Bulletin No. 255

Wartime Agricultural Research

Fifty-First Annual Report of the Idaho Agricultural Experiment Station. For the Year Ending June 30, 1944

UNIVERSITY OF IDAHO
Agricultural Experiment Station
JULY 1944

Published by the University of Idaho, Moscow, Idaho

R. G. BAILEY PTG. CO. LEWISTON, IDAHO

Introduction

C. W. HUNGERFORD, *Vice Director*

THE research staff of the Idaho Agricultural Experiment Station has been reduced very materially since January 1, 1941. On the Home Station at Moscow, 12 members of the staff have resigned and have not been replaced and 7 research fellowships have remained vacant due to inability to secure men for the positions. Three full-time research workers employed by the United States Department of Agriculture have left the University and these positions have not been filled. Nearly all of these men have entered the armed forces or war industry plants. The investigational program of the Experiment Station has been very materially curtailed because of this reduction in personnel, representing as it does a reduction of over one-third in the total research staff of the Station.

The program of the Station has been changed to meet wartime needs and many projects of great importance in peacetime but not vital to the war effort have been discontinued for the duration. Additional funds and men will be needed to bring the program back to a peacetime schedule again. Agricultural research will be needed in increased proportions after the war in order to guard against insects, plant diseases, and weeds which may be imported during the years following the war when foreign commerce again will be resumed on a much broader scale than ever before.

Technological development stimulated by the war will be of very great value to agriculture, but careful research is necessary to apply these new ideas and new machines to agricultural uses. Agricultural research must take its place along with industrial research in helping to shape a new world and use available manpower and other facilities wisely.

No airplane plant would attempt to produce fighter and bombing planes without blue prints of designs prepared after years of research and experimentation. No Army officer would use weapons of warfare which had not been thoroughly tested and approved by expert engineers. It is equally important that every farmer and every housewife use the best available advice and council and employ the best tools to do the job of producing food and preparing it for use. Food is a war weapon and its effective production and use are as essential as are guns, battleships, and airplanes.

What has been said about our Home Station at Moscow can also be said regarding the Branch Stations at Parma, Caldwell, Aberdeen, Sandpoint, and Tetonia. The programs of these Branch Stations have been placed on a wartime basis. State appropriations have been inadequate and the Stations have been financed largely through income. This has been possible only because the true functions of research have been sacrificed, partly at least, and the work has been more nearly on a commercial basis than is desirable.

The physical plant, including buildings, apparatus and equipment, and machinery, have all been reduced or badly worn during recent years. New buildings are needed, deferred maintenance must be brought up to date and new equipment and apparatus must be purchased.

In the reports of departments of the Home Station and of the Branch Stations contained in this publication will be found brief discussions of

results of investigations conducted during the past year. Only those of major importance are included and emphasis is given those related to the production of food and fiber necessary for our armed forces, our allies and our civilian population.

Over 150 projects are investigated in the Home Station at Moscow and in the Branch Stations at Sandpoint, Caldwell, Aberdeen, Parma, and Tetonia. Field trials also are conducted at various temporary field stations. Of the many interesting projects most directly connected with the production and preparation of foods the following are typical. Studies involving the vitamin content and nutritive value of butter, milk, peas, beans, potatoes, pork, and lamb; vegetable seed production problems; wartime poultry rations; control of plant diseases, insect pests and weeds; application of mechanized farm equipment for Idaho farms, and many others. Cooperative investigations with various federal, state, and private agencies also are conducted. These include, for example, wire worm and pea weevil control in cooperation with the Bureau of Entomology and Plant Quarantine, and vegetable seed production, weed control, grain improvement, plant disease survey, soil and irrigation study, and bean improvement study in cooperation with the Bureau of Plant Industry, Soils, and Agricultural Engineering of the U. S. Department of Agriculture. Nearly all the research staff have assisted in the preparation of a comprehensive report on postwar programs for Idaho.

Beef Cattle, Horses, Sheep and Swine and Animal Diseases

Different Methods of Feeding Bonemeal to Steers Tested

NO SIGNIFICANT difference was detected in the reaction of steers to three different methods of feeding bonemeal; namely, mixed with the ration at the rate of 1/10 lb. per steer daily; self-fed alone; and self-fed in a mixture of two parts of bonemeal and one part of salt. Bonemeal should not be force fed to steers on rations that are adequately supplied with phosphorus.

The experimental setup consisted of six lots of yearling steers which were fed as follows to compare methods of feeding and sources of phosphorus supplements for fattening steers: Lot I basal ration (phosphorus deficient) consisting of beet molasses 3.6 lb., alfalfa hay 9.0 lb. and wet beet pulp and salt ad libitum; Lot II basal ration plus 0.10 lb. bonemeal per steer daily; Lot III basal ration plus free access to bonemeal and salt; Lot IV basal ration plus free access to a mineral mixture of two parts of defluorinated phosphate and one part of salt; Lot VI basal ration plus free access to Cudahy's mineral feed "blox."

The steers fed the basal ration (Lot I) without a phosphorus supplement showed definite symptoms of aphosphorosis as indicated by low and inefficient gains, low blood phosphorus values, and a general unthrifty appearance. The steers in Lots II, III, IV receiving bonemeal by different methods, all made normal gains and showed no signs of a phosphorus deficiency. No significant difference was found in the reaction of the steers to the three methods of feeding bonemeal. It is interesting to note that the steers fed bonemeal and salt separately (free choice) consumed on an average equal parts of bonemeal and salt (0.05 lb. of each per steer daily). Steers fed the basal diet with free access to two parts defluorinated phosphate and one part of salt gained the slowest of any of the lots, were inefficient in the utilization of feed and showed severe symptoms of asphosphorosis. The steers consumed one-fifth as much defluorinated phosphate as bonemeal. The steers given free access to Cudahy's mineral feed "blox" (5.43 percent phosphorus) were on the borderline of being low in phosphorus. The gain or utilization of feed was not as good as those receiving bonemeal. (*W. M. Beeson, C. W. Hickman, D. W. Bolin, R. F. Johnson, and E. F. Rinehart.*)

Low Phosphorus Diet Affects Milking Qualities of Ewes

Ewes fed on roughage low in phosphorus (0.14 percent or less phosphorus) should be given free access to bonemeal or other feeds high in phosphorus. Low phosphorus diets decreased the number of lambs raised and depressed the milk production of the ewes.

The purpose of the experiment was to study the effect of a low phosphorus diet on the lambing and milking qualities of ewes. Since low phosphorus alfalfa hay was not available, alfalfa and clover chaff were used as the low phosphorus roughage. The phosphorus content of the roughages were: Alfalfa chaff 0.13 percent, clover chaff 0.10 percent, and alfalfa hay 0.20 percent.

One hundred and ninety-five yearling range ewes were bred at random to three purebred Suffolk rams for early shed lambing (February). The ewes were divided equally into three lots and wintered (started November 12, 1942) on the following rations: Lot I, alfalfa chaff and clover chaff and salt; Lot II, alfalfa chaff, clover chaff, bonemeal and salt; Lot III, alfalfa hay. After lambing ewes in all lots were fed 1 pound of barley per head daily.

The most striking difference between Lots I, II and III occurred in the birth weight of the lambs, milking qualities of the ewes, and the strength and livability of the lambs after birth. The average birth weights were respectively 7.9, 8.2, and 10.0 lb., showing a decided advantage in favor of the lambs from ewes receiving alfalfa hay. There was no significant difference in the number of lambs born, but a decided difference in the number of lambs raised. The ewes raised respectively 36, 46, and 61 lambs, making a corresponding lamb crop percentage of 55, 69, and 93 percent. In many cases the ewes on the low phosphorus diet had very little if any milk, which accounts for the high loss of lambs in Lot I.

Observation of the results obtained on alfalfa hay as compared to clover and alfalfa chaff plus bonemeal (Lot II) suggests that there are other factors besides adequate phosphorus which contributed to the superior lamb crop from ewes on alfala hay. The average phosphorus intake daily per ewe during the wintering period was respectively 1.58, 2.52 and 3.45 grams. (*W. M. Beeson, C. W. Hickman, D. W. Bolin, R. F. Johnson and E. F. Rinehart*).

Effect of Some Facts on the Blood Phosphorus Level of Range Ewes

A 4-year study on the seasonal variation in the blood phosphorus level of range ewes maintained at the Western Sheep Breeding Laboratory, Dubois, Idaho, has revealed the following results:

Seasonal trends in blood phosphorus level were fairly definite and variations between seasons were highly significant. Highest blood phosphorus levels were found on the winter and spring ranges, while lowest levels were found at lambing time, in the late summer and fall, and in the winter feed lot. Supplemental feeding of cottonseed cake or oats on the winter range or feed lot increased the phosphorus content of the blood.

Blood phosphorus was lower for ewes that had lambed than for ewes that had not yet lambed. Dry ewes had higher blood phosphorus than ewes that were pregnant or were suckling lambs. Ewes with one lamb had higher blood phosphorus than ewes with two lambs.

A relationship was found between gain or loss in body weight and blood phosphorus. Ewes which were losing weight tended to have higher blood phorphorus.

Blood phosphorus tended to decrease with age.

No definite evidence of phosphorus deficiency was found excepting for low blood phosphorus levels. The percentage of ewes having blood phosphorus values of 3.5 mg. or below for the various seasons were 5.3 for the fall range, 2.5 for the feed lot, 20.0 at lambing, 2.7 for the spring range and 10.0 for the summer range. (*W. M. Beeson, D. W. Bolin and C. W. Hickman, cooperative with the Western Sheep Breeding Laboratory, Dubois, Idaho.*)

Selection on Production Records Increases Gains of Hogs

Improvement of the University's Poland China herd is being conducted on the basis of selecting the sows for brood stock which raise the largest and heaviest litters of acceptable meat type and that do well in the feed lot. Four pigs from each litter are placed on feed under identical conditions and are self-fed on a balanced ration to a market weight of 200 pounds. This provides another basis for selection on the rate of gain and efficiency of feed utilization.

Definite progress is being made in increasing the size and weight of litters at 56 days of age and the rate of gain in the feed lot. From the inception of the experiment in 1940, the average daily gain of the pigs on test has increased from 1.13 to 1.39 pounds. This can be attributed, at least in part, to improved heredity. The amount of feed required to produce 100 pounds of gain has decreased from an average of 420 to 393 pounds. In general, the type and practical productive ability of the Poland China herd has improved, both from the standpoint of producer and meat processor.

This year (1943) the average daily gain of the eight litters on test varied from 1.29 to 1.60 pounds, and the feed required per 100 pounds of gain ranged from 362 to 412 pounds. The age of the pigs at an average weight of 200 pounds varied from 159 to 189 days.

The best litter on test averaged 200 pounds in weight at an age of 159 days and gained on an average of 1.60 pounds daily with a feed requirement of only 362 pounds of feed per 100 pounds of gain. (*M. L. Buchanan and W. M. Beeson.*)

Study of Phosphorus Requirement for Fattening Lambs Completed

Experiments to determine the phosphorus requirement for fattening lambs have been carried out employing 675 Western lambs in a series of five experiments. Lambs fed on rations containing 0.07 to 0.12 percent phosphorus or an intake of 1.20 to 1.67 grams of phosphorus per 100 pounds live weight showed abnormally slow gains, high feed requirements, and specific symptoms of aphosphorosis such as depraved appetite, unthrifty appearance and low blood phosphorus. A level of 0.14 percent phosphorus in the diet indicated a borderline phosphorus deficiency which proved to be inadequate for normal growth and feed utilization. Lambs receiving rations with a phosphorus content ranging from 0.15 to 0.23 percent were adequately supplied with phosphorus as indicated by good rate of gain, efficient feed utilization and normal blood phosphorus levels. On the basis of phosphorus intake per unit live weight, lambs receiving from 2.17 to 3.38 grams daily per 100 pounds of live weight will meet their phosphorus requirement.

Although a somewhat lower phosphorus level may be adequate, due to the different conditions under which lambs are fattened, it is suggested that the optimum feed phosphorus requirements for fattening lambs be set at 2.40 grams per 100 pounds of live weight or the ration should contain on an air-dry basis 0.17 percent or more phosphorus.

These results indicate that a phosphorus deficiency in lambs exerts a more depressing effect on the utilization of the feed than on the appetite. (*W. M. Beeson, C. W. Hickman, D. W. Bolin, R. F. Johnson and E. F. Rinehart*).

Progress Made in Swine Brucellosis Control

One hundred thirty-nine swine were in the experimental breeding herd at the beginning of the year. Included in this group were 116 negative to swine brucellosis, 6 suspect, and 17 reactor animals. At the close of the year there were 137 animals in the breeding herd including 135 negative, 2 suspects, and no reactors.

Tests were made on the breeding animals just prior to the breeding season. Tests were also made before the pregnant sows went into the farrowing pens and again at weaning time. By following this procedure the percentage of reactors has been reduced from 20.43 percent in 1941 to 0 percent in December, 1943. Only negative animals for replacement purposes were added.

During the year 30 pigs were vaccinated with *Brucella abortus* strain 19 to study reaction titres. Since *Brucella suis* and *abortus* apparently have identical antigenic properties it was felt that an induced reaction might make the gilts refractive to natural exposure from reactor pigs and lots. Pigs between the ages of 54 and 106 days were inoculated with 6.0 ml. of the vaccine. Group I, comprising pigs 102-104 days of age that had been weaned for 26-29 days, when injected developed an average reaction of partial at 1:400. Group II pigs were 62-68 days old and had been weaned 7 days when injected and developed an average titre of partial at 1:100. Group III individuals ranged in age from 54-60 days and were injected the day they were weaned. Their average reaction titre was partial at 1:50. Peak titres were reached 3 weeks after injection in all cases. It took 84 to 133 days for the animals in Group I to become negative, Group II required 67-180 days, and the pigs in Group III that developed reactions required 15-107 days to become negative. It is possible that the lack of immune response in the younger pigs was due to a refractive or resistance substance transmitted passively by the sow. None of the pigs, however, showed agglutinins at the time of vaccination.

Six gilts from Groups I and II were bred by a negative boar after their reaction titres had returned to negative. These animals, together with two negative controls, were then placed in a hog lot which had recently carried reactor sows. Only one animal developed a reaction (No. 210) and was the only animal bred that did not settle. All other animals remained negative and carried their litters until they were sold for slaughter approximately one week before farrowing. The animal which developed the reaction had, during the immunizing period, carried a peak titre of only plus-minus at 1:100 and took 180 days to return to negative. She showed a reaction at 1:50 119 days after becoming negative to the vaccination reaction. Her titre was again negative 14 days after reacting. Since the negative controls did not develop reactions it must be assumed that the reactor hog lot was either free from *Brucella suis* or that the virulence of the organism was so low that infection did not take place. This phase of the investigation will be repeated, using controlled artificial infection rather than natural exposure. (*G. C. Holm, W. B. Ardrey and W. M. Beeson.*)

Abortions in Range Ewes Investigated

The percentage of abortions and stillbirth has been increasing in the

range ewes of Lincoln and Gooding counties during the past few years. Specimens have been submitted from time to time, but no vital cause such as *Salmonella* or *Vibrio* could be isolated. During the 1943 lambing season cultures were taken and blood samples drawn from six different bands of ewes and case histories were taken on two other flocks.

The aborted lambs were well developed except the skeletons were fine boned. It was also noted that ewes were giving little milk. No losses were noted in the ewes except in cases where septic metritis developed. In none of the cases were symptoms of ketosis or iodine deficiency observed.

All cultures were negative to *Salmonella* and *Vibrio,* but blood samples were low in phosphorus. Bands showing the lowest average phosphorus levels had the highest percentage of abortions and stillbirths while flocks with blood levels approaching the lower normal levels had the smallest number of abortions. The percentage of lamb loss varied from 25 percent to 1 percent, according to the estimates of the owners.

One flock was selected for further study. Blood samples were taken during the summer while the sheep were on green grass. Blood phosphorus levels were in the high normal range. These sheep were given a phosphorus mineral supplement in salt while on late fall and winter range but did not consume a large amount because they were ranging on alkali flats. Blood samples were collected December 11, 1943, and were found to be low. It was recommended that the phosphorus mineral and salt be fed separately. Blood samples taken February 8, 1944, during the lambing season gave an average blood phosphorus of 5.33 mg. percent. Ten ewes that had aborted in January had 3.33 mg. percent. The lamb crop for 1944 was 130 percent as compared to the 1943 crop of 98 percent. Two other large bands were fed phosphorus mineral supplement on the fall and winter range during 1943. The lamb crop of one band was 80 percent in 1943 and 130 percent in 1944 while the other had a 1943 crop of 90 percent and a 1944 lamb crop of 125 percent. The ewes in these three bands were heavy milkers during 1944 lambing period in comparison to their poor milk production during the 1943 period.

Two flocks of sheep in the same vicinity had heavy losses during the 1944 lambing season. Neither of the flocks received mineral supplement until after the losses had started. Prior to the 1943 season one flock had access to irrigated alfalfa stubble and grass pasture during the late fall of 1942. There was only slight lamb loss during that season. This same band of ewes did not have access to green feed in the late fall of 1943 and the loss during the 1944 lambing season was estimated at 20 percent. Blood phosphorus determinations showed a blood level of 3.7 mg. percent in the aborted ewes and 4.8 mg. percent in the ewes that carried their lambs full time. The other flock lost approximately 10 percent but there was little or no difference in feeding or losses in 1943 and 1944. The ewes in both these bands of sheep were producing little milk and considerable scouring was noted in the live lambs.

Phosphorus determinations were made on the hay samples taken from the ranches in 1943 and 1944. These levels ranged from 0.104 to 0.232 percent. These determinations could not be correlated with lamb losses because of the short hay feeding period before lambing. One exception

to this occurred in 1943 when one flock owner brought his sheep in early and began feeding hay 2 months before lambing. The hay fed contained 0.19 percent phosphorus.

The findings of a high blood phosphorus during the green grass season and a low blood phosphorus after eating matured winter forage substantiates the findings of Beeson and Bolin reported in the Idaho Agricultural Experiment Station Bul. 225, 1938, showing that green forage is high in phosphorus while matured forage is low in phosphorus and high in calcium. (*G. C. Holm and D. W. Bolin.*)

Mastitis Treatments Studied

Forty-nine cases of bovine mastitis were treated with tyrothricin preparations and homogenized sulfanilimide. Two commercial homogenized sulfanilimide preparations, two commercial and three experimental tyrothricin products were tested. The homogenized sulfanilimide products gave the best results while the cows were lactating: 20 cows showed complete recovery, 1 partial, 4 no recovery, and 3 too recent to determine results. An experimental tyrothricin preparation compounded for use in lactating as well as dry cows cured three cows but did not cure eight others. The product however was effective in sterilizing the udder parenchyma during the dry period. The other tyrothricin preparations were effective in cases after the cows were dry but were not as effective as the sulfanilimide products in lactating cows. (*G. C. Holm, D. R. Theophilus, H. C. Hansen and W. B. Ardrey.*)

Lentin Effective in Atonic Indigestion of Cattle

Atonic indigestion results in an overloading of the rumen in cattle because of decreased muscle tone in that organ. The symptoms most commonly noted by dairymen are decreased milk production, reduced feed and water intake, and occasionally bloating. The beef cattle men observe "dry bloats" and reduced feed consumption.

For many years the standard treatment for this disease by stockmen has been to give laxatives and reduce grain rations. Rational treatments as used by veterinarians have included use of bland oils, large amounts of water, digestive stomachics, detoxifying agents, and rumen stimulants, all given with a stomach tube and pump. This line of treatment usually resulted in recovery, but in many cases the response was slow. Even after the animal appears to have recovered, the milk production was usually reduced and usually did not return to the previous production level.

