

Accomplishments of the Colorado Experiment Station

A Brief Review of the Work of a Half-Century-Old Institution
in Its Services to Colorado's Agriculture



Field of Trebi Barley Foundation Seed, Colorado Experiment Station

COLORADO EXPERIMENT STATION
COLORADO STATE COLLEGE
FORT COLLINS

Contents

	Page
Agronomy	4
Animal investigations	5
Animal Disease	6
Range and pasture management	7
Botany	8
Poultry	9
Horticulture	10
Entomology	12
Irrigation investigations	12
Chemistry	14
Rural economics and sociology	14
Home economics	14
Engineering	15
The future	16

Accomplishments of the Colorado Experiment Station

THE COLORADO Experiment Station, now in its fiftieth year, is completing a half-century of notable contributions to the advancement of Colorado agriculture. Operated in conjunction with Colorado State College at Fort Collins, its accomplishments are in both basic scientific research and in practical information based upon the investigation and experimentation of its research work. These immediately applicable findings and recommendations have made the station of definite economic value to farmers of the state, and hence to all citizens of Colorado.

To encourage the agricultural development of Colorado through the work of the station, the federal government meets a part of the costs of maintaining this institution. Federal funds which are available annually for fundamental research include the following approximate amounts: Hatch fund, \$15,000; Adams fund, \$15,000; Purnell fund, \$60,000; Bankhead-Jones fund, \$11,000.

Agricultural research projects of the federal government conducted at the Colorado Experiment Station are subject to the approval of the Office of Experiment Stations, U. S. Department of Agriculture, at Washington, D. C. The federal funds cannot be used for demonstration work nor for projects of a semi-research nature. Bankhead-Jones funds must be matched dollar for dollar by the state.

Present state funds made available through the mill-levy provision for the station are approximately \$72,000, making the total provision for the station at present, from both federal and state sources, \$173,000.

It will be seen from the foregoing figures that the federal government contributes the major portion of the Experiment Station income and exercises a supervisory control of the experimental work supported by these funds. The state funds are used to supplement the federal funds, and for work that is of more immediate concern to Colorado agriculture, such as cattle raising, lamb feeding, noxious weed control, variety testing of farm and garden crops, soil problems, and control of insect and other outbreaks.

We are facing new problems in agriculture; old theories and practices are being discontinued. Land use can no longer be considered from the individual standpoint but from that of the state and nation. We are becoming land conscious. Soil conservation, with its implied land use, must be studied and pursued from the standpoint of the future as well as the present. Land ownership must be looked upon as a trusteeship in which future generations have an interest. Agriculture must be stabilized, and as far as possible speculative hazards reduced.

These adjustments call for the solution of many problems, both in the field of economics and in the field of production. It further means that the Experiment Station must adjust its program to meet these new demands. While fundamental agricultural research must always be carried on as the main work of the Experiment Station, we should not forget the more pressing problems that the new order calls for, if we are to be of the greatest possible service to the state.

Presented in this publication for information of members of the Colorado General Assembly are brief summaries of accomplishments of the various sections of the Colorado Experiment Station in their service to Colorado agriculture, and through that to the entire state of Colorado.

Agronomy

Colorado No. 37 oats, originated by this station, is at present the best generally grown variety of irrigated oats in Colorado. It produces an annual value of from \$316,000 to \$490,000 upon farms of the state.

Brunker, the best dry-land oat variety, was originated by the station in cooperation with the U. S. Dry-land Field Station at Akron, Colo. It has not been as well distributed as might be desirable, but it is capable of increasing dry-land yields by more than 15 percent above the present yields.

Colsess barley, the beardless variety, is the highest yielding hooded-type barley now grown in the country, and it is the best of its type and quality. It was produced by hybridization and later selec-



Field of Colorado No. 37 oats, Colorado Experiment Station.

tion. Grown on about 20,000 acres of Colorado land, Colseess barley has a present annual value to Colorado farmers of \$400,000 annually.

The station originated Defiance wheat, which for more than 20 years was almost the only spring wheat grown under irrigation. It has produced about 3 million bushels annually during that period.

Included in present activities of the Agronomy Section are studies of the critical periods in use of irrigation water, particularly with respect to small-grain growth; studies of control of excessive soil nitrates, using sugar beets as a test crop; studies of control of bacterial wilt and winter killing of alfalfa; development of high-altitude grain production in work at Fort Lewis; development of higher-yielding plains crops and of improved methods of crop management in experiments at Akron; and production of improved-quality seed.

