, and income that have resulted from developments in production, marketing, financing, and public land administration. Summary records have been obtained from a group of cattle and sheep operators in western Colorado. These data are to be used in developing sound tenure policies for areas involving private and public lands, and they were also used in reports to the War Food Administration on production adjustments in Colorado agriculture.

Faster, easier cutting, inexpensive construction, and effective ring rot control characterize this two-edged knife potato cutter. It is 25 percent faster than the rotating disc because it requires fewer and shorter hand motions. As shown by the white strings, the first cut is made by pulling the potato toward the operator, and the second by pushing in the opposite direction. The cut potato is dropped in the opening as the second stroke is completed, and the operator reaches for another potato. Disinfecting fluid runs from the 5-gallon can down through the rubber hose to the knife to prevent kulfe-spread of ring rot infection. Five gallous of fluid will keep the knife clean during a full day's cutting.



Farm Work Simplification Studies in Colorado (Extension Service cooperating.)

The program has been to analyze those operations in crop production which use hand labor, and to develop methods of simplifying these jobs and of training laborers to acquire skill. Accomplishments include development of a method of cutting seed potatoes which is 25 percent faster than the best methods used in Weld County. The equipment costs about one-fifth of that formerly used. Results are about ready for publication. Press bulletin 98, "How to Pick More Potatoes," has been published.

Wartime Problems in Marketing Colorado Fruits and Vegetables and in Production and Marketing Colorado Poultry Products

Several of the larger midwestern markets and some of the smaller towns were visited to determine the market attitude toward Colorado peaches and to learn how Colorado fruit compares with peaches from competing states. These markets, with one exception, preferred Colorado peaches, which were generally superior in quality and size but were not displayed as attractively as peaches from other states. Brushing and washing peaches seem of increasing importance. Also, Colorado advertising fails to distinguish between producing areas and is not coordinated with the time peaches are available in specific markets.

Techniques and Procedures Associated with the Administration of an Overall County Agricultural Program in a War Economy

Office analysis of data pertaining to techniques and procedures of planning has shown that leadership training in the whole field of county agricultural extension work has been neglected. It has been found that special aptitudes are needed for special tasks and that county extension work will improve when more attention is given to this problem and to the human and social factors which contribute to success or failure of the program.

Seed Laboratory

Colorado Seed Testing Laboratory

Data reveals that work done by the Seed Laboratory has increased 138 percent during the last 3 years, or an average of 45 percent per year, while the expenditures have increased 36 percent, or an average of 12 percent per year. A large number of grass seed samples have been received from cooperators in the AAA program. Government purchases of onion seed have resulted in a marked increase in onion seed samples. Compliance with the new Colorado seed law has been gratifying, cooperation having been increased by seed inspection activity. Data as to the time required for the analysis of different types of seeds and samples of different degrees of purity have been accumulated over the past 3 years to afford a factual basis for determining fair charges for the Laboratory service.

Weed Control (Botany and Plant Pathology Section and Chemistry Section cooperating.)

Weed control work has been combined with seed work. This is a common and practical arrangement. The last Legislature made a special appropriation for investigations in bindweed control. One phase of the research program involves testing the new hormone or hormone-like herbicides. Fifteen or more of such preparations are now being investigated. Another phase involves seeking new and more effective herbicides. The Chemistry Section synthesized and prepared weed killers so that the herbicidal value of other hormones and related organic compounds could be studied. A third phase involves investigating the possibilities of the use of electricity in destroying weeds. Cultural and other methods of weed control will continue to be investigated as conditions warrant.

Veterinary Pathology and Bacteriology

Abscessed Livers in Cattle (Animal Investigations Section cooperating.)

Work conducted on this project during the past year may be divided into two phases: A study of the period of development of abcesses, and a study of the prophylactic effect of supplementary vitamin A fed during the fattening period on the development of abscesses.

To determine the period at which abscesses develop, an experiment was conducted using 125 Hereford heifers from Texas and 100 Hereford steers from Colorado ranges. At the beginning of the fattening period and at 40-day intervals thereafter, random samples of cattle were slaughtered. Several conclusions were drawn from data obtained by a careful study of the livers: (1) Liver abscesses develop both on the range and in fattening pens; (2) feedlot abscesses develop early in the fattening period; (3) the duration of an abscess is approximately 120 days, after which abscesses decline and scar tissue increases; (4) telangiectasis and "sawdust" may be related to abscessation.

In the vitamin A phase of the experiment 420 Hereford steers were divided into two pens and given equal management and basal rations. One pen received supplementary vitamin A to the extent of 45,000 U. S. P. units per head daily for 100 days. The pen receiving vitamin A supplement had 18 percent abscesses, 9 percent telangiectasis, and 3 percent "sawdust" livers. The pen not receiving vitamin A had 21 percent abscesses, 18 percent telangiectasis and no "sawdust" livers. This experiment is being repeated.

Overeating in Feedlot Lambs (Animal Investigations Section cooperating.)