A preliminary study was conducted to determine the value of Lentin (Merck) as a stimulant to the musculature of the rumen. Cattle in the Station dairy herd which developed atonic indigestion were divided into two groups. Group one was given the regular treatment, group two was given the regular treatment plus Lentin.

All cases receiving the regular treatment plus Lentin recovered rapidly and returned to normal milk production without complication. The group receiving no Lentin required more time in getting back to full feed and never returned to normal milk production during the lactation period. (*G. C. Holm and D. R. Theophilus*).

Dairy Production and Manufacturing

Holstein-Friesian and Jersey Herds Maintain Eminent Position

DURING 1943 the average annual herd production, including dry cows, of the combined Holstein and Jersey herds consisting of 46 cows, was 456 pounds of fat. The Holstein herd of 30 head averaged 509 pounds of fat and the Jersey herd of 16 cows averaged 360 pounds. Each herd had an average type rating of slightly higher than "Good Plus."

For the seventh consecutive year the American Jersey Cattle Club awarded the Constructive Breeder's Registry certificate to the Jersey herd. To the Holstein herd the Holstein-Friesian Association of America awarded the fifth consecutive Progressive Breeder's Registry certificate.

The continuous use of proved sires for 26 years in the Holstein herd and for 11 years in the Jersey herd is undoubtedly, in a large part, responsible for the high level of production and type of the two herds. (*D. R. Theophilus.*)

Riboflavin Content of Milk Studied

In cooperation with the Department of Agricultural Chemistry the riboflavin content of milk produced by two Hostein-Friesian and two Jersey cows has been determined over a period of several months. The data thus far obtained show that the riboflavin content of milk produced by Holstein cows is lower than milk from Jersey cows. The range of values for Holstein milk was 0.88 to 2.23 micrograms per milliliter of milk and for Jersey milk 1.43 to 3.56 micrograms per milliliter. There appears to be a definite negative correlation between the riboflavin content and milk yield.

A series of experiments were conducted to study the loss of riboflavin due to light. Raw, pasteurized, and pasteurized homogenized milk from the same milk lot was exposed to direct sunlight and diffused light in clear, brown, and paper bottles. The rapid destruction of the riboflain in the milk exposed in the clear bottles was quite significant considering the low temperatures (36°, 41°, and 45°F.) prevailing during the days of the experiments. Brown bottle and paper bottles protected the milk from riboflavin loss very satisfactorily. The maximum loss after 6 hours in such containers being less than 10 percent as compared to 80 percent in the clear bottles exposed under the same conditions. The work is being continued and will include a study of riboflavin content of milk during processing and distribution. (*D. R. Theophilus and Olof E. Stamberg.*)

Process for Dehydrating Cheddar Cheese Developed

In cooperation with the Department of Agricultural Chemistry a simple method of shredding and dehydrating cheddar cheese at various stages of ripening has been developed whereby the time of drying without loss of fat has been reduced to less than 2 hours for aged cheese and slightly longer for fresh cheese.

The dehydration of cheddar cheese is of value for several reasons: first, the quality of the cheese can be preserved at any stage of ripening; second, flavor and keeping qualities are maintained without refrigeration; third, handling is considerably improved by compressing the dried cheese

into convenient forms; and fourth, less storage and shipping space is required for dehydrated, compressed cheese.

Studies are in progress on reconstituting dehydrated cheese, as well as on the influence of moisture upon the keeping quality of powdered and compressed products. (*H. C. Hansen and R. S. Snyder.*)

Study Made of Calf Losses

During the 20-year period 1922 to 1943, 926 calves were born in the University of Idaho dairy herd. There were 556 Holstein-Friesian and 370 Jersey calves. In the first 6 months after birth or parturition 17.3 percent of the calves had died. Thirty-nine calves or 4.1 percent had died at birth, 3.6 percent had been born dead and 2.8 percent had been aborted and were dead. Pneumonia caused 2.2 percent of the deaths and scours 1.4 percent. The remaining 29 deaths were distributed among the various causes as follows:—deformity, 5; bloat, 5; digestive troubles, 5; tumors, 4; freemartins, 3; coccidiosis, 2; accidental, 3; paralysis, 1; and convulsions, 1. (*D. R. Theophilus.*)

Cooperative Work Reported by Other Departments

Results of some work conducted in cooperation with the Departments of Agricultural Chemistry and Animal Husbandry are presented by these departments.

Poultry

Meat Meal and Soybean Oil Meal Compared as Protein Supplements

THIS experiment constiuted one phase of a general project on wartime protein supplements for poultry rations; the results obtained demonstrate that different proportions of meat meal and soybean oil meal used for the supplementary protein in laying rations had no marked effect on egg production, egg weight, or body weight. The slight differences which were observed were in favor of those groups receiving some meat meal. Hatchability was high for all groups which received meat meal, even when it supplied only 25 percent of the supplementary protein. When soybean oil meal entirely replaced meat meal a marked reduction in hatchability was experienced.

To obtain information on the relative value of these two protein concentrates four lots in duplicate of 33 White Leghorn pullets each, distributed to eliminate the influence of breeding, were placed on experiment October 1, 1942, and continued throughout a period of 11 months. All mash rations were used in which the percent of supplementary protein was supplied by meat meal and soybean oil meal in the following proportions: lots 1 and 5, meat meal 100 percent; lots 2 and 6, meat meal 75 percent, soybean oil meal 25 percent; lots 3 and 7, meat meal 25 percent, soybean oil meal 75 percent; and lots 4 and 8, soybean oil meal 100 percent.

The average analysis of the rations was: protein 15.5 to 16.0 percent; calcium 1.2 percent, and phosphorus 0.8 percent. The meat meal was a product of one of the several rendering plants located in the State. The riboflavin content was calculated to be 1,250 to 1,300 micrograms per pound of ration. Oyster shell and grit were available in hoppers.

The results are briefly summarized in Table 1. The marked reduction in hatchability obtained from lots 4 and 8 (100 percent supplementary protein from soybean oil meal) is significant both from an experimental and practical standpoint. Both of the duplicate lots were low—lot 4 with 51.78 and lot 8 with 60 percent hatchability of fertile eggs. The slight difference in the riboflavin content in the ration for these groups and in those for lots 3 and 7, in which meat meal supplied only 25 percent of the supplementary protein, was not sufficient to be responsible for this marked difference in hatchability. The results suggest that the meat meal may have supplied some other essential factor involved in hatchability. This particular meat meal is reported elsewhere as having been proved more efficient in producing growth response in young chicks when compared with a typical packing house by-product. (*C. E. Lampman, C. F. Petersen, and D. W. Bolin*).

Simplified War Emergency Rations Tested

Formulated according to some of the feed shortages existing in Idaho a simplified war emergency laying mash which contained no fish meal, dried milk, corn, or bran proved reasonably satisfactory, although not equal to a typical first-grade mash containing the ingredients mentioned above. The emergency mash consisted of ground barley 30, ground oats 20, ground wheat 10, dehydrated alfalfa 7, meat meal 11, soybean oil meal 14, dried whey 2.5, oyster shell flour 2, bone meal 3, salt 1, and fish oil (400 D-2000 A) 0.5 percent.

This mash was given to duplicate lots of 70 birds each and a typical first-grade mash, used as a control, was given to two similar groups.

The scratch grain mixture consisted of wheat 70, oats 15, and barley 15 percent. During an experimental period of 10 months the average egg production was 52.3 and 58.6 percent, and the returns per bird over feed cost $3.23 and $3.76 for the simplified emergency and first-grade mashes, respectively.

Table 1.—The comparative efficiency of different proportions of supplementary protein supplied by meat meal and soybean oil meal.

Lots (Av. of duplicates)	1 & 5	2 & 6	3 & 7	4 & 8
Supplementary protein				
Meat meal percent	100.00	75.00	25.00	0.00
Soybean oil meal percent	0.00	25.00	75.00	100.00
Percent egg production				
" 1st 7 mo.	56.50	54.20	54.90	53.10
" 11 mo. period	51.00	49.50	50.90	47.40
Av. egg wt. (oz. per doz.)	24.95	24.94	24.81	24.54
Av. body wt. (lb.)	4.01	4.21	4.04	3.92
Hatchability (% of fertile eggs)	85.71	87.22	86.41	55.89
Av. cost of ration	$2.56	$2.49	$2.49	$2.52
Feed cost per doz. eggs	16.5¢	16.9¢	16.6¢	17.6¢
Income per bird over feed cost	$3.35	$3.20	$3.30	$2.98

Reduced egg production was the principal reason for the lower income from the birds receiving the simplified emergency mash. There was no significant difference in egg size, body weight, or mortality. (*C. E. Lampman and C. F. Petersen*).

Methionine in Peas not Sufficient to Promote Normal Chick Growth

Experiments recently completed with young chicks have shown methionine, one of the essential amino acids, to be the principal growth-limit-

ing deficiency in the protein of Alaska field peas. Cystine, on the other hand, appears to be present in sufficient amounts to permit normal growth when methionine is added. These results are in agreement with data previously reported in the *Journal of Nutrition*, Vol. 26, No. 4, October, 1943, by Woods, Beeson, and Bolin, at this station after experimenting with rats.

The study was one of several phases of a project designed to obtain further information on the efficiency of vegetable proteins, and was conducted co-operatively by the Departments of Agricultural Chemistry and Poultry Husbandry. Synthetic rations were used in which peas furnished the sole source of protein at levels of 6, 12, and 18 percent; the intermediate level, however, was used for the greater portion of the work.

On the 12 percent pea protein basal the chicks made very poor growth and in some instances lost weight. Methionine added to the basal at the rate of 0.25 percent resulted in a growth response comparable to that obtained on a practical type control ration containing fish meal, dried milk, and meat meal but with the protein content limited to 12 percent. Furthermore, the level of 0.25 percent methionine produced as good growth as the higher levels of 0.50 and 0.75 percent. The addition of 0.4 per cent cystine resulted in no significant gains over the basal.

The results have an important practical application in explaining earlier work in which it was found that ground peas had to be supplemented with animal proteins to promote efficient egg production; apparently the latter furnished the methionine necessary to supplement the pea protein. The information serves to further explain why some animal protein concentrates are more efficient than others in supplementing the vegetable proteins in poultry rations. (*C. F. Petersen, D. W. Bolin, C. E. Lampman, and O. E. Stamberg*).

Animal Protein Concentrates Vary in Efficiency

While the general trend of the feed industry throughout the United States has been to use soybean oil meal in increasing amounts to replace the animal proteins in poultry rations, the program has not been wholly satisfactory for this area because of the limited supplies of soybean oil meal shipped into the region. Meat meal, produced at several rendering plants, and trash fish meal were two products of local importance about which more specific information was desired. The latter has been produced on a limited scale by the Idaho State Fish and Game Department in an attempt to reduce the population of non-game fish, principally carp and suckers, in the various bodies of water in the State.

Two series of experiments were conducted with White Leghorn cockerel chicks to determine the value of these products as compared to herring fish meal and the typical packing house meat meal. The experimental diets contained 14 percent protein, of which a cereal basal supplied 9 per cent and the protein concentrate to be tested, 5 percent. The experimental procedure of the two series varied slightly in that in the first, day-old chicks were put on the experimental ration and in the second, the chicks were carried for one week on a regular chick-starter mash and then selected and distributed on the experimental rations, using only those of uniform weight.

The average gross values for the various concentrates, based upon growth response, were as follows when the value of 100 was arbitrarily given to herring meal: trash fish meal 80, rendering plant meat meal 75.5, and the packing plant meal 57.5. The value for net gain per gram of supplementary protein consumed were: herring fish meal 4.7, trash fish meal 3.8, rendering plant meat meal 3.6, and packing plant meat meal 2.70 grams.

Considering the fact that the trash fish meal ranked next to herring, it would be highly desirable if more of this product could be made available to the poultry industry. The most logical explanation for the superiority of the rendering plant meal over the typical packing plant product is that in the former whole carcasses, including muscular red meat and glandular tissues, are used. (*C. F. Petersen and D. W. Bolin*).

Laying Flock Mortality Studied over 10-year Period

A study of the mortality of the Experiment Station Leghorn flock over a 10-year period, involving approximately 7,400 birds, has now been completed and is briefly summarized in Table 2. Steady progress in the improvement of the viability of the stock through selective breeding, together with good feeding and management, was climaxed at the end of 7 years with a low mortality of 3.5 percent, of which 0.9 percent was due to the avian leukosis complex. It was also shown quite definitely in 1939 and 1940 by the exchange of stock with two other stations that the virulence of the leukosis complex infection at the Experiment Station farm had progressively declined to the low ebb at that time.

During the past 3 years the total laying flock mortality has steadily increased with the loss for this past year being greater than any year since 1934-35. However, the incidence in the leukosis complex was only about one-half of that of the earlier years. The total mortality during the past pullet laying year was 36.55 percent. As determined by post-mortem examination 11.6 percent of the original number housed either died from some form of the leukosis complex, or showed definite symptoms of the disease; coccidiosis accounted for 3.53 percent; ovarian disturbance 4.46 percent; peritonitis 4.36 percent; cannibalism 4.05 percent; and miscellaneous causes 8.52 percent. As in previous years, there was a highly significant difference in the leukosis mortality of the progeny of the various sires used, varying from 2.8 to 20.3 percent.

Table 2.—Summary of mortality in the Experiment Station Leghorn flock for 10-year period 1933-1943

(Percent mortality during the pullet laying year—11 months period)

Year	Total percent mortality	Leukosis complex	Miscellaneous
1933-34	44.6	24.1	20.5
1934-35	37.0	20.5	16.5
1935-36	23.7	9.8	13.9
1936-37	27.9	13.2	14.7
1937-38	17.6	6.9	10.7
1938-39	7.1	2.5	4.6
1939-40	3.5	0.9	2.6
1940-41	12.1	2.6	9.5
1941-42	27.0	12.4	14.5
1942-43	36.5	11.6	24.9

The total mortality for 1941-42 was 27.0 percent, with 12.4 percent loss from leukosis. A 10 percent increase in total mortality during the

past year, with no increase in the leukosis complex during the same period, would seem to indicate some progress in decreasing the degree of susceptibility of the birds and the virulence of the disease.

Less favorable environmental conditions, labor shortages, coccidiosis, infectious colds, and an increase in cannibalism were factors largely responsible for the high mortality during the past two years.

Once the virulence of the leukosis complex disease has been partially or wholly reduced by selection of resistant stock, the most important factors in maintaining high livability during the pullet year are proper management practices for the control of such miscellaneous diseases as mentioned above. (*C. F. Petersen, C. E. Lampman, and Glenn C. Holm*).

Crops, Crop Breeding, and Soils

Climatic Conditions Favorable Except During Winter Months

CLIMATIC conditions during the crop year of 1941-43 (September 1-August 31) were exceptionally favorable for all spring-sown crops. Winter conditions were severe and resulted in a considerable abandonment of acreage of fall-sown crops. Practically all the fall-sown barley of the Palouse area was winterkilled and even winter wheat stands were greatly reduced. Moisture was abundant during the entire crop year with conditions very favorable during the critical months of June and July. Since temperatures in June were 4.3 and in July 1.5 degrees Fahrenheit below normal, conditions were ideal for spring-sown crops. High moisture supplies combined with moderate temperatures resulted in a most efficient use of water and accounted for high yields of cereals and peas, even when these crops were seeded late on account of the backward spring. For the entire crop year the precipitation recorded was 1.66 inches above the normal of 21.75 inches while average temperatures were 1.5 degrees below the normal of 47.2 degrees. Low temperatures in January, 5.8 degrees below normal, with a minimum of 8 below zero coinciding with a period of absence of snow cover together with unfavorable temperatures during March accounted for the damage to fall sown crops. (*K. H. W. Klages*).

Hay and Seed Yields of Grasses Respond to Nitrogen Fertilization

Table 3 gives the hay and seed yields of five grasses grown in solid stands (broadcast) and in cultivated rows with and without nitrogen fertilization. A low rate of fertilizer of 100 pounds of ammonium sulphate per acre applied in March was used. All grasses responded favorably. The average increase in hay yields amounted to 0.76 and 0.37 tons per acre for the solid plantings and for the cultivated rows, respectively. The average increases in seed production were 145 and 138 pounds per acre for the two methods of culture. The solid plantings responded to a greater extent to applications of nitrogen than the row plantings. The average increases on a percentage basis were 52.4 for hay and 39.2 for seed on the broadcast plots as compared to 14.0 and 26.3 on the cultivated row plantings.

The question of the relative merit of growing grasses for seed in solid

Table 3.—Yields of hay and seed of longevity, cultivation, and nitrogen fertilization plots established on Field 5 in 1942

Plot No.	Grasses	Broadcast		Cultivated rows	
		Without nitrogen	With nitrogen	Without nitrogen	With nitrogen
	Hay yields in tons per acre				
1-4	Mountain Brome 3368	2.48	3.18	2.93	3.07
5-8	Big Blue Grass	1.03	1.86	1.60	1.65
9-12	Orchard Grass	0.62	1.09	2.60	2.82
13-16	Smooth Brome	1.79	3.19	3.71	4.05
17-20	Crested Wheat	1.31	1.71	2.41	3.51
	Average hay yields	1.45	2.21	2.65	3.02
	Seed yields in pounds per acre				
1-4	Mountain Brome 3368	743	855	679	902
5-8	Big Blue Grass	289	572	622	726
9-12	Orchard Grass	91	160	550	616
13-16	Smooth Brome	407	517	558	754
17-20	Crested Wheat	322	473	781	883
	Average seed yields	370	515	638	776

stands or in cultivated rows is not fully answered by the first year's crop from these plots. The average increase in seed production due to row plantings and cultivation were 72.4 percent without nitrogen and 50.7 percent with nitrogen fertilization. One question to be answered by this particular experiment is to find how long economical grass seed production can be maintained by growing the grasses enumerated in Table 2 in solid stand and in cultivated rows with and without nitrogen fertilization. The grasses selected represent type species. The growing of grasses in rows requires more labor than production in solid stands and can be recommended only on comparatively level fields. This as well as other previously reported experiments show that a high availability of nitrogen in the soil is essential to successful grass seed production in the Palouse area. (*K. H. W. Klages and G. O. Baker*).

Pre-cropping with Alfalfa of Value in Bindweed Control

In the spring of 1937 an area uniformly infested with bindweed was seeded to Idaho common alfalfa. Beginning in 1939, after the removal of the first hay crop, 16 methods of handling the land for the control of the remaining bindweed plants were compared. The results obtained from four of these methods are given in Table 4.

It will be observed in cropping sequence No. 1 that where winter barley survived the winter with good stands continuous cropping with cultivation only between harvest and seeding eradicated bindweed and also permitted satisfactory crop production. The data also show (in cropping sequence No. 2) that the use of winter wheat in the same system resulted in complete recovery of the bindweed. In a previous experiment the use of continuous winter barley without pre-cropping with alfalfa during a 5-year period did not significantly reduce the stand of bindweed. In

areas where winter barley is likely to winter-kill a system of alternate cultivation and winter wheat, as in cropping sequencec No. 3, may be used to advantage. In this system, it should be noted, the sequence should be alfalfa-wheat-fallow rather than alfalfa-fallow-wheat as in cropping sequence No. 4. The latter system is scarcely better than a system of wheat alone, without alfalfa, this having been found in previous experiments to require about 50 percent more tillage than sequences 1, 2, or 3. Fortunately the system of alfalfa-wheat-fallow can be easily adopted on most farms. In all cropping sequences cultivation should be started immediately after harvest and continued at 2-week intervals until seeding time. (*C. I. Seely and K. H. W. Klages*).

