# 63rd Annual Report 1949-50

# COLORADO

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# Agricultural Experiment Station

Colorado A & M College Fort Collins

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## LETTER OF TRANSMITTAL

Sixty-Third Annual Report Colorado Agricultural Experiment Station

Honorable Walter W. Johnson Governor of Colorado Denver, Colo.

#### Sir:

In compliance with the act of Congress, approved March 2, 1887, entitled, "An act to establish Agricultural Experiment Stations, in connection with the colleges established in the several states under the provisions of an act approved July 2, 1862, and under the acts supplementary thereto," I herewith present the Sixty-Third Annual Report of the Colorado Agricultural Experiment Station for the fiscal year of July 1, 1949, to June 30, 1950, inclusive.

Hover & Henry

Homer J. Henney, Director

Fort Collins, Colorado July 1, 1950

# DIRECTOR'S ANNUAL REPORT

Sixty-Third Fiscal Year 1949-50

## **Colorado Agricultural Experiment Station**

## **General Remarks**

The year 1949-50 in Colorado agriculture stands out above all previous years because of the increase in requests by farmers and ranchers for help in finding answers to their problems.

This additional interest in help which the Station can give meant, however, that the limited funds available did not enable the Experiment Station to carry on projects in all fields of work in which assistance was needed.

Of the new problems presented during this year by the people of the state, sixty percent centered on maintenance of soil fertility, applying irrigation water more effectively, efficiently and economically, and how and when to use newly developed insecticides.

With regard to research work already established, the costs of professional researchers, laborers, materials, travel and supplies have increased, with the result that keeping this present work effective meant additional funds were needed.

It is recognized that limitations on research tend to limit agricultural income in the future. Therefore, every effort has been made, within the limits of the resources available, to carry on fundamental, basic and applied research which is of the most value to agriculture both now and in the years ahead.

Hover & Henney

Director Agricultural Experiment Station Colorado A & M College

## **Branch Experiment Stations**

"Relative to research requests, it is recommended that the outstate research and demonstration programs be expanded, with closer cooperation among the Experiment Station, the Extension Service, and the farmers and ranchers. There appears to be a necessity for research-extension type specialists to be stationed in widely selected areas, which, because of their peculiar climatic, soil, or other conditions require special consideration. When there are Branch Stations in the areas, this work

should be conducted in conjunction with them." This statement from the Annual Report of the **Research Advisory Committee** of the State Agricultural Planning Committee emphasized the importance of agricultural research in the various areas of Colorado in addition to that conducted at the Main Station. The eight branch station areas have headquarters so located that experimental and demonstration work radiating from them could reach all parts of the state, as envisioned by the Research Advisory Committee.

The first step toward putting this idea into effect would be to make each Branch Station Superintendent a joint employee of the Experiment Station and the Extension Service. He might be made a District Agent in the Extension Service. The next step would be to budget sufficient funds to each Branch Station to enable it to finance the expanded program of testing and demonstration on farms in the several counties in the branch station area.

The Branch Stations and branch station areas will in. crease in service to different sections of the state as existing stations are better supported and The addition equipped. of more inadequately financed stations or headquarters is not the solution.

Research results from the Branch Stations are reported by the various Sections, as the work is under the direction of project leaders at the Main Station.

Reports on experimental work in progress in three areas were written and distributed among interested farmers and ranchers. Meetings were held jointly with the Extension Service at which

ACCOMPLISHMENTS or al reports were given. Following or during each meeting plans for experiments to be conducted during 1950 were made with the farmers and ranchers participating through their designated committees.

## Crop Improvement

## Alfalfa

The two major breeding projects — maternal line inheritance studies for improvement of bacterial wilt resistance in the variety Meeker Baltic and seedsetting ability in the variety Hardistan — a d v a n c e d into fourth-generation material. In the Meeker Baltic program open-pollinated seed was obtained in 1949 from 184 thirdgeneration plants selected on the basis of wilt resistance, leaf-**MEEKER BALTIC** setting, and general plant vigor. Seedling progeny of each of these plants are to be wilt inoculated, planted into the field, and classified for wilt resistance in September. Plants found to be wilt resistant will be maintained to carry on the breeding program. A composite of open-pollinated seed from the third-generation selected plants was also obtained in 1949 to be used in yield test comparisons of this material with commercial Meeker Baltic and other varieties.

In the Hardistan study, although the major objective is the improvement of seed setting, all plant material is also initially tested for wilt resistance. Seedling progeny of each of 97 individual high seed-producing, third-generation plants are to be wilt inoculated

HARDISTAN and classified at the same time and in the same way as that mentioned for the Meeker Baltic material. Further selections of high seed-producing Hardistan plants will be made from material found wilt resistant on the basis of these inoculations. A composite of seed from the 97 selected third-generation plants was forage-yield tested and sent to six experiment stations for seed-production tests. These stations were Dominion Forage Crops Laboratory at Saskatoon, Saskatchewan, Canada, and the Oklahoma, Nebraska, Utah, Michigan and South Dakota

Agricultural Experiment Stations.

A second approach to production of a wilt-resistant Meeker Baltic variety is being conducted through use of inbreeding. Twenty-nine second-generation inbred wilt-resistant Meeker Baltic plants, representing five  $S_1$ families whose progeny showed high percentages of wilt resistance, were clonally propagated and in the spring of 1949 were set out in the INBREEDING field in a randomized and replicated polycross nursery for the production of open-pollinated seed. If the parent clones, having been selfed for two generations, are approaching homozygosity for wilt resistance, a polycross of such clones should produce high wiltresistant progeny and still maintain a broad genetic base for the segregation of desirable agronomic characteristics.

Preliminary tests on the alfalfa weevil made in Delta County indicate some of the new insecticides, because of objectionable residues, cannot be safely used **WEEVIL** on the hay to kill the larvae. Tests have shown they can be safely and effectively used to kill the adult weevils if they are used early in the spring when the alfalfa growth is not over 4 inches high.

## Apples

Stayman Winesap, Red Delicious, and Gano appear to have the greatest resistance to low

temperature at harvest time and can be safely picked and stored after freezes to approximately 25 degrees. Golden Delicious, COLD INJURY Ben Davis, and Jonathan are susceptible to cold injury and should be picked before severe freezes.

Threatened lowering of the tolerance of DDT spray residue on apples and pears at harvest forced attention to securing codling-moth control with the minimum **CODLING MOTH** number of applications or with combinations of spray materials. Reduced amounts of DDT in combination with parathion and methoxychlor showed good control. None of the eight spray schedules tested gave a DDT residue at harvest exceeding 5 parts per million.

Mites were not numerous in the experimental orchard so mite-control data are not conclusive. Mites were serious in many other orchards and the evidence continues to accumulate showing that generally a **MITES** DDT spray program favors mite develop-

Genetic studies and linkage relationships in barley are fundamental research. Several different crosses have been made with the object of studying the inheritance of short straw length. If straw can be shortened and yield maintained a variety less subject to lodging on high-fertility soils could be proment. Other workers have shown that DDT programs permit a build-up of the wooly apple aphid. This was true with all the Station's DDT treatments except where wettable sulfur was used in combination with the DDT. Here there was a highly significant wooly apple aphid control. No logical explanation for this is offered but if such results continue it will be of importance as wettable sulfur is effective against mites as shown by last year's results. It is probably the most effective fungicide against the powdery mildew of the apples.

Two new insect pests were taken during the year. One was a small curculio, as yet undeterapples in Delta mined, on County. The **RED-BANDED** other, taken LEAF ROLLER on pears near Clifton. Mesa County, is thought to be the red-banded leaf roller. The latter has become very destructive in a number of eastern states where DDT spray programs are being followed for codling-moth control.

## Barley

duced. Semi-dwarf types from Japan are being used.

Progress is being made in ob taining. smut - resistant barley. Several thousand rows from in oculated plants have been plant ed and seedlings for resistance to DISEASE RESISTANCE Be made in July and August of 1950. The winter-barley lines had a very high mortality due to winter injury — only a few of these lines survived the winter. A promising new variety was introduced this spring for growing under dryland conditions. This variety was obtained by selecting desirable yielding types from a Munsing x Spartan cross. It has been named Otis.

A total of  $350 \, F_{\delta}$  lines of a Purdue x Trebi cross were planted in the fall of 1949. These lines had been inoculated with loose smut in 1949. Sur-WINTER BARLEY viving, smutresistant rows will be selected in 1950 and placed in a preliminary yield test.

Yield tests are being made in 1950 to determine the relative yielding abilities of Lico I, Lico II, and Lico III (all smut-resistant, smooth-awn, white-aleurone barleys). New crosses using superior smut-resistant parents have been made in 1948 and 1949 and will undergo further tests for SPRING BARLEY smut resistance. Several hundred lines of Beecher x Trebi were inoculated in 1949 and will be selected in 1950 for smut resistance.

Selections were made in 1949 of rust-resistant plants of Scotch-Chevron x C. I. 7152, Moravian-Chevron x C. I. 7152, Scotch x Chevron and Moravian x Chevron. These will be further tested in the rust nursery in 1950.

## **Bean Research**

The breeding plan of bean research has been confined to exploration for desirable par-**Eighty** - five ental material. strains of beans obtained from the Division of Plant Exploration and Introduction of the USDA were ob-BREEDING served at Rocky Ford. Outstanding lines are being tested for resistance to bean rust in cooperation with the Division of Fruit and Vegetable Crops and Diseases of the USDA. Results of the tests to date indicate that the date of planting may be an important factor in obtaining disease-free beans in certain areas in Colorado.

Host range studies on red

node have been completed. Red node can be transmitted by seed to a small degree. The alfalfa aphid can transmit the disease; however, it is thought that it is DISEASES, not the main agent. It has been found INSECTS by use of controlled chambers that an air temperature of 80 degrees favors the expression of the symptoms of red node. This may account for the fact that more red node is observed in the warmer areas than in the cooler bean-growing sections. Early planting is advisable to avoid this disease.

Two or three chemical materials have shown promise as a control for root rots. Twenty selections of pinto beans have been made for rust resistance and vine type.

The cow-pea aphid Aphis medicaginis Koch and the rednode disease were less abundant than in 1948. This can be interpreted to support previous evidence that this aphis is a factor in the spread of the virus. However, it is felt that more work is required to establish its ability to transmit the red-node disease. A number of strains of beans reported to be resistant to curly-top virus are being tested in the greenhouse.

## Carnations

Disease-free carnation foundation stock is being continued with eleven varieties now available for a source of commercial FOUNDATION mother blocks free of disease and off - type plants. The technique for indexing these and new plants is still being refined.

Breeding on carnations has been started, using  $F_1$  hybrids between highly inbred lines of singles and bullheads, the progeny of which all fall into a commercial double class. Some parents tested this year have proved **BREEDING** especially potent. The testing of additional parents will widen the range of colors available. Being bred in Colorado, these new varieties are especially adapted to this region.

The relation of various levels of soil nitrates and water are being studied. On nitrogen and potash fertilization of Patrician variety, the highest total yield was produced where nitrate level was maintained at about 60 NUTRITION parts per million. Where equal amounts of nitrogen and potash were added, split-flower losses were reduced by one-third. No differences in yield resulted.

The influence of eight different mulching materials upon the soil structure and resulting quality of blooms is leading into more comprehensive work on greenhouse-soil structure. An instrument for measuring soil looseness is being devised.

A study of the effects of sodium selenate on carnations grown in gravel and nutrient solutions showed that the best rate was 31/8 grams per hundred square feet of bench area per month for This treatment months. 4 yielded just as many first-grade flowers and no greater numbers of third-grade and split-calyx flowers than the untreated check. In short-stemmed flowers (15 to 22-inch stems with flower quality otherwise equal to the first grade) this treatment produced a significantly greater number of flowers than the untreated check.

The treatment also gave adequate protection from red spider mite.

A large lithographed colored chart of the diseases of carnations was prepared and presented to the Flower Growers **DISEASE CHART** Association. **DISEASE CHART** Association. Chart is to go into all the greenhouses in the state and 500 copies have been purchased by eastern growers.

In the experimental field, carnation mosaic has been found to cut yield and quality. Evidence is at hand that certain varieties of carnations are hidden carriers of Fusarium and bacterial wilt. It has been demonstrated that

#### DISEASES carnation mosaic can be transmitted from plant to plant by the touching of roots, not by soil, however.

Through use of ultraviolet light most mosaic can be eliminated from the index stock while all of the streak can be eliminated. In the indexing program the total of 19 varieties now have been cleared of virus and mother blocks established. There is evidence that carnation streak is related to aster yellows. Soil treatments with new fungicides look very promising.