Work on this project this year has been centered on methods of prevention. One method tried was an attempted immunization with a *Welchii* toxoid. Four lambs were treated, and after a sufficient incubation period were injected intravenously with doses of toxin sufficient to kill normal untreated lambs within 8 hours. Two of the four treated lambs lived. A lot of 50 lambs were treated with this toxoid and then self-fed grain through the feeding period. Ten of these lambs died of overeating as compared with 4 in another lot of 50 untreated lambs fed the same ration. No protection was shown.

Another method for the control of overeating was the use of sulphur incorporated in the grain ration. With the co-operation of two local feeders, 2,400 lambs were used in this experiment, 1,200 being fed sulphur and 1,200 serving as controls. In the 1,200 hand-fed lambs given sulphur, only 7 (0.58% died from overeating as compared with 33 (2.75%) of the 1,200 lambs not given sulphur. This difference is believed to be quite significant, but the work should be repeated where conditions can be more carefully controlled. To subject sulphur to a more critical test, 50 lambs were self-fed grain in which sulphur was incorporated in the same manner as those treated with toxoid and the 50 controls described above. Two of these sulphur-fed lambs died of overeating. This is a mortality of 4 percent as compared with 8 percent of the controls and 20 percent of the toxoid lambs.

Feedlot Gains of Lambs as Affected by Drenching (Animal Investigations Section cooperating.)

In this project half the 240 lambs in 12 lots which were used for feeding experiments were treated, the other half being used as controls. A copper-sulphate-nicotine drench was used. Only one dose was given, which was administered on November 21, 1944, when the lambs were started on feed. The lambs were slaughtered on March 16, 1945, and the livers were examined for tapeworms.

In the treated lambs, 15.8 percent were found to have fringed tapeworms in the livers while 20 percent of the control lambs were affected. This is a difference of only 4.2 percent in favor of drenching. From this and previous work it would seem that treatment should be administered earlier in the season while the tapeworms are still in the intestine. No significant difference in gains was noted.

Problems Affecting the Fur-Bearing Animal Industry in Colorado

DISTEMPER—Two spontaneous outbreaks of distemper in foxes and mink following interstate shipments of show animals were treated and a preventive vaccination program was begun. Immunization of foxes and mink on seven ranches by the Green Distemperoid method proved highly successful.

LEPTOSPIROSIS IN FOXES—Following numerous reports that this disease had appeared on Colorado ranches, 110 foxes from 3 of the ranches were blood tested. Since no reactors were found, this disease cannot be considered a new entity affecting the fur industry.

LUNGWORMS—Fecal examination on experimental foxes housed on raised wire floors for 2 years showed the infection still present. It is therefore concluded that the widely advocated raised wire pens do not serve to eliminate lungworm infestation in foxes.

EAR MITES—This pest has rapidly spread over Colorado ranches in the past few years. A 5-percent solution of thiocyanate esters of aliphatic fatty acids in mineral oil proved highly effective against ear mites in foxes, and this product is now widely used on ranches.

FLEAS—These thiocyanates were incorporated in a special powder base and proved effective in keeping ranches reasonably free of fleas.

AUTOPSIES—Two hundred ninety two foxes and mink were examined for routine diagnosis.

NUTRITION IN RELATION TO PUP LOSES—To determine the effect of nutrition on pup-loss at or after birth (lactation failure, etc.) a special cereal mixture for fox feed was devised (Poultry Section cooperating). The growth-promoting vitamin potencies of the cereal were tested on day-old chicks, and after 6 weeks' feeding the new cereal was found to be twice as potent as the standard brand used by the farmers. Twenty-two fox ranches are feeding this product in a cooperatively mixed feed in preparation of the herds for this breeding season. The feed produced excellent growth of last year's young and the effect upon whelping will be seen shortly.

Tests are being continued to investigate the merits of the addition of ground offal from poultry packers as a substitute for beef by-products, which are difficult to obtain. This material substantially increased the palatibility of fox feed as seen in increased feed consumption.

BREEDING—Five to 15 mg. of testosterone propionate eliminated impotence in 6 out of 10 male foxes and increased breeding efficiency in 22 out of 28 males. Shy-breeding vixens were brought into season with repeated doses of 1 mg. of alpha-estrodiol-dipropionate.

Nymphomania in Cattle (Animal Investigations and Poultry Sections cooperating.)

COLORADO AGRICULTURAL RESEARCH FOUNDATION PROJECT: This project attempts to determine the cause and treatment of nymphomania in dairy and beef cattle. In an attempt to produce nymphomania experimentally, 6 yearling dairy heifers were treated with 5,500 mg. of testosterone propionate over a period of 9 months. The heifers were changed in behavior, body conformation, and voice to that of bulls, with greatly enlarged clitori, atrophic udders, constant heat, and loss of weight. The pituitaries became degranulated and the adrenals granulated. Cystic ovaries and atonic uteri were not produced. Since nymphomania appears in cows 4 years old and older, the work was begun with mature, high-producing dairy cows. Feces and urine were collected from three cows in various stages of lactation and reproduction for 22 days and nights to determine the hormonal output and metabolism of normal cows. These feces and urine samples are being extracted and fractionated and the fractions assayed on chicks by the comb-growth method.