Table 4.—Crop production and bindweed control from four crop rotations on bindweed infested land

	1939	1940	1941	1942	1943	Totals
Cropping sequence #1	alfalfa 3 yrs.	winter barley	winter barley	winter barley	winter barley	
Yield [1]	1.5	75.2	87.3	46.8	56.2	265.5 bu.
No. of cults.	7	5	4	2	0	18
Bindweed [2]	5.5	2.2	0.8	0.01	0.0	....
Cropping sequence #2	alfalfa 3 yrs.	winter wheat	winter wheat	winter wheat	winter wheat	
Yield [1]	1.5	61.4	45.9	40.4	15.0	162.7 bu.
No. of cults.	8	3	3	4	....	18
Bindweed [2]	5.5	1.4	7.0	9.0	15.0	....
Cropping sequence #3	alfalfa 3 yrs.	winter wheat	culti-vation	winter wheat	culti-vation	
Yield [1]	1.5	54.2	....	68.2	....	122.4 bu.
No. of cults.	8	3	8	0	....	19
Bindweed [2]	5.5	2.2	....	0.0	....	....
Cropping sequence #4	alfalfa 3 yrs.	culti-vation	winter wheat	culti-vation	winter wheat	
Yield [1]	1.5	....	43.6	....	76.0	119.6 bu.
No. of cults.	8	11	3	7	0	29
Bindweed [2]	5.5	....	0.6	....	0.0	....

Peas and Alfalfa Respond to Applications of Gypsum

Comparative yields of peas grown with and without applications of 100 pounds of gypsum per acre were checked on seven farms in the vicinity of Moscow in cooperation with the personnel of the Latah Soil Conservation District. The average increase obtained amounted to 205 pounds of dry peas per acre. The peas in portions of the fields to which gypsum was applied showed a more thrifty growth and had a darker green color than the plants on untreated areas. The tests indicated that applications of gypsum to peas had a slightly delaying effect on maturity.

A detailed test conducted on the University Farm on land which had not previously been cropped to peas or legumes showed no response to variable rates of gypsum and sulphur applications. Greater response to gypsum may be anticipated on land previously cropped to legumes than on fields which have not grown legumes which are heavy users of sulphur, the element supplied by gypsum.

Alfalfa hay yields were increased by 1.76 tons per acre per year over a 5-year period by the application of 200 pounds of gypsum per acre every other year. In the course of the experiment the use of 600 pounds of gypsum increased hay production by 9.50 tons. In the same test applications of straight sulphur at a rate to supply equivalent amounts of sul-

phur as applied in the gypsum increased hay yields to the extent of 1.23 tons per year, or over the 5-year period by a total of 6.15 tons. (*G. O. Baker*).

Legumes and Grasses of Value on Eroded Hill-top Soils

The values of legumes, legume-grass mixtures and grasses in relation to the use of steep eroded hill-top soils is well illustrated by a series of plot tests laid out in 1938 and carried on to date. The low productivity of the site selected on Field 9 of the University Farm is indicated by the low average yield of only 15.6 bushels of spring wheat per acre for the 6-year period, 1938-43. Crested Wheat over a period of 5 years averaged only 64 pounds of seed per acre. Grass seed production demands an available source of nitrogen. With the aid of two applications of gypsum of 200 pounds per acre each, alfalfa averaged over the same 5-year period, 2.32 and an alfalfa-grass mixture 2.35 tons of hay per acre. Crested Wheat averaged only 1.07 tons of hay.

After the alfalfa, the alfalfa-grass mixture, and the Crested Wheat had been established for a period of 4 years, one series of each was plowed up in the autumn of 1941 and cropped uniformly to spring wheat in 1942 and 1943. The yields obtained show interesting differences. Spring wheat following the plowing up of the alfalfa plots averaged 41.4, after the alfalfa-grass mixture 39.1, while the yields after Crested Wheat averaged only 20.5 bushels per acre. The continuous spring wheat during these 2 years gave an average yield of 16.7 bushels. These preliminary yield data demonstrate the values of legumes and legume grass mixtures on thin, eroded soils. Grass alone, as indicated by the comparatively low yields of the wheat following Crested Wheat, can be expected to exert only a moderate influence on the yields of cereals following them in the course of the cropping sequence. A legume-grass mixture offers greater resistance to soil erosion losses than straight alfalfa on sloping land. (*G. O. Baker*).

Differences in Winter-survival Influence Wheat Yields

Due to the climatic conditions already discussed, the varieties included in the spring wheat tests outyield the winter wheat varieties tested. The spring wheats averaged 44.0 as compared to 41.9 for the winter wheat varieties. Rex and Elgin survived the winter in good condition and were among the highest yielding winter varieties. Golden was severely damaged and produced relatively low yields. The high yielding spring wheat varieties were Federation, Idaed, and Onas. (*H. K. Schultz*).

Stem Rust Resistance in Spring Wheat Important

Black stem rust is a hazard to wheat production in Idaho. Due to its relatively early maturity winter wheats generally escape severe damage from this disease. Spring wheat is less likely to escape damage. In 1943 the 20 varieties of winter wheat in the variety test averaged 33 percent of stem rust infection as compared to 68 percent for the 28 varieties of spring wheat tested. In the case of the winter varieties the damage to yield and quality was insignificant, however, the epidemic resulted in considerable damage to the spring wheat varieties. Some of the late maturing types carried from 85 to 100 percent of rust.

The two major spring wheat varieties of northern Idaho, Idaed and Federation, together with a third strain, Australian Sel. 735, were crossed with Premier, a hard red spring wheat resistant to black stem rust, in the winter of 1941. Around 200 rust resistant F4 and F5 selections were made of each of these three crosses in 1943. These slections are in the main white kerneled, short strawed, and awnless. Unfortunately, many of them have kernels that are hard to semi-hard in texture. Attempts are being made to isolate soft texture strains by means of selections within the F4 lines and by backcrossing the F4 isolates with their soft, white parents. This wheat breeding program was expedited by combining field with greenhouse work which made possible the production of two generations per year. (*H. K. Schultz*).

Fruit and Vegetable Crops

Cooperative Study of Vegetable Seed Problems Initiated

THE vegetable seed industry is relatively new in Idaho. Its development has been phenomenal. It now constitutes one of the major types of farming in Canyon, Payette, and Twin Falls counties. With the advent of this industry there have appeared various cultural problems, diseases, and insect pests new to Idaho agriculture. Cognizant of the fact that the continued development and well-being of this new enterprise hinged upon early solution of these difficulties, the Experiment Station in 1937 initiated a program of research on vegetable seed crops. Most of this work has been conducted at the Parma Branch Station, in the heart of one of the major vegetable seed areas. In furtherance of this program, arrangements were made early in 1943 for the assignment of a vegetable crops specialist of the United States Department of Agriculture to collaborate with members of the Experiment Station Staff in this work. Through the services of this additional technician, whose headquarters are at Parma, it has been possible to expand the vegetable seed research program to include extensive tests on the effects of various kinds, amounts, and combinations of fertilizers on the major crops being grown for seed. Experiments on frequency and amount of irrigation as affecting these crops also have been undertaken. Conclusive results on these projects are not yet available but the work will be continued in 1944.

Selective Oil Spray Eliminates Hand Weeding of Carrots

Hand weeding has recently cost growers of carrot roots, either for market or for seed purposes, up to $100 per acre in southen Idaho. Trials conducted at the Parma Branch Station in 1943 indicate that this expense can be largely eliminated through the use of stove-oil sprays, a method of weed control recently developed in California.

Carrots of the Danvers Half Long variety, planted July 10, were cultivated July 26 and again on August 6, with the knives on the power cultivator set as close to the rows as possible without covering the plants. At the time of the latter cultivation the plants were approximately 3 inches high and averaged about 4 true leaves. Immediately following this cultivation, undiluted stove-oil, also known as stove-top, was applied directly to the plants in the rows from a knap-sack-type hand sprayer at the rate of approximately 60 gallons per acre.

The spray thus applied was very effective in killing all grasses, "pig weed," Red Root, Mallow, Nightshade, and most of the Lamb's Quarter; and it did not, in any way, appear to injure any of the carrot plants. Control of weeds thus obtained was so highly satisfactory that no further cultivation for the purpose of weed control was necessary throughout the growing season. Similar results were observed in the few commercial fields where growers tried the method, but with power sprayers.

Although cooking tests of the sprayed carrots did not reveal the presence of oily residues or tastes, it is believed that where this spray is employed for the weeding of market carrots, particular care must be taken to apply the spray at the stage noted above or slightly earlier, and at a rate not greater, and preferably less, than that noted herein, if absence of the oily taste is to be insured.

At 13 cents per gallon for the oil, and negligible costs of application and tractor cultivation, the total cost for controlling the weeds was slightly less than $15 per acre.

The use of kerosene or other substitutes for stove-oil cannot be recommended. (*D. F. Franklin*).

New Apple Varieties Show Promise

"Idagold" is the name given to a new apple variety just released by the Idaho Agricultural Experiment Station for trial by growers and nurseries. This variety is a cross between Wagener and Spitzenburgh. It attains large size, is bright, clear yellow in color when fully ripe, and has a rich flavor somewhat resembling that of Golden Delicious. Unlike Golden Delicious, it shows no tendency to shrivel in storage. It has an excellent finish, taking a high polish. The flesh is firm, tender, fine grained, and juicy. In form this apple is variable; but, in general, it is short- to oblong-conic, prominently and irregularly ribbed.

Idagold is recommended primarily as an addition to the home orchard. Its superior quality both for fresh consumption and for baking and pies, and its excellent keeping qualities, will appeal to those who grow their own fruit. As a commercial variety its value may be questioned because of its lack of uniformity in size and shape, and because of the persistence of a deep green color in the stem cavity and calyx basin even in mature specimens. Further experience with the variety may, however, prove that it has a place in commercial production.

"Payette," a large, dark red apple of excellent dessert quality also has been released for trial. This variety is a cross between Ben Davis and Wagener. In form it resembles Wagener, but it is considerably larger. Payette first develops good dessert quality after a few weeks or a month in storage. At that time the flesh is crisp, tender, sprightly, and exceedingly juicy. Later in the season it becomes more mellow, somewhat less juicy, and more aromatic. It remains in prime condition and retains its high quality in cold storage until April or longer. (*Leif Verner*).

Seed Yields May Be Increased by Proper Placement of Onion Bulbs and Carrot Stecklings

Due to the scarcity and increased cost of labor in planting onion bulbs for seed purposes, many growers have eliminated the usual practice of

setting the bulbs in an upright position, and have adopted the practice of merely strewing them into the furrow and covering without regard for the direction assumed by the growing points.

In the production of carrot seed, different angles of root placement result from slightly different planting methods and equipment, so that one grower may set all roots in a vertical or upright position, while another may insert the roots at angles approximating 45 degrees.

To determine just how much manner of placement of bulbs and stecklings influences onion and carrot seed yields, different methods of placement were tested in 1943 at the Parma Branch Station, with results as listed in Table 5.

Table 5.—Yields of onion seed from variously placed, spring planted bulbs of the Brigham Yellow Globe variety

Manner of bulb placement	Per acre yields, in lb., of plot replications 1	2	3	Average yields in lb. per acre
Bulbs placed upright in the furrow before covering	418.2	516.2	402.2	445.7
Bulbs strewn in the furrow at random	298.1	350.9	265.2	304.8
Bulbs set upside down in the furrow	116.1	117.8	40.1	91.3

From these results, it appears that an increase of approximately 141 pounds of seed per acre was realized from the plots of set-up bulbs over those in which the bulbs were strewn in the furrow at random, after the practice newly adopted by some growers. At the prevailing price of labor in 1943, the setting-up operation would have increased production costs by $25 to $35 per acre, but, at the contract price of $1.20 per pound of onion seed the same year, $169.20 would have been added to the gross income. That a similar situation can be expected from the setting up of fall-planted bulbs has not yet been ascertained, but fall plantings of these plots have already been made at the Parma Station, so that these data will be available in the fall of 1944.

Table 6.—Yield of carrot seed from variously placed, spring planted, stecklings of the Danvers Half Long variety

Manner of root placement	Per acre yields, in lb., of plot replications 1	2	3	Average yields in lb. per acre
Roots inserted into narrow, closed furrow in an upright position	1175	1177	515	955
Roots slanted at an angle of 45 degrees in a wide, V-furrow	697	492	467	552
Roots dropped in horizontal position in wide V-furrow	301	486	684	490

Interpretation of the figures in Table 6 indicate that roots planted in a vertical position in a narrow, closed type of furrow such as is made with a spear point or similar tool, yielded 403 pounds more per acre than roots planted in the wide, open, V-furrow at angles approaching 45 degrees. At the contract price of 45c per pound for carrot seed in 1943, this in-

crease would have paid the grower a premium of $181.35 per acre for employing this method of planting. This experiment will be repeated in 1944 as a further check on these findings. (*D. F. Franklin*).

Agricultural Engineering

Dehydration An Idaho War Industry

A NUMBER of commercial dehydration problems have been presented from the industry in Idaho. These include problems of air circulation, combustion, preparation and handling of product, and causes of spoilage. There appears to be a direct relationship between the maturity and the conditions of storage of the raw product and the quality of the dehydration obtained. The type of product produced in the majority of the dehydration plants in Idaho is the julienne-type dried potato; however, three plants produce the dehydrated shredded potato, and one plant produces a dried diced potato. New processes of dehydrating potatoes were studied, including the dehydration of baked potatoes.

A survey of the potato processing industry in Idaho shows a total of eight major companies engaged in potato dehydration and potato flour production. Two of these companies also produce dehydrated onions. In addition to the dehydration plants there are three potato starch plants in production.

The dried material output of the dehydration plants is approximately 165,000 pounds on a daily basis, and for the average operating schedules they produce about 5,000,000 pounds per month. The product recovery ratio varies between 6 to 1 and 10 to 1, with an average of about 9 to 1 as based on a total of about 45,000,000 pounds of fresh product monthly, or one thousand 450-bag cars. The yearly requirements on the basis of an 8-month operating season would mean that of the total potato production in Idaho, between 8,000 and 10,000 cars will be required by the dehydration industry.

The electrical energy used by dehydration plants varies with the type of production, the product, the efficiency and the management of the equipment. A study of two typical plants operating on a raw product input of from 70,000 and 85,000 pounds of potatoes daily revealed a kilowatt-hour requirement of 2.08 per 100 pounds and 1.06 per 100 pounds respectively for the overall plant use.

For the 1942-43 season, the cull potato input to the three potato starch plants totaled 100,000,000 pounds from which was recovered approximately 13,000,000 pounds of starch. Improved methods of starch processing and the utilization of starch plant wastes are being studied in cooperation with the St. Anthony plant. (*Hobart Beresford, Olof E. Stamberg, Marvin Aslett*).

Radiant Energy Drying Studied

A 500-pound raw product capacity dehydrater was designed and built to use with a 10-kilowatt heating capacity obtained with two banks of R-40 drying lamps. Air circulation was obtained by using a ¼-horsepower motor and fan. The study of the design and construction of small home dehydraters was continued and a number of experimental models

were built and furnished the Home Economics Extension Division. Several types of electrical heating units were used, including standard brooder kits, heat lamps, standard Mazda lamps, and iron wire elements. A record of the operation of the dehydraters furnished the Twin Falls district showed that the small household units dehydrated over 100 bushels of fruit and about 20 bushels of vegetables.

Steaming under pressure proved to be the fastest and a satisfactory method of blanching most products for dehydration. In general, the labor requirement for the preparation of products for dehydration and the kilowatt-hour consumption for operating the electric dehydraters was about the same as the labor requirement and energy requirement for pressure cooker canning. (*Hobart Beresford, Leif Verner, Olof E. Stamberg, Kenneth R. Frost, Marion Hepworth, Florence Schultz*).

Increased Potato Production Required New Storages

A survey was made of new potato storages constructed in Idaho during 1943. The majority of the new storages were of the underground or cellar type with a total capacity of 9,600 cars; however, storages built in connection with some of the dehydration plants were of the aboveground type with a capacity of 1,400 cars, making a total capacity of 11,000 cars of new storages available. The improvement in trackside and farm storage facilities aided greatly the handling of the 1943 crop, which was the largest in the history of the state.

Progress was made on the design for reenforced concrete framing for semi-underground potato structures in view of the need to reduce the existing high replacement costs of the underground cellars now in common use. Methods of treatment for timbers used in potato storages to prevent dry rot were investigated. Plans were developed for the design of emergency storage structures.

A field trial of the methods of waterproofing earth-covered storages with the use of bentonite and layers of mildew-proof paper was made at the Sandpoint Branch Station. The techniques worked out for applying these waterproofing materials included the use of drainage layers between the earth covering and the waterproofed section.

Harvesting and Handling Studies

Damage occurring in the harvesting and handling of potatoes is the direct responsibility of the producer and should be controlled easily by the use of modern equipment and proper management and handling practices. The reduction in the cull classification resulting from harvesting and handling injury would mean a material increase in the marketable grades. In many cases the mechanical equipment that has been developed to save labor has increased the overall handling damage. A study of the most promising farm-made laborsaving equipment was made and plans for these prepared for distribution.

Removing sharp projections along the sides of the potato diggers, combine pickers, washing and sorting tables, especially at the entrance and discharge ends of this equipment, offers one of the greatest opportunities for reducing handling injury. The rubberizing of chain aprons, baskets, and tables, and the padding of field trucks and transport trailers

are other means of lowering this loss. The number of times the potatoes are handled is directly proportional to the percentage of injury which can be reduced to 2 or 3 percent as compared to the usual damage of 12 to 15 percent.

Attempting to operate the mechanical potato diggers with too little drawbar power is one of the main causes of damage from cuts which results from the operator raising the shoe of the digger to prevent the tractor wheels from slipping. This condition also increases the damage from bruising caused by not handling sufficient dirt to protect the potatoes on the elevating chain, and from operating the elevator chain at too high a speed. This is especially true on potato diggers equipped with a power-take-off drive.

Much of the damage occurring after the potatoes have reached the storage is due to poor washing and sorting equipment and bad handling practices. It is difficult to detect damage occurring from these operations until after the potatoes have reached terminal markets.

A rotary knife, hot water sterilized potato cutter was redesigned to include a hopper and cutting table arrangement. This work was done in cooperation with the Department of Plant Pathology, and the equipment supplied to the Aberdeen Branch Station. (*Hobart Beresford, Mark R. Kulp, Kenneth R. Frost, Eugene Whitman, Ralph E. Knight, John L. Toevs, James E. Kraus, J. M. Raeder*).

Beet Machinery Development Surveyed

Field studies of mechanical beet harvesting equipment during the 1943 season showed that under favorable conditions the single-row topper, lifter, and windrowing machine could handle a maximum of 5.5 tons per hour; however, due to inexperienced operators and the fact that the machines were in the development stage, the average operation was about 2.5 tons per hour. The rotary disk variable-cut-type of topper appeared to have some advantage over the fixed blade.

For the harvesting of 65 acres of beets yielding 1,239.7 tons, 38 machine days were required with a total of 501.5 man hours needed for their operation. As improvement in this type of equipment is made, the average operating capacity of the machines may be expected to reach 4 or 5 tons per hour. The labor requirement of 7.7 man hours per acre for the mechanical harvesting operations is about one-third of that required for hand topping and loading. This results in a saving of two-thirds of the labor requirement, or about 15 man hours per acre.