Animal Investigations

The Animal Investigations Section of the Colorado Experiment Station has carried on experiments with all the common feed-stuffs of the state's irrigated and dry-land areas for fattening cattle and sheep. Much of the feeding of the state is done in the sugar beet growing areas, and the experimental work has covered thoroughly the feeding of sugar beet by-products.

As a result of the conclusions drawn from experiments by this section, feeding in the state has shown a change from a simple ration



Steers in feedlot, Colorado Experiment Station.

of alfalfa hay and corn, or alfalfa hay, cotton cake, and beet pulp, to a large number of combinations of different feeds yielding better economic returns to the feeders. Recent feeding work has included a study of the value of minerals in the rations.

Feeding experiments have been carried on with lambs and pigs in the San Luis Valley, covering particularly the pasturing of peas as compared with other rations. It also included work to determine the best succulence to use in connection with field peas.

Lamb feeding experiments in cooperation with the Extension Service of the Colorado State College at Fort Collins were carried on in the Western Slope country for the purpose of utilizing the feeds grown in that part of the state.

Range management experiments comparing delayed and rotated grazing with continuous grazing have been in progress for a long period. Early work in connection with the carrying of range cattle centered upon the results of wintering calves or yearlings that were to be turned back on the range. Recent work has been done on the value of protein supplements in connection with native hay for calves in an attempt to make a scanty hay supply go farther in winter feeding.

An irrigated pasture grass mixture developed here is in use in every agricultural county of the state.

Animal Disease

The Animal Disease Section of the Colorado Experiment Station is known chiefly for its extensive work on sheep diseases. Because Colorado is one of the leading sheep-feeding states of the Union, special attention has been given to maladies of feeder lambs, a problem not previously studied by any experiment station.

Many problems of the sheep feeder have been solved; many remain for further study in the interests of increasing profits for feeders. It has been possible to demonstrate improved methods in feeding and shipping which have been of enormous advantage to the industry.

Special study has been given to two diseases of cattle: brisket disease, occurring in the high altitudes, control of which was worked out by this station many years ago; and contagious abortion, control work on which is now bearing fruit in a nation-wide program conducted by the U. S. Bureau of Animal Industry. The laboratory of the section still makes the blood-tests for the federal campaign of control in the state.

Much attention has been given to studies of effects upon livestock of certain poisonous weeds of Colorado. Studies have been made of loco, larkspur, milkweed, timber milkvetch, and several other poisonous plants. This section was the first to show that the whorled

milkweed, or any milkweed in fact, was poisonous to livestock. As a result of drought and over-grazing, control of poisonous weeds upon ranges has become a matter of dollars-and-cents concern to stockmen of the state.

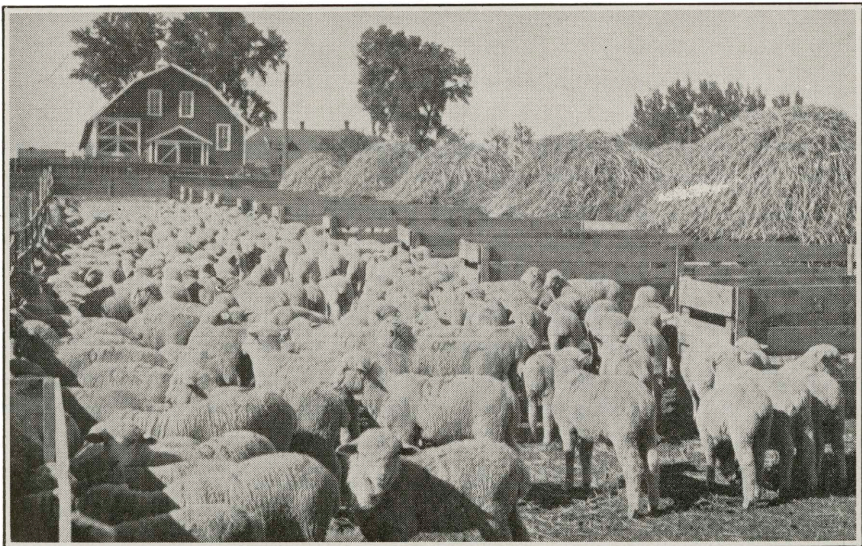
The Animal Disease Section is giving much study to the so-called Kansas horse disease of 1912, which has been widespread in Colorado in the past 5 years. Unfortunately, this disease still takes a heavy toll of horses in this state, and is a problem of such proportions that a great deal of future work will be necessary, especially to find the relationship of other diseases which simulate the original.