A new virus of carnations known as "rosette" has come in from plants imported from Holland.

#### Corn

Corn-breeding studies were conducted in 1949 on the Agronomy Farm at Fort Collins and on the Arkansas Valley Branch Station at Rocky Ford. Convergent improvement trials with locally produced inbred lines of corn were continued at Fort Collins. The original Colorado lines have combined well in hybrids from the yield standpoint but had some un-BREEDING desirable plant characteristics. A total of 34 improved lines were included in a topcross yield test. Topcross yields of some of the new improved lines isolated indicate that it is possible to retain high yield in hybrid combinations as

well as to obtain lines low in smut, suckers, and lodging.

An attempt is being made at Fort Collins to develop by the pedigree method additional inbred lines for use in hybrids adapted to northern Colorado conditions. Several high-yielding single and double crosses have been inbred. An inbred yield test was conducted in 1949 with 138 lines of the first selfpollinated (31) generation. The same lines were simultaneously topcrossed to a standard hybrid variety to procure seed for a test of combining ability,

A yield test at Rocky Ford with 34 experimental single crosses involved eight Rocky Ford inbred lines crossed with proved Cornbelt inbreds. The Rocky Ford inbreds were isolated from a local strain of Reid Yellow Dent in 1940. Predictions from the single-cross yield test indicate that several doublecross combinations may yield 150 bushels or more of shelled corn per acre.

A vield test of 11 double crosses was also conducted at Rocky Ford in 1949. Some of these hybrids show considerable promise for Colorado irrigated conditions, particularly in the Arkansas Valley. The highest experimental h y b r i d yielded 156.8 bushels of shelled corn per acre, or 16 percent more than the standard Colorado Hybrid 322 which yielded 135.0 bushels. Two other hybrids with Line No. 19 in their pedigrees yielded over 150 bushels. A seed supply of some of the new hybrids is being expedited.

The Agronomy section also cooperated with corn growers to produce a supply of inbred and single-cross stocks for Colorado registered corn hybrids. Foundation Station inbreds were increased by hand pollination to assure a **INBREDS AND** supply of SINGLE CROSSES pure inbred stocks for the production of recommended hybrid varieties. Approximately 18 acres of single-cross seed were produced by growers under contract. A total of 19,218 pounds of single-cross seed was obtained. The single crosses produced were: WD456 x KB397, Y111 x Y31, WF9 x R3, CC6 x M13, and Wisconsin 23 x 26.

Commercial hybrid-corn varieties were tested for yield in 1949 in six different localities of the state that represented the principal corn-growing areas The tests were at Fort Collins. Rocky Ford, Akron, Johnstown, Haxtun, and Fort Morgan. The first three VARIETY TESTS tests were located on experiment stations while the other three were on farms. Approximately 160 different hybrid varieties were included in these tests. The results of these tests have been published in Miscellaneous Series Paper No. 450.

Tests under irrigation indicate that the farmer has some choice in hybrid varieties for different parts of the state. Although several others yield essentially the same, the highestyielding varieties in each of the various tests were as follows: Fort Collins, 1945-49, Colorado 152; Rocky Ford, 1945-49, De-Kalb 847; Fort IRRIGATION Morgan, 1947. 49, Ohio C-12; and Johnstown, 1949, United 40R. In Fort Collins tests, Kitely K-4 has yielded high as a 2-year average for 1948 49. At Rocky Ford, Keystone 45 has been high during the same period.

Results from dryland tests at Haxtun, supplemented by data from an earlier test in Sedgwick County, indicate that Colorado 152 has yielded high over a **DRYLAND** 5-year period. The Akron test in 1949

was abandoned because of a poor stand that resulted from a period of wet weather immediately after the test was planted.

## Onions

The objective of the onionbreeding program is to produce a disease-resistant variety or hybrid of the Sweet Spanish type. The tests of 50 hybrids and 300 inbred lines made it possible to select five hybrids which show considerable promise of being disease resistant RREEDING and high yielding. The increase and further testing of disease-resistant lines is being expanded as rapidly as funds and facilities permit. The grey top and more pungent types show more disease resistance and have better storage characteristics. This work should provide an important means of cutting down heavy disease losses to growers when present types can be replaced with new hybrids. It will require several years to increase and further test the resistant hybrids for wide adaptation.

Eleven commercial - fertilizer treatments applied to onions at Rocky Ford showed that 30-120-30, 20-80-10, and 10-40-0 mixtures of available nitrogen, phosphorus and potash produced significantly higher yields per **FERTILIZERS** acre than the unfertilized check plots. The treatments are listed in available pounds of nitrogen, phosphorus and potash per acre. Single applications of nitrogen or phosphorus and potash gave no increase in yield over the untreated.

The 1949 dates of harvest tests indicated that storage - disease DATE OF HARVEST losses, due to purple blotch, can be reduced by earlier harvesting without decreasing the yield.

The 1949 chemical weed-control trials for onions showed that the application of 75 pounds of Aero Cyanamid per acre, as a pre-emergence dust, controlled **WEED CONTROL** weeds for a period of 21/2 weeks after the plants had emerged. Other treatments applied after emergence reduced stands and yields. This is only 1 year's results and is subject to further testing.

Chemical dusts are not satisfactory for purple blotch. A spray at the rate of 125 gallons per acre, which is sufficient to cause the spray to run down to the base of the onion, gave good control for purple blotch. A **PURPLE BLOTCH** spraying is a good sticker; the substance known as P. E. P. S. (polyethylene polysulphide) has proved satisfactory. The most important finding has been that so-called "brown blotch," which shows up early in the season, is caused by the same organism producing "purple blotch" late in the season.

Onion smut has shown up in the state for the first time.

During 3 years out of 4 significant increases in yield of Mountain Danver onions have resulted from thrips control. In 3 years of tests on Sweet Spanish onions no significant yield in. creases have resulted. This sea. son parathion and THRIPS chlordane reduced thrips more than the other ma. terials tested. Toxaphene, first in 1948, was third in 1949. The addition of nicotine sulfate to DDT did not give added thrips control. Two dusts of 5-percent DDT gave little or no control. Studies on thrips control will be discontinued for the present.

#### Peas

Some 93 lots of peas obtained from the U. S. Foreign Plants Introduction have been checked in infected soil. Unfortunately all of these were found susceptible to pea root rots in Colorado.

#### Peaches

The primary objective of peach research was to determine the maturity at shipping point which will bring to the consumer the best quality possible, give the grower the highest packed weight, and still keep damage and rot losses to a minimum. This is the third year of study. A positive correlation exists between measurable factors and maturity SHIPPING which the grower PROBLEMS or fieldman can Trees stripped when most use. were firm gave 66 lugs of size 60's, 31 lugs of size 50's, and only 6 lugs of the smaller size 70's as compared with 78 lugs of 60's, 12 lugs of 70's, and only 11 lugs of

the large 50's, when trees were stripped at the time most were of the hard maturity. Peach damage continued to be highest in the field (34.9 percent), packing shed (22.7 percent), and dock (30.7 percent), with faulty equipment contributing a large share of punctures and bruises. It is entirely practical to ship firm, maturity peaches to distant markets (Milwaukee this year) and have them arrive in desirable condition, especially when shipped in fan cars.

It is possible to predict the harvest date of peaches in Mesa County within a 4-day error by the application of mean-temperature records for March through July, inclusive.

Seven treatments, each replicated seven times, were tested in a 10-acre peach orchard near Palisade to determine methods of preventing blemishing of peaches through feeding of lygus. Due to a light infestation and low percentage of blemished fruit in this particular orchard, no significant differences were

LYGUS BUG INJURY found between treatments or between treat-

ments and no treatments. The DDT treatments that showed promise in early tests under this project were quite generally used by growers with good results. Use of DDT in orchards, however, continues to favor a build-up of the Howard scale and the clover mite. It is planned to discontinue the peach phase of the lygus problem.

In the study of insects as vectors of the peach mosaic virus, most attention has been given to the green-peach aphid with special emphasis being placed on: (a) the reason of transmission; (b) conditions under which transmission takes place; and (c) incubation period of the virus in the peach. Wood from all trees used in transmission tests is budded or grafted into standard MOSAIC Elberta trees. These are carried in plantings at Fort Collins and Whitewater. To date stem mothers and first-generation young, after flower feeding, seem to be the most active in trans-

mission. In studying the peach aphid in the orchard, it has been found that fall treatments continue to be as effective as spring treatments in control. DDT is the most effective material for fall applications. In spring treatments nicotine, benzene hexachloride, hexaethyl tetra phosphate and chlordane prove to be equally effective. With the proof that the green-peach aphid is a vector of the peach mosaic, a test has been inaugurated involving 25 growers and 12,500 trees to determine the effects of five peach aphid-control programs on the incidence of the disease. It is hoped that this test will also show if the common practice of cutting trees without first treating for insect control is a factor in the spread of the virus. This study is in cooperation with the peach-mosaic eradicators of the State Department of Agriculture and the U.S. Bureau of Entomology and Plant Quarantine.

A critical statistical study of the incidence of mosaic in a number of the Palisade peach orchards over a 15-year period is being made to see if any correlation exists between time of cutting diseased trees and spread of the virus. This will be correlated with the data that have been taken on the development and habits of the peach aphid. There is some evidence to indicate that methods of inspection and destruction of diseased trees may have a bearing on the disease spread.

#### Potatoes

The effect of commercial fertilizers on the permanent plots in the San Luis Valley on the yield, grade, color, cooking quality (measured by specific gravity) and keeping quality of potatoes were studied over a 4-year period. The results are in manuscript form and ready for publication. The results of the permanent plots in the San Luis Valley were COMMERCIAL tested on FERTILIZERS nine farms

in 1948 and eight farms in 1949. The results of the 2 years were in excellent agreement. These conclusions seem justified:

A fertilizer containing 40 pounds of nitrogen, 160 pounds of available phosphorus and 0-20 pounds of potash per acre has given best results for 2 years on farmers' potato fields and for 4 years on the San Luis Valley Farm. This is equivalent to a 6-24-0 or a 6-24-3 fertilizer when applied at about 600 pounds per acre.

The interaction between fertilizers and farms was significant. This means that even though one fertilizer was generally good that it is possible that slight changes in the analysis would be better on some farms.

In 1948 the above-mentioned fertilizer produced yields which averaged 85 sacks per acre higher than where no fertilizer was applied. In 1949 the average difference between no fertilizer and the recommended fertilizer was 84 sacks per acre.

Response in yield was due primarily to nitrogen and phos phate, the partial correlation be tween potash and yield was nil

Grade and quality difference resulting from the use of fertilizers up to 1,000 pounds per acre have not been large enough to be of practical importance.

Color and specific gravity (measure of cooking quality), of tubers when grown on the same ground for about the same length of time each year have varied greatly between years. Variations are probably due to differences in time of frost, cultural and climatic conditions.

Copper, iron and manganese sulfates when applied at 10, 20 and 50 pounds per acre of each sulfate, with fertilizer and sulfur, or with fertilizer alone, have failed to produce differences in yield or tuber quality, which differed significantly from fertilizer alone.

The following information has been obtained from the Arkansas Valley: the linear nitrogen effect between zero and 30 pounds per acre and the quadratic effect between 30 and 60 pounds per acre were highly significant. The linear phosphate effect between zero and 120 pounds of available phosphorus per acre and the quadratic effect between 120 and 240 pounds per acre were highly significant. Neither the linear nor the quadratic potash effects were significant. The yield increase between July 19 and August 5 was large enough to be very highly significant. The average percentage increase in 100-pound sacks per acre was 13.6 sacks per acre.

At the U.S.D.A. Potato Station, Greeley, and growers' fields, the permanent fertilizer plot was continued for the second year and for the second time no statistically significant increase in yield due to commercial fertilizer resulted. One experiment on a grower's field showed significant increases in yield due to commercial fertilizers.

Ten methods of vine destruction on two soil-moisture levels were tested and the following ascertained: Internal discoloration of potato tubers is negatively correlated with soil moisture. Sodium nitrite, Dowspray 66 Improved, and the flame thrower produced significantly **POTATO VINE KILLING** more internal discoloration than the check

on dry soil. Sodium nitrite was the only treatment which produced significantly more internal discoloration than the check on wet soil. Sinox General, the Roto Beater and Compound V5 produced significantly more internal discoloration on moist soil than on dry soil. Undercutting, sodium arsenite, and the untreated check produced about the same amount of internal discoloration on both the moist and dry soils.

