Bulletin No. 280
UNIVERSITY OF IDAHO
Agricultural Experiment Station

Agricultural Research In Idaho

FIFTY-SEVENTH ANNUAL REPORT

Year Ending June 30, 1950

Moscow, Idaho, July, 1950

University Research Activities

Branches of Idaho Agriculture

Agricultural Research Activities

Research workers are often asked, "Why does the University of Idaho have such an extensive agricultural research program and how does it help the people of Idaho?"

Agriculture is Idaho's largest industry. In half a century it has grown from a relatively small one consisting mainly of range livestock to one highly diversified with an annual farm income value of about $350,000,000. Problems affecting farm income have a definite effect on the economy of the State as a whole. Expansion and more diversification of agriculture always bring new questions which only research can answer.

Agricultural research in Idaho is aimed directly toward the security of the state's greatest industry. There is need for new crops and new uses for agricultural products. There is continued need for new or improved methods of culture, disease and insect control, and control and elimination of weeds. There is need for better methods of distribution and marketing of agricultural products.

Research in agriculture, as in other fields, is not and cannot remain static.

JAMES E. KRAUS
Associate Director

OUR COVER

Sandpoint Branch Experiment Station—

Serving the cut-over timbered areas of northern Idaho is the Sandpoint Branch Experiment Station. Consisting of 170 acres, it is located at Sandpoint, Idaho in Bonner County. It was established in 1912 and has been in continuous operation since that time. Research at the station consists of testing new cereals and grasses; development of grass-alfalfa mixtures for permanent pastures; and the development of the most suitable fertilizers and rates of application for a variety of crops. The station has also played an important role in the production and dissemination of pure seed stocks of cereals and grasses adapted to the area. This station is one of 8 branch experiment stations or field stations included in the Idaho Agricultural Experiment Station system.

Human Nutrition

Availability of Thiamine

THE American habit of serving meat with potatoes seems to be of practical importance in making available the thiamine of these foods, according to the results of studies made by the Home Economics Research Department.

One of the projects this year was to study the availability to human subjects of the thiamine in some commonly used Idaho foods. This was done by balance studies, which were supervised by Mrs. Kathleen Porter and Mrs. Isabel Harvey. In these balance studies, the subjects—staff members and senior Home Economics students majoring in foods and nutrition—ate controlled amounts of a diet planned to furnish adequate amounts of the recognized nutrients and a known amount of thiamine. The meals were prepared and eaten in the laboratory. All foods were carefully weighed; each subject eating all the food served to him and nothing additional. During the study each subject made 24-hour urine collections which were subsequently analyzed for thiamine.

Reports on tests.—Three series of balance studies of varying length with 15 different subjects (194 subject days) were carried out on the availability of thiamine from baked potatoes and roast leg of lamb. In the first two studies, the test foods replaced similar foods with a low thiamine content in the basal diet so that, in effect, the thiamine from the lamb and potatoes was added to that in the basal diet. Pure thiamine was also added to the basal diet. Comparison of the excretion values for the two periods indicates that under the conditions of this study, the 12 subjects utilized the thiamine from lamb and potatoes about 75 per cent as well as the pure vitamin.

In the third study, approximately one third of the daily intake of thiamine was furnished—in successive two-day periods—by potatoes, lamb, lamb and potatoes together, and pure thiamine, with two days of basal diet separating the test periods. The test foods replaced foods in the basal diet having a similar thiamine content so that the intake remained uniform.

Analysis of results.—With all seven subjects there was better availability of thiamine, as judged by excretion, when the potatoes were eaten with lamb then when the potatoes alone furnished the same amount of thiamine. These subjects apparently utilized the thiamine from lamb and potatoes together as well as the pure vitamin. Studies will be continued on the availability of thiamine from these and other Idaho foods, singly and in combination.

Beef, Sheep, Swine

Alfalfa Hay Levels for Feeder Steers and Lambs

THE State of Idaho produces an enormous quantity of high-quality alfalfa hay. This crop ranks second only to all cereals in total acreage and third to cereals and potatoes in monetary value. A large number of the feeder steers, some feeder lambs and a considerable portion of alfalfa hay is moved to feeding areas outside of Idaho. Any method of feeding that will increase the utilization of this hay within the borders of the State will help develop the agriculture of Idaho.

Tests have been completed on the most profitable ratio of concentrate-to-hay for fattening steers and lambs for any feed price relationship. Ratios with concentrate-to-hay of 1:3, 1:2, 1:1, 2:1, 3:1, and 4:1 for steers, and 2:3, 1:1, 3:2, 2:1, and 5:2 for lambs were studied. This work was conducted under the supervision of R. F. Johnson, Caldwell Branch Station; T. B. Keith and C. W. Hickman, Animal Husbandry.

Sixty steers were fed in individual stalls. Ten steers were used for each ratio. The steers were fed twice daily in their assigned stalls. *(Fig. 1)*. During the time between feeding periods, the steers

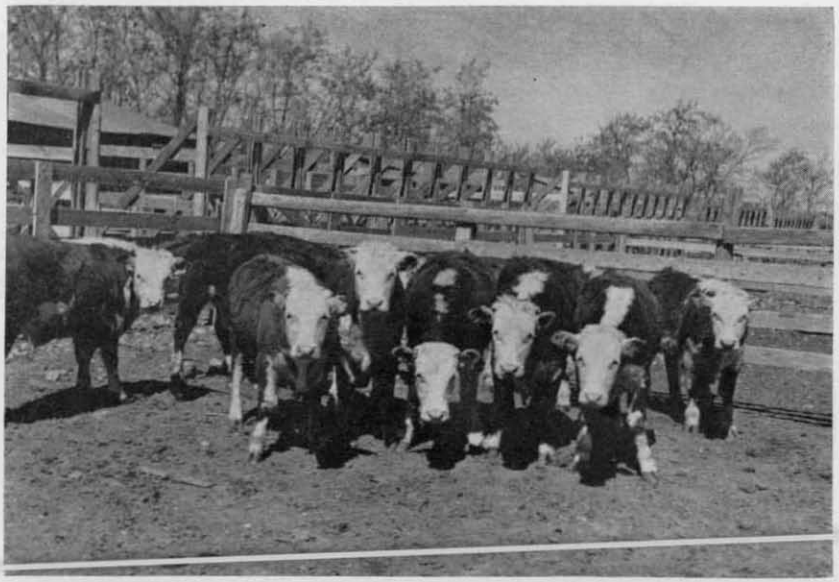


Figure 1.—One of the steer lots in the alfalfa hay trials at the Caldwell Branch Station. In the background are the individual stalls used in this feeding experiment.

were permitted to exercise in a lot adjacent to the feeding stalls. Data relating to the results of the steer feeding are shown in Table *1*.

TABLE 1. Gains, feed consumption and feed requirements of six lots of steers fed six different ratios of concentrate-to-hay

Ratio of concentrate-to-hay	Total gain Pounds	Average daily ration		Feed per 100 pounds gain Pounds
		Concentrate Pounds	Hay Pounds	
1:3	233	3.54	10.61	933
1:2	290	5.18	10.38	817
1:1	281	8.28	8.28	852
2:1	324	10.39	5.20	740
3:1	301	10.60	3.54	722
4:1	302	11.24	2.81	716

There was a definite decrease in average total feed required for each 100 pounds of gain as the intake of hay decreased. The cost per 100 pounds of gain has been determined for a combination of price relationships. The high alfalfa-hay ration produced the most economical gain, but the rate of gain of this group is too slow for profitable feeding. The most economical returns will depend upon the relative price of hay and concentrate. However, under normal conditions, the most profitable ratio should be between 1:2 and 2:1 of concentrate-to-hay for maximum gains and minimum costs of fattening steers.

A similar study was made with lambs. Forty lambs were divided into groups of eight each. Each lamb was fed in an individual stall all the feed it would consume of a definite ratio of concentrate-to-hay. The lambs were fed three times daily. A summary of the results are given in Table 2.

TABLE 2. Gains, feed consumption and feed requirements of 5 groups of lambs fed five ratios of concentrate-to-hay.

Ratio concentrate-to-hay	Total gain Pounds	Average daily ration		Feed requirements for each 100 pounds gain Pounds
		Concentrate Pounds	Hay Pounds	
2:3	16	1.13	1.70	871
1:1	23	1.51	1.51	628
3:2	26	1.87	1.25	595
2:1	28	2.13	1.07	588
5:2	29	2 29	.92	568

The results obtained with the lambs were very similar to those obtained with the steers. The total quantity of feed required for each 100 pounds of gain decreased with the increase in the ratio of concentrate-to-hay.

The most expensive gains were made with the lambs fed the high alfalfa hay ration, which was 2 parts of concentrate and 3 parts of alfalfa hay. The most economical ration for average normal price relationships approximates 3 parts of concentrates and 2 parts of hay.

Phosphorus Requirement of the Pregnant and Lactating Ewe

THREE lots of 50 ewes each were used in a study of the effect of a ration low in phosphorus on the development of the lamb, the milking qualities of the ewe, and the blood phosphorus level of the

penicillin during the first, second or third milking after treatment, a sufficient amount of the drug will be in the milk to restrict the growth of the bacteria. When this happens the cheese is a complete loss, or at least of poor quality. Milk taken from the treated quarters at the fourth milking was normal in all respects and could be used satisfactorily for cheese making.

Use of the milk.—Milk from cows treated with these drugs will, in most cases, appear normal shortly after the treatment. The milk from the treated quarters is not normal, however, and it is recommended that it be withheld from the milk offered for sale for at least four milkings after the treatment. This milk may be fed to calves, however, with no harmful effects. Milk from untreated quarters of the same cow is not affected and may be included in the milk sold to cheese factories or other milk-processing plants.

Failure of the dairyman to cooperate in this respect will, no doubt, result in much poor quality cheese being produced. Such cheese will bring a lower price and eventually result in a lower price to the dairyman for his milk.

Making Use of Cheese Whey

THE manufacture of cheese is one of Idaho's major dairying enterprises. Factories within the state produced approximately 22½ million pounds of cheese in 1948, and production in 1949 was little, if any, under that figure. For every pound of cheese manufactured, however, there are left approximately 9 pounds of cheese whey which has presented a disposal or utilization problem for many years. In 1948, only about one-half of the whey produced was used, and most of it went for animal feed, a not-too-profitable outlet.

When whey is wasted, large amounts of nutritious food material are lost. Disposal of whey as a waste product is becoming more difficult. Stream pollution regulations may soon prevent cheese factories from dumping cheese whey into streams, and disposal of whey through ordinary sewage disposal systems is expensive and troublesome.