The dried feces from the above normal dairy cows were found to contain large amounts of male hormones as demonstrated by a 350-percent increase in comb weights when 10 percent was fed to pullets and cockerels. Fractionation showed these feces to contain up to 40 mg. of 17-ketosteroids per 100 gm. of dried material. The possibility that cow feces constitute a new and cheaper source for commercial exploitation is evident.



That cow manure contains large amounts of male hormones, a fact suggesting possible commercial exploitation, was demonstrated by feeding dairycow feces to chickens. Left, chicks fed a normal ration; right, chicks whose ration included 10 percent dried cow manure.

Bovine Mastitis (Animal Investigations Section cooperating.)

During the past year a survey has been conducted to determine the incidence of infectious mastitis of dairy cattle in Colorado. To date, 2,106 animals in 125 herds have been examined. Eighty-eight and eight tenths percent of the herds and 28.92 percent of the animals were found to be infected with streptococcic mastitis. Two and four tenths percent of the herds and 50.38 percent of the animals were completely negative. In addition 5.5 percent of the animals were found to be infected with other organisms causing mastitis. Thus, 34.42 percent of the animals examined, or more than one out of every three cows, have been found to be affected with some form of bovine mastitis. Control work has been started in two experimental herds consisting of some 150 animals. Various therapeutic agents are being used in the treatment. There has been a definite increase in both the quantity and quality of milk production.

ENGINEERING DIVISION

Civil Engineering

Government Cooperation

The work of the Civil Engineering Section is carried on in cooperation with the Division of Irrigation of the Soil Conservation Service, United States Department of Agriculture.

Meteorology

The regular twice-daily observations on meteorological conditions at the College were continued without interruption. These include: Barometric pressure, current temperature, maximum temperature, minimum temperature, dew-point temperature, relative humidity, precipitation, soil temperature at depths of 3 inches, 6 inches, 1 foot, 2 feet, 3 feet and 6 feet and air temperature 6 inches above the surface. Evaporation observations are made during the ice-free part of the year. Continuous records made by instruments are kept of wind direction and velocity, duration of sunshine, temperature, rainfall, and barometric pressure.

Records are made at the Airport Station of wind direction and velocity. Airway observations, made eight times a day by student observers, include ceiling, sky, weather, visibility, temperature, dewpoint, wind direction, and wind velocity.

Structures and Devices Used in Irrigation

A model of a riffle-deflector type of sand trap was laboratory tested and found to capture effectively from 85 to 90 percent of the moving bed load. Both sand and coal were used as media. Inspection trips were made to view canals in Colorado, Utah, and New Mexico for the purpose of advising on sand-removal problems. Three small structures for dividing water were designed for canals in Colorado near Fort Morgan, Longmont, and Fort Collins.

Canal Seepage

A preliminary report was prepared from data gathered on an extensive survey of canal seepage made in California in 1922. Inspections were made on seepage conditions from canals in Oregon and seepage losses were measured from a lateral on the College farm at Fort Collins and another near Gilcrest.

Application of Irrigation Water

From supervised farmer-kept records of use of water on about 75 farms in Logan, Morgan, Boulder, and Larimer Counties, no relationship appeared evident between crop yield and water applied. This result was anticipated. Since soil type and soil fertility are important factors in yield, direct comparisons are not valid in uncontrolled data of this character. However, the records revealed curious practices in applying water. It is quite evident that much water is wasted either in applying excessive amounts at one time or making unnecessary applications. The average seasonal use on sugar beets was found to be 29.8 inches, on wheat 12.2 inches, on alfalfa 17.7 inches, on barley 12.4 inches, and on corn 12.3 inches. Variations of 500 percent occurred.

A controlled experiment on the application of two heavy, two light, one heavy and one light irrigation to oat plots indicated that one irrigation of 4.6 inches when the grain was in the boot stage was as effective as two irrigations totaling 15.1 inches. A second experiment on sugar beet plots corroborated previous work on beets in that greater efficiency was obtained in applying five light irrigations than with either four moderate or four heavy irrigations. Five irrigations totaling 17.0 acreinches produced 5,970 pounds of sugar per acre, four irrigations totaling 24.2 acre-inches produced 5,680 pounds, and four irrigations of 31.4 acre-inches produced 5,410 pounds. A potato irrigation demonstration indicated that seven irrigations with water applied in every furrow produced better results than fewer irrigations or when water was applied to alternate furrows.

Ground-Water Supply of Prospect Valley

This investigation, which was begun in 1942, was completed and a report has been prepared for publication as a technical bulletin. Except for two 1-year periods since 1933, ground water has been withdrawn by pumping in excess of the replenishment rate. A maximum lowering of the water table of 17 feet has occurred in places during the 11 years since pumping began.