The mechanical beet loader handling the 8-row windrows at the rate of a ton per minute makes it possible for a single loader to handle beets from more than one topper. Some farm-made windrow beet loading equipment included the adaption of the standard potato digger with elevator, and others used the small combine grain harvester. (*Hobart Beresford*).

Laborsaving Equipment Investigated

Investigations of the progress being made in the development of mechanical equipment for reducing labor for hay harvesting included direct field chopping, field baling, and combined operations for buck rake and hay stackers.

Records on the operation of a farm-made field chopper developed by Lynn Hempleman, Twin Falls, Idaho, showed that it took 4 machine days and 8 man days to handle a 60 ton yield from 36 acres. The direct chopping of hay from the windrow required only 20 per cent of the labor that was needed formerly for hauling the hay from the field and chopping at the storage shed. The overall labor requirement for the operation from standing hay in the field to chopped hay in the storage shed was about 2 man hours per ton. The equipment consisted of a truck-mounted windrow pickup, auxiliary-power chopper, and a 2-ton capacity side-opening truck box equipped with an apron-type bed, driven by a ½-horsepower motor through a worm gear reduction and ratchet mechanism.

Fifteen minutes were required to unload two tons of chopped hay into the 24- by 100-foot storage shed. Unloading was accomplished by plugging in the motor and regulating the flow of chopped hay off the side of the truck into a standard ensilage cutter blower. Each cutting of hay was spread successively over the entire area, which made it possible to limit the depth to 6 feet. This system of storing chopped hay eliminates the danger from heating and provides a thorough mixing of the three cuttings of hay when it is fed.

By combining haying operations which included windrow mowing attachments and the use of the tractor-powered buck rake for the hoisting operation of the overshot stacker, a low labor requirement of one man hour per ton was obtained for handling standing hay in the field to the stack. This was accomplished by using a slide and hook attached to the stacker cable and employing the power buck rake to raise the stacker as it withdrew from the loading operation. By this means the tractor operator loaded the stacker with the buck rake and by means of an overshot stacker raised the hay to the stack without leaving the seat.

Field studies of a number of combines revealed that excess wind blast was the cause of weed seeds in the straw. The correct wind adjustment reduced the number of weed seeds and enabled their collection in the weed sack which is provided on most combines.

Plans were developed for farm-made pea dusting equipment and tests were made of units from salvaged automobile parts and non-critical materials. (*Hobart Beresford, Kenneth R. Frost*).

Farm Buildings and Equipment

In cooperation with the Department of Animal Husbandry plans were prepared for the construction of self-feeders for livestock. The protection and saving of feed as well as the reduction of labor required for handling livestock were considered in these designs. Test units of the self-feeder for hogs were built of plywood, and are now under trial at the University Farm.

The demand for small backyard poultry houses to accommodate small flocks for wartime food production required the study and development of plans in cooperation with the Department of Poultry Husbandry. (*Hobart Beresford, Kenneth R. Frost, W. M. Beeson, C. E. Lampman, Pren Moore*).

Irrigation and Drainage Problems Studied

Irrigation and drainage pumping is one of the chief uses of electric

service in Idaho's agriculture. During 1943 the requirement for irrigation pumping was about 12,000,000 kilowatt hours less than in previous years when less storage water was available. An increase in the number of pumping plants from 656 to 738 was reported; however, the connected horsepower was reduced from 34,383.5 to 27,216.

In one project 11,000 acre feet of water was pumped for drainage and supplemental irrigation from wells on 5,600 acres of land that could not be drained adequately by means of gravity drains. Six-thousand acre feet were estimated as necessary to control the ground water and the other 5,000 acre feet were pumped for irrigation.

In the irrigation of potatoes, soil moisture depletion was not pronounced at 10-day irrigation intervals in a soil with good water holding capacities but 15-day intervals depleted the available moisture and reduced the percentage of U. S. No. 1's but not the total yield. A 15-day delay in first irrigation did not reduce total yield but reduced the percentage of U. S. No. 1's. (*Hobart Beresford, Mark R. Kulp, John L. Toevs, James E. Kraus*).

Rural Electrification and Rural Industries

The extensive rural elecrification development in Idaho has played an important part in the agricultural war production in helping to meet the labor shortage and the need for increasing power- and time-saving applications. The 1943 records show a total of 35,061 electrified farms (80 percent) served by 10,361.08 miles of distribution line. The kilowatt hours used on farms during the past year was the highest on record even though electrical appliances and wiring materials were not readily available. Records of one of the major utility companies show an average of more than 200 kilowatt hours per month for their farm customers. Plans have been developed for farm-made laborsaving equipment utilizing electrical energy for heat, light, and power. Many of these have been designed to use non-critical materials.

A study was made of the relation between rural electrification development and industrial development throughout the state. In the same way that irrigation pumping played an important part in the development of rural electrification, the latter has had a similar influence in the development of rural industries. Many of these industrial loads such as the starch and dehydrating plants are seasonal, and their service requirements extend over a period of about eight months, but tend to compensate for the load demand created by irrigation and pumping. The energy requirements for the frozen storage locker plants are more evenly distributed through the year. The same is true of creameries, cheese and milk processing plants, packing plants, flour mills, and saw and planer mills; while seed and seed processing plants, canneries, and sugar beet factories are seasonal.

Locker plant facilities are being completely utilized for the accelerated Victory garden and "Food Fights for Freedom" programs. A survey of the 130 frozen storage locker establishments shows that practically all have a waiting list for the rental of the lockers and a high percentage of the lockers have been used to full capacity. The meat rationing program has had some influence on the increased use of the lockers for freezing fruits and vegetables.

A comparison of the kilowatt-hour consumption of a group of typical frozen storage locker plants gave a range of from 50 to 100 kilowatt hours per locker unit with an average of about 75 kilowatt hours per year; however, the average farm freezer has from 5 to 10 times the storage capacity of the frozen storage locker plant unit. The average farm frozen storage unit has a capacity of about 40-cubic feet as compared with the average 4-cubic foot locker unit. Records show an energy consumption of 600 kilowatt hours per year for a 20-cubic foot lift-top cabinet, and 900 kilowatt hours for an 80-cubic foot cabinet of the same type. On the basis of this storage capacity and the average energy consumption of 750 kilowatt hours per year for the farm storage unit, the relative efficiency of the two methods of refrigeration is quite comparable. (*Hobart Beresford*).

Bacteriology

Bacteriological Factors Affecting the Growth of the Alfalfa Plant Investigated

FURTHER studies to determine the factors responsible for reduced yields on so-called "alfalfa-sick soils" have been started. These studies include determinations of the influence of certain environmental factors, such as drying, flooding, clipping, etc., and of fertilizers, minor elements, various types of organic residues, soil sterilization, and inoculation on the growth and nodulation of the alfalfa plant. At this time only preliminary results have been recorded. These observations, however, indicate the following tendencies: When the soil is allowed to dry out at intervals to a degree approaching the wilting point of alfalfa the yield is reduced slightly, nodulation is retarded, and some of the nodules already present die and disintegrate. When the soil is flooded at intervals for various periods of time, but never allowed to dry out, nodulation is increased; however, plant yields are not. In fact, slightly reduced yields may result. (*W. V. Halversen*).

Effect of Microorganisms and Organic Residues on the Aggregation of Idaho Soils to be Studied

In sections of Idaho erosion is gradually carrying off the more productive surface soils and is thereby contributing towards reduced crop yields. One of the ways to reduce soil losses by erosion and to maintain productivity is to build up the organic matter content of the soil by the addition of suitable organic residues. The process of microbial decomposition of organic materials brings about increased aggregation of the soil particles and consequently reduced erosion. Investigations concerning the relationships between microbic residues that produce the greatest aggregating effect on the soil have been started. (*J. P. Martin*).

Animal Diseases Investigated

In cooperation with several hatcheries throughout the state a comparison is being made between the standard tube antigen and a new experimental whole blood antigen to be used in the detection of pullorum disease in turkeys. To date the results seem to show that the whole blood antigen will detect a slightly higher percentage of reactors than will the standard

tube antigen. Further studies are necessary in order to demonstrate whether this higher percentage is due to actual infection or to a too high sensitivity of the antigen.

Veterinarians and livestock owners have continued the use of this laboratory as an aid in the diagnosis of livestock diseases. This has made it possible to determine the prevalence of certain livestock diseases in the state, especially those diseases affecting poultry. A total of 1,243 samples was examined during the year. (*W. B. Ardrey*).

Agricultural Chemistry

Method of Potato Dehydration Perfected

PREVIOUS to the present war production program there were two potato dehydration plants in Idaho producing a riced product as well as potato flour. At the end of 1943 Idaho had 10 potato dehydration plants producing a major portion of the requirements for the armed forces and overseas shipments. The estimated capacity of all dehydraters in Idaho now in operation is about 85 tons of dried product every 24 hours which requires about 800 tons of raw material.

Two types of dehydrated potatoes are chiefly made at present, namely the shoe string or julienne type in which potatoes are diced or cubed and then dried following a blanching treatment, and potato shreds which are made by passing cooked potatoes through a ricer before drying. In these processes some 20 percent or more of the skin and exterior portion of the potatoes has been entirely lost and wasted creating in some cases serious sewage disposal problems. During the early months of operation the final yield in many plants was quite low, but with added experience, and attention called to the losses involved, most plants now operate quite efficiently.

Interest in potato dehydration lead to the development at this Experiment Station of a process with complete recovery of the potato for food and feed purposes. In this process the potatoes are first washed and then baked. The baked potatoes are peeled which removes about 30 percent of the exterior portion. This is dehydrated and ground into a meal for animal feed. The remaining 70 percent of the potato is riced and dried for shreds which can be ground into potato flour. Thus all of the potato is recovered. Data obtained by this process and analytical values of the materials are shown in Table 7. The peel portion has fairly high protein and phosphorus contents and should be valuable as a feed. (*Olof E. Stamberg and Hobart Beresford.*)

Table 7.—Data on baked potato dehydration process

	Large potatoes	Medium potatoes	Small potatoes	Average
Average weight, grams	257.4	170.1	107.3	178.3
Loss in weight during baking (%)	15.67	16.23	18.69	16.86
Dry material of potatoes (% recovered)	23.72	22.48	24.44	23.55
Dry materials as shreds (% of total)	72.38	70.92	65.19	69.50
Dry material as peel (% of total)	27.62	29.08	34.81	30.50
Crude protein in shreds (% dry basis)	11.26	10.88	10.16	10.77
Crude protein in peel (% dry basis)	11.51	11.59	11.70	11.60
Phosphorus in shreds (% dry basis)	0.235	0.254	0.263	0.251
Phosphorus in peel (% dry basis)	0.249	0.264	0.272	0.262

Time-Saving Method for Phosphorus Analysis Developed

Phosphorus content of feeds, forages and farm crops is of importance and several hundred determinations are made annually of Idaho products. A rapid procedure was developed which eliminates the usual several hours of ashing of samples in a muffle furnace. The ashing is replaced by acid digestion requiring only about 5 minutes. This method has proved to be a valuable time saver. (*D. W. Bolin and Olof E. Stamberg*).

Vitamin A and Carotene Content of Idaho Butter Studied

The departments of Dairy Husbandry and Agricultural Chemistry are cooperating in studying the vitamin A and carotene contents of Idaho butter as part of a national survey. Six creameries in Idaho supply semi-monthly samples. The survey was started August 1, 1943, and will continue for a year to obtain seasonal variations.

The average results of the first 5 months show that the vitamin A content was highest during September and October and the carotene content was highest in October. A decrease in both values was noticed in November with a further decrease during December. The different creameries also show some variations. When the survey has been finished, a more complete picture of the vitamin A and carotene contents of Idaho produced butter will be available for comparison with results from other states. (*D. R. Theophilus, D. W. Bolin, H. C. Hansen, and Olof E. Stamberg*).

Soil Improvement Noted

Alfalfa, alfalfa-grass and crested wheat have been grown continuously upon thin, eroded hill-top soils at Moscow during the past 4 years (Table 8). The alfalfa and alfalfa-grass rotations increased the organic matter and nitrogen of the soil appreciably. Crested wheat increased these constituents in the soil slightly. There was a loss in nitrogen and organic matter from the soils cropped continuously to wheat.

Table 8.—Nitrogen and organic matter content of hill-top soil at Moscow

Plot No.	Rotation	Soil Nitrogen		Organic Matter		Wheat—1942-1943 crop averages	
		1939 %	1943 Gain or loss. Lb/A (6")	1939 %	1943 Gain or loss. Lb/A (6")	Yield Bu.	Protein %
1, 5, 9	Checks..... Continuous wheat.....	0.099	— 60	2.005	—1690	16.7	11.67
2	Alfalfa (4 years).....	0.109	+160	2.121	+6793		
6	Alfalfa (2 years)..... Wheat (2 years).....	0.092	+101	1.790	+4344	41.4	15.24
3	Alfalfa-grass (4 yrs.).....	0.103	+220	1.960	+4310		
7	Alfalfa-grass (2 yrs.)..... Wheat (2 years).....	0.094	+260	1.843	+5448	39.1	13.37
4	Crested wheat (4 yrs.).....	0.090	+ 40	1.746	+1655		
8	Crested wheat (2 yrs.)..... Wheat (2 years).....	0.103	+100	2.057	+ 517	20.5	11.19

The crop on one plot in each series was plowed out after 2 years and wheat was grown for the following 2 years. The yield of wheat from

the alfalfa and alfalfa-grass rotations was more than double the yield of the check plots. The protein content of the wheat was increased also. The yield of wheat from the crested wheat plot was increased slightly. (*R. S. Snyder*).

Soil Management Practices Important

The effect of various soil management practices upon crop yields and soil nitrogen has been studied at the Moscow Station over a period of 5 years. Certain rotation systems have maintained crop yields at high levels but at the expense of soil fertility and soil structure. Desirable yields should be maintained with good management practices rather than by rapid depletion of the soil reserve.

Continuous wheat and wheat-fallow systems deplete the soil rapidly and are therefore detrimental to the maintenance program. The burning of straw in these rotations causes even more rapid soil losses. The reserve supply of nitrogen was decreased in the pea-wheat and pea-sweet clover-wheat rotations. Nitrogen in the form of ammonium sulphate and manure additions increased the reserve supply in the soil. Results are shown in Table 9. (*R. S. Snyder, G. O. Baker*).

Table 9.—Effect of management practices upon crop yields and soil nitrogen on Palouse silt loam.

Treatment	Yield per acre (5 yr. average)		Protein of wheat (4 yr. Ave.) %	Soil Nitrogen		
	Grain Bu.	Straw Tons		1937 %	1942 %	Loss or Gain in soil Lbs. /A.
Continuous winter wheat	28.8	1.00	12.38	0.156	0.154	— 40
Winter wheat—fallow	58.1	3.43	14.44	0.177	0.173	— 80
Continuous winter wheat straw burned	32.2	1.08	11.75	0.162	0.156	—120
Winter wheat—fallow straw burned	63.3	3.38	13.00	0.174	0.166	—160
Peas—Winter wheat	55.8	2.55	11.81	0.177	0.173	— 80
Peas—Sweet clover—Sweet clover plowed under. Wheat—1st year	56.8	3.43	14.75			
Wheat—2nd year	52.3	2.14	10.94	0.175	0.173	— 40
Continuous winter wheat 150 lb. $(NH_4)_2SO_4$ each year before plowing	39.1	1.47	12.25	0.157	0.158	+ 20
Continuous winter wheat 10 tons manure every 3rd year	36.1	1.34	11.81	0.162	0.167	+100

Phosphate Fertilizer Improves Alfalfa

Samples of alfalfa were obtained from the Aberdeen Branch Station from plots receiving phosphate fertilizers in 1939, 1940 and 1941. The phosphate applications were at different rates and intervals as shown in Table 10.

The checks and lower rates of single applications gave amounts of phosphorus in the dried alfalfa of from 0.128 to 0.144 percent and low protein content of from 14.4 to 14.9 percent. The yields were low from these plots.

Higher single applications of 200 to 300 pounds per acre, double applications of 150 to 250 pounds, and a triple application of 375 pounds all yielded alfalfa of higher phosphorus content, ranging from 0.151 to 0.159 percent. The yields and protein content were higher also.

Double applications of 200 and 300 pounds per acre, and triple applications of 75, 200 and 300 pounds applied in successive years gave the highest phosphorus and protein values, ranging from 0.163 to 0.198

per cent phosphorus and from 15.19 to 15.99 percent protein. The yields were further increased. For more detailed information see the report from the Aberdeen Branch Station. *(R. S. Snyder, G. O. Baker, John L. Toevs, and Olof E. Stamberg).*

Table 10.—Effect of phosphate applications on alfalfa hay (Aberdeen Branch Station).

Phosphate applications (1939, 1940, 1941)		Yield 1941	Weighted average for 3 cuttings (1941)	
Amount applied per year pounds	Total pounds applied	Tons per acre	Phosphorus %	Protein %
Check	Check	3.61	0.1283	14.42
75	75	3.59	0.1317	14.59
125	125	3.54	0.1444	14.96
200	200	4.13	0.1543	14.90
300	300	5.37	0.1593	14.53
75	150	5.18	0.1592	15.24
125	250	5.56	0.1514	14.81
200	400	5.80	0.1980	15.23
300	600	6.21	0.1690	15.56
75	225	6.21	0.1645	15.19
125	375	6.03	0.1591	16.12
200	600	6.16	0.1632	15.65
300	900	6.34	0.1886	15.99

Cooperative Projects

Members of the staff of the Department of Agricultural Chemistry are particularly active on the chemical phases of numerous projects listed under other departments. These involve analyses of feeds, feed mixes, and farm crops for protein, phosphorus, calcium and other constituents. Vitamin determinations are made on numerous food products and the vitamins especially studied are vitamin A, thiamin, riboflavin, niacin, and vitamin C. Details of these projects can be found under the headings of other departments. *(D. W. Bolin, R. S. Snyder, and Olof E. Stamberg).*

Farm Economics

Medium-size, Diversified Farms in the Palouse Region Compare Favorably with Large Grain and Pea Farms

BUSINESS records for the year 1942 were taken for 72 farms located on the better grain lands between Moscow and Grangeville. These farms were divided into five classes which included as their major enterprises: (1) peas and small grain, (2) small grain, (3) peas, small grain, and livestock, (4) small grain and livestock, (5) small grain, some peas, and 20 percent and more of acreage in canyon pasture land. The most revealing comparison is between classes 1 and 3 where the only difference in enterprises was livestock. The difference in average acreage of crop land was considerable, with 844 in class 1 and 476 in class 3. Class 1 farms averaged 85.3 percent of farm sales as grain, peas, and seeds, while class 3 farms averaged 60.7 percent for the same items. The balance of the sales was livestock and livestock products.

The difference in type of expenses reflected the importance of the enterprises in class 1 and class 3. For example, machinery costs on class

1 farms averaged $2519, 45 percent of the total expenses; but on class 3 farms $1746, or 40 percent. Hired labor was 32.7 percent of the expenses on class 3 farms and 29.3 percent on class 1 farms, but even so the total on class 3 farms was less by about $200. Livestock and farm improvement expenses were small and differed little between the two classes.

Farm family labor income was calculated by deducting all expenses from total sales and also 5 percent on the operator's capital. Changes in inventory were either added or subtracted. This labor income is very high indeed for the year 1942. On class 1 farms it averaged $11,830 and class 3 farms $10,174. The average family labor income per acre of tillable land was the highest on class 3 farms ($21.58) and next highest on class 1 farms ($14.00). On the operator's average investment of $43,867 in class 1 farms and $46,668 on class 3 farms, the percentage returns as labor income was 26.2 percent and 20.8 percent respectively. It thus appears that class 1 farms returned the largest percentage return to the operator. However, if the total investment which includes rented land is used as a base, $80,206 for class 1 farms, a percentage return considerably greater resulted for class 3 farms with a total investment of $54,191. This situation in returns on operators capital explains why operators with limited amounts of capital prefer to rent a large part of their lands. More leisure because of less livestock may also be an element in choosing class 1 farms.