A study by Elmer D. McGlassen and J. C. Boyd, Dairy Husbandry, on the recovery and utilization of the food solids in cheese whey has shown that the protein portion of the whey can be removed from the water and other food materials, and utilized in certain bakery products. A study of different chemicals which can be used to remove the protein material has shown that calcium chloride is the most effective agent for this work. Another discovery is that drying this protein in the same spray type equipment used to dry milk has improved the quality of the recovered protein. Bakery goods made with whey products stay moist longer than similar goods made of ordinary materials.

A treatment of the liquid left after the protein was taken out removed most of the remaining substances except lactose. A lactose solution of better than 99 per cent purity has been produced by this

means, and it is possible that further research may develop a means whereby this lactose can be cheaply recovered from the liquid.

Further utilization of the materials left in cheese whey will not only provide additional items for the dairy industry to sell, but will also eliminate the problem of disposing of whey as a waste product.

Open Shed Housing vs. Stanchion Barn Housing

OPEN shed housing saves time and labor but requires more bedding than when dairy cows are housed in a stanchion barn.

D. L. Fourt, Darrel Kerby, and R. H. Ross, Dairy Husbandry, compared open shed housing to stanchion barn housing at the Caldwell Branch Station.

Fifteen per cent less time was required to care for the open shed cows, but it required 79 per cent more bedding than for the stanchion barn cows. Milk and fat production was slightly higher for the open shed group. The occurrence of mastitis and the quality of milk was approximately the same under the two systems of housing. Cows in the stanchion barn had more injuries, lameness, stiffness, and bruised knees and hocks than the open shed cows. The open shed cows appeared to be more comfortable than the stanchion barn cows.

Picking up droppings daily required 1.16 minutes per cow but saved 2.6 pounds of straw bedding per cow daily.

Poultry

Winter Management of Laying Flocks

DAMP houses, wet litter, and the chore routine involved in the care of laying flocks during the winter season are still unsolved problems with many flock owners. Three major phases of the winter management of laying flocks have been studied during the past several seasons by C. E. Lampman and C. F. Petersen, Poultry Husbandry. A brief description of contrasting conditions observed by these investigators during the past winter, when outside temperatures were ranging between —10 degrees and —26 degrees Fahrenheit, serve to illustrate the difference between what constitutes unsatisfactory and more favorable conditions.

Pen A—Inside air temperature 27 to 29 degrees Fahrenheit, relative humidity (per cent moisture in air) 85 per cent, water content of litter 37 to 40 per cent, frost on uninsulated walls, and birds huddled in rear portion of pen with very few eating at the mash hoppers.

Pen B—Inside air temperature 40 to 44 degrees Fahrenheit, relative humidity 68 per cent, water content of litter 28 per cent, no frost on insulated walls, birds active and feeding freely at the mash hoppers.

Following is a brief explanation of some of the observations made and results secured pertaining to ventilation, litter management, and watering equipment.

Ventilation improved by insulation and adequate outlets.—Studies made at the University of Idaho Agricultural Experiment Station and observations in the field demonstrate that satisfactory ventilation cannot be obtained in laying houses with walls of single-board construction because the moisture condenses on these cold surfaces before it can be removed from the building. In other words, insulated walls and ceiling have been found to be fundamentally necessary to make the interior surfaces sufficiently warm that the moisture will not condense.

The two-span type of roof, sealed on the inside with insulation above the ceiling, has proved more satisfactory than the shed-type roof. This has been particularly true when the outlet flues have been at least 5 feet long. A flue of this length develops a more definite and continuous outflow of air from the building. Positive exhaust of the damp air has been found fundamental for adequate ventilation and, when established, makes it possible to restrict incoming air to the extent that it diffuses and mixes more gradually with the air already in the building.

Ventilation was improved when the incoming air was taken in through several smaller openings as compared to fewer larger openings. During cold weather, intakes located near the ceiling proved more satisfactory than those located lower in the wall. When window openings were used as intakes, results were better when the opening was at the top. When the cold air is taken in lower down, it settles rapidly to the floor and makes the litter cold. The moisture from the air then condenses on the cold litter, causing it to become wet in a short time. These studies, repeated during several winter seasons, have served as the basis for recommending a ventilation program based upon the fundamental principle of providing a positive and continuous outflow and restricting incoming air in accordance with outside temperatures.

Good litter management reduces labor and litter cost.—In studies previously reported, promising results were obtained in developing a built-up litter program that would reduce the labor and expense involved in the frequent removal of wet litter. Continued work has confirmed the earlier reports. The several types of litter used have included straw, peat moss, a mixture of these two, sawdust, and shavings. Straw litter has given better results in later trials than in the earlier observations.

When straw is used, it has been found necessary to start the built-up litter program early in the fall. Best results have been secured when the schedule was started the latter part of August or early September and then adding more straw at one- or two-week intervals, as the older straw became broken up, until a depth of 8 inches was secured. After the straw is broken into finer particles, its moisture-holding capacity is greatly increased. When coarse straw was added in any great amount in midwinter, it became damp

Figure 3.—This "drip-valve" type of waterer, equipped with an overflow trough 5" wide, has proved highly satisfactory. Note the heat cable, which is thermostatically controlled, attached to water pipe with friction tape to protect against freezing.

and tough and would not break up into finer particles. Sawdust has proved highly satisfactory and has the advantage that the particles are already small. It has been found necessary to fork the litter into piles periodically, at least once and preferably twice each week during the cold weather. When this was not done, the litter packed and became damp and sticky on the surface.

Periodic application of hydrated lime to the litter proved helpful, particularly during January and February. Regardless of the type of litter used, it has been found necessary to use some lime to make deep litter carry through satisfactorily. The lime has proved especially beneficial when added to the areas around the mash hoppers and waterers, where there was a greater tendency for the litter to pack. The amount of lime used varied from 15 to 25 pounds per 100 square feet of floor space, depending upon the weather and condition of the litter. The practice used in these studies was to scatter the lime on the surface of the litter before forking it over.

Suitable watering equipment essential.—Several types of watering equipment have been used in these studies. The old conventional open-type pail or trough, filled to the top, permitted so much waste and spillage that the litter was constantly wet within an area of several feet. The principal factor involved is that the birds dip their beak so deep in the water that the wattles become wet and then this excess water is shaken off on the litter. Shallow troughs, with the depth of water limited to less than 1 inch by float valves, were

fairly satisfactory. Some difficulty, however, has been encountered in securing continuous automatic operation of the float valves with this shallow depth of water. The drip valve type of watering equipment with an overflow trough has proved highly satisfactory from the standpoint of minimum spillage of water and in maintaining dry litter near the watering equipment. This system, equipped with heat cables to prevent freezing in cold weather has proved to be the most over-all satisfactory equipment used in reducing the chore routine and in supplying fresh, clean water at all times. A drip-valve type waterer with heating cable is shown in Figure 3.

The results of the studies and observations in laying house management here reported demonstrate conclusively that labor routine and litter cost can be materially reduced with a program of good ventilation, suitable watering equipment, and a well-planned schedule of litter management.

A.P.F. Supplement Reduces Cost of High-Efficiency Broiler Rations

ANIMAL protein factor (A.P.F.) supplements containing vitamin B_{12} became available at a time when animal protein concentrates, especially herring fish meal, were both costly and in short supply. An experiment was conducted by C. F. Petersen and C. E. Lampman, Poultry Husbandry, and A. C. Wiese, Agricultural Chemistry, to determine how effective one of these supplements would be in replacing part or all of the animal proteins in broiler rations. Total protein of the rations was maintained at a level of 20.5 per cent by increasing the amount of soybean oil meal, a plant protein supplement.

Four duplicate lots of 18 New Hampshire cockerel chicks were fed the experimental rations for 10 weeks. The ration contained, in addition to protein concentrates, yellow corn, dehydrated alfalfa meal, minerals, and vitamins A, D, and riboflavin. The protein supplements and vitamin additions to the four rations were as follows:

Ration 1—Herring fish meal 10 per cent, soybean oil meal 10 per cent, and meat meal 7 per cent.

Ration 2—Soybean oil meal 35 per cent and choline chloride 0.1 per cent.

Ration 3—Soybean oil meal 35 per cent, choline chloride 0.1 per cent, and an A.P.F. supplement 1 per cent.

Ration 4—Soybean oil meal 27 per cent, herring fish meal 5 per cent, and an A.P.F. supplement 1 per cent.

The results obtained by substituting an animal protein factor supplement for part or all of the animal proteins are shown in Table 4. Ration 2, containing no animal proteins or A.P.F. additions, did not permit maximum gains. The fairly good growth obtained with this ration was due to the high quality soybean oil meal used and chicks which were hatched with an ample reserve of A.P.F. factors for the first few weeks. Ration 3, an all-vegetable ration containing the A.P.F. supplement, was almost as effective in producing maximum gains as Ration 1, containing 10 per cent fish meal and 7 per cent meat meal, or Ration 4, which was supplemented with 5 per cent fish meal and the A.P.F. supplement.

Complete omission of all animal proteins is not advisable at the present time because of considerable variability in protein quality of soybean oil meal. The use of A.P.F. supplements is at the present time limited primarily to feed manufacturers. The supply is limited and, because of the small amounts needed, proper mixing into the complete feed is quite difficult.

TABLE 4.—Effect of an animal protein factor supplement in replacing animal proteins for broiler production

Ration No.	1	2	3	4
Supplement	Fish, meat, and soybean oil meal	Soybean oil meal	Soybean oil meal +A.P.F.	Soybean oil meal +5% fish meal +A.P.F.
Av. wt. at 10 weeks (lbs.)	3.61	3.25	3.50	3.65
lbs. feed consumed per lb. gain	2.79	2.99	2.77	2.78
Profit per bird over feed cost (cents)	63	61	66	66

High-Efficiency Broiler Ration Reduces Cost of Production

HIGH-ENERGY, low-fiber broiler rations which result in faster growth and more efficient broiler and fryer production have almost completely replaced the more standard type rations previously used. Average feeding time has been reduced 2 to 3 weeks.

The first rations of this type contained many costly and hard-to-obtain ingredients such as liver meal, dried brewers' yeast, niacin, pantothenic acid, and choline. These ingredients, used in very small amounts, are also difficult to properly mix into a ration without costly mixing equipment.

C. F. Petersen and C. E. Lampman, Poultry Husbandry, and A. C. Wiese, Agricultural Chemistry, conducted an experiment using 845 cockerels and pullet chicks to determine whether any or all of these concentrates or vitamins could be omitted when herring fish meal was used at a fairly high level. It has been previously shown that this fish meal was of exceptionally high quality, both as a source of high-quality protein and unknown nutritional factors.