Range and Pasture Management

Profitable production of range livestock in Colorado is dependent upon a grazing system that will keep the range forage resources on a sustained-yield basis. Adverse climate and overgrazing upset this sustained yield.

Because of the importance of the range problem in Colorado, a new section of range and pasture management of the Colorado Experiment Station was established in April of 1936. This section is specializing upon the problems which previously were studied by the Botany Section.

Projects which have been conducted during the past 15 years include that of improvement of native range by natural revegetation. Among the results of this work was the demonstration of the practicability of deferred-and-rotation system of grazing in Colo-



Lambs in feedlot, Colorado Experiment Station

rado's mountain parks, forest-range areas, foothill ranges, and in the Great Plains region. Studies of range-improvement possibilities for the sagebrush areas of the state are also carried by this section.

Some preliminary work has been done on another matter of concern to the livestock industry: that of improvement of native-range areas and abandoned cultivated areas by artificial revegetation. Studies of another phase, that of establishment and maintenance of irrigated pastures of the state, have been made to a limited extent.

Maintenance and improvement of the famous native-hay meadows of Colorado began in 1913, particularly with respect to regulation and distribution of irrigation water, with a view of increasing productivity of these meadows and obtaining more economic use of water. Other work in connection with this type of hay-raising will include studies of the amount of water necessary to produce a ton of hay, effects on hay yield of early and late grazing of meadows, and improvement of meadows by artificial reseeding and other practices to increase yield.

Studies of a preliminary nature deal with the problems of spring and fall pastures, developing earlier and hardier grasses for early pasturage, determining best methods of sowing, and developing better cultural methods.

Botany

Work of the Botany Section of the Colorado Experiment Station has been of outstanding value to Colorado. Stinking smut of wheat 12 years ago was costing farmers of this state 3 million dollars annually. Studies and development of control methods by this section have eliminated most of this tremendous waste.

The Botany Section, in cooperation with federal agencies, has had a most important part in eliminating the rust of wheat which for many years took a heavy toll. Despite epidemics in other states, Colorado has not suffered.

Peach mosaic, which in 1933 and 1934 threatened the peach-growing industry of Colorado, has been brought under control, with an estimated saving of \$1,200,000 annually.

The station's work on wilt of cucumbers saved one Colorado greenhouse \$12,000 in two seasons. Work on carnation rot saved another greenhouse \$28,000 in one season, and the recommended practices adopted by other similar establishments made the disease an uncommon one, whereas it had threatened a 2-million-dollar industry.

Savings of many hundreds of dollars have resulted from work on miscellaneous diseases such as bulb rot of gladiolus, carnation wilt, wood rot of apples and cherries, wilt of tomatoes, canker of tomatoes, purple blotch of onions, storage rots of onions, wilt of pep-

pers, and wilt of chrysanthemums. Control methods have been recommended for all these.

In weed-control and -elimination campaigns, the Botany Section has reduced the annual 10- to 20-million-dollar loss due to weeds in Colorado, showing the limitations of the chemical methods and the practicability of clean cultivation and other cultural methods in contrast.

The work of this section, in cooperation with other sections, has been most valuable in range-improvement work. This station pioneered in the testing of grass varieties, and was one of the first stations to make a survey of range resources. Range reseeding has been a specialty. Study of poisonous plants on ranges has been a valuable service; in cooperation with the station veterinarian a solution was furnished for the puzzling "cracker heels" disease of livestock in Northwestern Colorado, resulting from eating timber milk-vetch.

The Colorado Seed Laboratory of the station helps any agency concerned with seeds. Its services have been available in the work of the registered seed service, various range studies, weed control programs, and soil erosion work, in addition to the free testing of seeds for farmers and dealers and the inspection and law-enforcement work under the state law and the interstate seed act.

The laboratory has prevented the sale of much seed, particularly that of alfalfa, which was badly infested with seeds of noxious weeds. Similar results have been obtained with respect to wheat and barley, which frequently are carriers of seeds of injurious weeds. In one instance the laboratory succeeded in putting off markets of the state a notorious fraud in purported lawn grass.