Ground-Water Supply of Big Sandy Valley

A reconnaissance survey was made of ground-water possibilities for pump irrigation in Big Sandy Valley. Opportunities exist in the creek-bottom lands throughout most of its course and on parts of the large tributaries for obtaining moderatecapacity irrigation wells. Eleven wells were found in operation during the 1944 irrigation season.

Ground-Water Fluctuations

Depth-to-water measurements were made in the spring and fall in about 190 observation wells in the South Platte and Arkansas Valleys. No significant water-table changes occurred during the year.

Design and Operation of Pumping Plants

Observations were made at the Bellvue laboratory on the loss of head through a 12-inch light-weight check valve for discharge from 100 to 3,000 gallons per minute. Loss of head studies were also conducted on 6-, 8- and 12-inch gate valves at various gate openings for a wide range of discharges.

Out-of-State Investigations

An inspection was made of the pumping conditions in the High Plains area of Texas and a report prepared. In Washington and Oregon, inspections were made of projects involving the drainage of tidal lands by means of pumping. Recommendations were made on methods of improving the operation of these pumps.

Snow Surveys and Irrigation Water Forecasts

Snow surveys for forecasting irrigation water supplies have been continued for the Missouri, Arkansas, Colorado, and Rio Grande drainage basins. The snow courses directly reporting to this office, of which there are 194, are located in Colorado, Wyoming, South Dakota, New Mexico, and Arizona. Supplemental snow-course data are submitted by the states of Montana, Idaho, and Utah. The usual snow-survey and irrigation water supply reports were issued in February, March, April, and May. In addition to these, special short reports were issued for Arizona in January, February, and March.

More forecasts of stream flow than in the past were made on streams where accumulated data were sufficient to indicate existence of definite correlation between snow depth and runoff. These forecasts will be extended to other streams as rapidly as conditions permit. The relative accuracy of the forecasts made April 10, 1944, on total stream flow for the months of April, May, June, and July was excellent.



This is one of the pictures used in the photographic method of determining snow cover from which an accurate forecast of water flow in the Cache In Poudre River was made.

The photographic method of determining snow cover was continued by taking pictures on April 1 and May 1 of the usual mountain area in the Cache la Poudre River drainage. A forecast of the flow of the Poudre River based on the snow cover pictures was made on April 1. A flow of 172,000 acre-feet was forecast for the period from April 1 to July 31. The actual flow was 187,000 feet.

Mechanical Engineering

Sugar Beet Machinery Development (U.S.D.A. cooperating.)

Work has been devoted to planter improvements, mechanical thinning techniques, and mechanical harvesting developments. Planter improvements have been designed (1) to secure a higher percentage of healthy seedlings per seed ball planted and (2) to secure an improved distribution of plants which in turn would facilitate mechanical thinning. These objectives have been sought by the building of a large variety of planter improvements which will be compared in an extensive field trial during 1945.

Sugar beet harvesters have developed to the point where several hundred have been built commercially. These machines have performed quite satisfactorily where conditions were not too difficult. There still remains a serious problem of separating

FIFTY-EIGHTH ANNUAL REPORT

beets from clods where the soil is heavy. This difficulty is being approached by incorporating hand laborers on the harvester to do this separating. This idea which has been developed here at the Station shows considerable promise and is being tried out more conclusively in 1945.

Mechanical thinning tests in 1945 showed from 7 to 9 percent loss as compared with handwork, while showing a 70 to 80 percent saving in labor involved. Trials will be continued.

Potato and Onion Storage (Horticulture Section and U.S.D.A. cooperating.)

The major activity was the design and building of a 70,000bushel experimental storage for potatoes and onions at Keensburg incorporating (1) improved insulating and ventilating systems, (2) an entirely new large-container system of handling and storing potatoes and onions, and (3) mechanical handling. Apparently excellent quality can be produced, and the labor saving by lift-truck handling was demonstrated.

"The Victory Garden Cellar" was published as an aid to noncommercial growers in constructing storage. Three additional publications on potato storage were published in cooperation with other states. The War Production Board of the Denver headquarters region has routed all priority requests on storage structures through this office. In some cases substitute plans were made incorporating improvements in design and use of noncritical materials.

Feed Processing (Animal Husbandry Section cooperating.)

Investigations have been conducted as follows: Power and labor requirements for handling bulk cull potatoes; cooking potatoes in large quantities; chopping green alfalfa, sweet clover, wild lettuce, and discarded grain crop for silage.

Unloading of potatoes from cars into trucks was done mechanically. Potatoes were cooked at the rate of 8 tons per hour, using 50 pounds of coal per ton of potatoes cooked. If a less efficient boiler were used, it might be expected that the cost for coal might amount to 30 cents per ton of potatoes. Potatoes were delivered into silos at a temperature of 145° F. A highly satisfactory grain mixer was designed and built which would meter any desired quantity of cracked grains into the green silage as it was cut in the field.