The test ration contained ground corn, dehydrated alfalfa meal, minerals, vitamins D and riboflavin, in addition to protein supplements as follows: meat meal 7 per cent, soybean oil meal 10 per cent, and herring fish meal 10 per cent. Additional supplements were made to this ration, as shown in Table 5, in ration numbers 2 to 8. The first ration, containing none of the additional supplements previously shown to be needed when other fish meals were used, was as effective in producing broilers of maximum size as the other rations used. In addition, this ration produced broilers more economically than other test rations. These results do not mean that factors present in liver meal, dried brewers' yeast, or specific vitamins are not needed, but rather that they were present in adequate amounts in the basal ration containing 10 per cent herring fish meal.

Figure 4.—C. E. Lampman, left, and C. F. Petersen weigh broilers in ration test.

TABLE 5.—Results obtained with simplified high-energy broiler rations

Ration No.	Supplement	Av. 10-week wt.—lbs.		Feed consumed per lb. gain		Profit per bird over feed cost—cents	
		New Hampshires	Hybrids	New Hampshires	Hybrids	New Hampshires	Hybrids
1	None	3.15	3.03	2.66	2.61	65	63
2	Choline	3.12	2.87	2.61	2.72	63	56
3	Choline Niacin	3.09	2.91	2.77	2.66	62	58
4	Pantothenic acid Liver meal	3.22	2.99	2.65	2.83	61	55
5	Choline Niacin	3.02	2.93	2.57	2.62	61	59
6	Pantothenic acid Choline Liver meal	3.12	2.93	2.68	2.56	57	55
7	Choline Dr. Brewers' yeast	3.12	3.05	2.77	2.66	57	57
8	Choline Niacin	3.12	2.85	2.76	2.76	61	55

Turkeys—Larger and More Efficiently Produced with High-Energy, Low-Fiber Rations

THE success of high-efficiency rations for fryer production has resulted in inquiries regarding the value of this type of ration for turkey production. A preliminary study of this problem has been initiated by C. F. Petersen and C. E. Lampman, Poultry Husbandry; L. H. Scrivner, Veterinary Science; and A. C. Wiese, Agricultural Chemistry. A comparison has been made of standard turkey starter and growing rations with starter and growing rations of considerably higher efficiency. This was accomplished by increasing the protein content from a standard level of 24 to 27.5 per cent, reducing the fiber from 6.5 to 4.0 per cent, and increasing the net energy content by using high levels of ground corn and omitting or reducing high-fiber feeds such as alfalfa meal, oats, barley, wheat, and millfeeds. The protein supplements used in the standard starter ration were fish meal 7.5 per cent, meat meal 15, soybean oil meal 5, and corn gluten meal 5 per cent. The high-efficiency starter ration contained fish meal 10 per cent, meat meal 10, soybean oil meal 17.5, and corn gluten meal 5 per cent.

A total of 148 day-old poults were started on each ration. At 8 weeks of age the poults which received the standard ration weighed 3.86 pounds, whereas those given the high-efficiency ration averaged 4.26 pounds. Less feed was consumed per poult by those fed the high-efficiency ration. Mortality to 8 weeks of age was 5.4 per cent for both groups.

At 8 weeks of age one-half the poults from each group were transferred to the other ration. Observations and gains were recorded from this period to 26 weeks of age. This permitted an opportunity to determine how effective the improved growth rate obtained during the first 8 weeks from the high-efficiency ration would be in maintaining efficient production when the standard ration was fed during the growing period.

From the information obtained and briefly summarized in Table 6, it was shown by these workers that the improved ration permitted more efficient production through increased body weight, more efficient feed utilization, and greater returns per bird over feed costs. The use of the improved type ration appears to be equally as valuable during the growing season to market age as for rapid early growth. The birds finished on the high-efficiency ration carried less pin feathers and were better finished at 28 weeks of age than those fed the standard ration. This preliminary study was conducted with a limited number of birds. Further work is planned to obtain more information regarding this type of ration, since this study indicates that toms make better gains than hens with high-efficiency rations.

TABLE 6.—Comparison of standard and high-efficiency starter and growing rations for market turkeys.

Starter ration fed	Standard	High-efficiency	Standard	High-efficiency
Growing ration fed	Standard	Standard	High-efficiency	High-efficiency
Av. wt. to 8 weeks (lbs.)	3.9			4.3
Av. lb. feed consumed per lb. gain at 8 weeks	2.3			2.0
Per cent mortality—8 to 26 wks.	9.1	4.5	4.3	4.5
Av. weight at 26 wks. (lbs.)	20.1	20.1	20.7	21.1
Av. wt. hens at 26 wks. (lbs.)	15.9	15.8	16.1	16.2
Av. wt. toms at 26 weeks (lbs.)	24.4	24.5	24.6	25.9
Av. lb. feed consumed per bird to 26 weeks				
Mash	37.4	37.0	34.2	33.8
Grain	44.6	44.7	44.8	44.8
Oats	4.4	4.4	3.8	3.8
Total	86.4	86.1	82.8	82.4
Av. lb. feed consumed per lb. gain	4.3	4.3	4.0	3.9
Feed cost per lb. gain (cents)	15.5	15.7	15.5	14.9
Profit per bird over feed cost (dollars)	4.70	4.69	4.98	5.10

Animal Diseases

Mastitis in Dairy Cows

AS a means of establishing the presence or absence of *Streptococus agalactiae* in the udder in chronic cases of bovine mastitis, the Hotis test is used rather extensively. This test depends upon growth of *Streptococus agalactiae* in a milk sample taken directly from the suspected udder. Some other types of bacteria will also develop during the test.

In routine testing for mastitis it was discovered by Grant E. Wiggins and W. B. Ardrey, Veterinary Science, that milk taken from cows which had recently had udder infusions of various antibiotic and chemical materials commonly used in mastitis treatments retained sufficient amounts of bacterial inhibiting material to render the test without value in these cases. From present information it is believed that the Hotis test is not reliable in mastitis testing of treated cows unless a period of 4 to 5 and preferably 7 days has elapsed since the last treatment of the udder with such material.

Brucellosis Agglutination Tests

EXTENSIVE research has been directed at the wide variation in brucellosis agglutination tests run on the same serum by different laboratories. The purpose of this project and the work reported herein is an attempt to determine some of the present obscure factors responsible for the wide variation of titers that appear in the brucellosis agglutination tests.

Recent investigators are advocating that U.S. Department of Agriculture, Bureau of Animal Industry, antigen for *Brucella abortus* be used for all tests in an effort to further standardize the test and eliminate conflicting or contradictory results. The use of a standard antigen is a step in the right direction but discrepancies

are still evident. For this reason, the possible effects of bacterial contamination of serum used for brucellosis agglutination tests are being studied by Walter L. Harris and V. A. Cherrington, Bacteriology.

Serum from a vaccinated calf was tested with U.S.B.A.I. antigen and the titer was found to be 1-50 by both the test tube and the rapid slide agglutination tests. *Streptococcus liquefaciens, Sarcina lutea, Proteus vulgaris, Micrococcus pyogenes* (var. *aureus*), and *Escherichia coli* were inoculated in the quantity of 1,000,000 viable organisms per ml. into separate portions of the serum. A small amount of each portion was removed and allowed to remain at room temperature for 3 days and the remainder was stored in the refrigerator. The test tube and rapid slide tests were repeated on the sera incubated at room temperature for 3 days and on the refrigerated sera at frequent intervals for a period of 8 weeks. This same procedure was also used for sera from vaccinated calves that no longer showed demonstrable agglutinins for *Brucella abortus*.

Analysis of results.—Present indications are that storage up to and including two weeks does not alter the titer of sera positive for *Brucella abortus* agglutinins if the sera contain no contaminating organisms. When contaminated by bacteria aliquots of the positive serum may show a depression or a rise in titer in both the test tube and rapid slide methods after two weeks refrigeration of the serum. Contamination of the serum with *E. coli* resulted in a depression of the titer, but contamination with *S. lutea* resulted in a rise in titer. The positive serum was shown originally to contain natural agglutinins for *E. coli* but not for *S. lutea*. At present no indications are evident that bacterial contamination of serum negative for *Br. abortus* agglutinins will be reflected by showing a false positive titer. Further studies are in progress in an attempt to determine the effect of other bacterial contaminants growing in serum positive for *Br. abortus* agglutinins.

Erroneous determinations of brucellosis agglutination tests could result in serious economic losses to the dairy production industry. Failure to recognize non-specific agglutination could wrongly classify acceptable animals as unacceptable or as reactors. Conversely, failure to obtain the maximum titer could wrongly allow reactors to be classed as acceptable.

Newcastle Disease of Chickens

THE suspected presence of Newcastle disease of chickens in Idaho has been confirmed by blood test by W. B. Ardrey and Lloyd H. Scrivner, Veterinary Science; and Reid Merrill, Poultry Extension. Proven cases of this serious poultry disease in Idaho during 1949 were traced to imported chickens. Preliminary information for the hatching period during early 1950 indicates that this disease is now affecting some of the resident flocks of Idaho.

The use of vaccines, which are reported to be effective in con-

trolling the disease, is restricted because of the danger of establishing new centers of infection. Some vaccines contain live Newcastle disease virus.

Pullorum Disease in Chickens

CONFIRMATION of the suspected presence of variant type pullorum infections in Idaho has been obtained during the past year by W. B. Ardrey and Lloyd H. Scrivner, Veterinary Science. In cooperation with members of the Idaho Poultry Improvement Association, a study is being made of the difficulties of pullorum eradication through blood testing of supply flocks. In addition to variant types of pullorum infections, which complicate the results of the blood test, it appears that some other types of infection may cause confusion in interpreting the blood test results. Certain types of staphylococcic infections appear to be of the greatest importance. Final identification, relative disease-producing ability and ability to stimulate the production of confusing blood test reactions for some of the various types of bacteria isolated await further examinations.

Insect Control

Toxicity of Chlorinated Hydrocarbon Wettable Powders to Flies

WHEN DDT and other closely related chlorinated hydrocarbons became available during 1943 and 1944 for experimental work, extensive tests both in the laboratory and in the field showed DDT to be an outstanding insecticide for the control of most species of flies as well as many other insect pests. The chief advantage of DDT over other chlorinated hydrocarbons was its long residual action. One application during the season was all that was necessary to keep flies under control even in the more heavily infested areas. During 1945, 1946, and 1947 DDT was used on a wide scale throughout Idaho for fly control. In practically every instance excellent results were obtained. However, in 1948 and 1949 many individuals reported extremely poor results even where higher concentrations were used and two or more applications were made during the season.