Two experiments using periodic vine removal as Carbondale have shown that net necrosis can be greatly reduced by early vine removal. The implication is that a good spray program to control insects might also reduce net necrosis by killing rather than evading the insects.

New methods of grading, packaging, and shipping to improve and maintain quality of potatoes and to determine consumer acceptance have been studied. The grader for separating potatoes into cooking-quality grades has been greatly simplified and the capacity increased to 12,000 pounds of potatoes per hour. The error of separation

## MARKETING, SHIPPING

when separating a given lot of potatoes

into two groups is about 2 percent. A public service patent is being applied for but due to delays and the interest encountered, 19 sets of blueprints have been mailed out upon request with the understanding that the machine is not yet patented.

A field survey in the state has shown appreciable loss of potato stand as a result of Leak. This disease is associated with excessive soil water. In greenhouse tests there was a high death rate of tubers planted in highly infested soil. Where the soil is LEAK DISEASE full of the organism the seed-piece rot occurs irrespective of moisture. Storage at low temperatures, 40 degrees, greatly retards the progress of the disease. Tests on spread of Leak in storage indicate that the causal fungus will not penetrate the unbroken cork of the skin. A small amount will enter through wounds in the skin and through the eyes. Several dry fungicides have shown promise of value in seed-piece treatment.

The control of potato insects, suspected of carrying potato viruses and toxins, was continued at the U. S. Potato Station at Greeley. A heavy outbreak of the potato psyllid *Paratrioza cockerelli* Sulc gave an excellent opportunity to test various sprays and dusts. DDT gave good control of the psyllid, preventing psyllid yellows and at the same **INSECTS** time preventing serious marking of the tubers by the tuber flea-beetle

A comprehensive study of the influence of methods of cutting upon the vigor and production of greenhouse roses is under way. Records have been obtained on when cycles of crippled roses

Several lines (38) of rust-resistant, bunt-resistant hybrids were planted at Akron for yield test in 1950. Preliminary yields will be taken on 226 lines larvae. Results from the use of parathion were promising Control of leaf hoppers was not satisfactory. A condition known as "purple top" or aster vellows and thought to be spread by feeding of the aster leafhoppers, was prevalent under all treatments. Diseased plants from these plots and plants from Carbondale and Basalt, areas of Garfield and Eagle counties where many necrotic tubers were produced, have been studied intensively in the greenhouse. Necrotic tubers have been produced through feeding of the aster leafhoppers that had previously fed on aster plants infected with the virus of aster yellows.

The relation of aphids to leaf roll and tuber necrosis is being studied. Control of insects that may spread virus diseases of the potato, particularly those grown for certification or as foundation stock, is very important.

## Roses

occur in this climate preliminary to starting a project in cooperation with Roses, Inc., on the causes of malformation in rose flowers.

## Wheat

of a promising rust- and bunt resistant hybrid at Fort Collins. New crosses using superior rust resistance of several springwheat and winter-wheat types are now in the rust nursery. Additional crosses will be made in 1950 to further use these types of a wide range of germ plasm. Because of the serious epidemic of dwarf bunt in northwestern

Colorado in 1949, a new phase of the breeding program will be to obtain resistance to dwarf bunt and good milling quality in a wheat. At the present time there is no such variety of wheat.

## **Economics and Sociology**

Manuscript, "The Economics of Sugar Beet Mechanization," by Harry Sitler (for BAE) and R. T. Burdick.

Cooperation in preparation of manuscript, "Shifts in the Trade in Western Livestock," by Harold Abel (for BAE) for the 11-ACCOMPLISHMENTS state Western Livestock Marketing Committee. The section chief, as chairman of the 11-state committee, supervised the preparation of this report.

Secured 200 field records of cattle marketings for 1949 season from men located in all important cattle-producing areas of Colorado as Colorado's part of the above cooperative project. Secured summaries of the 1949 year's business on cooperating farms in farm businessanalysis project in northern Colorado irrigated and northeastern Colorado dry land, and western Colorado stock ranches.

Secured market data on consumer acceptance of peaches of varying maturities as part of section cooperation in a western regional project, and participated in preparation of regional report, to be published in Utah, entitled "Consumer Demand for Peaches of Varying Stages of Maturity 1949."

Secured Colorado shipping point records of mechanical injury to potatoes as part of section cooperation on a western regional project.

## Home and Farm Management

The high-altitude cake bulletins (Technical Bulletin No. 40 and Extension Bulletin No. 404-A), which contain cake recipes have had a distribution of 23,000 copies. Seven states and one foreign country ordered HIGH-ALTITUDE BAKING and requests for reorders have

been received from some of them. This bulletin contains only recipes for cakes, and the project is continuing according to plan to obtain other information needed by Colorado homemakers and others living at high altitudes. A preliminary project on the baking of bread at three different altitudes has been furnished. Definite corrections for proofing times and amount of yeast given in sealevel recipes were obtained.

A dry mix for use at altitudes of 5,000 feet from which cookies, griddle cakes, waffles, cakes, muffins and other leavened products can be made has been prepared. Adjustment for the mix for 10,000 feet is now in progress.

The complete physical and nutritional examinations of selected residents of Lake and El Paso Counties have been completed. Ninety-four children 14 to 16 years NUTRITIONAL age and of STATUS 107 adults over 60 were examined in Lake County (10,000 feet altitude), and 68 children and 66 adults in El Paso County (5,000 to 6,000 feet altitude). The examinations included a complete physical examination, medical history, nutritional history, 7-day food record, Kahn test, Brucellosis test, X-rays of the wrist and heel, chest X-rays of children and some adults, and determinations of vitamin A, ascorbic acid, ribocarotene, flavin, cholesterol, non - protein nitrogen, glucose and albumin globulin ratios in the blood and albumin and glucose in the urine. Hemoglobin was also deand other hematotermined logical tests conducted. The results are being tabulated, and only preliminary figures are available now. Diets were found

to be inadequate in many cases, and various physical abnormalities were found. Reports on the condition of participants were sent to them and to their personal physicians if desired. The coding of all the forms used for the collection of information has been set up so that the results can be tabulated by IBM machines. The coding of the completed forms is now in progress.

Laboratory studies to determine the space, equipment and utilities needed for specific household functions have been outlined and started by participating states in a cooperative study. Colorado has outlined and started work RURAL on the study of HOUSING dressing area and related clothes storage - space needs in farm homes in this region. The information on kinds of clothing and number of garments has been tabulated from the field study and is being used as the basis for this study. Techniques and procedures for carrying out the study have also been established. Colorado has completed a pilot study of a method of compiling and utilizing existing information concerning climate, topography, natural resources, etc., in the design of farm houses in this region. Plans have been developed to complete this study in Colorado.

The Poultry Section has suffered extreme losses of production, fertility, and hatchability during severe winter weather in

## NEW LAYING HOUSES

the old-type laying and breeding

houses at the Poultry plant. Changes and repairs included insulating two laying houses and installing automatic water systems and community nests. Another laying house and the breeding house were partially remodeled. Fan ventilation was installed in all four houses. Plans for a new 30x60' commercial laying unit, a remodeled Colorado laying unit for community nests, and directions for installing fan ventilation and **POULTRY** HOUSING AIDS been prepared for release by the Extension Agricultural Engineer in cooperation with

the Poultry Section.

#### Improved Seed

A total of 3,867 samples were tested by the Seed Laboratory for the period July 1, 1949, to March 31, 1950. This exceeds the number of samples received

SEED LABORATORY year by 449 samples, or slightly more than 13 percent, and is over three times the number received for the same period 8 years ago. Reporting of tests promptly is one of the main objectives of the laboratory.

Variety tests were conducted with winter wheat, winter barley, spring wheat, barley, oats, and safflower. Sorghums observed under irrigated conditions at Rocky Ford were: Honey, Fremont, Western IMPROVED Blackhull, Hegari SEED 750, Early Hegari, Martin, Coes, and Alliance. The first frost occurred on October 12. All varieties were mature at time of frost, except possibly Honey in which the seeds were a little soft.

Sorghums planted at Hesperus were: Alliance, Coes, Martin, Early Hegari, Western Blackhull, Fremont, and Chinch Bug. The first fall frost occurred on September 18. Because of a cool season, none of these varieties matured seed.

Samples of various seeds are being tested for germination. LONGEVITY OF FARM SEEDS Milling and baking tests have been made on the Marquis and Kanred wheat samples.

The Agronomy Section cooperates with the registered seed producers, who are members of the State Seed Growers Association, in production of foundation and breeders seed of crop FOUNDATION SEED varieties recommended for registration. The seed is produced on the

Agronomy Farm and distributed to the growers under the direction of the Extension Service.

The following amounts of

foundation seed were produced in 1949: Barley: Moravian, 2,900 pounds; Otis (Munsing x Spartan), 1,200 pounds; Trebi, 2,400 pounds; Lico II, 600 pounds; Lico III, 300 pounds; Ward, 920 pounds; Pueblo, 700 pounds. Winter Wheat: Comanche, 2,100 pounds; Pawnee, 2,000 pounds; Tenmarq, 1,300 pounds. Spring Wheat: Thatcher, 1,200 pounds. Oats: Fulton, 1,600 pounds; Colorado No. 37, 2,200 pounds.

In addition, the following crop varieties were grown in head rows for purification: Comanche, Wichita and Pawnee winter wheat, Thatcher and Reward spring wheat; and Scotch barley.

### Insect and Plant Disease Controls

Control tests this year showed parathion and methoxychlor significantly better than DDT in controlling cherry fruitworm. DDT was not significantly better than the untreated check. The parathion also gave good control of two species of mites on cherries and also reduced the Putnam INSECTS CAUSING scale on WORMY CHERRIES cherry The addition fruits. of nicotine sulfate and oil in the second and third applications of methoxychlor made practically no difference in cherry fruitworm control. Rains interferred with timing of applications this season. Additional information on the cherry fruitworm life history was obtained. Parathion appears to be the most ideal material tested for the control of cherry insects, but the hazards connected with its use make its recommendation inadvisable.

Tests for host range of ring pox and X-disease have been continued. Resurvey and check

on little cherry have been made on West and East slopes. The chemical test for this disease has a limited use. A survey has also been made for a new disease which is a complex of ring spot and sour-cherry yellows. One variety of apricot, "Royal," does not take STONE FRUIT ring pox. VIRUS DISEASES The rasp leaf has been found on cherry variety Montmorency. The type of root stock does not affect in the incidence of rasp leaf. Five-year results on the study attempting to determine whether the mild strains of peach mosaic develop into severe strains has indicated that in no instance do these mild strains become severe.

Chlordane as a spray or dust in the nests has been found effective but a less expensive and more practical method of appli-**RED HARVESTER ANT CONTROL** sought. A number of poisoned baits are being tested. Kills secured cannot be accurately determined until summer.

Attention was given largely to determining species involved, their life histories, the relationship of the different kinds of fruits and methods of handling, to population build-up. Two species of Drosophila are involved, D. obscura (Fallen) and FOOD CONTAMI. D. repleta NATING INSECTS species of Well. Two insect parasites were reared from the Drosophila. There was no evidence of the Drosophila over-wintering in the old piles of cull fruit during the winter of 1948-49 but they wintered in numbers during 1949-50. This may have a direct bearing on the populations for 1950.

They will breed in orchards in limited numbers on windfall fruits, especially apricots, peaches and pears when such fruits are shaded by the trees or weeds. Breeding occurs in decaying cull cantaloupes and watermelons in the fields. Breeding in cull tomatoes in the field did not appear to be an important factor this season, however, early freezes may have prevented a late season build-up. Sanitary fills operated by Mesa County and Public Health officials served to prevent much breeding in the truck loads of cull peaches and pears usually dumped on river banks and unused lands. The fills when properly maintained are

effective but rather expensive.

There was little evidence of breeding in cull peaches and pears when such fruits were scattered in the direct sun on a smooth soil. The proximity of many acres of barren, non-irrigated land surrounding the fruit-growing areas makes this appear to be a practical means of cull-fruit disposal.

Studies under this project are in only the preliminary stage. Attention will be given to the possibilities of control through the use of certain antibiotics. It has been determined that penicillin in dilutions that inhibit

EUROPEAN FOULBROOD OF HONEYBEES

growths of test bacteria is not lethal to a d u l t

honeybees. The penicillin is effective in inhibiting growths of test bacteria after it has been in the honey stomach and the lower digestive tract of the adult bee for several hours. Brood studies will be made as soon as disease appears in the hives.