Equipment Design

An inspection trip indicated the possible development and use of electrical equipment for killing weeds such as bindweed. A "flow meter" was built which can be attached to a gasoline engine, such as on a tractor, and instantaneous readings of gallons of gasoline per hour consumption can be taken. The principles involved are not original; however, the instrument is worthy of extended use. Rabbit hutches were designed and built incorporating many of the most desirable features of sanitation, labor savings, cost, and improved production.

Plans for a mechanical manure fork designed by the Farm Superintendent have been drawn and are ready for publication.

SUBSTATIONS

Substation programs are designed to aid farmers in meeting the problems and obstacles peculiar to farm and livestock production in different districts of Colorado. The wide diversity of agricultural production and of climate has created many special problems which can be studied only in the local areas where they occur. Each substation has a local advisory committee which is consulted on local policies, the relative need and importance of research programs, and on any new emergency problem that may need attention in the district.

The programs of all substations include: (1) Testing of new crops, new range grasses, and new varieties of important crops; (2) conducting of livestock feeding tests, using locally grown feeds, and studying local livestock management problems; (3) testing the application of new facts developed at the main station, such as new chemical treatments for soils, new insect, disease, and weed control methods, and others; (4) work on local soil fertility problems peculiar to a local district; (5) taking up emergency problems as they develop during the growing season; (6) arranging field days, demonstrations, and meetings with growers through the Extension Service; and (7) studying range reseeding practices and methods of improving livestock grazing practices.

Ten different sections of the main station carried work in cooperation with the substations on livestock and crop production problems. Several thousand visitors attended field day programs on the substations; these programs serve as a means of acquainting farmers with the work carried and afford a direct local contact with research work. Under war-time conditions the interest and attendance was especially high.

Popular Bulletins:

No.

Title and Author

- 486 "Land Types in Eastern Colorado," by L. A. Brown, D. S. Romine, R. T. Burdick, and Alvin Kezer.
- 487 "Spring Wheat Production in Colorado," by D. W. Robertson, Dwight Koonce, and J. F. Brandon.
- 488 "Improving the Distribution of Water to Farmers by Use of the Parshall Measuring Flume," by R. L. Parshall.

Press Bulletins:

- 98 "How to Pick More Potatoes," by J. L. Paschal.
- 99 "The Effect of Planting Dates on the Yield of Triumph and Red McClure Potatoes in the San Luis Valley," by John G. McLean.

Bimonthly Bulletins:

Vol. VI, No. 4, Colorado Farm Bulletin, July-August, 1944.

Vol. VI, No. 5, Colorado Farm Bulletin, September-October, 1944.

Vol. VI, No. 6, Colorado Farm Bulletin, November-December, 1944.

Vol. VII, No. 1, Colorado Farm Bulletin, January-February, 1945.

Vol. VII, No. 2, Colorado Farm Bulletin, March-April, 1945.

Vol. VII, No. 3, Colorado Farm Bulletin, May-June, 1945.

Annual Report:

Fifty-Seventh Annual Report, Colorado Agricultural Experiment Station, 1943-44.

Other Publications:

Forty-five papers by Station staff members were edited for publication in scientific journals and elsewhere.

Forty-three radio manuscripts and 103 news stories were written. Six issues of the "Monthly News Letter," containing news of the College and of Station workers, were mailed to staff members in military service.

Miscellaneous:

A total of 43,459 bulletins were mailed, of which approximately 18,000 were in answer to individual requests and the rest sent to addresses on the Farm Bulletin and regular bulletin mailing lists. One thousand five hundred and ninety-five requests for information could not be handled by sending bulletins, and these were sent to various sections of the Experiment Station for individual replies.

Out of 16,000 "New Bulletins" card3 sent out, 1,395 were returned, requesting 4,446 bulletins and 426 "Lists of Available Publications."

A pictorial progress report on the potato utilization project was prepared and sent to the Office of Experiment Stations.