Research work was commenced by H. C. Manis, W. F. Barr and A. J. Walz, Entomology, to determine what factor or factors were contributing to the decline in the effectiveness of DDT. A series of laboratory tests were conducted using DDT, methoxychlor, lindane, chlordane, BHC-toxaphene, aldrin, and dieldrin wettable powder formulations and two different strains of house flies. One of the strains had never been exposed to DDT and was considered nonresistant while the other strain was obtained from the field where it had been exposed to heavy dosages of DDT and was found to be highly resistant.

Check commercial formulations.—In the first test conducted, 14 commercially available 50 per cent DDT wettable powder formulations were used. All were used at the concentration of 2 pounds of 50 per cent material per 100 gallons of water and applied to the tops of the test cages at a nozzle pressure of 400 pounds per square inch. Non-resident flies were introduced into the cages at weekly intervals throughout a period of 4 weeks. This test revealed that there was considerable variation in the toxicity and residual action of commercial DDT formulations. Twenty-four hours after the cages were treated kills of non-resident flies varied from 74.4 to 100 per cent and at the end of 4 weeks from 22 to 65.4 per cent.

A second test was conducted to determine the relative effectiveness of several chlorinated hydrocarbons on both resistant and non-resistant fly strains. Fifty per cent DDT, 50 per cent methoxychlor, 25 per cent lindane, 50 per cent BHC-toxaphene, 40 per cent chlordane, 25 per cent aldrin and 25 per cent dieldrin wettable powder formulations were used. All materials were applied at a concentration of 1 pound of toxic ingredient per 100 gallons of water. Both resistant and non-resistant flies were used in these tests. Of the materials tested, lindane and dieldrin gave the most outstanding results. Both these materials continued to kill better than 90 per cent of non-resistant and resistant flies throughout a period of 6 weeks. At the end of 6 weeks the effectiveness of lindane decreased rapidly; dieldrin, however, continued to give better than 90 per cent control throughout the twelve-week testing period.

Mixture tested.—A third test was designed to determine (1) if mixtures of chlorinated hydrocarbons were more effective than when used alone, (2) if several commercial lindane formulations were equally effective, and (3) the effective concentration level of dieldrin. From this test it was found that mixtures did not increase the effectiveness of the treatment, that there was considerable variation in the effectiveness of commercial lindane formulations and that the effective concentration level of dieldrin is 2 pounds of 25 per cent dieldrin wettable powder per 100 gallons of water. Increasing the concentration of dieldrin to 4 pounds did not materially increase its effectiveness or residual toxicity. Again in this test dieldrin at the 2- and 4-pound concentration levels continued to give better than 90 per cent kills of both resistant and non-resistant flies throughout a 12-week testing period.

Although there is considerable variation in the effectiveness and residual toxicity of commercial DDT wettable powder formulations, the chief factor contributing to the decrease in effectiveness of DDT for house fly control in Idaho has been the elimination of non-resistant strains and the build up of resistant strains.

Because DDT no longer gives adequate control, other insecticides must be used. From the tests thus far conducted with the chlorinated hydrocarbons, only lindane and dieldrin give adequate control of the resistant house fly strains. At the present time only lindane is available for commercial use. For effective control under field conditions it should be used at the rate of 2 pounds of 25 per cent

wettable powder in 100 gallons of water. Under most Idaho conditions two applications during the season would probably be required.

Lygus Bug Control in Red Clover Seed Fields

RED CLOVER seed yields have been steadily declining in many of Idaho's seed-producing areas for the past several years. Previous research has shown that alfalfa seed yields can be materially increased by controlling lygus bugs on this crop. Because lygus bug populations are often quite high in red clover seed fields, research work was commenced in 1948 to determine to what extent these bugs affect the seed yield of red clover. Many growers are using DDT on red clover seed and feel that its use is justified although they have no conclusive evidence to show that lygus bug control results in increased seed yields.

Preliminary work in the Mountain Home area during 1948 showed that 5 per cent DDT dust applied at the rate of 30 pounds per acre gave better control of lygus bugs than any of the other materials tested. During the 1949 season a randomized block experiment was set up in the Mountain Home area by H. C. Manis, D. J. Walther, and W. F. Barr, Entomology, to determine the lygus bug population level required to cause reduced seed yields.

Control bug populations.—Plot treatment during the season consisted of the application of 5 per cent DDT dust at the rate of 30 pounds per acre whenever necessary to maintain the lygus bug population below a specified level in each plot. No DDT was applied to plot A during the season, thus allowing the lygus bug populations to develop normally. Plot B was treated three times with DDT to maintain the population below 5 lygus bugs per sweep. Plot C was treated twice to maintain the population below 10 lygus bugs per sweep and plot D was treated once to maintain the population below 15 lygus bugs per sweep. At the end of the season, seed yield data were obtained from the plots. These data are summarized in Table 7.

TABLE 7.—Red clover seed yields obtained from treated and untreated field test plots.

Treatments	Field No. I Average yields in bushels/acre	Field No. II Average yields in bushels/acre
Plot A—Lygus bugs allowed to develop normally (No DDT applied)	12.97	4.73
Plot B—5 lygus bugs/sweep (Three DDT applications during season)	13.83	4.34
Plot C—10 lygus bugs/sweep (Two DDT applications during season)	14.64	5.31
Plot D—15 lygus bugs/sweep (One DDT application during season)	14.50	4.88

Analysis of these data showed no significant difference in the seed yields obtained from the plots. The lower yields recorded from Field No. II are due to lower soil fertility, poorer stand, inadequate

irrigation, and shorter growing season. Populations in Plot A, Field No. I, reached an average peak of 39.1 lygus bugs per sweep during the season, while populations in plot A, Field No. II, reached an average peak of 68.3 lygus bugs per sweep. Although plot A in both fields had a high lygus bug population throughout the season, the seed yields were not significantly lower that the yields obtained on the other plots where the populations were maintained at very low levels. The yield data would indicate, therefore, that lygus bugs are not a contributing factor to the decrease in red clover seed yields in the Mountain Home area. Further work will be necessary before definite recommendations can be made.

Control of Clover Bud Caterpillar on Alsike Clover

THE clover bud caterpillar has spread throughout the alsike clover seed areas of northern Idaho since 1945. During this time it has caused slight to heavy damage in Clearwater, Idaho, Latah, Lewis, and Nez Perce counties. In 1949, serious damage occurred only in Latah County south of Deary. This pest appears to have passed the peak of its cycle and is once more being brought under control by natural factors. A new parasite was observed attacking the pupa of the clover bud caterpillar and undoubtedly helped to reduce the overwintering populations of this insect.

Field tests with five different insecticide formulations were made by W. F. Barr and A. J. Walz, Entomology, in an attempt to control the larvae of this pest. The materials used were 5 per cent DDT, 1 per cent dieldrin, 5 per cent DDT plus 0.5 per cent piperonyl cyclonene, 10 per cent toxaphene plus 1 per cent benzene hexachloride, and 5 per cent DDT plus 1 per cent benzene hexachloride. The 5 per cent DDT and the mixture of 5 per cent DDT and 1 per cent benzene hexachloride were significantly better than the check, but the control was not entirely satisfactory. Extremely dry weather following the application of insecticides prevented new plant growth and as a result the effect on seed yield could not be determined. Further research is necessary before a control recommendation can be made. Thirty pounds of a 5 per cent DDT dust applied when larvae are first observed and still quite small should give partial relief.

Cabbage Seedpod Weevil Control on Rape Seed

DURING the period from 1945 through 1949, the cabbage seedpod weevil population in Nez Perce, Lewis, and Clearwater counties has continued to increase in rape and turnip seed fields. During the 1949 season, extremely heavy infestations developed with some fields showing counts up to 220 weevils per sweep. Seed losses varied from 12.5 to 46 per cent of the total yield.

Biological studies conducted by A. J. Walz, Entomology, showed that the weevils come out of hibernation during the entire blooming period, although the majority were out before the fields were in full bloom. Very little oviposition takes place until after the lower

This additional research work strengthens the belief that wood-waste concrete is a practical building material with real advantages in construction. Two Moscow contractors used this concrete in houses built during the summer of 1949. Now under observation are four full-size buildings in which extensive use was made of this material.

Work was also done on processing wood shavings for fill insulation, to render them fire and vermin resistant. It was found that mill shavings ground together with diatomaceous earth are highly fire resistant, and constitute an effective and inexpensive insulation. This material is being used as a ceiling fill insulation in a dwelling now under construction near Moscow, and the builder is co-operating on this project. Observation will be made on the installation and long-time use of this insulation.

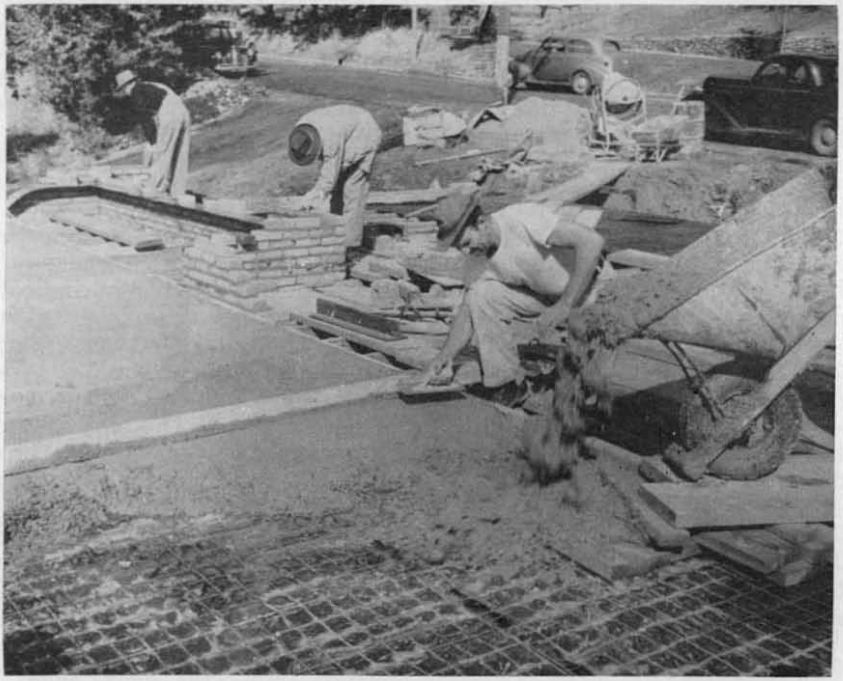


Figure 5.—Pouring wood-waste concrete floor in a Moscow residence.