More than 10,000 tests have been made in connection with the registered-seed program of the state since its beginning in 1922. Registration would have been impossible without this service. More than 120,000 tests made by the laboratory have furnished valuable information to dealers and farmers in regard to seeds.

Poultry

A Poultry Husbandry Section was established at the Colorado Experiment Station in July 1936. The first year necessarily will be devoted largely to construction and development of an adequate experimental plant. Actual research projects are about to get under way.

The research program will be based upon a survey of the entire poultry industry of Colorado, in order to determine the more pressing problems. At the present time, serious losses are being suffered by poultrymen of the state. Many of these losses are apparently due

to insufficient knowledge regarding sanitation, nutrition, breeding, housing, and general management.

The estimated value of all chicken and turkey products produced in Colorado is 7 million dollars, and the capital investment in stock and buildings may reasonably be figured at 12 millions. Losses previously mentioned may reasonably be figured at 2 millions.

The Poultry Section will attempt to reduce materially these losses and to foster the development of a sound poultry industry in Colorado by making available the necessary information, based upon results of fundamental research and practical applications at this station and elsewhere.

Horticulture

Much of the progress that Colorado has achieved in the fruit and vegetable industry during the past 20 years can be attributed to the work in horticulture by the Colorado Experiment Station. The Horticulture Section has guided, encouraged, and assisted in development of new potato and vegetable districts of the state and has developed better orchard practices for fruit growers.

Income in Colorado from horticultural crops ordinarily reaches 23 million dollars, although returns from the 1936 potato crop alone should equal that figure. Development of the production of high-altitude vegetable crops in the mountain districts has been fostered by projects and demonstrations showing that such crops will produce high yields of fine quality.

Benefits of station work in horticulture are accruing from a broad program based upon conservation of soil resources, reduction of costs of production, adjustment of production to market demands, improvement of the quality of fruit and vegetables, and the testing of new crops.

Potato seed improvement and certification work has been carried on for 20 years. Nearly 200 growers in 27 counties this year produced 500,000 bushels of disease-free potato seed. This seed is largely planted within Colorado by the 25,000 potato growers. Selection of seed by the station and use of certified seed have increased the yield of irrigated potatoes 59.7 bushels per acre. A conservative estimate of the increase in farm income as a result of this work is \$450,000 annually.

Breeding of new potato varieties is a station project, as is testing of new varieties to determine their adaptability. Out of this work the dark red Peachblow variety of potato was developed and introduced to growers 5 years ago. This type has today replaced 50 percent of the old, light-colored type and eventually will replace the entire acreage.

Considerable time has been devoted to assisting growers in use of improved cultural practices. In addition, the station has sponsored demonstrations and guided development of new potato districts in the dry-land areas of Logan and Moffat Counties and in the San Juan Basin district.

The most outstanding work of the station with fruit crops has been the development of proper cover crops and clean cultivation treatments for orchards. The use of cover crops, time to sow, amounts and mixtures to use, and time to plow under for green manure have been worked out at the Austin Substation. The results have been valuable to fruit growers, since the work has offset the detrimental effects of heavy applications of water, increased the nitrogen in the soil, reduced winter killing, increased fertility, and reduced injurious insect life harbored in orchard soils.

Other work with fruits includes testing out new and promising varieties, studies of control of fire blight, demonstrations of pruning, and aiding growers in complying with the new law for spray residue removal. Studies of new varieties, fruit-bud differentiation, pruning, and winter covering have contributed much to improvement of production methods.

In 1916 the Horticulture Section demonstrated that head lettuce, cauliflower and pod peas would produce high yields in the high mountain valleys of Colorado. Since that time, production of these crops has been sponsored and encouraged by the station. Cultural varieties have been worked out, and work on varieties and strain tests alone has meant greatly increased profits to growers. Crops and practices recommended have increased the income to Colorado mountain agriculture by many thousands of dollars and have made it possible for growers to reduce production costs and to adapt their plantings to market demands.

In 1923 the Horticulture Section of this station introduced onion production into the Arkansas Valley. Today one-half the onion crop of Colorado is produced in that district. Introduction of the industry in that section has increased the agricultural income to Colorado from \$200,000 to \$400,000 annually. Last year the Colorado Sweet Spanish No. 6 onion was introduced by the station.

The Horticulture Section, over a period of years, has determined the adaptability of many new crops to Colorado conditions. Work on pyrethrum, an insect-powder producing plant, and on perilla is in progress. Such work has saved farmers much expense, and resultant recommendations in many instances have prevented loss from planting crops not suited to the climate of the state.