Staff Contributions

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- Binkley, A. M. Tests Conducted in Mesa County on Bean Cutworm, Potatoes, and Peach Production. Colo. Farm Bul. 7(1):14-5. Jan.-Feb. 1945.
- Binkley, A. M. Trials of Vegetable Crop Seed Production Are Conducted in New Districts in Colorado. Colo. Farm Bul. 6(6):2-5. Nov.-Dev. 1944
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- Bryant, L. R. and J. L. Paschal. Check List for Cherry Pickers. Colo. Exp. Sta. mimeo. July 1944. Misc. Series 243
- Burdick, R. T. Should Colorado Farmers Increase Their Acreage of Sugar Beets in 1945. Mtn. States Beet Grower 694-5:4. Jan.-Feb. 1945. Misc. Series 257
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- Connell, W. E. Cooked Waste Pinto Beans Found by Tests to Be Good Protein-Rich Feed for Hogs. Colo. Farm Bul. 6(4):4-6. July-August 1944
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- Connell, W. E. and R. C. Tom. Cattle Wintering, Grazing, and Fattening Tests are Conducted in Eastern Colorado. Colo. Farm Bul. 7(1):10-3. Jan.-Feb. 1945
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- Connell, W. E., R. C. Tom, (E. J. Maynard, H. W. Dahlberg, and H. C. Millar). Ammoniated Beet Pulp and Urea Tested as Protein Sources for Fattening of Cattle. Colo. Farm Bul. 6(5):9-12. Sept.-Oct. 1944
- Connell, W. E., L. E. Washburn, R. C. Tom, E. M. Mervine, and J. T. Strate. Potatoes Tried as Cattle Fattening Feed in Tests at Station; Results are Reported. Colo. Farm Bul. 7(2):6-10. March-April 1945
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- Deen, J. L. The Second Mile Up is Forested. Amer. Forests 51(6):284-7. June 1945. Misc. Series 269-A
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- Deming, G. W. Saving a Small Stand vs. Replanting. U & I Cultivator 5(1)14-5. March 1945 Misc. Series 268
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- Edgar, Alfred D. Potato Damage from Field Exposure Following Digging. Spud Notes 2(8):1-2. August 1944. Misc. Series 245
- Edmundson, W. C. Distance of Planting Potatoes. Spud Notes 3(4):2-3. June 1945. Misc. Series 269
- Edmundson, W. C. Hail Injury. Spud Notes 2(8):3-4. August 1944. Misc. Series 245
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- Edmundson, W. C. The Effect of Psyllid Injury on Seed Potatoes. Spud Notes 3(2):2-3. April 1945. Misc. Series 265

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- Forsberg, J. L., Edward Olson, and A. M. Binkley. Experiments with Pea Seed Treatments in Colorado. Phytopath. 34(8):753-9. August 1944. Sci. Jour. Series 183
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- Hudson, Gerald T. Mesa County Peach Marketing in 1944. Mesa County Research Comm. mimeo. Dec. 1944. Misc. Series 252
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- Paschal, J. L. Check List for Potato Pickers. Colo. Exp. Sta. Mimeo. Sept. 20, 1944
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- Pyke, W. E. Packaging is Means of Preserving Eggs; Treatments Within Egg Cartons are Helpful. Colo. Farm Bul. 7(3):9-14. May-June 1945
- Fyke, W. E., Elizabeth Dyar, and William W. Allison. Colorado Progress Notes on Nutrition Research, No. 3. Colo. Exp. Sta. mimeo. Jan. 1945. Misc. Series 258
- Robertson, D. W. What Hybrid Corn is and How Different Types of Hybrid Corn are "Made" Explained. Colo. Farm Bul. 6(4):2. July-August 1944

- Schaal, Lawrence A. Scab. Spud Notes 3(2):4. April 1945. Misc. Series 265
- Simonds, Austin O. and W. A. Kreutzer. Infection Phenomena in Tomato-Fruit Rot Caused by Phytophthora Capsici. Phytopath. 34(9):813-7. Sept. 1944. Sci. Jour. Series 184
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- Wilgus, H. S., Jr. and D. V. Zander. Minimum Levels of Animal Protein for Reproduction. Poultry Sci. 23:344-6. July 1944. Sci. Jour. Series 171
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Personnel

The Station staff continued to be reduced by members on military and staff leaves. All those members on staff leave during the fiscal year 1943-44 continued on leave during the past year, with the exception of Robert Gardner, associate agronomist, who rejoined the staff in January 1944. However, Leslie B. Daniels, associate entomologist, left on sabbatical leave starting October 1944.

Those who went on military leave during the year were Allen Heidebrecht, assistant animal husbandman, in May 1945; and Donald Zander, of the Pathology and Bacteriology Section, in April 1945.

The following were on military leave during the entire year: George A. Beach, assistant horticulturist; Robert Eslick, Ralph Weihing, and Robert Whitney, assistant agronomists; Warren H. Leonard, agronomist; Melvin Hazaleus, assistant animal husbandman; H. H. Stonaker, associate animal husbandman; Frank J. Kapel, assistant in range management; Max E. Tyler, assistant bacteriologist; Marvin Russell, associate editor; and Herbert S. Wilgus, Jr., poultry husbandman.

There were three resignations from the staff during the year. They were: J. L. Forsberg, assistant plant pathologist, in January 1945; John G. McLean, horticulturist, in February 1945; and Ronald C. Tom, chief animal husbandman, in April 1945. W. E. Connell was appointed acting chief of the animal husbandry section.

Joining the staff during the year were: Rex W. Brown, associate editor, September 1944; Gerald E. Ferris, editor, September 1944; John F. Christensen, assistant veterinary pathologist and bacteriologist, November 1944; and Frank McGee, farm superintendent, Monte Vista Experimental Farm, March 1945.

The station staff was increased by transfer of the following from the resident instruction staff: E. L. Bailes, assistant chemist; J. Lee Deen, forester; H. D. Harrington, associate botanist; Allen Heidebrecht, assistant animal husbandman; Gerald T. Hudson, assistant rural sociologist; Howard H. Kob, assistant agricultural engineer; George H. Lane, assistant plant pathologist; and J. V. K. Wagar, associate forester.