The same conclusions arise when all costs and income are figured in prewar (1935-39) prices. The labor income on class 1 farms was $3856 and for class 3 farms $3044. As a percentage of operator's investment this pre-war labor income on class 1 farms was 8.8 percent as compared to 6.5 percent for class 3 farms. On a total investment basis, the labor income on class 3 farms (diversified) was higher with 5.6 percent return as compared to 4.8 return on class 1 farms.

It is significant that operators of class 3 farms own the largest equity in their farms. This equity is almost 90 percent as compared to about 51 percent for class 1. This shows that in class 3 the operators owned nearly all the land which they farmed. This seems to follow logically because $3044 labor income for class 3 less an estimated $1500 for living expenses leaves $1544 as a surplus to pay for 476 acres of crop land as compared to $3,856 less $1,500 or $2,356 to pay for 844 acres of crop land in class 1. Interest at 5 percent on the operator's owned capital is also available for land payments. Furthermore, it can be concluded that class 3 farms, being largely owned and having livestock enterprises, are more soil conserving, stable, and safer agricultural ventures even if the surplus above living expenses is somewhat less than for class 1 farms. Less risk can easily offset the smaller return. It can be seen that the total labor income available for farm families in the area would be much higher if the diversified plan of class 3 farms were followed on more of the land. (*Virgil B. Fielder and Paul A. Eke*).

Maximum Wartime Production Capacity of Idaho Estimated

In the light of wartime demand for foods, 1944 maximum capacity as well as the total wartime maximum production was estimated for the state. The following acreages of the more important crops and numbers

of livestock expressed in thousands are of future interest if a greater production than will be made in 1944 is needed.

Table 11

Crop	1944 (1) Capacity	Wartime (2) Maximum
Sugar beets	82.0	82.0
Irish potatoes	196.6	216.3
Beans, dry	191.2	221.3
Peas, dry	345.3	421.7
Wheat	948.0	1100.7
Hay	958.3	950.0
All cattle and calves	857.8	857.8
Cows kept for milk	266.6	266.6
Sheep and lambs	1821.0	2038.0
Hens and pullets	2740.0	2445.0
Sows farrowed	90.0	80.3

(1) What farmers will reasonably be able to do with machinery, labor, etc. available in 1944.
(2) What farmers could reasonably be able to produce if sufficient machinery, labor, etc. were supplied.

These figures are based on reasonable adequate soil conservation, average yields, and adequate feed production per animal assuming normal weather conditions.

In general for 1944, potatoes, dry beans, dry peas, canned and fresh vegetables and wheat are given special emphasis for increases. For livestock, dairy cows, sheep, and hens are the only classes being listed for any increases. Hogs and cattle and sheep put on feed are listed for large decreases. In general, crops can be increased in acreage after 1944 but for livestock a decrease from the peak numbers in 1943 seems in order, except for sheep and lambs, dairy cows and turkeys. (*Experiment Station and Extension Staffs and USDA Representatives, Paul A. Eke, Chairman*).

Preliminary Report on Postwar Programs for Idaho Compiled

The effort in making a postwar program for Idaho originated from the desire of the Secretary of Agriculture and the Directors of the State Experiment Stations to (1) make worthwhile employment in the postwar period, (2) to use this employment to conserve and improve natural resources, and (3) to enhance living conditions generally. As a beginning it involved the pooling of ideas and resources of Federal and State agencies in the region to evolve a program of correlated activity designed to attain the above objectives. Further, it is hoped that a program can be outlined by these agencies to stimulate activity (with the same objectives) by individual farmers, cooperatives, political subdivisions, corporations, associations, farm organizations, and individuals generally. Cooperation will be sought of other program-making organizations and informed individuals as the work proceeds.

The work was done by representatives of the United States Department of Agriculture and the Idaho Agricultural Experiment Station and Extension service. The following sectional headings will illustrate the nature of the report. The report was mimeographed and made available February 29, 1944:

1. Crop and Pasture lands.
2. Forest Lands and Farm Woodlands.
3. Range Land Resources.
4. Economic and Social Factors.
5. Marketing and Processing.
6. Rural Living Conditions.
7. Nutrition and Better Living.
8. Rural Electrification.
9. Farm Structures.
10. Education, Training, and Research.

The report will be continued during the coming months. The completed program visualizes the following steps:

1. Program making by areas and possibly by counties.
2. Actual "blueprinting" and organization of areas and local units for action.
3. Action in carrying out the program postwar.

Paul A. Eke has spent most of his time as chairman and secretary of the committee during December, January, and February. This committee consists of Experiment Station and Extension Service staffs and representatives of the United States Department of Agriculture. The work will continue until the end of the year.

Labor Requirements for the Major Peak-labor Crops in Idaho Studied

Estimates of the seasonal labor requirements for apples, cherries, peaches, and prunes were obtained from several dealers and others interested in the production and inspection of tree fruits. The balanced opinion was that over three-fourths of the year's work on cherries is done in June. Apples require nearly as much labor per acre as the cherries but, instead of being concentrated so heavily in one month, the main requirements are during June, October, and November. By October and November the seasonal labor demand has decreased to ease the situation. Most labor for peaches is needed in June and August and for prunes in August and September.

Records were obtained from farmers in southwestern Idaho on the field operations on the crops requiring large amounts of labor per acre. The actual amounts of labor that will be required will differ from the averages shown in Table 12 depending on the quality of labor, size of fields, yields, weather, and general efficiency and methods.

Table 12.—Per-acre man hours of labor required on some intensive crops in southwestern Idaho.

Crop	Total	Man Hours by months									Dec.
		Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	to Feb.
Sugar Beets	82	6	14	23	4	2	2	1	18	11	1
Potatoes, early	59	8	3	4	3	25	9		4	3	
Onions, dry	189	3	12	39	24	19	32	53	6	1	
Lettuce, fall	105					3	23	11	48	20	
Lettuce, spring	103	1	27	17	53				2	1	2
Hybrid sweet corn seed	101	3	4	6	12	25	10	7	28	6	
Onion seed, spring	127	25	4	6	18	8	56	7	1		2
Onion seed, fall	127	1	2	6	18	11	52	13	21	3	
Lettuce seed, head	94	7	14	14	12	13	24	10			
Carrot seed	80	15	15	7	8	4	10	12	7		2
Baby Lima bean, seed	51	2	3	5	4	14	4	19			

Experience indicated that the time for the demand for crew labor could be controlled slightly on some crops by earlier or later planting but generally this would be insignificant and might lower yields. If a farmer were to grow equal amounts of each of the 11 crops shown in Table 12 he would need too much labor in August and June. In order to level out his labor demand throughout the season he needs to have smaller acreages of crops requiring large amounts of labor during these months. The farmers are generally doing this through well-planned diversified crops and, to some extent, livestock. (*Norman Nybroten*).

Plant Diseases

Virus Diseases of Fruits Are Serious Menace

MOSAIC of bramble fruits continues to be the main problem in production of these crops generally in the state. Variety trials at Moscow and observations and test plantings in many areas indicate the value of planting clean stock of resistant varieties and careful roguing. Certain of the varieties such as Taylor, Marcy, and Newburgh are high yielding, producing high quality fruit and if properly isolated from susceptible sorts will be rather easily maintained in a healthy condition.

Attention is again called to the seriousness of the western disease of peaches and the need for an active program to clean up infected orchards on a community basis. Survey work over several years has shown that this disease spreads from peach to peach and in some areas rather rapidly. Prompt removal of infected trees is recommended. The work on other virus diseases of stone fruits has been continued but no new conclusive information is available.

In certain peach orchards sprayed with lead arsenate for twig borer control, considerable damage has been noted to the buds, leaves, and twigs from arsenic toxicity. It is suggested that if this spray is applied that *basic* rather than acid lead arsenate be used. (*E. C. Blodgett*).

Results of Bean Improvement Program Summarized

The bean improvement project was continued in 1943 on a basis similar to former years. Plots were maintained at Buhl and Twin Falls where many hybrid bean selections were tested for their reaction to the virus diseases, curly top and common bean mosaic. None of the 60 hybrid Pinto selections grown on the Buhl plots developed symptoms of either curly top or common bean mosaic. Of these, 16 were selected as superior in seed quality. Greenhouse tests are being conducted to make certain that all selections are completely resistant to common bean mosaic. The 16 selections will then be planted in a replicated yield-trial at Buhl in 1944. In addition a further check will be made on curly top-resistance. With the information obtained in the proposed trials it should be possible to select the strain of Pinto best adapted to the bean area of southern Idaho. The Pinto selection thus chosen will then be ready for increase preparatory to release to the bean growers of the State.

Hybrids of Great Northern, Red Kidney, pea or Navy bean, and various garden bean types were tested for resistance to curly top and common bean mosaic. Greatest progress in obtaining resistance to these

diseases in snap beans has been made with the green pod and wax pod Refugee types. Some such selections have been entirely free from curly top and common bean mosaic for several years, and also have desirable quality and pod type. Resistant garden beans of these types will be of immense value when grown within the curly top area. It is anticipated that Refugee beans of these two types resistant to both curly top and common bean mosaic can be released in a short time.

This project is conducted in cooperation with the State Leafhopper Control Fund Administration, the Bureau of Entomology and Plant Quarantine, and the Bureau of Plant Industry of the U. S. Department of Agriculture. (*Leslie L. Dean*).

Tomato and Pea Disease Resistance Studies Continued

About 1,200 tomato plants representing 15 selections of fourth generation progeny from a cross between Marglobe and the curly top resistant *Lycopersicon chilense*, and 53 back crosses to commercial varieties were tested at Moscow for yield and quality. Several of the back-crossed selections produced fruits of commercial quality, but these must be selected further for resistance. Also several outstanding single plant selections were made from segregates from the original cross.

A greater number of plants, though representing fewer selections, were tested at Buhl for resistance to the curly top disease. Low incidence of the disease greatly handicapped the work there this season. (*Glenn KenKnight and Leslie L. Dean*).

Progress Made in Pea Breeding for Resistance to Near-wilt

In addition to greenhouse trials, over 50 pea selections, originating from the cross Wisconsin Perfection by the resistant Rogers Kay, were planted in infested soil in the greenhouse and transplanted to the field. This method worked very well. Wisconsin Perfection, the susceptible parent died out completely. Several selections appeared to be as resistant as is Rogers Kay. (*Glen KenKnight*).

Aster-yellow Disease of Truck Crops Studied

In plots at the Caldwell Branch Station lettuce, carrots, marigolds, and asters were naturally infected by aster-yellows. These hosts are susceptible to both the eastern and western strains of the virus. Zinnias, delphiniums, and celery, which are susceptible to only the eastern strain, were not affected on the Caldwell plots, indicating that the western strain of the virus is involved. In cooperation with the Parma Branch Station, cloth cages were employed for study of the time of natural inoculation by the leafhopper vector. Young carrots in a field adjoining an aster-yellows infected carrot seed field, were caged from the time of emergence to harvest with the exception of two weeks. Nine different 2-week intervals were employed with two replications of each. The exact results of the experiment will not be known until the roots grown under the cages are used as stecklings for production of a seed crop. (*Glenn KenKnight*).

Pea Root-rot Studies Begun

The fungus, *Aphanomyces eutiches,* was established as the casual

agent of at least part of the serious damage by root-rot to field peas that occurred locally in the Grangeville-Craigmont area in 1943.

In soil naturally infected with Rhizoctonia root-rot in the greenhouse, apparently resistant single plant selections of Alaska and of Early Wisconsin Sweet were carried through three generations and then lost by accidental contamination of the soil with the Sclerotinia disease which killed all plants. Although Rhizoctonia root-rot does not appear to be a serious problem at this time, these results indicate that some resistance to it can be obtained by selection. (*Glenn KenKnight*).

Vegetable Seed Treatments Studied

In the national cooperative vegetable seed treatment tests for control of damping-off, no treatments significantly improved stands of peas or beans, whereas with spinach all treatments employed gave highly significant increases in stand, with zinc oxide at 2 percent by weight the best and cheapest of the treatments. (*Glenn KenKnight*).

New Potato Seedlings Show Promise

A total of 340 seedlings were grown and their reactions to infection with various potato viruses were observed. Sixty-seven seedlings were discarded because of virus infection or undesirable horticultural characters. Thirteen of these have been grown for 10 years. One hundred seventy-two have been observed for 6 years. Enough seed of 25 of the most promising seedlings has been saved to be tested more extensively at the Sandpoint Branch Station. (*J. M. Raeder*).

Control of Spread of Bacterial Ring-rot of Potatoes Possible

Sterilization of the cutting knife can be depended upon to reduce the spread of the ring-rot organism, when seed containing 4 percent infected tubers, by count, is cut. B.K. powder in a water solution (12½ level teaspoons per gallon of water), boiling water or Semesan Bel (1-60) in combination with a 4 percent solution of Triton 420, proved to be equally efficient in this respect.

Dipping the cut seed, which had been infected 100 percent with the cutting knife in a solution of B.K. powder (12½ level teaspoonful per gallon of water) and 2 percent Par Soap materially reduced the amount of disease appearing in the field. The reduction in the amount of disease resulting from this treatment was significant. On the other hand, a 10-minute exposure of the cut seed infected in a similar manner in the same solution showed no reduction in the amount of disease appearing in the field. Either dipping or soaking the cut seed for 5 minutes in a solution of mercuric chloride (1-500) materially reduced the amount of disease appearing in the field, but not sufficiently to warrant its use.

It was conclusively shown that a contaminated picker type planter is more responsible in spreading infection than is an assist-feed type. In tests conducted at the Aberdeen Branch Station, no diseased plants were found in the plots planted with a contaminated assist-feed planter, while in the plots planted with a contaminated picker type, the number of diseased plants ranged from 30 to 33 percent. (*J. M. Raeder*).

Insects

Substitute Insecticides for Pea Weavil Control Found

INVESTIGATIONS on the pea weevil and its control were continued in cooperation with the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture. Work on the project was directed toward finding an alternate control measure which would alleviate the rotenone shortage that developed as a result of the war. A total of 88 materials, ranging from new compounds recently developed to old insecticides incorporated into new mixtures, were tested during the winter of 1942-43. As a result of these tests, the following materials were found to have sufficient promise to warrant field tests: Mixtures containing 25, 50, and 100 percent of cryolite, pyrethrins 0.1 percent in magnesium oxide, pyrethrins 0.1 percent in pyrophyllite, and undiluted magnesium oxide. All these materials reduced weevil populations by at least 74 percent when applied at the rate of approximately 26.6 pounds per acre. Undiluted cryolite reduced populations 98.6 percent, which was comparable with the reduction obtained when mixtures containing 0.5 percent of rotenone and 1.0 percent of rotenone were used. These mixures reduced populations 97.1 and 96.5 percent, respectively, when applied at 13.3 pounds per acre.

A commercially prepared material containing a dinitro-o-cyclohexylphenol (dicyclohexylamine salt) reduced populations of the weevil to within the range of satisfactory field control. In a comparative test with a mixture containing 0.5 percent of rotenone, both materials being applied at the rate of 20 pounds per acre, this compound reduced the populations of the weevil 94.7 percent, whereas the reduction in the rotenone plot was 97.9 percent. The yield of peas was not affected by the dinitro compound. *Derris malaccensis* was tested for the first time and practically 100 percent reduction of the pea weevil populations was obtained with a mixture containing approximately 20 percent of this ground root. The studies on the relation of the adult weevil populations to infestations of harvested peas showed that the average of one weevil per 25 sweeps of a collecting net 15 inches in diameter resulted in an infestation in the harvested peas of 4.77 percent. Similar sampling in 1940, 1941, and 1942 has given a range in infestations from 3 percent in 1940 to 8.6 percent in 1942.

In addition to these projects, work was conducted on factors influencing the emergence of weevils from hibernation and those influencing the number of "pinhole" weevils in harvested peas and the damage caused by a weevil during the crop season of 1943. *(Tom A. Brindley, Ralph Schopp, and W. E. Shull.)*

A Partial Control for Onion Thrips Found

Further field trials in the control of the onion thrips, *Thrips tobaci* Lind., by spraying and dusting were made during the summer. The two materials used were tartar emetic-sugar spray prepared in the proportion of 2 pounds of tartar emetic, 4 pounds of granulated sugar to 100 gallons of water, applied at the rate of 100 gallons per acre and Code 2 dust, a proprietary insecticide. The Code 2 did not become available because of wartime restrictions until quite late in the season and it, therefore, could not be entirely satisfactorily tried in the field this year.

Field trials with these two materials were carried out on onion fields in Canyon and Owyhee counties in cooperation with onion growers and seedsmen. Limited trials were made by hand dust gun application of Code 2 to onion seed fields. Extensive trials were made with tartar emetic-sugar spray on commercial and bulb onion fields. Population counts showed the population of the thrips to be reduced from 50 to 60 percent by Code 2 dust on onion seed fields. One field tested showed an increase of over 16 percent of seed produced in the field by dusting at the rate of 35 pounds per acre with Code 2 when only two applications were made, one on July 10 and the other on July 17. Further trials with Code 2 applied at the proper time might indicate its usefulness in thrips control on seed onions.

Bulb and commercial onion fields sprayed two or more times with tartar emetic-sugar spray showed an increased production of from 2,438 to 4,201 pounds per acre over unsprayed fields. Similar fields dusted with Code 2 dust showed an increase of from 770 pounds to 6,580 pounds per acre over undusted fields. These results show that the thrips may be at least partially controlled by either the spray or dust used. A great deal more research work will be necessary if we are to find an entirely suitable economical control for thrips on onions. *(W. E. Shull and J. A. Callenbach.)*

Wireworm Injury to Beans Studied

Research on the control of wireworms in cooperation with the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, has been continued during 1943 with the work being done at Twin Falls, Idaho. Due to changes necessitated by war conditions, the program of work consisted mostly of two phases, relation of crops to growth and survival of wireworms, and relation of wireworm numbers and depth distribution to their damage of beans. Hardly enough information has yet been obtained in these studies to justify drawing definite conclusions.

However, some trends can be noticed. The cereals and beans produced the most rapid growth in wireworms in the greenhouse studies, oats showing the least growth of the cereals. Alfalfa and barley seeded together produced definitely more growth than alfalfa alone, but the combination was inferior to barley alone. This brings up the possibility that wireworms may increase faster where alfalfa is seeded with grains than where it is seeded alone. The principal species of wireworm doing damage is the sugar beet wireworm *(Limonius californicus* Mannh.*)* which apparently has at least a 3-year life cycle in the Twin Falls area, with some wireworms extending their life into the 4th and 5th years.

In connection with beans, one of the main crops in the Twin Falls district, studies have not shown a very definite correlation between wireworm numbers and bean damage. There are apparently other agronomic and plant-disease factors entering into the obtaining of a good stand of beans. Some evidence is shown that less damage occurs to beans which follow alfalfa than to those following beans or some other crop. Wireworms of this species apparently remain in the top 6 inches of soil throughout the growing season, although the principal damage to beans is done in June and early July. *(M. C. Lane, F. H. Shirck, and W. E. Shull.)*

Nutrition

AS a result of the food problems produced by war there is an increased interest in the adequacy of the daily diet and emphasis in nutrition research this year has been placed on investigations dealing with the changes in the nutritive value of foods during preparation and cooking. Some of this work is a part of the National Cooperative Experiment Station Project on the Conservation of Nutritive Values of Foods.