Farm Electrification

INFORMATION on farm electrification is contained in a series of 4-page leaflets prepared by W. H. Knight, Agricultural Engineering. These leaflets are:

1. Electric Motors for the Farm.
2. Adequate Farmstead Wiring.
3. Electric Light for the Farm.

4. Electric Heating for the Farm.
5. Electric Brooding on the Farm.

To help 4-H Farm Electrification Clubs with their projects, a series of workbooks have been designed for a 5-year program. The third- and fourth-year work manuals have been published and distributed to 4-H Clubs interested in farm electrification projects.

Research activities.—One farm electrification project in progress is aimed at a more economical stock tank de-icer that can be built on the farm. Another project consists of the development of an electro-magnetic device to remove metal particles from livestock feed. In still other projects, tests are being conducted on a more efficient farmstead yard pole switching system; the development of an electric branding iron for sheep; the effect of different weed spray chemicals upon the electrical properties of underground rubber-covered cable; and the possibility of using infra-red heat lamps to dry calf pen litter.

Irrigation

Inventory Quality of Idaho's Waters for Irrigation

TWO years' investigations to inventory the quality of Idaho's waters for irrigation were completed this year. M. C. Jensen, Agricultural Engineering; Glenn C. Lewis, Agricultural Chemistry; and G. O. Baker, Agronomy, are investigating the waters and will

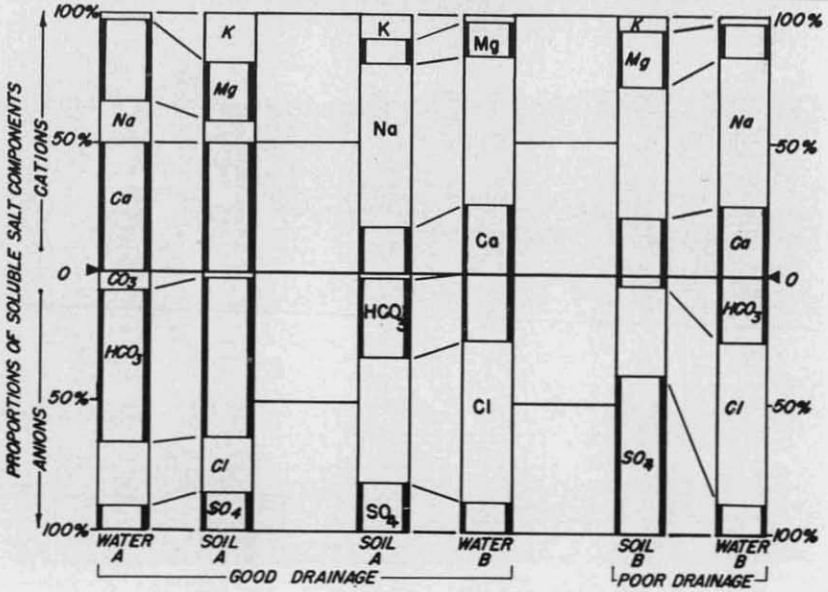


Figure 6.—Water quality influences on arid soil under intensive irrigation.

determine the influences they are having on Idaho soils. Their study has included streams which supply the water for over 80 per cent of Idaho's 2½ million irrigated acres.

Studies on most of the sources were made throughout a 2-year period. Systematic samples were taken three times per week on each source. Individual samples were composited by 2-week periods. The salt concentrations and the proportions of the individual salts varied quite similarly the second year as they did the first.

According to the standards of the U.S. Salinity Laboratory, all the major water sources are No. 1 in quality for irrigation. A few minor sources have been studied which are questionable. The waters can be divided into four characteristic groups:

(1) Proportionately high calcium and high bicarbonate
(2) Proportionately high magnesium and high bicarbonate
(3) High sodium to calcium ratio
(4) Very low total salt content

Preliminary investigations were made on the influences the water had on the soil after several years of irrigation. Figure 6 indicates the character of the soil has been modified by the character of the irrigation water. Under poor drainage, the character of the soil did not correspond as closely to that of the water as under good

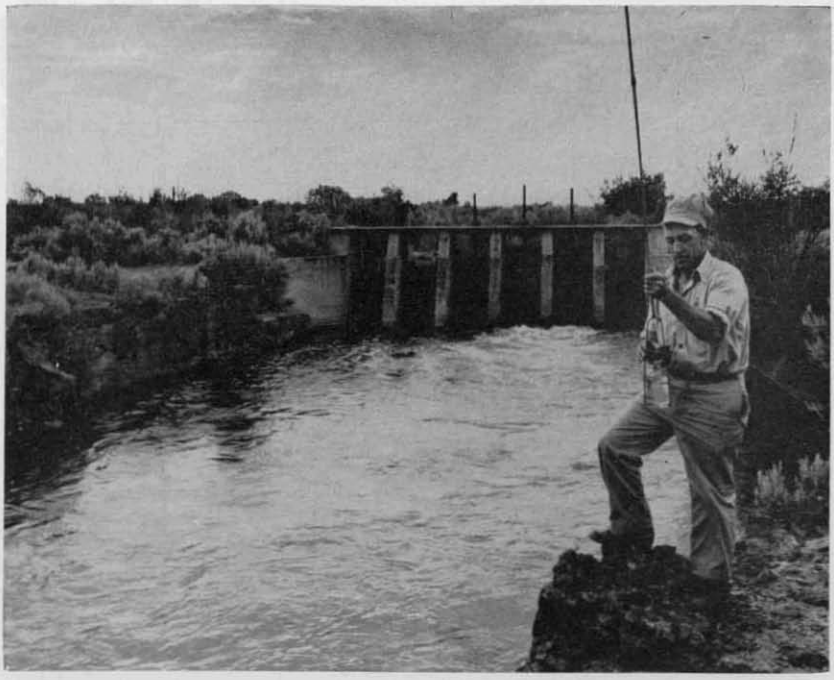


Figure 7.—Watermasters and ditchriders throughout the irrigated sections cooperated in sampling their streams and canals for the water quality analysis.

drainage. Under poor drainage, investigations showed accumulations of total salts.

The remaining objectives are (1) to establish the influences the various waters are having on the soils and (2) to establish practices for controlling influences of the irrigation water where they are detrimental.

A technical bulletin reporting the results of the 2 years' study is planned for 1950.

Study Sprinkler Irrigation Systems

RAPID expansion of sprinkling as a method of applying irrigation water throughout the state raised two questions: Where should it be used? Where not? M. C. Jensen, Agricultural Engineering; and Bruce L. Brooks, Agricultural Economics, have been working with the Farm Home Administration on the problem for the past 2 years.

Investigations have been made on 61 sprinkler systems throughout the State. These cooperating systems represent slightly over 30 per cent of the estimated 200 total operating in Idaho. The sample is large enough to represent the method in Idaho and is spread out geographically to provide representative data for the various areas of the State.

For analysis of the economic data the systems are divided into two groups. Those at Lewiston and north are in the "northern Idaho" group; and those south of Lewiston in the "southern Idaho" group. This preliminary grouping enables the application of data by geographic location as well as size of farm.

TABLE 8—Average investment per acre for sprinkler irrigation systems relative to size of farms in Idaho in 1948-49.

AREA	Size of Farm (Acres)		
	0-24.9	25-49.9	50 & over
Northern Idaho			
Total Cases	9	12	6
Total acres	145.25	408.5	468.0
Cost per acre	$156.61	$76.92	$66.77
Southern Idaho			
Total Cases	12	8	14
Total acres	186.3	281.7	1227
Cost per acre	$121.33	$120.30	$77.37
Northern & Southern Idaho			
Total Cases	21	20	20
Total acres	331.55	690.2	1695.0
Cost per acre	$136.78	$94.62	$74.44

Table 8 summarizes the initial investment per acre. The water sources for 14 of the 34 systems investigated in southern Idaho were wells. Costs of the wells are included in the initial cost of the systems. The other systems in the study obtained water from surface sources.

Table 9 summarizes the annual total cost per acre to own and operate a sprinkler system. Larger power costs in southern Idaho

TABLE 9.—Summary of annual operating costs per acre on sprinkler irrigated farms in Idaho, 1948-1949.

Area	Items of Cost	Total farm years	Av. Cost per acre	% of Total Cost
Northern Idaho				
	Power	42	$ 2.37	14.16
	Water	33	4.04	24.25
	Moving	47	3.83	23.00
	Interst	47	1.93	11.60
	Depreciation	47	4.36	26.15
	Rep. & Maint.	47	0.14	0.84
	Total		16 67	100
Southern Idaho				
	Power	57	3.91	17.94
	Water	27	3.11	14.23
	Moving	58	6.12	28.02
	Interest	58	1.88	8.60
	Depreciation	58	6.44	29.48
	Rep. & Maint.	58	0.38	1.73
	Total		21.84	100
Northern & Southern Idaho				
	Power	99	3.36	16.77
	Water	60	3.55	17.71
	Moving	105	5.27	26.30
	Interest	105	1.90	9.48
	Depreciation	105	5.67	28.29
	Rep. & Maint.	105	0.29	1.45
	Total		20.04	100

are largely attributed to the longer growing season and less rainfall. Greater depreciation is due to more expensive installations.

It is planned to publish a summary of the complete study during 1950.

A Remedy for Clogged Sprinkler Nozzles

TRASH stopping up sprinkler nozzles is a serious problem on farms where open water supplies are used for sprinkler irrigation. B. E. Berry, Research Fellow, has been working with M. C. Jensen, Agricultural Engineering, on a method to remove the trash from the water with a self-cleaning screen device. A screen has been developed which operates satisfactorily in surface ditches which have excess fall. The impact of the falling water is used to clean the screen. All the water is screened without requiring water waste with this principle.

Screening the water from ditches not having excess fall is also being studied. Plans will be out in 1950 to guide screen construction on the farm.

Beans and Peas

Control of Certain Seed-borne Diseases

ONE of the main reasons for seeds being grown in Idaho is to produce disease-free seed. Therefore, seed-borne diseases are important to the Idaho seed industry. Foundation seed from other areas often carry seed-borne diseases. Such seed is subsequently grown in Idaho with the objective of making it disease free.

It is the purpose of this project to test methods of freeing this foundation seed of the seed-borne pathogenes before it is planted in Idaho. These studies were started by Ronald Robinson and are being carried on by Lewis Coltrin, under the direction of R. D. Watson, Plant Pathology.

It should be possible to kill the important seed-borne pathogenes of peas and beans with heat. Hot water works very well in controlling some seed-borne diseases of other crops, but it is undesirable for peas and beans as it causes the seed coats to slip, rendering them unfit for seed.