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AGRICULTURAL DIVISION

Agronomy

Alvin Kezer, A.M.	Agronomist
D. W. Robertson, Ph.D.	Agronomist
†Warren H. Leonard, Ph.D.	Agronomist
Robert Gardner, M.S.	Associate Agronomist (Soils)
Dale S. Romine, M.S.	Associate Agronomist (Soils)
†Ralph Weihing, Ph.D.	Assistant Agronomist
†Robert Whitney, M.S.	Assistant Agronomist (Soils)
†Robert F. Eslick, M.S.	Assistant Agronomist
Jasper J. French, B.S.	Assistant Agronomist

Animal Investigations

W. E. Connell, M.S.	Animal	Husbandman
L, E, Washburn, Ph.D.	Animal	Husbandman
Howard C. Dickey, Ph.D.	Associate Animal	Husbandman
†H. H. Stonaker, Ph.D.	Associate Animal	Husbandman
†Melvin Hazaleus, M.S.	Assistant Animal	Husbandman
A. Lamar Esplin, M.S.	Assistant Animal	Husbandman
Eugene Bertone, B.S.	Assistant Animal	Husbandman

Animal Pathology and Veterinary Medicine

Floyd Cross, D.V.M.	
I. E. Newsom, B.S., D.V.S., D.Sc	
*Dudley P. Glick, Ph.D.	Associate Bacteriologist
A W. Deem, D.V.M., M.S.	Associate Veterinary Bacteriologist
Frank X. Gassner, D.V.M.	Associate Pathologist
†Max E. Tyler, M.S.	Assistant Bacteriologist
Rue Jensen, D.V.M., M.S.	Assistant Veterinary Pathologist
Paul C. Brown, D.V.M., M.S.	Assistant Veterinary Pathologist

Botany and Plant Pathology

L. W. Durrell, Ph.D.	Botanist and Plant Pathologist
W. A. Kreutzer, Ph.D.	Plant Pathologist
Bruce J. Thornton, M.S.	Associate Botanist
*E. W. Bodine, M.S.	Associate Plant Pathologist
A. O. Simonds, Ph.D.	Assistant Botanist
George H. Lane, M.S.	Assistant Plant Pathologist

Chemistry

J. W. Tobiska, M.A.	Chemist
Earl Douglass, M.S. Associate	Chemist
C. E. Vail, M.A. Associate	Chemist
*C. F. Metz, Ph.D. Associate	Chemist
*Lowell Charkey, M.S. Assistant	Chemist
Merle G. Payne, B.S. Assistant	Chemist
E. B. Crone, Ph.D. Assistant	Chemist
Howard A. Durham, M.AAssistant	Chemist
Paul R. Frey, Ph.D. Assistant	Chemist

Entomology

Charles R. Jones, Ph.D.	Entomologist
George M. List, Ph.DAssociate	Entomologist
John L. Hoerner, M.S. Associate	Entomologist
Leslie B. Daniels, M.SAssociate	Entomologist

Forestry and Game Management

J.	Lee	Deen, Ph	, D	Forester
J.	. V. K	. Wagar,	M.SGame	Conservationist

Home Economics

inga M. K. Allison,	S.MHome 1	Sconomist
W. E. Pyke, Ph.D	Professor of Food	Research
Elizabeth Dyar, Ph.	DProfessor of Home Economics	Research
*Hazel T. Stevens, M	SAssociate in Home Economics	Research
William W. Allison,	M.SAssistant Professor of Food	Research

Horticulture

A, M. Binkley, M.S.	Horticulturist
Louis R, Bryant, Ph.DAssociate	Horticulturist
John G. McLean, Ph.D. Associate	Horticulturist
fGeorge A. Beach, M.S. Assistant	Horticulturist
Walter C. Sparks, M.S. Assistant	Horticulturist

Poultry

†H.	S. Wilgus	. Jr	Ph.D		.Poultry	Husbandman
F.	Howard I	Tatze	r, Ph.D	Associate	Poultry	Husbandman

Range and Pasture Management

E. W. Nelson, A.M.	Range	Conservationist
Clinton H. Wasser, B.S.	Assistant Range	Conservationist
†Frank J. Kapel, M.S.	Assistant Range	Conservationist

Rural Economies and Sociology

R.	T. Bur	dick. M	I.S		Rural	Economist
J.	L. Pasel	nal. Ph.	D	Associate	Rural	Economist
R.	W. Ros	kelley.	Ph.L	Associate	Rural	Sociologist
G.	T. Hud	son, Pl	h.D	Assistant	Rural	Sociologist

Seed Laboratory

Bruce	J.	Thornton	M.S	In	Charge
Helen	M.	Kroeger,	B.S.	Seed	Analyst

ENGINEERING DIVISION

*N. A. Christensen, Ph.D. In Charge

Civil Engineering

*N. A. Christensen, Ph.D.	In Charge
W. E. Code, B.S.	Associate Irrigation Engineer
*Adrian R. Legault, M.S.	Assistant Civil Engineer
*D. F. Gunder, Ph.D.	Associate in Hydraulics Research
Maxwell Parshall, B.S.	Meteorologist
Floyd Brown, B.S.	Associate Agricultural Engineer

Cooperators:

R. L. Parshall, B.S	Irrigation	Engineer,	U.	S.	D.	Α.
Carl Rohwer, B.S., C.E.,	Irrigation	Engineer,	U.	S.	D.	А.
Everett H. Davis, B.SAssociate	Irrigation	Engineer,	U.	S.	D.	А.