New Potatoes Have Extra Antiscorbutic Value

In 1935 results from the use of the biological method for the study of vitamin C were published from this laboratory which showed that new, that is immature, potatoes were at least twice as rich in vitamin C as mature tubers. This year using the chemical method with 2, 6-dichlorophenol indophenol dye and a photoelectric colorimeter new Russet Burbank potatoes were found to have slightly more than three times as much ascorbic acid as the average for 46 tubers of the same variety analyzed between February and May.

In a study of Idaho baked potatoes it was found that the most important factor in determining their value as an antiscorbutic in the diet was the promptness with which they were eaten after they were baked. Since the tubers could not first be sampled and then baked whole the values for raw and baked are made up of averages of tubers analyzed in each state and are practically the same for baked as for raw when the analyses of the baked ones were carried out at once. If the baked potatoes were allowed to stand at room temperature the loss of ascorbic acid varied from almost 33 percent in half an hour to about 50 percent in 2 hours and 100 percent in four hours. *(Ella Woods and D. W. Bolin.)*

Meat Loses Thiamin in Broiling

Lean meat is one of the richest sources of thiamin in the human diet and it is important to know something of the amount present in various types of meat and of the losses which occur in their cooking.

Lean pork, for example, is one of the richest natural sources of this water soluble vitamin. Analyses of chops from six different pork loins gave an average value of 8.35 micrograms per gram raw and 5.34 micrograms per gram after they were broiled. The cooking resulted in an average reduction of 37 percent from the original thiamin value. Part of this loss may be accounted for in the drippings and the utilization of the liquor from cooking meat will aid considerably in the conservation of the original vitamin value.

An assay of 108 lamb chops gave a value of approximately 1.0 microgram of thiamin per gram of fresh tissue and a value of 0.68 micrograms per gram for the broiled chops, a loss of approximately 34 per cent. These data show that even on a raw basis lamb is a very poor source of thiamin when compared with pork.

The heart, liver and kidney of lamb contained 4.2, 3.0 and 2.7 micrograms respectively per gram of fresh tissue. While these results are still lower than pork muscle, it may be emphasized that the heart and glandular tissues of lamb are much richer sources of thiamin than the muscle tissue. *(M. L. Buchanan, W. M. Beeson, D. W. Bolin and Ella Woods.)*

Cooked Peas Supply B Vitamins

If the legumes are to be used to any great extent to replace meat in the diet, it is important that their value as a source of the vitamins which meats supply should be investigated.

Mature Alaska peas were analyzed for thiamin and riboflavin both raw and cooked. The cooking was carried out after soaking and the water used for soaking and cooking was included in the final product.

The peas were found to be a good source of thiamin but a rather poor source of riboflavin. The losses on cooking were approximately 13 per-cent of the thiamin and 18 per cent of the riboflavin.

One good way to compare foods in regard to any nutritive factor is to determine what part of the daily allowance each will contribute to the diet when used in amounts which approximate the usual servings. When pork or lamb muscle and peas are thus compared on the basis of 100 gm. the results are as follows:

Portion	Thiamin ugm.	Daily Allowance %
100 gm. pork muscle	534	30
100 gm. lamb muscle	68	4
100 gm. cooked peas	288	16

(Ella Woods, W. V. Halversen, D. W. Bolin, and Olof Stamberg.)

Peas Lack Methionine

The Alaska field pea is an excellent source of the amino acids essential for growth with the single exception of methionine but this lack will retard growth if peas are used as the only source of protein. However, when pure methionine is added to the pea diet the resulting gains are better than when casein, the principal milk protein, is used as the sole source of amino acids.

In experiments conducted in this laboratory young rats on the pea diet gained an average of 29 grams in 8 weeks but those with peas and added methionine gained an average of 125 grams while those receiving casein gained only an average of 85 grams in the same time.

This information is important and practical because when peas are used in place of meat in the diet care must be taken to have at least a small amount of egg, milk or cheese included among the foods eaten at the same meal for they will supply the needed methionine. *(W. M. Beeson, Ella Woods, and D. W. Bolin.)*

Caldwell Branch Station

R. F. Johnson, *Superintendent*

Pasture Gains on Lambs Increased by Supplemental Feeding

THE average daily gains of 67-pound range feeder lambs are increased approximately 0.11 pound daily by supplementing the ration of each lamb on fall pasture with ¼ pound of whole barley and ¾ pound of chopped alfalfa hay. These lambs were corralled at night.

In previous years the gains of lambs pastured on third crop alfalfa and grain stubble without supplementary feed were 0.30 pound per lamb daily, while the addition of barley and alfalfa hay to the diet increased the daily rate of gain to 0.41 pound. *(R. F. Johnson, E. F. Rinehart, and C. W. Hickman.)*

Protein Supplements Not Needed for Fattening Lambs

Adding 10 percent of cottonseed cake to the grain ration of 92-pound lambs that were fed 1.8 pounds of alfalfa hay and 1.4 pounds of whole barley daily did not increase the rapidity of gains or reduce the feed cost per unit gain. Supplementing the diet with cottonseed cake increased the cost per 100 pounds of lamb produced from $13.54 to $14.06. These lambs were fed for a period of 48 days. These data agree with previous experiments at this Station which have repeatedly shown that a ration of bright leafy alfalfa hay and whole barley is not improved by supplementing with 10 per cent of cottonseed cake.

These data seem to be of particular interest at this time because of the need to conserve protein concentrates. *(R. F. Johnson, E. F. Rinehart and C. W. Hickman.)*

Relative Feed Value of Corn Silage, Beet Top Silage and Wet Beet Pulp

One of the perennial questions among cattle feeders is, "How much is beet top silage, wet beet pulp and corn silage worth per ton?" Three years of research on this problem has shown that at present feed prices (chopped alfalfa hay $18.00 per ton and ground barley $33.00 per ton) corn silage has a value of $7.50 per ton, beet top silage $5.55 per ton and wet beet pulp $3.47 per ton. On a percentage basis beet top silage has a value of 74 percent of corn silage and wet beet pulp 46 percent.

This year these succulent roughages were compared by adding limited amounts of corn silage, beet top silage and wet beet pulp to a ration of ground barley and alfalfa hay for 510-pound Angus steer calves. The succulent feeds were fed to each lot on an equivalent dry matter basis, the respective lots receiving a daily allowance of corn silage 6.3 pounds, beet top silage 5.2 pounds, and wet beet pulp 12.8 pounds, along with 8 pounds of ground barley and 10 pounds of chopped hay.

The daily gains of the steers fed beet top silage were slightly lower than the calves receiving corn silage or wet beet pulp. The cost of feed per 100 pounds of gain was 37 cents more on beet top silage than corn silage fed steers and 99 cents per hundred weight more than the calves eating wet beet pulp. These results parallel the reports of previous years. *(R. F. Johnson, E. F. Rinehart and C. W. Hickman.)*

Preparation of Beet Top Silage

For our experimental studies beet top silage was prepared by stacking green beet tops and crowns with alternate layers of straw in ricks approximately 12 feet wide, 16 feet long and 10 feet high.

The preparation of good quality beet top silage requires gathering the beet tops and crowns as soon as possible after their removal from the beets and with the least possible amount of soil. The ash (essentially dirt) content on beet top silage varied from 18 to 31 percent on a dry basis.

Since dirt readily clings to the leaves of the beets during rainy weather and satisfactory machines for picking up the tops are yet in the development stage, the task of gathering the tops for the making of silage remains essentially a dry weather, hand labor job. *(R. F. Johnson.)*

A Profitable Way to Fatten Calves

Wintering, summer pasturing and dry lot feeding in the fall has proved to be one of the best ways to make the greatest use of pasture and roughage crops for growing and fattening steers for market under irrigated farm conditions. Out of 452 days that the steers were on the farm 58 percent of this time was spent grazing aftermath crops and irrigated pasture and 45 percent of the total weight was produced on pasture.

Thirty-seven 382-pound Angus stocker calves were purchased October 29, 1942 and marketed January 25, 1944 at an average finished weight of 1027 pounds. The steers were pastured on the aftermath of field crops during the first fall, wintered in the dry lot until April 27, then pastured on irrigated mixed grass pastures until October 12 when they were again brought into the feed lot for a 105-day finishing feed.

The calves were divided into three groups for wintering. Calves wintered solely on chopped alfalfa hay made 1.65 pounds of gain per day at a feed cost of $11.15 per 100 pounds of gain (chopped alfalfa hay $18.00 per ton). The steers fed 3.7 pounds of ground barley daily with chopped alfalfa gained 2.03 pounds per day but the cost per 100 pounds of gain increased to $12.43. The ground barley was valued at $33.00 per ton. Another group wintered on a limited allowance of alfalfa hay, corn silage and ½ pound of cottonseed cake per day made an average daily gain of 1.52 pounds at a feed cost of $13.80 per hundred weight. In this case the corn silage was valued at $7.50 per ton and the cottonseed cake at $61.00 per ton. In addition to the fact that this ration made the poorest showing, it should be recognized that corn silage is not always available in sections where wintering rations are of primary importance and that cottonseed cake is now one of the scarce protein feeds.

On irrigated mixed grass pastures the average daily gain made by the steers for the season was 1.37 pounds per day. The average carrying capacity was 1.44 steers per acre. One acre of pasture produced 343 pounds of beef which was worth $37.89 when the beef was figured at 12 cents per pound and a charge of $5.27 per acre deducted for the grain fed during the last 88 days of the pasture season. The pastures were not permitted to be grazed too closely during the grazing season.

On July 15 the steers were divided into two groups, with one group fed 4.9 pounds of ground barley as a pasture supplement and the other remaining on pasture with no supplement. The steers receiving grain maintained their rate of gain for the entire season, whereas the steers on grass alone gained 0.2 pound per day less during the latter part of the pasture season than they had during the first part of the season. On the basis of the extra pounds of gain produced by grain feeding, the barley consumed did not pay for itself. *(R. F. Johnson, E. F. Rinehart and C. W. Hickman.)*

Aberdeen Branch Station

J. L. Toevs, *Superintendent*

THE program at the Aberdeen Branch Station continued without any serious interruptions. While help was somewhat short at times, none of the projects were neglected. Some curtailment was necessary to meet the labor situation. Travel restrictions prevented a few cooperators from inspecting and cooperating with some projects as fully as desirable. Cooperative research continued with the Office of Cereal Crops and Diseases and the Soil Conservation Service of the U. S. Department of Agriculture. This Station further cooperated with the Soil Conservation Service in making available additional land for the purpose of increasing seed stock of certain grasses for further studies in this western region.

Heavier Rates of Phosphate Pay Dividends

Rates of fertilizer applications will always vary from one section to another—from one farm to another—and from one field to another on the same farm. Many factors have a bearing on fertilizer requirements, such as original fertility and physical condition of the soil, cropping and rotation systems practiced, types of crops grown, methods of irrigation and amounts of water used, length of time land has been cropped and to what extent plant food has been removed. Studies with respect to the most beneficial rates of phosphate applications are just getting well under way. The first phase of this experiment is nearing completion. Indications are that we have been more or less conservative in the use of phosphate fertilizers with legume crops on soil being definitely deficient in available phosphorus. Phosphate fertilizer is being applied at different rates and different intervals (to alfalfa only) in a 6 year rotation. While the lower rates give the greatest return for each fertilizer dollar expended, some of the heavier rates give the highest net returns per acre. This is shown in Table 13.

Table 13.—Higher rates of application of treble superphosphate prove economical.

Phosphate applications	Total phosphate applied	Ave. yrly hay yield 1939, 1940, 1941	Total increase in hay production 3 yr.	Fertilizer costs	Value* of increased production less cost of fertilizer
Lbs.	Lbs.	tons	tons		
No treatment	none	2.94	.....	.....	.....
1939- 75 TSP	75	3.51	1.71	$1.95	$15.15
125	125	3.52	1.72	3.25	13.95
200	200	4.32	4.14	5.20	36.20
300	300	5.00	6.18	7.80	56.00
1939-40					
75	150	4.56	4.86	3.90	44.70
125	250	4.43	4.47	6.50	38.20
200	400	5.33	6.87	10.40	58.30
300	600	5.73	8.37	15.60	68.10
1939, 1940, 1941					
75	225	5.06	6.36	5.85	57.75
125	375	5.25	6.93	9.75	59.55
200	600	5.57	7.89	15.60	63.30
300	900	5.50	7.68	23.40	53.40

* Hay valued at $10.00 per ton.

Rates from 400 to 600 pounds of treble superphosphate per acre during the three years of the alfalfa crop produced the highest net returns per acre. Furthermore, as is indicated in Table 14, the residual carry-over

for succeeding potato crops adds considerably more to the value of the higher rate.

Table 14.—Residual effect of phosphate applications on potato yields.

	1942		1943		Av. yield for 1942 & 1943	
	cwt.	% ones	cwt.	% ones	cwt.	% ones
Av. of all checks	251	76.0	228	61.0	239	68.5
Av. of plots receiving 75 to 250 lb. TSP	260	77.0	230	62.0	245	69.5
Av. of plots receiving 300 to 900 lb. TSP	291	75.0	273	69.0	282	72.0

The residual effects of the phosphate applied to the hay are definitely in favor of the higher rates. This was very evident throughout the growing season. The higher potato yields from the heavily fertilized alfalfa plots are significant. In fact the yield differences were greater than ever experienced from any direct application of commercial fertilizers to potatoes in any of the tests conducted at this station. This substantiates the recommendations made in the past—namely, supply ample phosphate to the legume in the rotation and a large part of the commercial fertilizer problems will be taken care of for succeeding crops (providing, of course, the interval is not too long between legume crops). *(J. L. Toevs and G. O. Baker.)*

Sweet Clover Builds Up Soil Fertility Rapidly

In 1941 three biennial sweet clover rotations were started on land which had previously been cropped heavily. Two years previous to 1941 grain was grown on this land. The sweet clover is seeded with the wheat. The following spring a dense growth of approximately 15 inches of sweet clover is turned under.

The experiment has not run long enough to indicate trends between rotations but results to date indicate a sharp rise in yields for the crops common to all. The average wheat yield for 1941 was 23.1 bu.; for 1942, 41.1 bu.; and for 1943, 62.5 bu. The potato yields for the same years were as follows: 194, 222, and 256 sacks per acre. Sugar beets were included only in one rotation. The first year the yield was only 12.8 tons per acre—and in 1942 the yield was 17.8 tons and in 1943, the yield went to 23.1 tons per acre. *(J. L. Toevs and G. O. Baker.)*

New Oat Variety Considered for Release

A new oat selection, C. I. 4136, from a (Victoria x Richland) X Bannock cross will be further increased in 1944 with the possibility of distributing it to farmers for 1945, providing it continues to perform in the same manner as in the past 2 years. Further tests will be conducted on both low and high fertility land. Records show to date that this new oat outyielded Bannock by 5 percent in the nursery trials from 1941 to 1943 and 6 percent in field plot trials for 1942 and 1943. For the same period it outyielded Marida 7 percent in the nursery and 5 percent in the plots. The principal advantage of the new oat is that it has a shorter straw and is not quite so susceptible to lodging as our standard varieties. It has resistance to all smut strains found in the western area and has some stem rust resistance. The latter is not sufficient for the corn belt states. *(T. R. Stanton, F. A. Coffman, H. Stevens, and J. L. Toevs.)*

Two Barleys Show Promise

Two barley selections made in 1936 by Harlan and Stevens show promise of being superior to Trebi and Velvon. They have only been in plot tests 2 years and will require more comprehensive tests before release can be considered. Figuring index yield of Trebi at 100, Velvon is 97, Sel. Ab. 36-6127 is 108, Sel. Ab. 36-5652 is 106. In addition the two new selections show considerable improvement in strength of straw. *(H. V. Harlan, H. Stevens, and J. L. Toevs.)*

Corn Hybrids Have Slight Advantage Over Standard Varieties

Minhybrid No. 702 and 800 and Wisconsin hybrids 275 and 335 appear to have a slight advantage over Minnesota No. 13 for production in Southeastern Idaho. Their average yield has been slightly higher and moisture content at harvest time slightly lower than No. 13. Wisconsin hybrid No. 240 is a flint-dent hybrid and has produced a very good grain yield but is low in forage production.

Two year average grain yields were as follows: Minhybrid No. 702, 89 bu.; Wisconsin hybrid No. 275, 91 bu.; Minnesota No. 13, 80 bu.; and Wisconsin No. 240, 94 bu.; on the basis of approximately 15 percent moisture.

It must be remembered that the frost free period for the past two seasons has been longer than normal. *(J. L. Toevs.)*

Sorghums Cannot Compete With Other Forage Crops

Sorghums should be used in this area as an emergency feed crop only. Dakota amber and Freemont seem to be the only varieties that will produce grain that is anywhere near maturity and still produce tonnage. None of the sorghums that have a fair chance to ripen produce a total forage yield that would make them desirable. *(H. Stevens and J. L. Toevs.)*

Observations from Grass Experiments in Cooperation with the Soil Conservation Service

Dryland

Unless otherwise indicated fall seedlings are being considered.

1. Seedbed preparation such as summer fallow is essential to establishment of a satisfactory stands of perennial grasses.

2. More uniform grass stands are produced from seedings made by drills equipped with press wheels than without the use of this equipment.

3. Satisfactory results may be obtained from seedings made in the early spring on summer fallow land.

4. Seedings made on summer fallow developed sufficiently for utilization in a shorter period of time than those made on any other type of seedbed.

5. Satisfactory grass stands may be obtained on seedbed cultivated just prior to seeding and on seedbeds where competition is eliminated by burning.

6. A prepared seedbed enables a wider choice of grass species and type of drills. *(R. H. Stark and J. L. Toevs.)*

Grass Seed Production

Results from fertilization of three grasses seeded solid and in rows were somewhat variable but in general the following conclusions appear evident.

1. Row seedings of Big Bluegrass *(Poa ampla)*, Chewings Fescue *(Festuca rubra commutata)*, and Blue Bunch Wheatgrass *(Agropyron spicatum)* produce two to four times as much seed as solid seedings.

2. Seed yields from row seedlings were practically the same for the three varieties.

3. Row seeded *Poa ampla* and *Festuca rubra* respond to nitrogen fertilization though much less in percentage than the solid seedings for the same species.

4. *Agropyron spicatum* in rows gave no response to nitrogen fertilization. Solid seedings of the species were abandoned.

5. Very little response if any was obtained from phosphate fertilization or from addition of phosphate and potash to the nitrogen application. *(R. H. Stark and J. L. Toevs)*.

Pasture Plots Under Irrigation

A number of grasses were seeded singly and in combination with Ladino clover in 1941. Clippings were made intermittently during each summer to determine yield differences. Striking differences appeared between single grass seedings and the grass seeded with Ladino clover. Roughly speaking twice the yields have been obtained from the grass-clover mixture. The following observations were made in the spring of 1943.

1. Grasses seeded in combination with Ladino clover did not survive the winter of 1942-1943 as well as where seeded alone.

2. Grasses seeded with Ladino clover and producing satisfactory stands in 1943 were Tall Oatgrass, Smooth Bromegrass, Orchard Grass, Red Fescue, and Sheep Fescue.