A search was undertaken to find a suitable treating material that would leave the seed in a good condition after being treated. Eighteen different materials were selected for this purpose. Seeds were subjected to soaking and being heated in these materials and then were germinated to determine the effect on them. Most of the materials were eliminated as unsuitable because of their toxicity. Several oils appeared suitable, but were eliminated in favor of cheaper and more available materials which were of equal value.

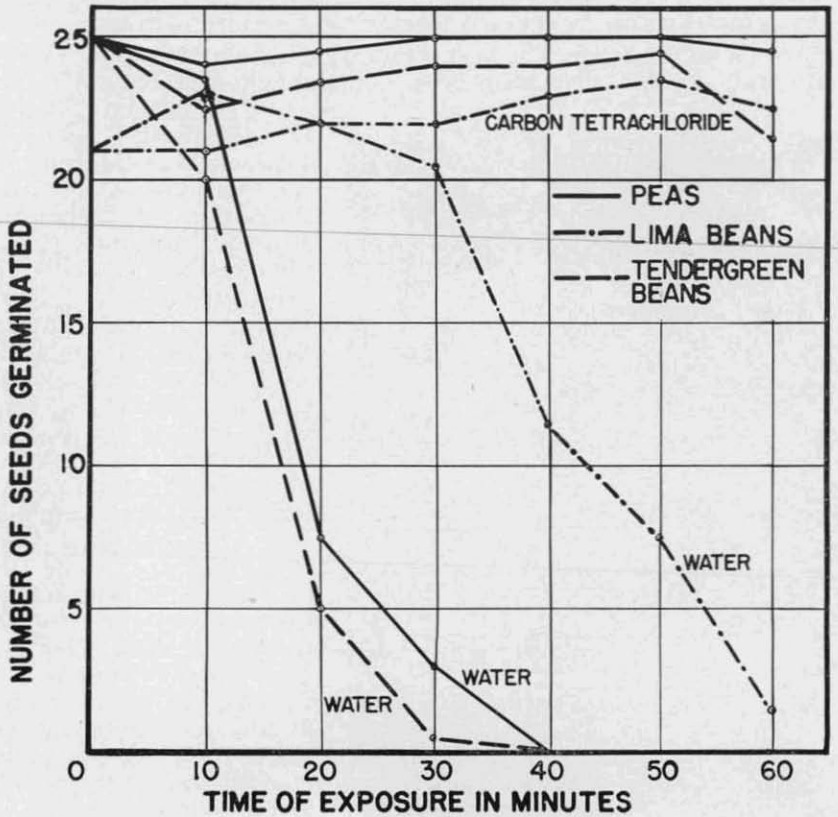


Figure 8.—Comparison of different solutions and periods of immersion on seed germination.

Carbon tetrachloride, motor oil S. A . E. 10, and fuel oil were selected for further tests. Oils were found to be toxic to the seed if not removed after treatment. Water was used in comparison in all tests.

Of the materials tested, carbon-tetrachloride appeared to be the least toxic. Seeds can be treated in it for a much longer period of time than in water, as is illustrated in Figure 8, without seriously reducing germination. Carbon-tetrachloride possesses other properties which make it desirable as a treating material. It does not create a fire hazard; dries rapidly, leaving no harmful residue on the seed. The vaporization point of carbon tetrachloride is about 75°C (167°F.), which would eliminate intricate temperature control mechanisms in maintaining constant temperature in the treating apparatus.

Research is being continued to develop methods to determine the presence of specific seed-borne pathogenes and the effect of these materials on their thermal death point within the seed.

New Snap Beans Developed

DURING the past year, emphasis has been given to selecting and testing the best of the many snap beans developed in the bean improvement program. The best green pod round and flat and yellow pod round and flat types were grown on the field station at Jerome, on the Branch Station in Caldwell, and at Prosser, Washington. In cooperation with the Washington Irrigation Branch Station. Canning tests were made by the Department of Horticulture at the Parma Branch Station. As a result of these tests, 12 of the most promising lots were chosen by C. W. Hungerford, Plant Pathology, for testing in eastern states next summer where the snap bean seed produced in Idaho is grown for processing. Cooperators in South Carolina, New Jersey, New York, Pennsylvania, Illinois, Wisconsin, and Michigan will evaluate these new varieties in comparison with standard varieties of snap beans. If any prove of sufficient worth they will be introduced into the seed trade.

Figure 9.—C. W. Hungerford, Plant Pathology, examining snap beans grown in green house tests.

Foundation Beans Produced

FOUNDATION seed of Great Northern UI 16 and UI 31 beans were produced at Twin Falls to be released through the Idaho Crop Improvement Association in 1950. Other varieties available for release through the Idaho Crop Improvement Association were Pinto UI 78, which was grown at the Aberdeen Branch Station, and Red Mexican UI 34, which was grown at the Caldwell Branch Station. The varieties and strains for release in 1950 with the amount of seed available are given below:

Great Northern	UI 16	11,000 pounds
Great Northern	UI 31	16,500 pounds
Red Mexican	UI 34	15,600 pounds
Pinto	UI 78	8,000 pounds

Single plant selections of several of the field bean varieties were made in 1947 and each year since. This work, conducted by Marshall LeBaron, Agronomy, was initiated in order that pure stocks of field bean seed would be continually available. The following amounts of seed are available for future increase as foundation seed stocks:

Great Northern	UI 16	95 pounds
Great Northern	UI 123	275 pounds
Great Northern	UI 59	200 pounds
Great Northern	UI 31	100 pounds
Pinto	UI 78	400 pounds
Pinto	UI 111	800 pounds

Grading Laboratory is Active

THE Federal inspection office which operates a grading laboratory for peas, beans, and lentils is a cooperative project with the Agronomy Department of the University and the U.S. Department of Agriculture, Production and Marketing Administration, Grain Branch. This arrangement has been continuous since July 1, 1945. The inspection territory covered by this office comprises the entire dry pea producing area of northern Idaho and eastern Washington, which produces a large proportion of the nation's supply of dry peas. In this territory there are approximately 200 inspection points where service is offered to both producers and processors of dry peas.

During the fiscal year, approximately 5,000 inspections have been performed. A majority of the inspections on field run peas are made in July, August, and September. While the bulk of the work of the grading laboratory comes during the harvest season D. E. Corless, in charge of the work, is kept well occupied during the remainder of the year with the grading of processed peas, beans, and lentils. In addition to his inspection duties, Mr. Corless conducts classes in grading and marketing.

Vegetables and Vegetable Seeds

Curly-top Control in Garden Tomatoes

INVESTIGATIONS were started early in Idaho on the effect of planting methods for control of curly-top. A series of tests were conducted during 1936-39 by Station entomologists and the leafhopper administration on insect control by the use of insecticides and the effect of cages and shade on the incidence of curly-top. The insecticides were not effective in the control of curly-top. The aster

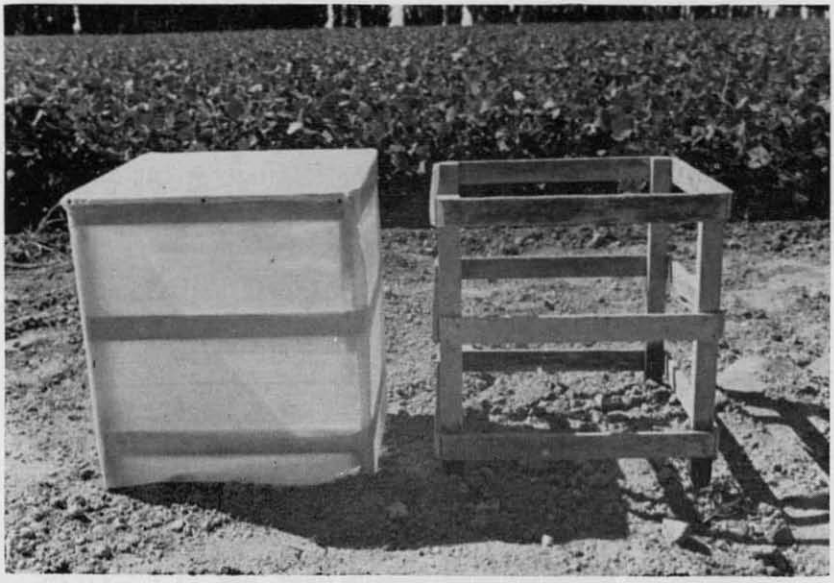


Figure 10.—The Idaho cage used to control curly-top and in forcing tomatoes.

cloth cage, the Idaho cage, and double-hill planting proved very effective in controlling the curly-top disease by preventing or discouraging the vector, the beet leafhopper, from reaching the plant.

The aster cloth house or the cheesecloth shelters used in previous experiments gave absolute control of curly-top and under these shelters the plants grew more vigorously than in the open, especially early in the season. The shelters are probably too expensive and require too much labor to be practical even for home gardeners.

The Idaho cage *(Fig. 10)* has been widely used in home and market gardens. It gives very satisfactory control of curly-top. The tomato yields are satisfactory even under severe curly-top exposures. *(Fig. 11)*. This cage gives absolute control during the early part of the season and the plants are much more resistant by the time they have grown through the tops and are exposed to the

insect feeding. The cages offer protection when it is needed most; that is, when the plants are young and during the migration season for the insect, which usually occurs during May and June. Cages probably require too much labor and are too bulky in storage to be practical for commercial growers, thus are restricted in usefulness to home and market gardeners.

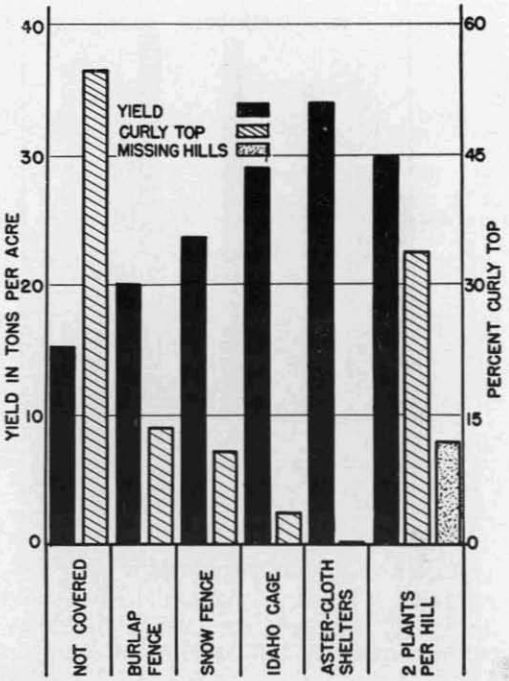


Figure 11.—Tomato yields under various methods of protection.