A new disease on lettuce, Fusarium yellows, has shown up at Granby. There is some varietal resistance. A Wisconsin variety, "Progress," shows resistance. **MISCELLANEOUS** a promising soil treatment. Copper sulfate in irrigation water gave good results for this disease. *Helminthosporium victori* on oats was found for the first time in Colorado.

### Industrial Processing

approximate moisture The contents of the three parts of sugar beet tops at harvest time are: leaves, 82 percent; stems, 90 percent; crowns, 82 percent; whole tops, 85 percent. The leaves contain about 45 percent of the total solids in the top, 85 percent of the carotene, and 65 SUGAR BEET TOP percent of the pro-UTILIZATION tein. Because of the higher-moisture content in comparison with percent), (75-77 alfalfa the chief green crop dehydrated in the United States, two main avenues of approach have been considered possible in dehydration of sugar beet tops. 'One of these is to remove part of the moisture mechanically rather than by heat. The other is to harvest the leaves alone, without stem or crown, for dehydration.

Studies last year showed that more than 90 percent of the protein, all of the carotene, and 88 percent of the total solids could be retained in the press cake, if the green material was steamblanched before pressing in a hydraulic press. By this method, the moisture content could be reduced to about 60 percent and the press cake dehydrated readily in the laboratory tray drier into a meal of excellent feeding value. Since the hydraulic press is uneconomical due to intermittent batch operation, common types of continuous-feed presses have been tried on blanched beet leaves but they were unsatisfactory because they break up the leaves. Considerable of the leaf material is forced out of the screens with the juice. Three new-type presses in development by other organizations have been tested and have been found unsatisfactory. Other means of dewatering mechanically are under consideration.

During the ensiling process, much moisture drains off but much of the carotene in the green leaves is lost by oxidation. Artificial ensiling with acid, using mycostatic agent, is in progress in three sizes of silos. This method results in satisfactory reduction of moisture. Stability of the carotene and protein is being ascertained.

An experimental stripper has been built which successfully re moved most of the leaves and but little of the stem from the beets in the ground. The leaves can not be removed before harvest of the roots without lowering sugar content.

Leaves or tops (leaf, stem, crown) can not be properly chopped for direct dehydration in a commercial drier in the conventional field chopper. The peg-tooth drum of a threshing machine has been found to chop the material into excellent condition for dehydration. A chop per and hammermill fitted with knives and no screen also is satisfactory, providing the material does not go through a blower fan.

Ensiling causes a modification in the carotenoid pigments so that carotene readings are falsely high. Progress in overcoming this problem and in ascertaining the types of pigments and their vitamin A activity is being made.

The three varieties of peaches tested showing the best processing and flavor characteristics are Stark's Early Elberta and two seedlings, CPS-4-4 and CPS-5-4.

Seventy percent of the individuals who prepared cherry pies using the frozen fruit piemix reported that the products were superior in color and flavor

#### FROZEN FRUIT PIE-MIX

to any with which they were famil-

iar. The newly developed uncooked stabilized, fresh frozen apple pulp created much interest when served unchanged and incorporated in an ice and sherbet.

Technical assistance was furnished a Colorado processor who was freezing a commercial pack of apples for the first time. Another Colorado processor who had difficulty with 6,000, 25pound cans of frozen apples BROWNING STUDIES which had excessive internal browning upon thawing, was helped to overcome this difficulty so that the investment was saved. Accelerated storage studies on dehydrated potatoes have shown that proper pretreatment before dehydration prevents non-enzymatic browning during dehydration and during subsequent storage at 120 degrees for 18 months.

The investigations under this project may be summarized under four headings: (1) intensification of red-skin color and vitamin C content of red-skin potatoes by plant-hormone treatment; (2) following the accumu-

COMPOUNDS RELATED TO DDT AND SYNTHETIC PLANT HORMONES

lation of glutamic acid in sugar beets after synthetic plant-hormone treatment; (3) investigation of

metabolic changes in plants subjected to plant-hormone treatments; (4) evaluation of fungistatic and fungicidal properties of selected plant hormones. A rapid method for starch evaluation in potatoes has been developed. It requires only about one-half the time of other quick methods and only a fraction of the time of acid hydrolysis procedures. Correlation with the several accepted methods is as yet not completed.

The practical objective is development of new anti-thyroid drugs. The immediate objective has been to develop methods for the iodination of rhodanine and its derivatives and evaluate the toxicity of the various compounds prepared. Several derivatives prepared from thodan-

#### IODINATED THIOURACIL DERIVATIVES

ine have been found to be relatively nontoxic to chicks

and to have goitrogenic properties. By agreement with sponsors of the project, details of the work are not to be released until it is agreed that findings have been firmly established.

In cooperation with Armour and Company Laboratories, Chicago, numerous assays were completed, comprising the determination of weights as well as the histological appearance of testes, seminal vesicles, prostates and coagulating glands from rats which had been subjected to

#### ASSAY OF PITUITARY GONADOTROPHINS

treatment at the Arm-

our Laboratories. Assays on adrenals were run to determine the effects of pituitary fractions (ACTH). These assays are designated to determine the purity of gonadotrophic fractions separated from packing-house material for the use in treating sterility in livestock.

Alcohol extracts of large amounts of dried manure from pregnant cows, which had been characterized as biological potent by chick tests **COW MANURE** were prepar-AS SOURCE OF ed. Following HORMONES the use of eight chromatographic separaof tions, a series oils and crystals were obtained. The chemical identification of these fractions in cluding melting points and the preparation of derivatives indicate that the steroid substances are so far unknown and should be considered as new compounds from natural sources. For the present time, laboratories of Ciba Pharmaceutical Products, Inc., are engaged in the final microchemical work to complete characterization of these new substances.

Approximately 18 experiments, involving about 5,000 chicks and rats have been completed in an effort to determine the anti-

### ANTITHYROID DRUGS

thyroid potency and toxicity of

13 compounds which are aromatic amines manufactured as industrial chemical intermediates. Nine of these compounds show promise as new and potent antithyroid drugs. Further tests are being done to ascertain mode of action, proper dosage levels, and attendant toxicity. This work is eliciting extensive interest in medical and pharmaceutical circles.

It has been found that the sodium salt of 2,4-D will increase the red color of the skin of Red McClure potato. This same chemical increases the vitamin C HORMONE content of potatoes both fresh and in STUDIES storage. Investigations of the effect of certain "carbamates" sprayed on sugar beets produced a significant increase in the glutamic acid content. A quantitative method for testing

glutamic acid in sugar beet juice by the use of chromatography has been developed.

A study is being made of the rate of germination of barley seed following spraying of the crop by 2,4-D. Knowledge of this subject would be very important in the brewing of barley. The indications are that when barley is sprayed for weeds the speed of germination of the seed from that crop is greatly increased. It would be obvious therefore that if barley lots were mixed, that from one farmer might have been sprayed and another lot unsprayed. In the malting process this would confuse the time of malting.

Study has been made of pentachloropheno oxyacetic acid and it has been found that this substance has a selective action on the organism causing potato scab. This academic finding will have considerable importance in sifting out mixed cultures and also suggest a possibility of use as a soil treatment.

## Irrigation, Drainage and Engineering

Much of the first year of Upper Colorado River basin studies has been devoted to establishment of a laboratory at **UPPER COLORADO RIVER STUDIES** ing investigations in irrigation, drainage and crop-production conditions in the area.

A study of the feasibility of pump drainage for the Willsea area near Grand Junction has been initiated and piezometers have been install-PUMP ed to determine DRAINAGE the depth to gravel and pressure from underground water. A contract is being completed with a welldrilling company to sink а series of exploratory wells to log the profile of the water-bearing strata preparatory to putting in experimental wells to be

pumped. Studies have been conducted at Fort Collins to determine relationship of types of minerals and particle size to soil structure on some poorly drained areas. It has been determined that types of mineral present and the high percentage of silt are probably contributing factors to much of the poor structure in soils of the Upper Colorado River Basin. The problem involves a large area of poorly drained and unproductive land. The solution for this problem will therefore be very expensive.

A direct correlation has been found between firmness of the soil under seed, moisture in seed zone and germination of sugar beet seed.

A new type of weeder for removing small weeds from the

#### SUGAR BEET WEEDER

row of small beets was designed and

tested in 1949. The machine has been re-designed for further testing in 1950.

A beet-leaf stripper has been designed and built for use in harvesting the leafy portion of the beet top without stems and **BEET-LEAF STRIPPER** for nutritional and processing studies in connection with the beet-top utilization project.

The John Deere Wagon Works has built 100 furrowforming beet-planter units for use in 1950. The units are patterned after a design developed by the Mechanical Engineering Section for the improvement of sugar beet - seedling emergence.

An attachment for mixing phosphoric a c i d with green alfalfa for silage was built for the John Deere No. 66 field-forage harvester.

This section assisted in the testing of a specific gravity SPECIFIC GRAVITY OF POTATOES potato separator developed by USDA cooperators

and the Horticulture Section.

The second version of a beettop-unloading device for use in **BEET-TOP** UNLOADER connection with the beet-top utilization project is under construction. This work is being done primarily by USDA cooperators.

Standard meteorological observations have been taken during the entire year without interruption in cooperation with the U. S. Weather Bureau. This **METEOROLOGICAL OBSERVATIONS** in formation is pub-

lished by the bureau for the benefit of farmers and ranchers and others. It is also used by the bureau in furnishing information for commercial airways and in making routine weather predictions. Construction on an improved type of sunshine recorder was started.

Accumulation of data regarding ground-water resources of Colorado has been carried on as usual. Ground-water elevations **GROUND-WATER STUDIES** measured semi-annually. This study is especially valuable in parts of Kit Carson County which have just recently begun to develop pump irrigation.

Snow surveys were continued as usual. Several new snow courses were established in Colorado and the cooperative staff **SNOW SURVEYS** in releasing several discussions and articles in the snow-surveying field. The Soil Conservation Service has established a Junior Engineering position to provide assistance. Runoff forecasts using photographic methods of snow surveying on the Poudre River were made as usual. This method is still in the development stage.

Complete designs for a hydraulic sand separator have been conceived. The purpose of this sand separator is to separate dynamically similar particles for

SAND SEPARATOR wodel of this apparatus is now being constructed from plastic and a testing program has been started. The hydraulic laboratory is the first to use dynamic modeling of sediment in hydraulicmodel testing. This separator, when developed, will be of great importance in the field of hydraulic-model studies.

Information on sand traps was collected and consultant service SAND TRAPS was provided to canal companies and the state engineer's office on water measurement and canal regulation problems.

An extensive investigation on

the use of sprinkler irrigation in SPRINKLER IRRIGATION sprinkler systems on irrigated farms throughout the state is observed and recorded.

The intensive program of measuring friction losses through various types of well screens and well gravel packs, which is being **WELL-SCREEN** FRICTION LOSSES between the Soil Conservation Service, Division of Irrigation, various well-screen manufacturers, and the Experiment Station continues.

If seepage losses are not accurately predicted, areas of land brought under irrigation may be greatly in excess of or less than the area for which SEEPAGE water is available. LOSSES · A cooperative project between the Bureau of Reclamation, the Soil Conservation Service, and the Experiment Station was initiated September 1, 1950, to investigate ways and means whereby reasonable predictions of seepage losses in advance might be made.

## **Contract Projects**

A number of projects are being conducted by the Section through the Colorado Agricultural R e s e a r c h Foundation. These are conducted under specific contract with various private

or governmental agencies. During the current year nearly \$30,-000 has been earned by projects of this kind, either in cash or in increased facilities. The gross volume of this kind of research for 1949 and the first half of 1950 exceeds \$100,000.

Testing of three model dams, Bhakra, Hirakud, and Rihand, designed by International Engineering Company for various MODEL DAMS Agencies has been completed. The final reports have been written for the Bhakra Dam and preliminary drafts of the final reports of the others are complete.

One of the major problems in hydrology as well as in physics and engineering has to do with the dissipation of mass, heat or **WIND TUNNEL** momentum from various kinds of objects. This problem is being studied for the Office of Naval Research in a wind tunnel in which wind velocities up to approximately 80 miles per hour may be produced. The wind tunnel is nearly complete and the propellor and power unit are being installed.

A research project was sponsored by Armco Corporation to design a new type stilling well for the Armco metergate which is used extensively for measuring flows of water into lateral and farm ditches. METERGATE It is proposed to replace the 10-inch stilling wells now in use with 4-inch wells. Investigations for design of such a well have largely been completed and tested. In connection with the investigations for this project, however, certain discrepancies in the previous discharge ratings of the gates was noted. Officials of the Armco Company have requested the Section to undertake recalibration of their gates.