Mechanical Engineering

J. T. Strate, M.S.	
*Raymond D. Barmington, B.S., M.E.	Assistant Mechanical Engineer
E. M. Mervine, M. E.	Agricultural Engineer
Cooperators:	
A D Edgar B.S.	
S W McBirney, B.S.	Senior Agricultural Engineer, U. S. D. A.
Coorgo Stafford	Engineering Aid, U. S. D. A.
P. F. Gifford B.E.	
T T CITEOR CI	

SUBSTATIONS.

Hannan Fauber	MS	Supe	erintendent, i	LOCKY F	ora
Herman Fauber,	AP.A. + 1.7 -		Superintend	lent Aus	atin
Farris M. Green.	H.S.			icht, situ	30.11
TO DE LES AND DE LES CONTRA	ME	Associate	Agronomist,	Fort Le	W1S
Dwight Koonce,	M.D.	***************************************			

§As of June 30, 1945. †On military leave. *On leave.

FINANCIAL REPORT, COLORADO AGRICULTURAL EXPERIMENT STATION

For the Year Ending June 30, 1945

5		Hatch	Adams fund	Purnell fund	Bankhead- Jones fund	State mill levy fund	Special fund	Research Foundation	Total funds
3	DR. (Receipts) Balance July 1, 1944. From the treasurer of the United States per appropriations for the fiscal year ending June 30, 1944, under the Acts of Congress approved March 2, 1887, (Hatch fund), March 16, 1906, (Adams fund), February					\$ 8.782.75	\$ 15.782.77*	\$ 2,771.21	\$ 27,336.73
	24, 1925, (Purnell fund), and June 29, 1935, (Bankhead-Jones fund). Other sources than the United States.	\$15,000.00	\$15,000.00	\$60,000.00	\$22,430.96	110,422,20†	142,030.04‡	31,530.00	112,430,96 283,982.24
		\$15,000.00	\$15,000.00	\$60,000.00	\$22,430,96	\$119,204.95	\$157,812.81	\$34,301.21	\$423,749,93
	CR. (Expenditures)								1.1.1
	Personal Services. Travel Transportation of Things	$\substack{14,388.56\\289,42}$	$\substack{12,003.28\\225.72}$	$46,218.79 \\ 1,860.93 \\ 33.84$	$16,917.38 \\ 608.29 \\ 18.00$	$77,296.58^{\circ}$ 1,352.78 927.41	33,308,70 2,380,29 694,96	$2,857.66 \\ 118.63$	\$202,990.95 6,836.06 1,674.21
	Communication Service. Rents and Utility Services. Printing and Binding.	8.78	$5.82 \\ 69.14$	$147.71 \\ 1.735.01 \\ 14.37$		1,501.52 5,083.23 1,266.50	446.57 3,831.23 764.65		2,162.81 13,281.52 2,208.88
	Other Contractual Services. Supplies and Materials Equipment		$ \begin{array}{r} 118.66 \\ 859.82 \\ 1.463.26 \end{array} $	1,318.47 5,974.89 1,938.23	726.77 2,694.90 631.06	3,430,52 8,335,20 1,688,40	6,745.84 65,277.77 5,023.54	$ \begin{array}{r} 40.00 \\ 312.66 \\ 169.01 \end{array} $	12,380.26 83,455.24 10,913.50
	Contributions to Retirement	313.24	225.30	757.76	218.69	773.32	425.00		2,651.00
	Total-Regular Disbursements	\$15,000.00	\$15,000,00	\$60,000.00	\$22,430.96	\$102,299.60*	\$119,261.24	\$ 3,497.96	\$337,489.76
	Total—Station Disbursements	\$15,000.00	\$15,000.00	\$60,000.00	\$22,430.96	\$102,299.60	\$119,261.24\$	\$ 3,497.96 30,803.25	\$337,489.76
	Grand Total.	\$15,000.00	\$15,000.00	\$60,000.00	\$22,430.96	\$119,204.95	\$157,812.81	\$34,301.21	\$423,749.93

*Includes \$1,766.91 Sugar Beet fund, \$615.82 Hybrid Corn fund, and \$1,080.74 Potash fund.

†Includes \$13,900.00 H. B. 44.

79.20

‡Includes \$4,500.00 Pure Seed fund and \$1,388.35 Hybrid Corn fund.

\$Includes disbursements of \$303.20 Sugar Beet fund, \$593.29 Hybrid Corn fund, and \$4,500.00 Pure Seed fund. °Includes disbursement of \$13,900.00, House Bill 44, personal services.