By 1949, some new problems had developed and more detailed answers were necessary to advise both home gardeners and commercial canners as to the advisability of using more than one plant per hill and direct seeding for curly-top control. These tests were planned by R. D. Watson, Plant Pathology, and the field work carried out by William Simpson, Plant Pathology, in cooperation with the Parma Branch Station. The results of the 1949 test at the Parma Branch Station are shown in Table 10. These results may be summarized briefly as follows:

1. There was less curly-top in the multiple-plant hills.
2. The use of 2 or 3 plants per hill resulted in greater early yields and total yields of ripe fruits.
3. Similarly, the multiple-plant hills produced a higher percentage of U.S. 1 fruits than did normal single-plant hills.
4. The use of single-plant hills but with the hills spaced only half as far apart as normal also resulted in better yields and a lower percentage of curly-top.
5. The calculated per acre yields varied from about 8 tons to 15 tons, the multiple plantings producing much greater yields than single-plant hills.

Multiple-hill planting, close spacing, and direct seeding are useful control measures affording less protection against curly-top than the

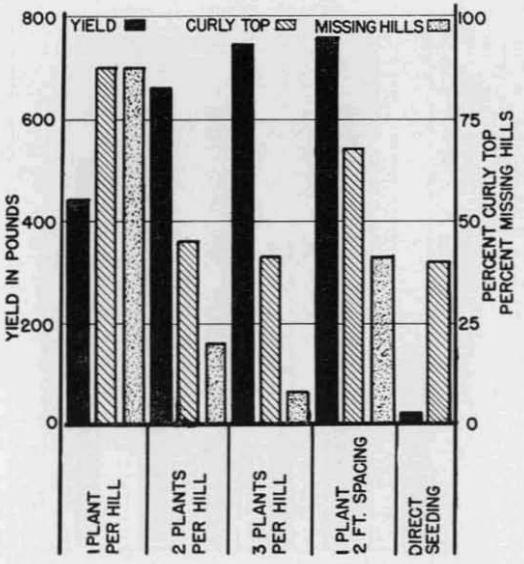


Figure 12.—Results from different plant spacings.

cages, but the cost is small in relation to the control achieved. This type of control is as suitable to large scale plantings as to the home garden. The multiple-hill planting control is achieved by at least three factors which reduce the amount of curly-top or reduce the injury to the crop. One is that the beet leafhopper does not like shade and by increasing the number of plants per acre the field will be covered and becomes less attractive to these insects. The second factor is that more plants had to be killed per hill by curly-top before a missing hill was produced in the field. The third is that lower percentage of curly-top develops when more plants per acre are planted.

TABLE 10.—Comparative tomato yields from plantings with variable number of plants per hill

Planting method	No. plants per acre	Per cent curly-top	Yield first picking*		Per cent U.S. I	Season yield*		Per cent U.S. I
			Total pounds	U.S. 1 pounds		Total pounds	U.S. 1 pounds	
1 plant per hill‡	2178	88.0	59.5	19.5	32.8	444	240	54.1
2 plants per hill‡	4256	46.0	79.5	39.5	49.7	661	448	67.8
3 plants per hill‡	6434	43.0	128.0	63.0	49.1	744	463	62.2
1 plant per hill 2 ft. apart in row	4256	67.0	101.5	48.5	47.8	764	488	63.9

* All yields expressed as pounds per total of 5 plots, 40 feet in length.
‡ Hills 4 feet apart in rows 5 feet apart

New Carrot Variety Makes Debut

IMPERIDA, the new short-topped carrot variety released in March from the Parma Branch Station, is expected to eliminate some of the difficulties encountered by Western carrot packers when older varieties are used.

These varieties, according to DeLance Franklin, Parma Branch Station, who developed the new Imperida, frequently become a packing problem when grown on fertile soils. Tops grow so long that the standard pack of 6-dozen bunches cannot be accommodated in a carrot crate. Packers who encounter this difficulty are faced with two highly undesirable alternatives: (1) Leaving the tops exces-

sively long and skimping on the crushed ice used in the package, or (2) shearing the tops to provide space for adequate package ice. In either case, the package arrives at the market in a very unattractive condition.

Because the main purpose of leaving the tops on carrots is to create an attractive appearance and to attest to the relative freshness of the product, Franklin believes that the short tops of Imperida can meet these requirements in good style and still leave plenty of room for package ice without trimming back the tops.

In addition to the improvement of the tops, the roots of Imperida have also received attention. As a result, roots of Imperida average approximately 1 inch longer than those of Imperator, currently the most used western shipping variety. Again, Imperida's roots have smaller, darker cores.

The original selections for the new variety were made in 1940 from a field of commercial bunching carrots grown by Mr. Donald W. Tolmie at Donnelly, Idaho. The variation of the carrots in this field indicated that the seed from which this crop was grown had resulted from the chance crossing of Imperator with a relatively small population of an undetermined variety, probably Red Core Chantenay. Numerous individuals were observed which possessed not only roots of outstanding size and length, but in addition, bore tops 6 to 8 inches shorter than the field average. By selection and inbreeding, this short-top character has been fixed along with the modifications respecting root length and core characters already noted.

A limited amount of stock seed is being made available to seedsmen this spring, who should have some seed available for growers by 1952.

Cultural Methods and Varieties of Sweet Corn

SWEET corn experiments under the direction of G. W. Woodbury, Horticulture, at the Parma Branch Station the past several years have been directed toward improving cultural practices, as well as gathering information relative to varieties. Yield and quality, as affected by planting date, have also been studied. Among cultural practices investigated, spacing or rate of seeding per acre has been given principal attention.

Golden Cross Bantam is the principal variety for processing in Idaho. This variety is well adapted to Idaho conditions and good yields of high quality corn result from its use. Some effort has been made at Parma to lengthen the processing season by testing earlier varieties which might have merit for canning or freezing. From a rather large number of varieties tested so far, none appears to meet such a need either from the standpoint of quality or yield. Seneca Golden, however, maturing perhaps a week earlier than Golden Cross, seems to show promise.

Summary of results.—A general summary of the various experiments reveals the consistency of Golden Cross in producing high

yields of first quality corn. Ioana is another good yielder, but quality is only fair. Iochief and Golden Bounty were both good in 1949. Golden Bounty is similar to Golden Cross, with equal quality. Iochief, a new variety from the Iowa Agricultural Experiment Station, promises much as a processing variety. Perhaps two days later than Golden Cross, it is a vigorous grower. Kernels are particularly deep with from 14 to 18 rows per ear. Cut corn percentages may run as high as 40 per cent.

Special trials have indicated that close planting may be advisable on well-fertilized ground. Wider planting is indicated where nitrogen is likely to be lacking. At the same time, it should be borne in mind that maximum yields may be obtained only from good stands in fields of high fertility.

In the interest of prolonging the processing season, plantings may be made over a period of a month or more without danger of lowering either yield or quality.

Results of Tomato Trials Have Wide Application

EARLY Chatham is highly recommended as an early tomato variety for home gardens. Danmark and Red Cloud, other varieties of this same group, may prove useful for the high-altitude and short-season areas.

These conclusions are the result of experiments conducted by J. E. Kraus, Horticulture, and are based on data from several years' work at the Lewiston field station. Early Chatham was developed at the Michigan station to provide a suitable variety for northern Michigan gardens.

Results from the tomato trials warrant the recommendation of the variety Sioux for canning and for general use in Idaho's warmer areas. Sioux should be ideal for the Boise Valley, Lewiston, and the Snake River Valley from Boise to Rupert. It may also produce well as far east and north as Idaho Falls. Sioux is an early-mid-season variety producing several days earlier on the average than John Baer or Bonny Best.

Sioux best at Lewiston.—In the Lewiston trials, Sioux has been outstanding in performance. In most all instances it has produced the highest percentage of U.S. No. 1 fruits and, in some instances, has produced the highest total early yield. Another Sioux characteristic that makes it valuable is its apparent resistance to blossom-end rot. In the 4 years Sioux has been under trial this disease has not been observed in the fruits. This is in comparison with other varieties such as Early Stone or Early Baltimore which, in some years, have produced 30 to 50 per cent affected fruits. Sioux has given a high quality canned pack, especially when allowed to become completely ripe before harvesting.

Early Stone, Early Baltimore, and other varieties of this type have not given good results in the Lewiston trials and are not recommended for any Idaho area. These varieties are too late in maturing and are subject to severe cracking and blossom-end rot.

Several of the selections of the variety Moscow, which originated in Utah, have been included in the Lewiston trials. While some of these have shown possibilities for canning production, they cannot as yet be recommended for general Idaho use.

Irrigation and fertilization.—Irrigation experiments on tomatoes indicate that they produce best with abundant water after the fruits have started to ripen. A marked reduction in total yield resulted when water was withheld from the plants in the Lewiston district after August 15. A word of caution should be given here. In high altitude areas, or in any area where the average growing season temperatures are low, the application of irrigation water too often during the ripening season may seriously delay ripening of the fruits. This is apparently not true in areas where the average temperatures are relatively high.

Preliminary experiments indicate that the use of starter solutions at transplanting time may bring marked advantage. A solution made by mixing 4 pounds of a 10-20-0 fertilizer, or its equivalent, in 50 gallons of water is suitable. This should be used at the rate of ½ to one pint per plant around the roots at the time of transplanting.

It should be emphasized that none of the varieties under test are resistant to curly-top. Where this disease is a serious factor, it is doubtful whether tomatoes can be grown consistently as a commercial crop.

Cytogenic Studies in Interspecific Tomato Crosses

THIS project was started in 1948 and has been conducted as Project No. 15, supported by special research funds. It was initiated to study the fundamental problems of the inheritance of curly-top resistance in tomatoes. The project is under the direction of R. D. Watson, Plant Pathology. T. E. Randall, Associate Horticulturist, Washington State College, is now working cooperatively on these problems. Others working on the project are William Simpson and Elmer Heinrich, graduate students in Plant Pathology at the University of Idaho.

Two general problems are being investigated in which it is hoped to discover the mode of the inheritance of resistance and why resistance cannot be retained when the resistant types are crossed back in order to obtain a desirable fruit type.

Potatoes

Damage to Idaho Potatoes in Transit to Market

A STUDY of transit damage and deterioration of quality in early crop potatoes from the shipping point to the terminal market was conducted in August 1949. In February 1950, damage to the

late crop was studied. These studies were made to supplement the work done in previous years on damage originating with the digger, picker, truck, and piler. There yet remains the need for more detailed study to measure the damage and deterioration from wholesale warehouse to retail display.