## Livestock and Poultry Production

## Livestock

Work with females to date has given results in general similar to earlier observations with steers. Winter and summer gains and blood carotene and vitamin A values closely parallel former

VITAMIN A NUTRITION OF BEEF CATTLE IN REPRO-DUCTION results. Cows receiving alfalfa hay supplement with a cane ration dropped a calf crop of 100 percent, all of

the calves being on the ground

within a calving period of 21 days. Other lots followed in the following order: Vitamin oil supplemented cane -A percent in 35 days; 80 continuous pasture lot - 100 percent in 49 days; and the basal cane lot-80 percent in 56 days. Average birth weight of calves was the same for all except the continuous pasture lot in which the average was 69 pounds, or 3 pounds lighter than the average for the other lots. At 7 months

of age the calves weaned from dams receiving alfalfa supplement weighed 31 pounds (11 percent) more than the control lots averaged. Calves from the vitamin A oil supplemented dams weaned 14 pounds (5 percent) heavier than the controls.

Yearling heifer calves which received a supplement of alfalfa hay in one case and alfalfa pellets in another had shown equal gains by the end of their first summer - range period, being about 6 pounds (2 percent) more than the gain observed for the control lots.

The cows, approximately 4 years of age, which have been carried at the U.S. Dry Land Field Station at Akron are currently dropping their second calf crop. These animals were fed basic dryland rations supplemented with alfalfa hay or fish oil on an equivalent vitamin A intake during the winter. This is a repetition of last year's experiment with the same group of cows. These cows, together with a group of 2-year-old heifers wintered on similar rations, will go to pasture about May 10.

Three bull calves (two Hereford, one Shorthorn) were started on nurse cows about December 1, 1949, in an attempt to develop symptoms similar to those previously observed and described in purebred herds in Colorado. These calves were 6

RICKETS-LIKE CONDITION IN CATTLE months old when started on the nurse cows, and one calf had been weaned. Owing to the difficulty in securing good nurse cows, the milk-fed bulls have not been receiving enough milk. Nevertheless early symptoms of stiffness were observed in the Shorthorn bull. These were transitory and disappeared within about 1 week. Blood analyses have failed to reveal any significant lead.

Seven lots of 10 steers were started on feed November 17, 1949. These cattle gained over 300 pounds in 132 days. Up until March 10, 1950, the differ-

#### PROCESSED ALFALFA FED FATTENING CATTLE

LAMBS

ences were small in total gains and cost of gain between the lots

fed alfalfa processed in various ways (dehydrated alfalfa, windrow chopped alfalfa hay, windrow baled alfalfa hay, stacked alfalfa hay, plain alfalfa silage, phosphoric acid silage, and alfalfa-molasses silage).

Ten lots of 50 lambs each were fed 138 days on rations varying only in amounts of dehydrated alfalfa, or the addition of corn silage or trace minerals. The dehydrated alfalfa proved to be **DEHYDRATED ALFALFA FOR FATTENING DEHYDRATED** 

than chopped alfalfa hay

while costing 21/3 times more than the chopped alfalfa hay. From these results, the conclusion can safely be made that it is not profitable with present feed prices to feed de-

hydrated alfalfa in rations in which chopped alfalfa hay is also fed. This test does give a comparison of dehydrated alfalfa and chopped alfalfa hay when fed together. Corn silage when fed with chopped alfalfa and dehydrated alfalfa gave larger and much cheaper gains than the chopped alfalfa hay and dehydrated alfalfa fed without corn silage. The one lot fed trace (copper, manganese minerals and iron) made about the same gains as the lot fed the same ration except for the trace minerals.

The third year of experimental feeding and slaughter of different types of Hereford steers is under way. Thirty-two unselected steers of different types

IMPROVEMENT OF BEEF CATTLE THROUGH BREEDING

bred at Fort Lewis A & M for this purpose are being individually fed.

The calving of approximately 90 cows of large, small and intermediate types is in progress at Fort Lewis A & M. Matings of different types of bulls and cows in 1949 were as follows: large x large, intermediate x intermediate, small x small, and intermediate x small. The second year of winter feeding six lots of 2-year-old and yearling females of large, intermediate and small types has just been completed.

Forty bull calves from the Fort Lewis herd are being individually full-fed at Fort Lewis A & M. This is the second group of bulls to be developed in order to measure individual feed utilization, rate of gain, and probable beef quality. Selections for line replacements will be made partially on the results of these tests. Three small lines of cattle were started in 1949-50. Five heifers were purchased from OXO Ranch, Stevensville, Montana; 5 from G. S. Sidwell and Sons, Carr, Colorado; and 5 from Redd Ranches, LaSal. Utah. Two of these lines are being developed on cooperating ranches on a share-the-calf-basis.

A progress report on the type studies on 2 years of data and part of a third indicated the following: Small-type calves graded significantly higher as feeders. Conventional - type calves had

larger daily gains, TYPE ate more feed per TESTING day, and produced larger steer calves and wholesale cuts when finished than smalltype calves. There were no consistent or significant differences in pounds of feed required per pound of gain, percentage of different wholesale cuts in the carcass, or percentage of fat, lean, and bone in the 9-10-11 rib cut. Differences in length of cannon bone, height of chest, hip height and wither height best serve to distinguish between small- and conventional - type steers. Conventional-type steers showed the largest average ratio of weight to wither height but small-type steers showed the largest average ratios of other body measurements to wither height. Body measurements cannot be used as a reliable indication of the individual steer's capacity for growth and fattening. However, correlation studies of total digestible nutrients per pound gain with certain body measurements and ratios of these measurements indicated that feeder steers which are shorterlegged, shorter in height, shorter in body and narrower in the chest tend to be more efficient than those that average longer, taller and wider. There is a highly significant positive correlation between circumference of hind quarters in the feeder steers and the area of the rib eye muscle.

## Wool Investigations

A total of 6,190 fleeces was graded at the shearing shed and sacked according to grade. The remainder of the clip, 2,509 fleeces, was kept as original bag wool to be used as a control in comparing the prices received

## WOOL PREPARATION AND PROCESSING

lots of wool. The two lots of wool were core tested and the shrinkage report sent to the grower. Since these two lots were sold as one unit, no marketing information was obtained.

Grading at the shearing shed is to be continued this spring to learn if shearing shed grading will be acceptable to the wool trade. Similar clips will be selected, one to be graded at the shearing shed and the other clip to be prepared in the usual manner. These clips will be detagged and tags scoured and sold as clean wool. Both clips will be core tested for shrinkage and results sent to the grower. The graded clips and the unprepared clips will be appraised in a warehouse and both offered for sale. Price comparisons will be made between the graded and ungraded clips. Information as to the cost of shearing shed grading compared to warehouse grading will also be obtained.

A total of 700 fleeces was graded and these grades core tested to determine shrinkages. Hand samples were taken from the fleeces and processed individually in the wool laboratory. These

## WOOL SHRINKAGE

results were sent to the producer to

enable him to select those individuals producing the greatest number of clean pounds of wool of the preferred grade. This flock was culled, before shearing, for staple length and desired body type. Individuals from this flock were sheared separately and a comparison made between the selects and the remainder of the flock for shrinkage and number of pounds of clean wool per ewe.

A total of 112 Corriedale ram and ewe lambs was sampled on

## **Dairy Cattle Investigations**

Thirty acres of irrigated pasture seeded in 1947 were used for the second full season in 1949. The two basic mixtures were (1) brome grass, orchard grass, meadow fescue and sweetclover; (2) brome grass, orchard grass, meadow fescue, and a mix-

#### IRRIGATED PASTURES FOR DAIRY CATTLE

ture of alfalfa, red clover, ladino clover, and alsike clover. Each of these

basic seedings has been pastured under two different systems: continuous grazing and rotation grazing. Results to date indicate: Rotation grazing of grass - sweetclover pastures showed a carrying capacity of 2.18 cows per acre vs. 2.09 cows per acre for continuous grazing. The opposite results with the grass - legume mixture have shown: rotation grazing, 2.31 cows per acre; continuous grazing, 2.67 cows per acre. The grass - legume mixture under both systems of grazing has had an appreciably higher average carrying capacity. The grasssweetclover pasture had a high carrying capacity the first year, but declined the second year as

the stand of sweetclover was reduced. The 2-year average for all pastures is: days on pasture, 124; cows per acre, 2.16. Further tests of the pasture value of the original mixtures will be conducted this year.

Fructose content of the semen of bulls has been found to be related to the fertilizing capacity and longevity of sperm. Castration resulted in complete loss of seminal fructose, showing that

FERTILIZING CAPACITY OF BULLS

testicular activity is related to this phenomenon. Attempts to

restore fructose of seminal fluid of castrates by administration of testoterone propionate and to effect that of normal bulls by injections of estrogen and of testosterone are in progress in an effort to learn how to assure high-fertilizing capacity of bulls used artificially. Pilot experiments with rats show that testosterone alone will not maintain fructose level of the accessory organs at more than two-thirds of normal. The role of the hypophysis is also under investigation.

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FINENESS AND VARIABILITY OF WOOL the shoulder, side, and thigh for fineness and

variability of wool. Variations in fineness have been noted between the progeny of different rams.

## Poultry

Earlier studies indicated large reserves of vitamin A and carotene in newly hatched chicks. The rate of depletion of these reserves during the first 3 weeks

UTILIZATION OF CAROTENE IN THE ANIMAL BODY of life of the chick is being studied. Further information is

being collected regarding site or conversion of carotene to vitamin A in the chick. Attempts are being made to isolate the factor (s) responsible for promoting the utilization of carotene in the animal body. The laboratory is cooperating with the Association of Official Agricultural Chemists in national collaborative studies to improve techniques for the determination of vitamin A and carotene.

Two experiments with chicks have substantiated previous work with hens showing that the carotene in alfalfa meal is more effective as a source of vitamin A activity than pure carotene or vitamin A itself. The presence of a carotene utilization factor has been strongly indicated. This factor is insoluble in water, is soluble in hexane or acetone, is in the saponifiable fraction, and is resistant to moist heat. An antioxidant in commercial use did not interfere with carotene utilization. Neither a dispersing agent or vitamin E influenced carotene utilization. Exploitation of alfalfa products because of this utilization factor requires that the products be standardized, especially in carotene content, and that means of preventing carotene destruction during storage be attained. Establishment of these conditions is being sought by the industry.

A commercial vitamin B-12 supplement has been shown to improve growth and feed utilization and to lower blood level of certain amino acids. Presumably, this vitamin therefore enables more rapid growth by promoting deposition of blood amino acids in new body tissue. As another phase of this project, the mutual

#### AMINO ACID UTILIZATION IN CHICKS

sparing effect of vitamin B-12 and the methyl don-

ors, choline and betaine, have been demonstrated in growing chicks. In the presence of ample vitamin B-12, the requirement for methyl donor is lessened. Choline, a synthetic product, is generally used as a methyl donor but betaine, derived from beet sugar molasses and Steffens filtrate, has been shown to be equally effective in practical chick rations. These studies have demonstrated that Steffens filtrate, or waste, and a by-product from this after removal of glutamic acid not only are the cheapest sources of methyl donor but that they also contain another factor which is essential for maximum early growth of chicks. This unknown factor appears to function like a similar

one in dried whey and to lower methionine requirements.

As a result of these experiments, it appears possible that a highly successful chick starting mash may be evolved without the use of any animal protein supplements or dried milk products which are considerably lower in protein than present rations and which are much lower in cost. Also, an important use for sugar-factory waste may be developed. Practical application of these findings is in progress.

A further outgrowth from this project was a study of a new type of high-protein, low-fiber, soybean oil meal and the various fractions of soybean protein. In the new starter-mash formula, composed essentially of corn, soybean oil meal, and the usual vitamin mineral supplements, the new soybean oil meal has given over 10 percent greater early growth and better feed utilization than the regular solventprocess meal and has been superior to the standard high-density starting mash which contains animal protein supplements.

The results of 10 incubation trials, involving about 8,000 chicken eggs, indicate that levels approximating 23.5 percent oxygen and 0.4 to 0.6 percent carbon **ALTITUDE INCUBATION** timum for maximum hatchability and quality of chicks at an altitude of 5,000 feet. The average increase in hatchability was about 10 percent of fertile eggs. Quality of chicks was improved slightly by levels up to 24.7 percent. Time of hatch was lengthened by lower levels of carbon dioxide and decreased by levels up to 0.9 percent. When no oxygen is added, optimum carbon dioxide content appears to approximate 0.4 percent.