3. Grasses seeded with Ladino clover showing a high percentage of winter killing during the winter of 1942-1943 were Intermediate Wheatgrass, Red Top, Meadow Foxtail, Mountain Bromegrass, Meadow Fescue, Big Bluegrass, and Wood Bluegrass. *(R. H. Stark and J. L. Toevs.)*

Potato Research
Aberdeen Branch Station

J. L. Toevs, *Superintendent*
J. E. Kraus *in charge Potato Research*

Faulty Seed Handling an Important Factor in Production of Good Stands

WORK on this project is considered completed with the data obtained from the 1943 tests. Results in 1943 substantiated conclusions reached in previous years. Seed cut and planted immediately or stored in

the cellar 24 to 144 hours and then planted produced good stands and good yields. Cut seed stored in an open machine shed or in the greenhouse in comparatively high temperatures and low humidities gave poor stands, low yields, and poor quality potatoes.

Reduction in stands of approximately 30 percent resulted from storing uncut tubers 6 days at temperatures of 70° to 80° F. and then cutting and planting immediately. If the cut pieces from such tubers were stored in the cellar for 24 hours, there was no reduction in stands. *(J. E. Kraus.)*

Are There Superior Strains of Russet Burbank?

Further tests were made in 1943 to determine the possibility of there being seed stocks of the Russet potato which are superior in yielding ability or in type. From the 1942 certified seed plots several lots were picked to represent low and high yielding stocks. Along with these, some stocks containing high percentages of mosaic were tested. There was a difference of approximately 80 sacks per acre in total yield and approximately 70 sacks in yield of U. S. No. One between the high and low stocks in 1942. The replicated plot yields of 1943 show that there is a maximum difference of only 5 sacks per acre in total yield and even less in yield of U. S. No. Ones between the two sets of seed stocks.

As in 1942, the results indicate that it is very doubtful if there are seed stocks of the Russet Burbanks which are actually different in yielding ability, or in quality or type. The indication is that any difference in yield between stocks of Russet Burbank is due to difference in disease content, size of seed piece used for planting, or some environmental factor. *(J. E. Kraus.)*

New Potato Varieties Tested

Replicated yield tests were conducted with nine varieties of potatoes at Aberdeen in 1943. None of the new varieties showed promise as a competitor for Russet Burbank. Kasota, which is similar to Bliss Triumph, appeared to be but very little better than the latter variety. Although it appears to be somewhat resistant to Fusarium wilt and stays green longer, it has most of the shortcomings of Bliss Triumph; namely, it has a tendency to crack unless handled very carefully and it is subject to potato scab.

Colorado Seedling 3412, which was reported as having some promise in 1942, is too late in season to compete with Bliss Triumph as an early potato. It is a very attractive red potato and is somewhat similar to Peachblow or Colorado Red McClure. For a storage potato on soils not severely infested with scab, it has some possibility. Mohawk, a new variety named in New York, was released specially for growing in the East as a substitute for Russet Burbank as a quality baker. It did not show much promise in the tests at Aberdeen in 1943. It yielded considerably less than Russet Burbank and had a tendency to form very large misshapen tubers. It will be tested further with close plant spacings to determine what possibility it has under conditions where it is not as likely to get so large and rough. *(J. E. Kraus and J. L. Toevs.)*

Many Factors Involved in Causes of Jelly-end Rot

Results of tests in 1942 indicated that soil moisture was one of the most important factors affecting occurence of jelly-end rot. Results in

1943 did not confirm those of 1942 as there was but little effect of skipping one or more irrigations during August or September on the amount of jelly-end rot formed. Better methods of determining soil moisture and of obtaining differences in soil moisture between treatments are necessary before conclusive results can be obtained.

Other experiments indicated that date of planting might influence the amount of jelly-end rot occurring at harvesting time. It appears this may be related to the stage of plant growth and that jelly-end rot is associated with some growth condition just previous to harvesting. Plantings made late showed less jelly-end than those made early although harvested at the same time.

Other observations, and the experiences of growers, indicate that jelly-end of potatoes might be related to a nitrogen-phosphorous balance or to other nutritional conditions, and that this disorder may develop in storage on tubers that appeared sound at digging time. There is also some indication that there may be more than one kind of jelly-end rot and these may be caused by different factors. *(J. E. Kraus and J. M. Raeder.)*

Some Causes of Second Growth Determined

There is a definite correlation between the number of stems per hill and the amount of second growth. One-stem plants produce a high percentage of second growth tubers. As the stem number increases, within limits, the amount of second growth decreases. Further evidence was obtained indicating that second growth is correlated with the ratio of the amount of tops to the number of tubers on the plant. The top-tuber ratio is much higher on hills with one stem than on hills with more than one stem. Other data which support this contention were obtained by removing part of the foliage from plants with one stem. One effect of such partial defoliation was to reduce the amount of second growth almost equal to that of plants with two stems.

The amount of second growth varies on different soils. More was produced on second-year potato soil than on first-year potatoes grown on clover land. Growth was rapid throughout the season on the clover land but on the second-year potato land the plants grew very slowly until about August first. Second growth started early on the clover soil, but it was just beginning on second-year potato soil the first part of August. Consequently, on the latter tubers, the knobs were near the apical end but they were nearer the stem end on tubers produced on clover land. These results strongly indicate the rate of plant growth or food manufacture is an important factor in second growth production.

Data obtained from seed handling experiments show that uniformity of stand may markedly affect the percentage of second growth. In this experiment, stands varied from 38 to 98 percent and the corresponding percentages of second growth varied from approximately 2 to 17 percent of the total yield.

Studies conducted to determine whether soil temperature is a factor influencing second growth were not conclusive. These studies indicated that high soil temperature might increase the amount of second growth, but more experimental data are needed to positively determine this relationship.

Results of irrigation studies in relation to second growth were not in accord with those of the previous year, indicating that either irrigation is not an important factor in this problem, or that a more refined technique is necessary in studying this relationship. *(J. E. Kraus.)*

Station Develops Foundation Seed Stock

Approximately 200 sacks of increase tuber unit stock of Russet Burbank potatoes were obtained at Tetonia in 1943. Most of this stock will be released to certified growers in 1944 for foundation stock to be used for seed plots.

Approximately 1500 tuber units of Bliss Triumph were planted on dry land at Tetonia in 1943. Because of frost and drought, only 15 sacks were obtained from this stock. All tubers of sufficient size were indexed again at Aberdeen during the winter and the remainder will be planted for increase in 1944. *(J. E. Kraus and E. W. Whitman.)*

Tuber Maturity Hastened by Killing the Vines

Because of wide spread interest in getting potatoes harvested early in 1943, experimental work was continued on the use of sprays and dusts to kill the vines and hasten maturity. Materials used included 1 and 2 percent Sinox sprays, Sinox dust, and a Sinox-oil dust mixture.

All sprays and dusts used killed the vines within 24 to 48 hours following application and all reduced the amount of skinning or feathering of tubers. The most effective treatment seemed to be Sinox dust. A 1 percent spray was nearly as effective as a 2 percent spray. Sinox-oil dust gave fair results. The main consideration as to choice of these sprays and dusts appears to be in ease and cost of application. The oil-dust is very heavy and not as easy to apply as the straight dust.

Although some reduction in skinning was evident 7 days after application, only after approximately 14 days was the reduction enough to be of importance commercially.

As in previous years' work at Aberdeen, but little, if any reduction in yield was obtained by killing the vines. However, this would depend primarily on the relative maturity of the plants at the time of application. On spray demonstration plots in the Boise Valley in 1943, there was a marked reduction of yields in some fields. *(J. E. Kraus.)*

Seed Potato Storage Studied

Work was continued on the effect of various storage conditions on the value of tubers for seed purposes. As in 1942, storage temperature, number of desproutings before planting, date of desprouting before planting, and extent of sprouting, had but little if any important effect on yield or grade. From 2 years' results the indications are that if ordinary sanitary storage of seed potatoes is maintained, good results should be obtained regardless of storage temperature within ranges of 32° to 55° F. Planting of potato tubers directly out of cold storage (below 35° F.) is not recommended, however, because of slower emergence following planting. In years of unfavorable environmental conditions for rapid germination, more severe injury from such diseases as rhizoctonia, is likely to occur. *(J. E. Kraus.)*

Causes of Storage Loss Studied

Field run potatoes were stored in bulk at temperatures of 32° F., 40° F., and 55° F. in controlled refrigeration rooms in 1942-43. The results show that it is entirely inadvisable to store tubers in cold storage (near 32° F.) immediately after harvesting. Severe rotting and discoloration of the surface of the tubers resulted from such storage.

Prolonged storage (over 1 month) at temperatures near 55° F. resulted in increased rot but tubers which did not rot had excellent appearance and quality.

Immediate storage after harvesting at 40° F. resulted in excellent keeping and a minimum of rot throughout the entire winter. Potatoes given preliminary storage for 2 to 3 weeks at temperatures of 50° to 60° F. and subsequent storage at lower temperatures kept very well and showed very little rot.

Immature potatoes lost more weight than mature ones due to shrinkage in all storages during the first 2 to 3 months of storage; but after that period of time there was but little difference in shrinkage.

Potatoes stored in the Experiment Station cellar at ordinary temperatures prevalent in southern Idaho cellars kept about as well as those in controlled temperature storage. *(J. E. Kraus.)*

Experimental Work Continued on Many Projects

Experimental work will be continued on many projects and the results of such work will be released as they become available. Studies of seed piece size have indicated that 1½ to 2 ounce seed pieces give the best economical yields of marketable potatoes.

Studies have been continued on the relationship of rotation and fertilizer practices to the occurrence of fusarium wilt. Large plant types have been found in commercial fields of Russet Burbank and these types show promise of having some fusarium resistance. Further tests are being made to more adequately study them.

Studies on spacings have indicated that Russet Burbank should be spaced between 8 and 12 inches in the row for best yields and quality. In general, the lower spacing is best on high fertility soil and the higher spacing best on low fertility soil.

Temperature studies are being made on large bins in commercial potato storages to determine the relationship between temperature, ventilation, and keeping quality. *(J. E. Kraus and J. L. Toevs.)*

Sandpoint Branch Experiment Station

RALPH KNIGHT, *Superintendent*

Size and Yield of Potatoes Affected by Seed Spacing

MOST of the certified potatoes grown in this section are shipped to outside points, commanding a higher price than commercial potatoes sold locally. The seed growers are therefore interested in obtaining the highest possible yields with a minimum of rough or over-sized tubers, and have raised the question as to what effect seed spacing might have on these factors.

Using both the Netted Gem and Chippewa varieties, seed pieces were dropped at 12, 18, 24, 30, and 36 inch intervals in rows 3 feet apart. After harvest, each lot was sorted and the small, rough, over 8 ounces, and No. 1's under 8 ounces were weighed separately. It was arbitrarily assumed that all or most of the tubers over 8 ounces would, in a more favorable season, have reached a size too large for desirable seed. The bulk of the No. 1's from the 12 inch spacings ranged from 2 to 6 ounces, while from the 30 and 36 inch spacings 5 to 8 ounce tubers predominated. The results are summarized below. It should be noted that probably at least half of the small tubers would make satisfactory single drop seed, so that they should not be considered as having no value.

Table 15.—Effect of seed spacing on size and yield of Netted Gem and Chippewa potatoes.

Spacing	Yield in Cwt. per acre									
	Small		Rough	Over 8 oz.		Under 8 oz.		Total No. 1's		Total Yield
	Chp.	Gem.	Gem.	Chp.	Gem.	Chp.	Gem.	Chp.	Gem.	Chp. Gem.
12 in.	11.9	8.0	2.3	1.8	0.5	78.4	65.0	80.2	65.5	92.1 75.7
18 in.	5.3	4.6	2.3	2.9	3.0	59.0	57.0	61.9	60.0	67.2 66.9
24 in.	4.2	3.8	3.1	6.6	4.1	53.2	57.6	59.8	61.7	64.0 68.6
30 in.	4.2	2.9	3.5	9.8	5.2	51.4	48.7	61.2	53.9	65.4 60.3
36 in.	3.1	3.0	4.2	10.5	5.2	45.2	41.2	55.7	46.4	58.8 53.6

(Ralph Knight)

Hilling Potatoes Lowers Yields

Two plots were hilled immediately after the last cultivation, while two additional plots receiving the same number of cultivations were left unhilled. Single drop seed, hilled, produced 90.8 cwt per acre, while the adjoining plot, not hilled, made 101.6 cwt per acre. Comparable results were secured where cut seed was used, with yields of 90.2 cwt and 104.2 cwt per acre, respectively. It was observed that the soil tended to dry more rapidly when hilled, probably accounting for the lower yields. In more favorable seasons, when many of the tubers are pushed partially above the surface of the soil, hilling would no doubt be of some benefit in helping to reduce the amount of sunburn. It would appear, however, that the operation should be deferred as long as possible as a means of conserving moisture. *(Ralph Knight.)*

New Methods of Water-Proofing Potato Cellar are Tested

Looking toward the possibility of effecting a saving in labor, materials, and capital outlay, bentonite (KWK No. 33 Volclay), and sisalcraft paper are being tried as water-proofing materials for the newly constructed straw-and-soil covered potato cellar. Basic treatments included: (1) ¼ inch layer of bentonite; (2) 6-foot strips of over-lapping sisalcraft paper; (3) continuous strip of sisalcraft paper with 4-inch pleats every 6 feet; (4) one-half the standard application of bentonite raked into the soil, and the balance then applied in a layer. On half the cellar roof, the above materials were covered with 2 inches of coarse sand and then 2 inches of soil, while on the other half the sand drainage layer was omitted. The object in pleating or lapping the paper was to allow for some give in case of uneven settling. Where the sand layer was used, there has been no erosion of any consequence so far. When omitted, erosion was moderate

to heavy. This was particularly true on the two strips of paper, as the soil all slid off during a heavy rain. Preliminary observations suggest that bentonite may prove satisfactory for water-proofing provided erosion is not too severe during the critical period in the spring when the frost is leaving. If so, mechanical means for making a uniform application should be devised. A relatively short life for the sisalcraft paper is anticipated which, if true, would tend to discourage its use on potato cellars. *(Ralph Knight and Mark Kulp.)*

Grass Nursery Provides Desirable Information

This was the first year for taking yields and comprehensive field notes on the acre grass nursery that was established a year ago in cooperation with the Soil Conservation Service. Data recorded from this planting included both green and dry weights of the numerous species or selections, percent of dry matter, height, time of bloom, disease, lodging, leafiness, spring recovery, and recovery after harvest. As a result of the information obtained from the nursery and from the grass plots at Spirit Lake, it is proposed to expand the program of reseeding burned over land next spring, employing mixtures of several grasses and legumes rather than single species, and grazing the seedings for at least part of the time. The Soil Conservation Service and the Agronomy Department will participate in this proposed project. *(Ralph Knight.)*

High Altitude Branch Experiment Station

W. A. Moss, *Superintendent*

Dwarf Smut a Factor in Winter Wheat Production

THE prevalence of dwarf smut in fields of winter wheat of the dry land areas of southeastern Idaho has created a demand for varieties that show resistence to this disease. The need for such varieties is emphasized by the fact that no seed treatment is as yet known for this type of smut. Dwarf smut can be readily distinguished from the common smut or bunt of wheat. Infested plants attain less than half the height of healthy plants, thus accounting for the name of the disease; furthermore the smut balls produced are short and more or less round, rather than larger than the kernels of the varieties infested as is the case in common smut of wheat. Common smut or bunt does not materially decrease the height of infested plants. Two hybrid varieties, Ridit X Relief (C I No. 11925) and Ridit X Utah Kanrid (C I No. ? ? ?) were free from dwarf smut when grown in the winter wheat nursery. Since these varieties are also high in yield, they are being increased at the present time. *(W. A. Moss.)*

Seed Yields of Grasses Highly Dependent Upon Climatic Conditions

In last year's report good seed yields of grasses for the years 1941 and 1942 were reported from plots established in 1940. The yields of these grasses in 1943, the third seed year, were disappointing. The main factor accounting for the low yields obtained were the unusually dry season and the occurrence of a frost in July. In addition the age of the stands contributed to the low yields. Tall Meadow Oat grass withstood the severe climatic conditions better than any of the grasses included in the

test. A stand of Mountain Brome established in 1941, consequently in the second crop year, produced a rather good yield of 360 pounds of seed per acre.

In 1942 type species of grasses were established in rows and in solid stands with the objective of determining their yielding abilities when grown in cultivated rows in solid stands with and without applications of ammonium sulphate. Due to unfavorable climatic conditions the yields obtained were low and did not show significant differences for either the method of establishment or the fertilizer treatment. In the absence of a sufficient supply of moisture the grasses were unable to utilize the nitrogen supplied by the ammonium sulphate.

The high yielding alfalfas in the variety test plots were certain Turkestan selections, Meeker Baltic, and Hardigan.

The grass test plots are carried on in cooperation with the Department of Agronomy and the Regional Nursery Division of the Soil Conservation Service of the United States Department of Agriculture. *(W. A. Moss, R. H. Stark, and K. H. Klages.)*

Legume-Grass Mixtures of Value in Rotations

Extensive sets of crop rotation and soil management plots were established on the Station 5 years ago in cooperation with the Department of Agronomy and Research Section of the Soil Conservation Service of the United States Department of Agriculture. While the number of years has not been sufficient to complete a cycle on some of the longer rotation systems certain valuable relationships are apparent and will be reported on in a preliminary way. The data so far obtained indicate that alfalfa-grass mixtures can be used to advantage in the rotation systems in this area. Three-year average wheat yield following alfalfa-grass mixtures in the course of the rotation were 2.4 bushels per acre higher than those after straight alfalfa and 1.9 bushels greater than where the wheat was grown in an alternate wheat fallow system. The fibrous materials supplied by the roots of grasses had favorable effects on soil conditions. It is interesting to note that the plowing under of straight sweet clover reduced wheat yields to the extent of 1.2 bushels per acre in comparison with the alternate wheat fallow system of cropping, while when straw was added to the sweet clover prior to plowing the following wheat yields were slightly higher than those after the summer fallow. The addition of the straw counterbalanced the excess nitrogen supplied by the sweet clover.

One objection raised to the use of sweet clover and alfalfa with or without grass admixtures is the loss of time incident to the establishment of these crops. The general practice is to precede the establishment of these crops by a year of fallow. In 1943 good stands of sweet clover were obtained without a fallow intervening between the wheat crop and the time of seeding. This is of significance insofar as this particular season was one of the driest on record. *(W. A. Moss, Hugh McKay, and G. O. Baker.)*

Stubble-Mulch Farming Practical

While the burning of stubble and straw of the previous crop again resulted in somewhat higher yield in 1943 than where this material was utilized, soil erosion losses were greatly increased by this method of

management. The continual destruction of stubble is certain to aggravate the erosion problem. With the use of the lister bottom or the modified moldboard plow it is possible to prepare the soil so that most of the straw will be left at or near the surface. When this method of soil preparation was used the yields obtained were about equal to where the straw was burned and an ordinary moldboard plow was used in preparing the land for the fallow. This method of soil management makes it possible to utilize the straw and stubble without a sacrifice of yield and at the same time protect the soil from erosion. *(W. A. Moss, Hugh McKay, and G. O. Baker.)*

Foundation Seed Stocks of Potatoes Grown for Distribution

Tubers of Netted Gem potatoes indexed in the greenhouse at the Aberdeen Branch Station were grown on a rented irrigated field near Driggs. On this 135 sacks of disease free seed was produced. There is a definite need for such foundation stock of seed in connection with the potato improvement program of the State. Special attention was given to keeping this stock of seed free from bacterial ring rot. *(W. A. Moss, J. E. Kraus.)*

Active Experiment Station Projects

Agricultural Chemistry

Ag. Chem. P-2	A Study of Certain Types of Chlorosis as Found in Idaho on Trees, Shrubs, and Herbaceous Plants. (In Cooperation with Plant Pathology, Agronomy, and Horticulture.)
Ag. Chem. P-5	A study of the Availability of Plant Nutrients and the Response to Fertilization of Idaho Soils. (In cooperation with Bacteriology and Agronomy.)
Ag. Chem. P-7	The Utilizatoin of Wastes from Idaho Farm Products. (In cooperation with Agricultural Engineering and Bacteriology.)
Ag. Chem. P-8	The Preservation of the Carotene Content in Alfalfa and Other Forages. (In cooperation with Poultry Husbandry.)
Ag. Chem. A-2	Relationship of Nitrogen Content and Yield of Crops to Soil, Nitrogen, and Organic Matter as Influenced by Management Practices.
Ag. Chem. A-9	Influence of Irrigation Practice Upon Physical and Chemical Properties of Soil with Particular Reference to Salinity. (In cooperation with Agronomy.)
Ag. Chem. H-11	The Feeding Value of Distillers By-Products. (In cooperation with Animal Husbandry, Poultry Husbandry, and Home Economics.)
Ag. Chem. S-64	Studies on Starch.
Ag. Chem. S-77	The Effect of Phosphate Fertilization on the Nutrient Value of Forage.