Colorado is now fifth among the 48 states in production of carnations under glass, with growers receiving income from that source

of 3½ millions annually. This section has work under way on production problems which already has aided in production of a better quality of flowers.

Entomology

Of direct and important value to Colorado are the services of the Entomology Section of the Colorado Experiment Station in its studies of the insect fauna of the state and in experiments for the control of insect pests. In the latter work the section assists the Extension Service of Colorado State College in making information available to citizens of Colorado.

Among the most important investigations of recent years have been those dealing with such insect pests as the fruit-tree leaf roller, the boxelder leaf roller, the alfalfa weevil, the codling moth, the Mexican bean beetle, grasshoppers, the potato flea beetle, and the potato and tomato psyllid.

Development and demonstration to growers that non-arsenical dusts and sprays for truck crops can be used as efficiently as arsenicals has saved truck growers of Colorado at least \$50,000 annually, and has given Colorado vegetables a prominent place on the markets as being free of poison residue. Tree-spray service information has done much to aid in beautification of the state. A rodent-control formula developed at this station saves \$25,000 annually, formerly lost to destructive rodents.

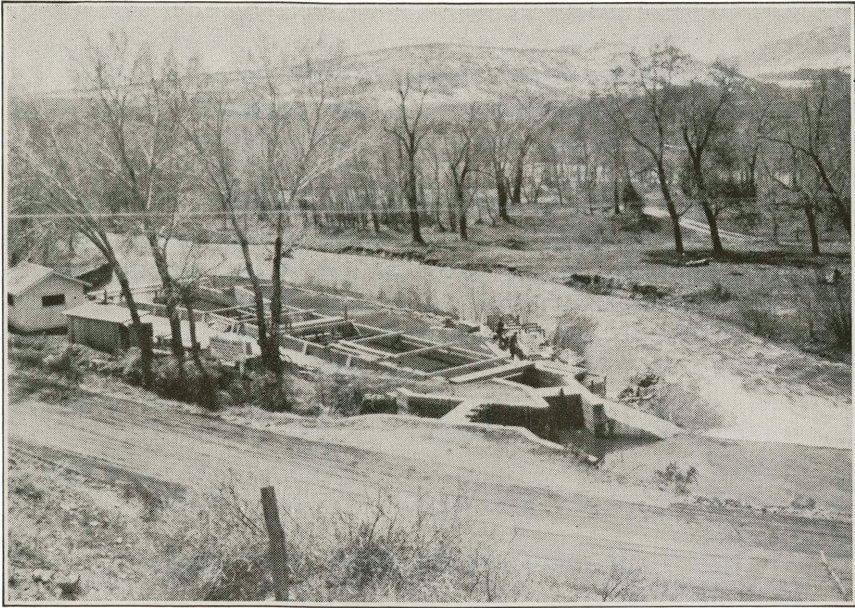
Colorado industries depending to a great extent upon the research work of the section include the greenhouse industry, the truck-crop industry, fruit-growing, and potato production.

Irrigation Investigations

Irrigation investigational work of the Colorado Experiment Station, in cooperation with the United States Department of Agriculture, has done much to advance agricultural irrigation engineering in Colorado, and much of the work has been of permanent value elsewhere as well.

Investigations in the laboratory and field have made possible the development of various types of practical measuring devices. Weirs, measuring headgates, and orifices have been investigated and improved types invented. Current meters also have been similarly studied. The Parshall measuring flume, developed at this station, is the device officially recognized by Colorado and by other western irrigated states; it is used not only by irrigation projects but in measuring municipal water supplies and sewage, and in various industrial enterprises.

This section of the station maintains a meter rating station,



Hydraulics laboratory of Colorado Experiment Station on Cache la Poudre River near Bellvue, west of Fort Collins.

used by the Colorado state engineer and many others for calibrating current meters.

Investigations by this section have determined certain limits of loss from existing or contemplated irrigation and domestic storage reservoirs, moisture loss from irrigated fields, and loss in stream flow which have been of great value in various irrigation activities.

Considerable progress has been made on correcting sand and silt accumulation in irrigation canals and ditches. A device known as the vortex-tube sand trap has been perfected and has been tried out successfully, both in the laboratory and in the field.

Recognizing that the return-flow water to streams forms a basis of better economic use of irrigation water supplies, this station has studied that subject for more than 40 years, and has made a valuable contribution to irrigation development of the state and of the West as a result.