Evidence was obtained with chickens and turkeys that increases in hatchability due to use of oxygen were greatest in eggs of hens that hatched poorest without oxygen. It therefore appears possible that hypoxia due to altitude may show up genetic weaknesses in hatchability. Efforts to develop an instrument for measuring carbon dioxide levels in incubators continue to be discouraging. Practical application of the results of these studies has been made by several large hatcheries in Colorado. hatching chicks and poults, with excellent and economical results.

Comparisons among progeny from three strains of turkeys showed that moderate inbreeding (37.5 percent) has thus far not resulted in any significant influence on reproductive performance. Varia-TURKEYS tions appeared to be characteristic of families, whether inbred or not. Closely related toms showed notably uniform family performance in fertility and hatchability. This work is illustrating the great importance of family performance rather than individual performance in selection of breeding stock.

Analysis of egg fractions for amino acids is continuing. Comparable fractions were obtained from high-quality and low-qual-

## COMPOSITION OF EGGS

ity eggs. Attempts are to be made to

correlate amino acid composition with quality. Highly purified fractions of mucin and chalazae are being compared with ovomucin and lysozyme obtained from the Western Regional Research laboratory.

Fleshing and body measurements were taken on the fourth generation from well-fleshed and normally fleshed lines derived originally from one strain of White Leghorn chickens. Selections are **BROAD-BREASTED** based on WHITE LEGHORNS these observations at 5 and 12 weeks Data indicates that of age. there is no clear-cut correlation between fleshing and body measurements but that fleshing does differ at 12 weeks of age. It appears that egg production and meat production can be combined, since some families evidence excellent egg production, growth, and fleshing. Attainment of this goal would simplify production of stock and would improve economy of egg and meat production.

Alfalfa meal is an excellent source of vitamin A activity and of certain other vitamins in poultry rations. However, it has also been found to inhibit early growth when fed in excess. The

EFFECT OF ALFALFA ON CHICK GROWTH effect of alfalfa meal on the early growth of chicks w a s ascertained on 100 samples of

alfalfa meals, mostly of known source and history. When incorporated in a high-density mash at a level of 10 percent, approximately 20 percent of these samples depressed early growth significantly, 35 percent demonstrated moderate depression of uncertain significance, and 45 percent showed no appreciable effect. Three of the samples exerted serious depression.

Growth-depressing meals were more common in third-cutting alfalfa. Inhibitory samples were found in sun-cured as well as dehydrated meals. No evidence has been found yet to incriminate weed contamination, 2,4-D spraying, or other production factors. Granular grinding was superior to grinding very fine. The inhibitory factor is soluble in water, and ethanol is insoluble in acetone and is relatively stable to moist heat. The effect is not due to fiber.

One percent of strongly inhibitory alfalfa meal improved growth slightly. Between 2.5 and 5 percent did not interfere with excellent growth. White Leghorn chicks appeared to be less susceptible to this effect than New Hampshire chicks.

From the practical viewpoint, the significant expression of growth depression is accomplished with levels of alfalfa meal in excess to those used in practical rations or of those necessary to supply ample vitamin A activity when the level of carotene in the meal is known to be normal by analysis. The amounts of this product in high-density chick starting mashes should be limited to about 2.5 percent, because of the low available energy content, the high percentage of fiber, and the bulkiness -- not primarily because of the growthinhibiting factor. For ordinary farm-type starting mashes, the level should not exceed 5 percent for best results. Maximum efficient levels for older birds remain to be ascertained.

A new-type shelter and breed-

## Pathology and Bacteriology

Research has been mainly applied to the two authorized projects, "Necrobacillosis in Cattle" and "Listerellosis in Farm Animals." In addition to the work on these projects, some further studies have been made on X-disease and forage poisoning in cattle, in some poultry diseases, and fringed tapeworm.

Diagnostic work consists of autopsies of animals and poultry, with cultures or tissue sections being made as part of the diagnostic procedure when indicated. Trips are made by members of the staff to aid both livestock owners and veterinarians in making diagnoses in outbreaks ing house has been constructed for year-around use. This pilot

TURKEY RANGE SHELTER feeders for both turkeys and chickens have been constructed.

Effect of storage on starter mash showed after 18 months of storage, that a commercial starter mash and the College starter mash had lost from 12-20 percent of their growth-promoting ability and nearly all of the original carotene and vitamin A. New Hampshire chicks showed more depressed growth rate on the stored feed than did Leghorn chicks.

of disease when the cause is obscure.

This project concerns three diseases: liver abscesses, foot-rot, and calf diphtheria. All are associated with Actinomyces necrophorus.

The development of liver abscesses has been studied. Experimental calves, approximately 6 months of age, were inoculated **NECROBACILLOSIS IN CATTLE** we in with a pure culture of A.

necrophorus which was carried by blood directly into the liver. These animals were autopsied at subsequent intervals. Thus, livers are on hand containing lesions of actinobacillosis which vary in age from 36 hours to 30 days. Study of these specimens has not been completed.

It has been determined that a relatively large dose of living A. necrophorus is necessary to produce abscesses under circumstances of the experiment. It is now important to determine if fattening increases susceptibility of liver to formation of abscesses. The study of foot-rot consists of two phases: (1) a survey of naturally diseased feet, and (2) intra-arterial inoculation of the foot with A. necrophorus. For the survey, 116 naturally diseased feet were collected, studied, and classified into eight groups, one of which constituted true foot-rot and represents 53 percent of the total.

In the experimental phase, eight calves, approximately 6 months of age, were inoculated with a pure culture of *A. necrophorus* into the common digital artery. The bacteria were carried to all parts of the foot where multiple foci of infection were produced. From comparing the experimental infections with natural cases of foot-rot, it is concluded that natural foot-rot infections originate from the surface of the foot, not from the blood.

The study of calf diphtheria consisted of two phases: (1) autopsy of a series of cattle that died of the disease, and (2) experimental production of calf diphtheria. Larynges and other organs were collected from 105 cattle that died of natural calf diphtheria. Some of them have not been completed. To determine cause of the disease, experimental calves were exposed as follows: two had a culture of A. necrophorus applied to the mucosa of the larynx at daily intervals for 10 days; two were given intra-laryngeal spray of a culture of virulent Pasteurella multicida at daily intervals for 10 days; two were given a combination of Pasteurella multicida as a spray and A. necrophorus on the surface of the mucosa. Animals receiving the combined exposure developed changes in the larynx similar to natural calf diphtheria. It is concluded that pasteurellosis may predispose to growth of A. necrophorus in producing the disease.

The work on this project has included the following different lines of investigation: Observation of as many clinical cases as possible in outbreaks to determine possible methods of transmission. Agglutination tests of infected animals and of apparently normal animals in the LISTERELLOSIS same herds.

## IN FARM ANIMALS

These tests indicate a fairly wide-

spread sub-clinical infection in animals not showing symptoms. A study of the organisms isolated from outbreaks in cattle and sheep to see if there were any morphological or cultural differences in strains. A study of the resistance of the organisms to such environmental factors as pH, temperature, and drying, and to the action of antiseptics and antibiotics. Attempts to reproduce the infection in various species of animals by different methods of exposure.

Several cases of X-disease have been observed. Tissues collected have been examined grossly and microscopically. Some microscopic sections have shown what would appear to be inclusion bodies. Inclusion bodies are usually indicative X-DISEASE of a virus infection. Recently obtained were two animals which appear to be affected with X-disease and are to be used for further studies. Transmission experiments will be attempted.

Numerous cases of forage poisoning have been studied. Some evidence indicates **POISONING** a correlation of the incidence of this disease with highly mineralized water.

Hatcherymen in Colorado have experienced considerable confusion in testing their breeding flocks by the great number of hens which show a doubtful or partial reaction to the pullorum agglutination test. In an endeavor to de-PULLORUM termine whether DISEASE or not these birds REACTORS were infected, a number of them were kept in a laying house, and by trapnesting, their eggs were collected and identified and later incubated. It has been determined from the hatchability of their eggs and the livability of the resulting chicks that these birds were apparently not infected.

beginning life history In studies on the fringed tapeworm. Thysanosoma actinioides. of sheep, an attempt was made to establish an infestation of this parasite on a pasture on the campus. A small FRINGED plot of approxi-TAPEWORM mately 2 acres IN SHEEP having good drainage was chosen. It consisted of exposed and shaded portions. Part of the exposed and shaded areas was irrigated by means of a sprinkler system. The remainder did not receive any water other than natural precipitation.

Fourteen adult sheep, part of which came from infested range and part of which were known by fecal examination to be infected with fringed tapeworms, were placed on the experimental plot early in the spring of 1949. Four lambs were born on the pasture where they remained from 6 to 10 months before be ing examined post-mortem for fringed tapeworms.

In order to determine if the eggs of the fringed tapeworm had been passing on to the pasture during the time the lambs occupied it, seven of the adult sheep were examined post-mortem about l year after having been placed on it. Five of these animals harbored adult fringed tapeworms. The presence of these tapeworms indicated that the means of infecting any suitable intermediate host on the pasture, and subsequently the lambs born and kept on the experimental plot were supplied.

Post-mortem examination of one lamb September 30. one October 25, one March 17, and one April 15 showed them all to he free of fringed tapeworms. The absence of fringed tapeworms in lambs born on a pasture that was shared with adult sheep that harbored the tapeworms is an indication that the necessary intermediate host was not present. The broad tapeworm (Moniezia expansa), whose intermediate host is a soil mite. was present in the lambs. This condition is further evidence that the fringed tapeworm and the broad tapeworm of sheep do not share the same intermediate host.

Demand for all phases of this work is increasing. No other diagnostic facilities are now

DIAGNOSIS OF ANIMAL AND POULTRY DISEASES available in the State of Colorado. Following is a summary of the diagnostic work completed from the inception, July 1, 1949 to April 13, 1950:

Consignr	nents
Poultry	456
Farm animals or tissues	
from farm animals	296
Fur-bearing animals	26

In addition to the animals, poultry or tissues received for disease diagnosis, we have made special tests on the following:

Bovine blood samples	
for Br. abortus ag-	
glutination tests	503
Milk samples for mastitis tests	. 352
Turkey blood samples for pullorum ag-	15 891

In special cases in which extensive livestock or poultry losses were being incurred, one or more staff members have made trips to the farm or ranch to study the disease problem in order to make a diagnosis and to aid in suggesting methods of control or treatment. In the period covered by this report, more than 60 such service trips were made by the several staff members to almost all parts of Colorado.

### **Range and Pasture Management**

A new phase of this project to test the effect of commercial fertilizers on the yield and nutrients in six range grasses was ini-NUTRITIVE tiated. First year's results indicate VALUES OF that application FORAGE of nitrogen at 20 PLANTS and 40 pounds per acre gave a definite increase in yield of range forage. The response in nutrient level of the forage awaits chemical analysis.

Cows and calves were placed in both native and seeded pastures to determine seasonal weight gains, rate of grazing and utilization of each forage species by livestock. Measurements on

#### PRACTICES FOR INCREASED CATTLE PRODUCTION

yields and heights of the important grasses under

study were obtained. Rainfall and soil moisture records again were a definite part of the program. A range survey was made of each native pasture which is only a periodic procedure. Excellent forage growth of the early season grasses occurred because of excess rainfall of 14 inches (March 1 to June 15). Even with summer precipitation very scant, blue grama, however, relied mainly on the subsoil moisture reserves for its substantial forage growth.

Again early season introduced grasses showed their value for grazing. Tall wheatgrass (firstyear grazing) slightly outranked

Russian wild rye in beef produc. tion per acre. However, Russian wild rye is more palatable than the above grass because of less coarseness of leafage and stems. Intermediate and smooth brome produced 2.4 times less beef per acre than the Russian wild rye. The two above rootstock grasses were sodbound and therefore produced less forage. The condition of cows at weaning time varied from fair to good because they had been on dry native feed of rather low nutritive value during the summer and fall.

This project has been revised to study the condition and trend of rangelands. Techniques and methods of measuring condition and trend have

and trend have been studied.

No actual field work has been conducted. Methods will be compared this summer on experimental ranges.