Agricultural Economics

Ag. Econ. P-30A	A Study of the Factors Influencing the Market Value of Real Estate in Latah, Nez Perce, and Lewis Counties.
Ag. Econ. P-30B	Factors Influencing Selling Price of Wheat Lands in Northern Idaho.
Ag. Econ. P-60	Salient Problems in the Rural Economy Surrounding Farragut Naval Training Station.
Ag. Econ. P-62	Post-war Program Making for Idaho.

Ag. Econ. P-71	Economic Study of the Use of Recently Developed Small-Sized Tractors and Supplementary Equipment on Irrigated Farms in Idaho. (In cooperation with the Bureau of Agricultural Economics, U. S. D. A.)
Ag. Econ. P-75	Profitableness of Diversification in the Idaho Palouse Wheat Area.
Ag. Econ. P-141	Factors Deterrent or Success-determining in Maximum Production and Welfare in the North Shoshone Extension of the Gooding Canal. (Pending.)

Agricultural Engineering

Ag. Engr. P-32	A Study of Methods, Equipment, Crew Organization and Cost of Harvesting and Stacking Hay in Southern Idaho.
Ag. Engr. P-33	A Study of the Adaptation of the Combine to the Harvesting of Field Peas and Beans.
Ag. Engr. P-34	The Preparation and Maintenance of Farm Lands for Irrigation as Affected by the Use of Farm Machinery.
Ag. Engr. P-35	Effect of Movement and Distribution of Irrigation Water on Field Crops. (In cooperation with Agronomy.)
Ag. Engr. P-37	A Study of the Cost, Effectiveness, and Methods of Pumping for Drainage and Supplemental Irrigation.
Ag. Engr. P-41	Potato Production Structures and Equipment. a. Structural and functional design of potato storages under Idaho conditions. b. The design and function of mechanical equipment in the handling, sorting, grading, washing, sizing, packaging, and shipping of potatoes. c. Field power and machinery for the mechanization of potato production (planting, cultivating, harvesting, transport).
Ag. Engr. P-42	Farm Refrigeration Requirements.
Ag. Engr. P-45	Radiant Energy Drying in Agricultural Processes. (In cooperation with Horticulture.)

Agronomy

Agron. P-46	Forage Crops Seed Production.
Agron. B-J 2	The Control of Noxious Weeds, Particularly European Bindweed *(Convolvulus arvensis)*.
Agron. H-8	Breeding of Silage Crops.
Agron. H-9	Cereal Breeding.
Agron. H-10	Changes in the Physical Properties of Soils Under Different Management Practices.
Agron. H-12	Flax Investigations.
Agron. S-25	Clover and Alfalfa Breeding.
Agron. S-26	Improvement of Grasses.
Agron. S-27	Pea Breeding and Morphological Studies.
Agron. S-28	Sweet and Field Corn Investigations.
Agron. S-29	Varietal and Genetic Studies of Field Beans.
Agron. S-30	Crop Rotation Studies.
Agron. S-31	Fertilizer and Soil Amendment Studies.
Agron. S-47	Resistance of Peas to Weevil Damage.
Agron. S-48	Resistance of Earworm Damage in Corn. (In cooperation with Department of Agronomy and Bureau of Entomology and Plant Quarantine, U. S. D. A.)
Agron. S-49	Specialty Crops.
Agron. S-60	Relationship of Minor Elements to Crop Production. a. Boron Investigations. (In cooperation with Agricultural Chemistry and Plant Pathology.)

Agron. S-61	Salinity Investigations: The Influence of Irrigated Agriculture Upon the Physical and Chemical Properties of Well Drained Soils. (In cooperation with Agricultural Chemistry and Agricultural Engineering.)

Animal Husbandry

A. H. P-51	Steer Feeding Investigations. A Comparison of Phosphorus Supplements for Fattening Cattle. (In cooperation with Agricultural Chemistry.)
A. H. P-55	The Biological Value of the Protein of Field Peas and the Effect of Heat Treatment on Pea Protein. (In cooperation with Agricultural Chemistry and Home Economics.)
A. H. P-57	Swine Progeny Testing and Improvement.
A. H. B-J 10	A Study of the Epidemiology, Pathology, and Control of Swine Brucellosis. (In cooperation with Bacteriology.)
A. H. B-J 11	The Phosphorus Requirement of Ewes for Reproduction and Lactation. (In cooperation with Agricultural Chemistry.)
A. H. B-J 12	Effect of Frozen Storage and Subsequent Cooking Thiamin, Riboflavin, and Niacin Content of Lamb and Pork Loin. (In cooperation with Agricultural Chemistry and Home Economics.)
A. H. S-1	Lamb Feeding Investigations. To Determine the Value of Dehydrated Beet Tops and Wet Beet Pulp.
A. H. S-2	Steer Calf Feeding Investigations. To Determine the Value of Dehydrated Beet Tops and Dried Beet Pulp.
A. H. S-3	Wintering Calves that are to be Grazed (Irrigated pasture) Following Season and Fattened for Early Winter Market.
A. H. S-4	Feeding and Management of Ewes, and Creep Feeding of Lambs for Early Lamb Production.
A. H. S-5	The Value of Peas as a Protein Supplement for Fattening Hogs.

Bacteriology

Bact. P-132	Bacteriological and Immunological Studies on Poultry. (In cooperation with Animal Husbandry and Poultry Husbandry.)
Bact. P-135	Vaccination as a Means of Controlling Avian Leukosis.
Bact. B-J 6	Bacteriological Factors Affecting the Growth of the Alfalfa Plant.
Bact. B-J 14	The Effect of Microorganisms and Organic Matter on the Aggregation of Idaho Soils.

Dairy Husbandry

D. H. P-87	Vitamin A and Carotene Content of Idaho Butter.
D. H. P-88	The Loss of Riboflavin During the Processing, Storage and Handling of Milk.
D. H. H-1	Continuous use of Proved Sires to Breed Dairy Cattle that Will be Pure in Their Inheritance for High Milk and Butterfat Producing Capacities.
D. H. H-2	Study of Breeding Efficiency in Dairy Herds.
D. H. H-3	A Study of the Solids-Not-Fat Content of Milk from the Cows of the Idaho Agricultural Experiment Station Holstein and Jersey Herds.
D. H. S-10	Official Testing for Advanced Registry or Register of Merit in the State of Idaho.
D. H. S-11	Investigation in the Use of Dairy Sires from Ancestors of Known Production with Cooperative Bull Associations and Dairy Bull Studs.
D. H. S-32	Improvement of Milk Supply for Idaho Creameries and Cheese Factories.
D. H. S-34	Comparison of Suggested Methods for Fat Analysis of Buttermilk, Skim Milk, and Whey.

D. H. S-71	Dehydration of Cheddar Cheese and its Influence upon Flavor, Reprocessing and Keeping Quality.
D. H. S-72	A Study of the Use of Various Chemicals and Biological Agents in the Treatment of Mastitis in Dairy Cattle.

Entomology

Ent. P-92	Experiments in Control of Wireworms on Irrigated Land and Study of Economic Species. (In cooperation with Bureau of Entomology and Plant Quarantine, U. S. D. A.)
Ent. P-93	Pea Weevil: Ecological Study and Investigation in Control. (In cooperation with Bureau of Entomology and Plant Quarantine, U. S. D. A.)
Ent. P-94	Studies in Insect Physiology and Toxicology.
Ent. P-94a	Studies of the Effect of Various Insecticides in Insect Physiology.
Ent. P-94b	Control of Various Garden, Field, Fruit, and Ornamental Crop Insects by Insecticides, Commonly Accepted as Standards in Comparison with Newly Developed Insecticides.
Ent. P-94c	Studies of Various Insecticides in the Control of Hemipterous Insects.
	1. Moisture and Insect Relationship in Alfalfa Production. (In cooperation with Agronomy.)
Ent. S-69	Survey and Population Studies of Potato Insects.
Ent. S-70	Vegetable Seed Insect Pests.
Ent. A-14	Biology, Ecology, and Control of the Onion Thrips, *Thrips tabaci* Lind.

Home Economics

H. Ec. P-103a	The Ascorbic Acid Supplied by Foods as Served in Dining Halls on the Idaho Campus.
H. Ec. P-104	The Alaska Field Pea as a Source of Thiamin, Riboflavin and Nicotinic Acid. (In cooperation with Bacteriology and Agricultural Chemistry.)
H. Ec. P-105	The Effect of Maturity on the Ascorbic Acid of Netted Gem Potato With Special Reference to its Retention After Cooking.
H. Ec. A-15	Nutritive Value of Protein of Beans.

Horticulture

Hort. P-111	Factors Influencing Crotch Angles in Young Fruit Trees.
Hort. P-114	Vegetable Seed Production in Idaho.
Hort. P-114a	Selectcion of Roots and Bulbs as a Means of Bringing About Uniformity in Varieties of Carrots, Onions, and Other Biennial Crops.
Hort. P-114b	Size and spacing of Carrot Stecklings as Factors Influencing Seed Yield.
Hort. P-114c	Developing High Seed-yielding Strains of Carrots and Onions.
Hort. P-114d	Factors Affecting Blasting of Seed in Onions and Carrots.
Hort. A-1	Apple Breeding.
Hort. A-8	Factors Influencing the Cracking of Sweet Cherries.
Hort. A-12	A Study of the Action and Effects of Various Floricidal and Insect Repellent Sprays Applied to Fruit Trees to Reduce Fruit Set.
Hort. H-5	Variety Testing of Fruits.
Hort. S-15	Orchard Fertilization and Cover Crops.
Hort. S-66	Fertilization of Vegetable Seed Crops.
Hort. S-67	Time and Frequency of Irrigation as Affecting Seed Production in Carrots and Onions.

Plant Pathology

Pl. Path. P-121	Bean Disease Investigations in Idaho.
Pl. Path. P-123	Investigation of Pea Diseases in Idaho.
Pl. Path. P-125	Control of Storage Diseases of Carrots.
Pl. Path. P-126	Cause and Control of Jelly-End Rot of Potatoes.
Pl. Path. A-11	An Investigation of Fusarium Wilts and Tuber Rots in Idaho.
Pl. Path. A-13	A Study of the Stem Nematode *Ditylenchus dipsaci* (Kuhn) Filipjev. in potatoes.
Pl. Path. B-J 1	Certain Diseases of Stone Fruits.
Pl. Path. B-J 7	Bacterial Ring Rot of Potatoes.
Pl. Path. B-J 13	Investigation of Aster Yellows Virus Disease of Truck Crops.
Pl. Path. H-13	Virus Diseases of Potatoes.
Pl. Path. S-18	Plant Disease Survey.
Pl. Path. S-19	Curly-top of Tomatoes.
Pl. Path. S-74	Sclerotinia and Botrytis Diseases of Truck Crops.
Pl. Path. S-75	Bacterial Blight of Carrots.
Pl. Path. S-76	Vegetable Seed Treatments.

Poultry Husbandry

P. H. P-134	Protein Supplements in Wartime Poultry Rations. (In cooperation with Agricultural Chemistry.)
P. H. S-22	Study of Laying Flock Mortality. (In cooperation with Animal Husbandry.)
P. H. S-53	The Efficiency of Simplified Mashes for Home Mixes.
P. H. S-54	Ventilation of Poultry Houses. (In cooperation with Agricultural Engineering.)
P. H. S-73	A Study of Pigmentation in Eye Color of S. C. White Leghorns.

NOTE: The letters used with numbers in identifying projects refer to funds used as follows:

P—Purnell
A—Adams
H—Hatch
B-J—Bankhead-Jones
S—State and Local Funds

Publications

THE results of investigations by the Station staff are published as bulletins, research bulletins, circulars, War circulars, and mimeo-leaflets by the University and as research papers by various scientific journals. The list of publications for 1943-44 follows:

Bulletins

251. 50th Annual Report—Wartime Agricultural Research.
252. Idaho Recommendation for Insect Control.
253. Pea Diseases in Idaho.
254. Potato Diseases in Idaho

Circulars

87. Publications for Free Distribution.
88. Progress Report of Potato Research.
89. Payette and Idagold Apples.

War Circulars

19. Preservation of Fruit and Vegetables by Drying.
20. Control of Corn Earworm in Seed Sweet Corn.
21. Wartime Haying.
22. Building a Home Dehydrator.
23. Wintering Idaho Range Stock.
24. Potato Harvesting Equipment.
25. Emergency Feeds for Dairy Cattle.
26. Hastening Potato Tuber Maturity by Killing the Vines.
27. Emergency Potato Storage.
28. The Colorado Potato Beetle.
29. Harvesting and Utilizing Black Locust Timber.
30. Send Your Trees to War but Conserve Your Woodlands.
31. Cultural Control of Wireworms.
32. Emergency Poultry Rations.
33. Farm Fire Hazard Quiz.
34. 8-Point Milk-Production-Program-1944.
35. Irrigation and Water Storage.
36. 1944 Wartime Fertilizer Recommendations for Idaho.

Mimeo-Leaflets

80. Farm Made Fire Fighting Tools and Equipment.
81. How to Pick and Handle Sweet Cherries.
82. Small Backyard Poultry Houses.
83. Labor Requirements on the Major Peak-Labor-Consuming Crops in Idaho.
84. Hastening Potato Tuber Maturity by Killing the Vines.
85. Tractor-Powered Manure Loaders.
86. Control of Cattle Lice in Winter.
87. Orchard Spray Recommendations for Idaho, 1944.
88. Farm Fire Hazard Quiz.
89. Radiant Head Brooders.
90. Seed Treatments for Vegetable Crops in Idaho.

Research Papers

216. The Influence of Carotene Intake as Supplied by Dehydrated Alfalfa on the Storage of Vitamin A and Pigments in the Liver of the Young Chick. D. W. Bolin, C. E. Lampman, and L. R. Burg.
217. An Unusual Bean Disease. W. J. Virgin.
218. Peach Wart. Earle C. Blodgett.
219. Dehydration of Baked Potatoes. Olof Stamberg.
220. Potato Seed Piece Decay. James E. Kraus and George Woodbury.
221. The Phosphorus Requirement for Fattening Lambs. W. M. Beeson, R. F. Johnson, D. W. Bolin, C. W. Hickman.
222. The Milk and Butter Fat Production Responses to Shark Liver Oil in the Ration. F. C. Fountaine and D. W. Bolin.
223. A rapid Digestion Method for the Determination of Phosphorus. Donald W. Bolin and Olof E. Stamberg.
224. The Effect of Some Factors on the Blood Phosphorus Level of Range Ewes. W. M. Beeson, Clair E. Terrill, and D. W. Bolin.
225. Carbonic Acid Soluble P_2O_5 of Calcareous Soils in Relation to Crop Response to Phosphate Fertilization L. E. Ensminger, H. W. E. Larson.
226. Peach Calico. Earle C. Blodgett.
227. Pea Meal Protein as a Source of Amino Acids for the Chick. C. F. Petersen, C. E. Lampman, D. W Bolin, and Olof E Stamberg.
228. Ascorbic Acid Nutrition of Some College Students. Almeda P. Brown, Margaret L. Fincke, Jessie E. Richardson, E. Neige Todhunter, and Dr. Ella Woods.
229. Crown Division of Roots as an Adjunct to Carrot Breeding and Seed Production Studies. George W. Woodbury and Herman K. Schultz.
230. Destruction of Riboflavin in Milk Due to Light. Olof E. Stamberg and D. R. Theophilus.
231. Lentin in Atonic Indigestion of Dairy Cattles. Glenn C. Holm.

HOME STATION DISBURSEMENTS

Detail of Expenditures of State Appropriations (1) and Income Funds
Idaho Agricultural Experiment Station
January 1, 1943 through December 31, 1943

	Salaries	Help	Expense & Supplies	Capital Outlay	Total
Administration	$ 40.00	$ .00	$ 131.02	$ 35.42	$ 206.44
Agr. Chemistry	.00	.00	25.71	.00	25.71
Agr. Economics	.00	.00	25.64	142.00	167.64
Agr. Engineering	.00	.00	174.44	107.15	281.59
Agronomy	.00	388.97	685.26	.00	1,074.23
Animal Husbandry	.00	.00	199.80	8.48	208.28
Bacteriology	.00	.00	3.15	.00	3.15
Dairy Husbandry	.00	.00	220.78	113.57	334.35
Entomology	.00	.00	136.16	.00	136.16
Home Economics	.00	.00	4.07	.00	4.07
Horticulture	.00	879.42	388.79	.00	1,268.21
Plant Pathology	.00	.00	132.64	.00	132.64
Poultry Husbandry	.00	724.40	1,012.05	24.25	1,760.70
Soil Survey	152.78	.00	7.10	.00	159.88
TOTAL	$192.78	$1,992.79	$3,146.61	$430.87	$5,763.05

(1) Includes General Appropriation and Institutional Funds.

BRANCH STATION DISBURSEMENTS

January 1, through December 31, 1943

	Salaries	Help	Expense & Supplies	Capital Outlay	Total
Aberdeen	$ 2,000.00	$ 9,016.38	$ 4,844.49	$124.25	$15,985.12
Aberdeen Potato Research	3,133.36	535.85	946.56	4.73	4,620.50
Caldwell	4,097.50	5,202.94	6,196.61	723.83	16,220.88
High Altitude	1,800.00	894.25	802.59	75.00	3,571.84
Sandpoint	3,196.70	733.45	1,246.69	.00	5,176.84
TOTAL	$14,227.56	$16,382.87	$14,036.94	$927.81	$45,575.18

FINANCIAL STATEMENT

Detail of Expenditures From Federal Appropriations
Idaho Agricultural Experiment Station
July 1, 1942 to June 30, 1943

	Hatch	Adams	Purnell	Bankhead-Jones
Personal Services	$ 7,526.60	$14,020.15	$51,440.60	$ 8,632.15
Travel	1,056.15	112.00	1,728.42	691.61
Transportation of Things	97.96	9.36	12.10	.00
Communication Service	1,090.21	.00	93.06	1.11
Rents & Utility Services	4.37	15.00	278.00	240.00
Printing & Binding	1,305.29	.00	271.47	17.30
Other Contractural Services	178.90	24.96	353.31	328.96
Supplies & Materials	2,768.35	714.23	4,881.55	3,959.70
Equipment	949.36	104.30	941.49	349.01
Structures and nonstructural Improvements	22.81	.00	.00	.00
Balance Unexpended, June 30, 1943	.00	.00	.00	.00
TOTAL	$15,000.00	$15,000.00	$60,000.00	$14,219.84