Credit must be given the station for solving many of the problems of pumping from wells for irrigation.

A comparatively new project, in cooperation with several federal agencies, is a snow-cover survey making use of special sampling equipment to determine the water content of the winter's accumulation of snow. From these data, when related to stream flow records, forecasts are made of the probable extent of the run-off. Irri-

gation companies, municipal water departments, and water power plants and individual water users are interested in this work.

Hydraulics laboratories are maintained for determining design and operation of engineering structures, especially those related to moving water.

Chemistry

Chemistry is a fundamental science, hence few agricultural problems are undertaken at the Colorado Experiment Station that do not involve assistance from the Chemistry Section. Investigations of soils, fertilizers, and poisonous plants are classifications under which fall a great part of the valuable work of this section.

An important study now in progress deals with the alkali salts in Colorado soils under conditions of irrigation.

Much service work is done for communities in water testing, insect poisons, fruit-spray residue, and similar problems.

Rural Economics and Sociology

Speaking directly the language of dollars and cents, the Rural Economics and Sociology Section of the station engages in study of such subjects as farm and ranch organization and operation, type of farming in Colorado, agricultural adjustments, analysis of production costs and labor requirements, and sociological research, all of which are closely related in recent years with various federal projects for benefit of farmers of Colorado.

As a concrete example of work of the station, a detailed study and analysis of records of a group of cooperative elevators in Eastern Colorado enabled this section to draw conclusions regarding practices of cooperatives and to make recommendations of benefit to the group.

This section frequently has presented briefs and arguments before the state board of equalization in the interests of tax equalization. Colorado farm lands in recent years have received greater reductions in assessed valuations than any other class of property. Farmers paid 6 million dollars less taxes in 1935 than in 1925. Much of this reduction is due to information collected by this section of the station.

Home Economics

Of particular importance to growers of Colorado products are many of the problems connected with the cooking qualities of those products. The Home Economics Section of the Colorado Experiment Station has done outstanding work on a number of these problems, to the financial benefit of the individual producer and consumer and of a number of industries.

A study of the culinary qualities of Colorado-grown potatoes assists the Horticulture and Chemistry Sections in choosing the best varieties and soils for the production of potatoes in Colorado. This study is still in progress.

Important contributions to scientific cookery, with especial attention to the factor of altitude, have been made in a series of experiments by this section which have been of widespread value to bakeries of the state, and to housewives. A unique altitude laboratory in which air pressure can be made to correspond to pressures at various elevations above sea level, and in which temperature and humidity are controlled, is used in this work.

Engineering

Of direct benefit to numbers of Colorado industries have been investigations during recent years by the Mechanical Engineering Division of the station's Engineering Section. Included in studies have been those of heat transmission of wallboards used in building construction; heat transmission of insulating materials; "hair cracks" in concrete and their "cure"; heat control by means of master control valves; mechanical methods of washing apples for market, in cooperation with the Entomology Section; sugar-beet machinery, in cooperation with the federal government; and proximate analysis of Colorado coals.

The Civil Engineering Division of this section has conducted research work on road construction and road materials for the past 10 years. For a number of years its roads-material laboratory was the official laboratory for the state highway commission in all its testing work.

Recent investigations have been made of oiled-gravel road construction with a view of determining why that type of road frequently proves inferior; definite recommendations based upon findings in this work have been released recently for the assistance of road engineers.

(Note Letter, page 16)

The Future

The Agricultural Experiment Station

COLORADO STATE COLLEGE

Fort Collins, Colorado

January 1, 1937

To Colorado Legislators:

The Colorado Agricultural Experiment Station, in its efforts to serve agriculture, must give more attention to local and regional problems that cannot be adequately served at the home station. In a state like Colorado, with its great diversities in soil, climate, and altitude, it is necessary that provisions be made for the establishment of substations where local problems can be studied, and where results of fundamental research carried on at the home station can be tried out and demonstrated. We have to recognize the fact that the results obtained from experimentation in one part of the state may, or may not, be of value to another part where conditions are different. Substations would more completely serve the interests of the farmer, and would aid in the solution of problems that are local and regional.

The present income for the support of the Colorado Experiment Station is inadequate, and if substations are to be established, additional permanent funds should be provided.

We hope that the Legislature will give thought to this matter at the 1937 session.

Respectfully,

 Director