A replicated test of dates and rates of application of 2,4-D and mixtures containing 2,4,5-T was conducted on big sagebrush at Great Divide. Gallonages of car-

#### SAGEBRUSH LAND IMPROVEMENT

GUIDES

riers and use of emulsifierspreaders were includ-

ed in tests. A new date of seeding test was initiated and other experiments continued while stand counts and first-year forage yields were obtained on previous tests. Date of application of 2,4-D markedly influences sagebrush defoliation and apparent kill; applications made May 15, June 1, and June 15 gave much better

## APPLICATION DATES FOR SPRAY

control than those made July 1. Satisfactory con-

trol of big sagebrush can be economically accomplished by the use of 2,4-D or a mixture of 2,4-D and 2,4,5-T. There is increased control by the addition of an emulsifier-spreader. Three gallons of diesel, I gallon of diesel in 4 gallons of water, and 5 gallons of water were more effective amounts of carriers. When applied prior to June 15, 16 pound of 2,4-D produced results equivalent to 1-pound rates which gave satisfactory control, although 2-pound rates gave superior results.

Five-pound rates of crested wheat gave yields almost equal to 10-pound rates indicating that economy in the use of highpriced seed is pos-SEEDING sible. Six- and 8-RATES inch drill spacings gave somewhat greater forage yields. Crested wheatgrass exceeded other grasses, including newer Russian wheatgrass, in yield on burned sage range in one test. However, intermediate wheatgrass gave superior yields in an abandoned cropland seeding. Seeding with rye reduced the resulting grass stand without adding much soil protection when needed. Cattle gains were good this year and grazing

continued well into November.

New strains of bromegrass, crested wheat, intermediate wheat and other grasses were tested in small plots. Most promising grasses were harvested for yield comparisons on abandoned cropland and flooded bottoms for hay. REVEGETATING Many new ABANDONED dryland CROPLANDS legumes AND DEPLETED were tested RANGES in small

plots. Date-of-seeding tests were initiated at Akron and the Main Station. Methods of seeding winter wheatlands were also tested. County grass-test plots were seeded at Wray, Fort Morgan and Colorado Springs.

Tall wheatgrass exceeded all other grasses in yield on dryland areas at Akron and Fort Collins, closely followed by intermediate wheatgrass. Intermediate wheatgrass continued to exceed three other standard hay grasses in yield on flooded bottomlands. Several new strains of grasses appear superior: Nebraska 50 intermediate wheat, Nebraska 36, 44, and Oklahoma No. 1, and synthetic bromegrass; K-31 fescue; Italian and Empire birdsfoot trefoil; and Sevelra alfalfa. Satisfactory stands of grass are produced by drilling directly into spring grain stubble after harvest without any tilling. Seeding in winter wheat stubble in the spring produced stands about equal to that obtained on fallow, although plants are less vigorous.

Alta fescue and big bluegrass make good late fall pasture, producing green forage in greater abundance than other grasses last fall up until December 10.

This experiment is to test the effectiveness of shelterbelts upon crop production and is being carried on in cooperation with the Agronomy Department. Work done FIELD in the past SHELTERBELT year was planting and harvesting of Brunker oats, the field crop used in the test. The data on the yield of oats is collected and analyzed by the Agronomy Department.

This project is one to determine the effectiveness of fencepost preservatives that are adaptable on the ranch or farm. More

The following has been found regarding available nutrients in Colorado soils: (1) practically all Colorado subsoils are extremely deficient in available phosphorus; (2) as the lime con-ACCOMPLISHMENTS tent of surface soils increase, the availability of phosphate tends to decrease; (3) phosphorus and nitrogen are the only two mineral nutrients which are evidentally deficient to any great extent in Colorado soil; (4) on some Colorado soils commercial fertilizers give increased yields comparable **FENCE-POST DURABILITY** plied to 500 posts and are being studied under various soil conditions. Annual records are being kept and a systematic summary maintained.

Work to date has consisted largely in developing plans for the current season and in getting equipment and other necessary facilities ready. However, а reconnaissance soil survey was made of HIGH-ALTITUDE part of the **MEADOWS** mountain meadow and the Gunnison area last fall and some preliminary fertilizer and moisture studies were conducted. Preliminary drainage surveys have been made and technical assistance has been given in installing drains on a small scale.

## Soils

to yields resulting from addition of barnyard manures; (5) the benefit of alfalfa in rotation is largely due to residual nitrogen left in soil as a result of atmospheric nitrogen fixation.

Work on classifying arid and semi-arid lands is in cooperation with the Soil Survey Division of the Bureau of Plant Industry and the Soil Conservation Service. Laboratory analyses have been completed on soil samples collected in connection with detailed soil survey on the U. S. Dry Land Station near Akron and the U. S. Potato Station near Greeley. This summarized and interpreted information is to be

CLASSIFYING ARID AND SEMI-ARID LANDS included in a soil survey report of the Akron and Greeley Experi-

ment Stations. To secure additional information on the Akron Station soils infiltration and permeability tests were made under field conditions over an 8-day period during September, 1949. Fallow and range conditions were studied on the Rago, Weld and Colby soils which are also quite extensive in the dryland areas of eastern Colorado. The soils studied have silt loam surface soils. The Rago soils have a heavy clay loam subsoil about 12 inches thick with a well - developed structure; the Weld soils have a subsoil about 6 inches thick with structure similar to the Rago subsoil; the subsoil of the Colby soils has no structure.

Regardless of the well-developed structure the Rago and Weld subsoils are slowly permeable when saturated. This appears to be due to excessive swelling of the clay fraction. The subsoils of the Rago and Weld soils have saturated intake rates of .5 inch per hour. On the fallow areas the limiting intake layer was the surface soil. Even on land freshly cultivated with a duckfoot, an application of 2 inches per hour storm-crusted the soil in 30 minutes, indicating the need for incorporating organic matter to increase the rate

of water intake and thereby reduce runoff and conserve moisture. In general, on slopes of 0-2 percent, a 50-percent runoff resulted from applying 2 inches when the soil was initially near field capacity. Infiltration and permeability tests were continued near the Akron Station during September, 1950. This series of tests will be made on slopes above 2 percent and on stubble mulched areas. It is felt that data from these studies will help to answer some of the current questions on land capability classification in the dryland areas in eastern Colorado.

Preliminary clay-mineral identification studies were made on surface soil samples collected from two soil types on the Greeley Station. There appears to be no significant differences between the clay minerals of the two Greeley Station soils and the Fort Collins Station soil. This study is being made to aid in determining whether the soil types on the Greeley Station should be re-classified.

The studies include comparisons of relative effects of commercial fertilizer and manures on yield of crops and on soil structure, as well as the effect of

RESTORING PRODUCTIVENESS fertility. Experiments have shown that corn, sugar beets and small grain, when planted before alfalfa on leveled land without fertilizers were very greatly reduced in yield. Alfalfa and corn following alfalfa, however, produced normal crops without fertilizers or manure. Wheat and sugar beets produced normal crops with heavy applications of nitrogen-phosphorus fertilizers and fair crops with heavy applications of manure.

Eventually it will be necessary to conduct this experiment on other major soil types to get the complete answer to the problem for Colorado. It is believed, however, that data which will be obtained after the experiment has gone through a complete rotation cycle will be appliable to most of the state's soils with calcareous subsoils.

The cooperative Soils Laboratory is maintained and operated under terms of a memorandum of understanding between the Colorado A & M College Experiment Station and the Soil Conservation Service. Soil samples

#### SOILS LABORATORY

**TORY** are analyzed for (1) Soil Conservation

Service technicians assisting Soil Conservation Districts; (2) Soil Conservation Service soil scientists engaged in mapping and classifying land; (3) county agents engaged in demonstration work; and (4) assistance of in. dividual farmers and others who submit samples on a fee basis to Colorado A & M College.

This is a regional project in which the Bureau of Plant Industry, Soils and Agricultural Engineering, The Tennessee Valley Authority, the National Industry Phosphate Committee the Western Regional Experiment Stations, and several private agencies are cooperating. The work is being done in con-

## CALCAREOUS AND ALKALINE SOILS

regional

phosphate laboratory at For Collins. During the two seasons since work began on this project the availability of six types of phosphate fertilizers have been compared by use of radioactive tracers. The results show that superphosphate, phosphoric acid, mono - ammonium phosphate and calcium metaphosphate are superior to alphatricalcium phosphate and dicalcium phosphate.

## Weed Control

Use of growth-regulating compounds such as 2,4-D continues to lead the field in weed-control activity both from the standpoint of research and that of practical application. However, **ACCOMPLISHMENTS** materials has many ramifications and in addition numerous other means of weed control are receiving the attention of research workers. New herbicides and new developments in their use are appearing with such frequency as to make keeping up with them a difficult task.

Additional knowledge is being

gained each year as a result of the extensive tests being carried under this project and, on the basis of the latest information, new and improved recommendations are available. Recommendations in the past have had an

important part in developing various weed - control programs that have been set up in the state through the activity of the Extension Service, working in cooperation with the Experiment Station and other agencies.

## **Editorial** Service

Scientific journals published 15 manuscripts bearing the Station scientific journal series numbers. Thirty - one papers were published in semi-technical journals or mimeographed form. More than 200 news stories were released to newspapers and radio stations. Special feature and information stories and photos were provided to the regional farm magazines.

#### Semi-Monthly Publications

Farm and Home Colorado Research-Vol. 1 No. 1 May-June, 1950.

#### Monthly Publications

Twelve Issues of the Colorado A & M News made up of Vol. 4.

#### **Technical Bulletins**

No. 41—"Friction Losses in Selected Valves and Fittings for Irrigation Pumping Plants," by Carl Rohwer (May, 1950).

#### **Popular Bulletins**

- No. 404-A—"Mile-High Cakes," by Elizabeth Dyar, Elizabeth Cassel, Miriam Hummel, Elizabeth Twomey, and Elsie Slayton (July, 1949). (Reprinted March, 1950).
- No. 405-A—"When to Use Sprinkler Irrigation in Colorado," by W. E. Code and A. J. Hamman (July, 1949).
- No. 408-A—"Fire Blight of Apples and Pears," by W. J. Henderson, Extension Service Plant Pathologist, and W. D. Thomas, Jr., Associate Plant Pathologist, Experiment Station. (July, 1949).
- No. 411-A—"The Economics of Sugar Beet Mechanization," by Harry Sitler and R. T. Burdick (April, 1950).
- No. 412-A—"Poisonous and Injurious Plants in Colorado," by L. W. Durrell, Rue Jensen and Bruno Klinger (May, 1950).

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- Johnson, Gestur. Frozen Fresh Fruit Sundae Toppings. Western Canner and Packer, Nov. 1950. Misc. Series 471.
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- Thornton, Bruce J. The Use of 2,4-D and 2,4,5-T in Controlling Herbaceous and Woody Plant Growth. Sta. Mimeo. Misc. Series 470.

	Hatch Fund	Adams Fund	Fund	Bankhead- Jones Fund	Hope Flannagan	State Mill Levy	Special	TOTAL
Receipts	5	s	\$	\$	\$	Ş	UP.	\$
Balance July 1, 1949 From the Treasurer of the United States Other sources than the United States	15,000.00	15,000.00	60,000.00	26,055.98	8,257.85 41,742.64	4,677.44 167,458.741	8,830.91 206,502.75 a	21,766.20 157,798.62 373,961.49
Total Receipts	15,000.00	15,000.00	60,000.00	26,055.98	50,000.49	172,136.18	215,333.66	553,526.31
Expenditures Personal Services	7,584.37	12,631.43	47,128.93	20,101.13	28,417.56	102,156.98	80,832.65	298,853.05
Transportation of Things	122	166.24	26.65	43.94	56.95	645.05	3,820.65	4.760.23
Communication Service	205.39	6.25	152.45	31.13	66.25	3,290.27	541.06	4,292.80
Rents and Utility Service	1.373.91	14.66	128.62	169.36	156.58	3.642.21	558.92	5.942.42
Other Contractual Services	2,646.25	374.38	707.52	198.73	457.60	3,637.10	5,668.66	13,690.24
Supplies and Material	. 355.05	818.81	4,766.67	2,595.16	3,092.62	12,054.10	54,930.60	78,613.01
Equipment	. I,655.35	314.12	2,448.39	1,126.85	5,304.18	9,781.73	19,234.17	39,864.79
Contributions to Retirement	366.23	323.55	1,944.60	743.75	980.49	1,441.51	3,697.13	9,497.26
Total Expenditures. Balance on hand June 30, 1950	15,000.00	15,000.00	60,000.00	26,055.98 0	39,927.53 10,072.96	141,845.84 <sup>2</sup> 30,290.34	191,837.55 <sup>4</sup> 23,496.11 <sup>5</sup>	489,666.90 63,859.41
Grand Total	15,000.00	15,000.00	60,000.00	26,055.98	50,000.49	172.136.18	215,333,66	553.526.31

<sup>1</sup> Includes 50,000.00 HB No. 74.

<sup>a</sup> Includes disbursements 50,000:00 HB No. 74.

Includes disbursements 91,050.89 Station Special; 9,998.03 Bindweed; 24,991.70 Plant Disease; 8,350.00 Pure Seed; 57,446.93 Special. Includes 22,932.77 Station Special Carry-over; 1.97 Bindweed, 8.30 Plant Disease, 553.07 Special-Returned to the State Treasurer. <sup>a</sup> Includes receipts 105,152,75 Station Special; 10,000.00 Bindweed; 25,000.00 Plant Disease; 8,350.00 Pure Seed; 58,000.00 Special.

Under provisions of Section 9 (b) (3) of the Hope-Flannkgan Act \$74,500.00 was received. \$3,162.37 was carried over from the previous fiscal year. This money is solved by the certain projects worked on in cooperation with other State Experiment Stations. Of this amount \$68,946,96 was spent during this fiscal year. In addition the Colorado Station spent \$91,24 of Hope-Flannagan 9 (b) (3) Repetiment Stations 10,10,200 for the previous fiscal year.

## Personnel Changes

10110.02

Joining the staff during the fiscal year were:

Ralph L. Collins	Assistant Civil Engineer
Arthur Katona	Associate Sociologist
p. M. Stevens	Associate Rural Economist
F. M. Willhite	Associate Agronomist
Lynn A. Griner	Assistant Veterinary Pathologist
R. H. Porter	Associate Botanist
J. J. Lehman, Jr.	Assistant Chemist
Merle G. Payne	Assistant Chemist
Joseph O. Moffett	Assistant Entomologist
Ferne Bowman	
E. G. Buss	Assistant Poultry Husbandman
C. L. Gish	Assistant Poultry Husbandman
D. F. Peterson	Chief Civil Engineer
S. D. Resnick	Assistant Civil Engineer
Irving S. Dunn	Assistant Civil Engineer
L. E. Jenneke	Assistant Mechanical Engineer
F. J. Shideler	Assistant Editor
Robert Martin	
Resignations from the staff d	uring the fiscal year were:
R. Scott Jackson	Assistant Veterinary Pathologist
H. E. Barrett	Assistant Chemist
Walter H. Schaeffer	Assistant Forester
R. L. Lewis	Chief Civil Engineer
H. H. Schweizer	Assistant Civil Engineer
W. F. McGee	Superintendent, San Luis Valley Branch Station
Marcia Gregg	Assistant Editor
Madelen Rey	Research Assistant, Chemistry

## **COLORADO A & M COLLEGE** COLORADO AGRICULTURAL EXPERIMENT STATION Fort Collins, Colorado

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James R. Miller, Sec'yFort Collins	<sup>2</sup> Charles P. Warren	Fort Coll

#### **EXPERIMENT STATION OFFICERS**

W. E. Morgan, M.SPresident	Joseph M. Whalley, M.S. Treasur
Homer J. Henney, M.S Director	Rex W. Brown, B.S.
Jean MaunierClerk	Chief, News & Radio Servic
Nellie L. Landblom, A.BStatistician	F. J. Shideler, B.S. Assistant Edite

#### **EXPERIMENT STATION STAFF**

#### AGRICULTURAL DIVISION

#### Agronomy

D. W. Robertson, Ph.D.	Chief Agronom		
Robert Gardner, M.S	Agronomist (Soils		
W. H. Leonard, Ph.D.	Agronomi		
D. S. Romine, M.S.	Associate Agronomist (Soils		
*R. W. Whitney, M.S.	Associate Agronomist (Soils		
W. R. Schmehl, Ph.D.	Associate Agronomist (Soils		
Walter R. Heald, M.S.	Associate Agronomist (Soils		
Dwight Koonce, M.S.	Associate Agronomi		
F. M. Willhite, M.S.	Associate Agronom		
G. J. Gausman, M.S.	Assistant Agronomis		
Thilo Haus, M.S.	Assistant Agronom		
J. L. Mellor, B.S.	Assistant Agronom		
Donald R. Wood, M.S.	Assistant Agronomi		
K. G. Brown, M.S.	Assistant Agronomia		
Constatory			
Cooperators;			
G. W. Deming, B.S.	Assistant Agronomist (USDA		
S. R. Olsen, Ph.D.	Senior Soil Scientist (USDA		
O. J. Kelley, Ph.D.	Soil Scientist (USDA		
E. M. Payne, B.S.	Soil Scientist (USDA		
R. C. Accola, B.S.	Soil Scientist (USDA		
Frank Watanabe, M.S.	Soil Scientist (USDA		
C. Vernon Cole, Ph.D.	Soil Scientist (USDA		
H. K. Rouse, C.E.	Irrigation Engineer (USDA		
E. W. Cowley, C.E.	Irrigation Engineer (USDA		
	- P (		

<sup>1</sup> Resigned December, 1949 <sup>2</sup> Appointed January, 1950 • On leave.

#### STAFF

#### Animal Investigations

s Wheeler, Ph.D.	Chief Animal Husbandman
E Washburn, Ph.D.	Animal Husbandman
H. Stonaker, Ph.D.	Animal Husbandman
W E. Connell, M.S.	Animal Husbandman
Eurene Bertone, M.S.	Associate Animal Husbandman
Malvin H. Hazaleus, M.S.	Associate Animal Husbandman
Lamar Esplin, M.S.	Associate Animal Husbandman
F.K. McKellar, M.S.	Assistant Animal Husbandman
T B. Blackburn, B.S.	Assistant Animal Husbandman
A L. Banta, B.S.	Assistant Animal Husbandman
I. H. Holland, B.S.	Assistant Animal Husbandman

#### Animal Pathology and Veterinary Medicine

A. W. Deem, D.V.M., M.S.	Chief Veterinary Pathologist
Floyd Cross, D.V.M.	Veterinary Pathologist
Rue Jensen, D.V.M., M.S.	Veterinary Pathologist
I. W. Tobiska, M.S.	Chemist
Lynn A. Griner, D.V.M.	Assistant Veterinary Pathologist
Frank K. Bracken, D.V.M.	Assistant Veterinary Pathologist
Maxine M. Benjamin, D.V.M., B.S.	Assistant Veterinary Pathologist

#### Botany and Plant Pathology

L. W. Durrell, Ph.D.	Chief Botanist and Plant Pathologist
Jess L. Fults, Ph.D.	Botanist
Bruce J. Thornton, M.S.	Associate Botanist in Charge of Seed Laboratory
A. O. Simonds, Ph.D.	Associate Botanist
H. D. Harrington, Ph.D.	Associate Botanist
George H. Lane, M.S.	Associate Botanist
R. H. Porter, Ph.D.	Associate Botanist
Walter D. Thomas, Jr., Ph.D.	Associate Plant Pathologist
R. E. Atkinson, M.S.	Associate Plant Pathologist
R. L. Skiles, M.S.	Assistant Botanist
Norman R. Gerhold, M.S.	Assistant Botanist
Cooperators:	
J. O. Gaskill, M.S.	Plant Pathologist (USDA)
L. A. Schaal, Ph.D.	Associate Plant Pathologist (USDA)
E. A. Lungren, M.S.	Associate Plant Pathologist (USDA)

#### Chemistry

W. E. Pyke, Ph.D.	Chief Chemist
A. R. Patton, Ph.D.	Chemist
Lowell W. Charkey, Ph.D.	Associate Chemist
Paul R. Frey, Ph.D.	Associate Chemist
Raymond E. Carlson, Ph.D.	Assistant Chemist
Edwin B. Crone, Ph.D.	Assistant Chemist

#### COLORADO AGRICULTURAL EXPERIMENT STATION

H. A. Durham, M.S.	Assistant Chera
M. S. Hopwood, B.S.	Assistant Chea
Gestur Johnson, M.S.	Assistant Chen
Patricia Chism, M.S.	Assistant Chem
Dale M. Griffin, M.S.	Assistant Chemi
Marjorie Mayer, M.S.	Assistant Chem
J. J. Lehman, Jr., Ph.D.	Assistant Chem
Merle G. Payne, B.S.	Assistant Cherry
Elsie Foreman, B.S.	Research Assistant
Duane Johnson, B.S.	Research Assista
Adeline Kano, B.S	
Madeline Ferrigan, B.S	Laboratory Assistant

#### Entomology

George M. List, Ph.D.	Chief Entomolog
John L. Hoerner, M.S.	Associate Entomolog
Leslie B. Daniels, M.S.	Associate Entomologia
J. H. Newton, B.S.	Associate Entomolog
Theodore O. Thatcher, Ph.D.	Assistant Entomolog
Joseph O. Moffett, Ph.D.	Assistant Entomologi

#### Forestry and Range Management

C. H. Wasser, M.S	Chief Range Conservation
E. W. Neison, M.A. (deceased)	Range Conservation
Donald F. Hervey, M.S.	Assistant Range Conservation
Charles W. Barney, D.F.	Assistant Foresto
H. E. Troxell, M.F.	Assistant Forester

#### **Home Economics**

Com.

Elizabeth Dyar, Ph.D.	Chief Home Economia
Ferne Bowman, Ph.D.	Home Economic
Miriam E. Hummel, M.S	Assistant Home Economic
Mariana Kulas, M.S.	Assistant Home Economia
May E. Combs, M.S.	Assistant Home Economia
Elizabeth N. Twomey, B.S.	Research Assistant
Kathryn C. Colmey, B.S.	Research Assistan

#### Horticulture

A. M. Binkley, M.S.	Chief Horticulturia
George A. Beach, M.S	
Robert Kunkel, Ph.D	
A. C. Ferguson, M.S.	Associate Horticulturiy
Carl J. C. Jorgensen, M.S.	Associate Horticulturis
W. D. Holley, M.S	Associate Horticulturis
J. S. Gregory, B.S.	Assistant Horticulturi
R. F. Farmer, B.S.	Assistant Horticulturin

#### Poultry

H.	S.	Wilgu	ıs, Jr.,	Ph.DChief	Poultry	Husbandmu
C.	L.	Gish,	M.S	Assistant	Poultry	Husbandma
E.	G.	Buss,	M.S	Assistant	Poultry	Husbandmu

r X. Gassner, D.V.M., M.S.	Associate Endocrinologist
suzberger, B.A.	Research Assistant
nebert Martin, B.A.	

#### **Rural Economics and Sociology**

n T. Burdick, Ph.D.	Chief Rural Economist
C B. Creek, M.S.	Associate Rural Economist
n M. Stevens, M.S.	Associate Rural Economist
Arthur Katona, Ph.D.	Associate Sociologist
u Prentiss Gazaway, M.S.	Assistant Rural Economist
Catherine R. Clark, A.B.	Research Assistant
Cooperators:	
L C. Crecink, M.S.	Agricultural Economist (USDA)
H. G. Sitler, M.S.	Agricultural Economist (USDA)

#### ENGINEERING DIVISION

#### **Civil Engineering**

D. F. Peterson, D.C.E.	Chief Civil Engineer		
W. E. Code, B.S.	Associate Irrigation Engineer		
M. L. Albertson, Ph.D.	Associate Civil Engineer		
S. D. Resnick, M.S.	Assistant Civil Engineer		
Irving S. Dunn, M.S.	Assistant Civil Engineer		
lack E. Cermak, M.S.	Assistant Civil Engineer		
Ralph L. Collins, M.S.	Assistant Civil Engineer		
Maxwell Parshall, B.S.	Meteorologist		
Cooperators:			
C. H. Rohwer, B.S.C.E.			
H. J. Stockwell, B.S.	Irrigation Engineer (USDA)		
lack N. Washichek, B.S.	Engineering Aide (USDA)		

#### **Mechanical Engineering**

J. T. Strate, M.S.	Chief Mechanical Engineer
R. D. Barmington, B.S.M.E.	Associate Mechanical Engineer
L. E. Jenneke, B.S.M.E.	Assistant Mechanical Engineer
Cooperators:	

S. W. McBirney, B.S.A.E.	Senior	Agricultural	Engineer	(USDA)
George Stafford		Engineer	ring Aide	(USDA)

#### **Branch Stations**

W. R. Horlacher, Ph.D.	Director
Herman Fauber, M.S.	Superintendent, Arkansas Valley
Ferris M. Green, B.S	Superintendent, Western Slope
C. Dale Rea, M.S.	Director, San Juan Basin
James Ingalls, M.S.	
Cooperators:	

#### W. C. Edmundson, M.S.\_\_\_\_\_Horticulturist, USDA, Colorado Potato Station J. F. Brandon, B.S.\_\_\_\_\_Associate Agronomist, USDA, Dry Land Field Station