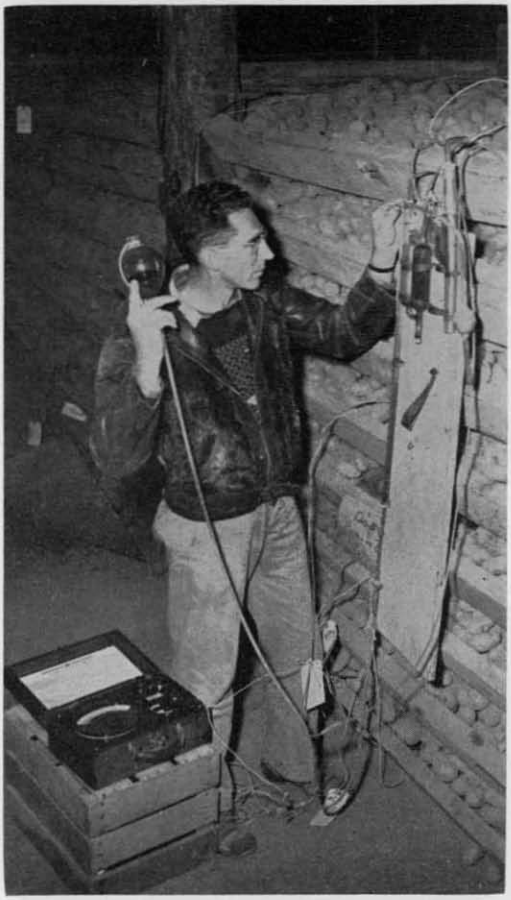


Figure 13.—Storage studies with potatoes. Walter C. Sparks, Horticulture, checks circulation of air by means of gas analysis in a bin of Russet Burbank potatoes at the Aberdeen Branch Station.

In the study on early potatoes, samples were shipped in 14 cars under standard refrigeration from the Idaho-Oregon early crop potato area during late July and August. Eight cars went to Chicago and vicinity; six cars went to Des Moines, Iowa. The cars were loaded to test two types of loads and the use of floor pads. The loads used were 3 x 5 and 5-3-2-3. Twelve 100-pound samples, plus two check sacks, were placed in each car. The samples were placed so there was always a sample sack on floor, center, and side positions in both padded and unpadded sections of each type of load. The sample positions were rotated within each section.

Samples were taken from the same lot of potatoes being used to load the car. They were taken after sorting when the potatoes were ready to be loaded. Thus there was no special selection or sorting. The samples were inspected very carefully at both the shipping point and terminal market to determine the amount of defective potatoes. After the inspection at the terminal market, two sacks from each car were held in the warehouse 5 days to find any additional increase in defects during that time. Also, 105 samples were purchased in retail stores to determine the quality of the potatoes that were being offered to the consumer.

Shipping damage and deterioration.—The average amount of

defects in the samples at the shipping point was 6 pounds per 100-pound sack. This increased to an average of 11.7 pounds by the terminal inspection, an increase of 5.7 pounds during transit. Transit damage, consisting of abrasions, breaks, bruises, and cuts was responsible for 2.7 pounds of this increase. An increase in the amount of shipping point bruises accounted for another 2 pounds of the increase. This increase in shipping point bruises was due to bruises which weren't detected at the shipping point. These bruises became visible only after they turned dark. Wet rot, heat, and external discoloration accounted for the rest of the increase.

The increase in defects in the Chicago samples was considerably greater than in the Des Moines samples. In Chicago, the average increase in defects was 9 pounds per sack, while in Des Moines it was only 1.8 pounds. The transit damage in the Chicago samples averaged 3.9 pounds compared with an average of 1.3 pounds for Des Moines. This difference was partly due to the different kind of potato shipped. Nearly all the Chicago samples were White Rose, while all of the Des Moines samples were Russet. The difference in transit damage was probably due to rougher handling of the potatoes in the Chicago yards.

There was only a slight difference between the 3 x 5 load and the 5-3-2-3 load. The 3 x 5 load was slightly better with an average of 0.3 pounds less transit damage per sack than the 5-3-2-3 load. This would amount to approximately 108 pounds of damaged potatoes in a 360-sack car.

Pads prove beneficial.—There was an average of 0.9 pounds less transit damage per sack in the padded sections. This is equivalent to approximately 324 pounds less damaged potatoes in a carload. In the 3 x 5 load the padded sections averaged 1.1 pounds less transit damage. In the 5-3-2-3 load the padded sections averaged 0.8 pounds less.

In the sacks held 5 days, defects increased an average of 13 pounds per sack during this period. Light greening was responsible for 12.4 pounds of this increase. There was a 2.2-pound average increase in defects that became visible with time, and a 1.6-pound decrease in heat damage. This left a net increase of 0.6 pounds for the last two items.

The retail samples that were purchased averaged 20.5 per cent defective potatoes that were out of grade for U.S. No. 1's. In addition, there was 15.4 per cent injury which would count against U.S. Fancy grade.

Figures on the transit damage on late potatoes are not yet available. This study was conducted in cooperation with Oregon State College. Milton F. Eberhard and Clifford Davis, Agricultural Economics, carried out the work for Idaho; and G. B. Davis and Gerald E. Korzan for Oregon. Inspectors of the Idaho Department of Agriculture and of the Production and Marketing Administration were active at shipping point and terminals.

Potato Harvester Being Developed

CONSIDERABLE progress has been made during the past two years by E. N. Humphrey, Agricultural Engineering, in developing a better machine for harvesting potatoes and in determining and pointing out to the farmers of the State better methods and procedures in harvesting and storing potatoes with equipment already on the farm.

The heart of the new machine is a series of rubber rolls for separating the potatoes from the soil. The rubber roll assembly has been developed in two sizes and installed on several experimental machines. The original machine was a single-row unit and has been in operation for two seasons. During the 1949 harvest three additional models were built through the cooperative effort of farmers in the vicinity of the Aberdeen Branch Station. These machines include a single row bulk harvester mounted on a small tractor, a light duty two-row bulk harvester, and a heavy duty bulk harvester.

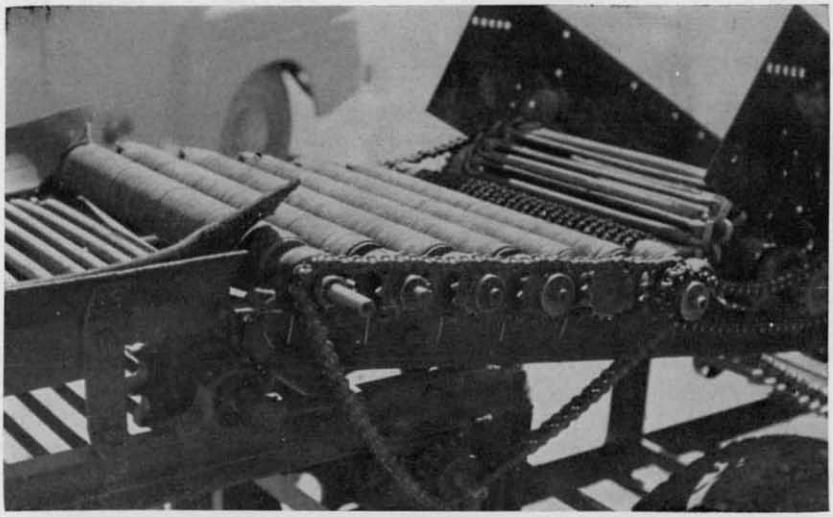


Figure 14.—Rubber roll assembly as used on the one-row digger-sacker.

Figure 14 shows the roll assembly installed on the one-row digger-sacker machine. On this machine the Number 1 roller is of different construction, aids in moving the potatoes along, and in getting dirt separation.

Figure 15 shows the complete machine and roll assembly in relation to the elevator and sacking table. The picture also illustrates the power drive and shows the platform space for the operators to work while removing vines, clods, and rocks. At the rear of the platform is a padded hopper to collect the potatoes while the operator is changing sacks.

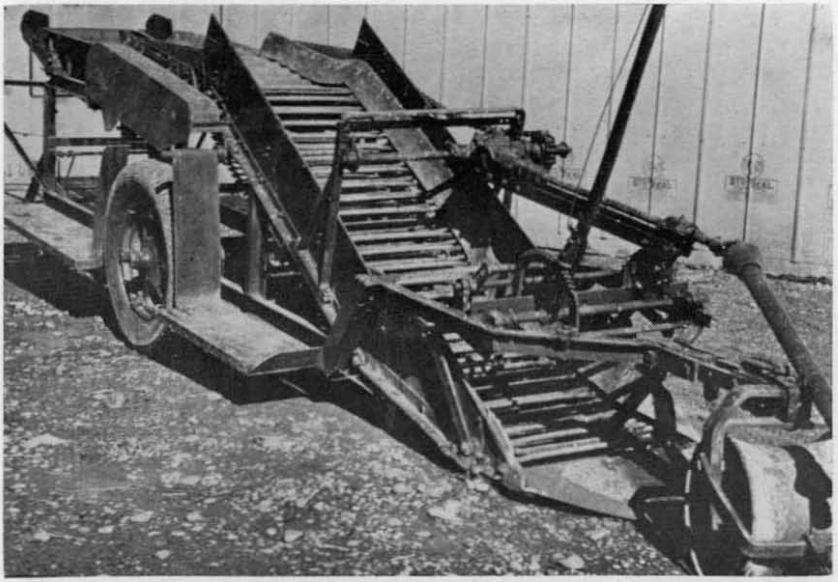


Figure 15.—The one-row digger-sacker machine.

A small single-row bulk handling unit has been made for the grower with less than 50 acres of potatoes. The unit is attached to a small tractor with part of the weight carried on two caster wheels. The digging operation is performed under the tractor and the potatoes elevated to the separating rolls mounted across the digger. The dirt is separated from the potatoes on the rubber rolls and any vines, clods, or rocks are picked off by operators standing on the rear platform. This machine was used during the 1949 season and appears to be very successful.

Two models of two-row bulk handling harvesters have been built. They are similar in design and construction. The light-duty model, shown in Figure 16, is intended for the larger operator. This machine was built using aluminum channel iron for support members to reduce weight. The power is obtained from a small gasoline engine. Figure 17 shows the complete machine. Platform space has been provided from which operators can remove vines, clods or rocks.

The two-row, heavy-duty harvester was intended to operate in the most difficult soil conditions and where rocks are a problem. The machine is carried on heavy channel irons and mounted on rubber-tired wheels set under the machine. One large engine operates the unit. If better speed regulation is required a smaller engine can be used on the main drive and a separate engine on the elevator. The rubber separating rolls are mounted across the entire width of the digger. The machine is built with a large operator's platform so several persons can pick rocks if necessary.

Operation Suggestions.—Many farmers already have very satisfactory machines. The following recommendations will help in using the present equipment to reduce bruising:

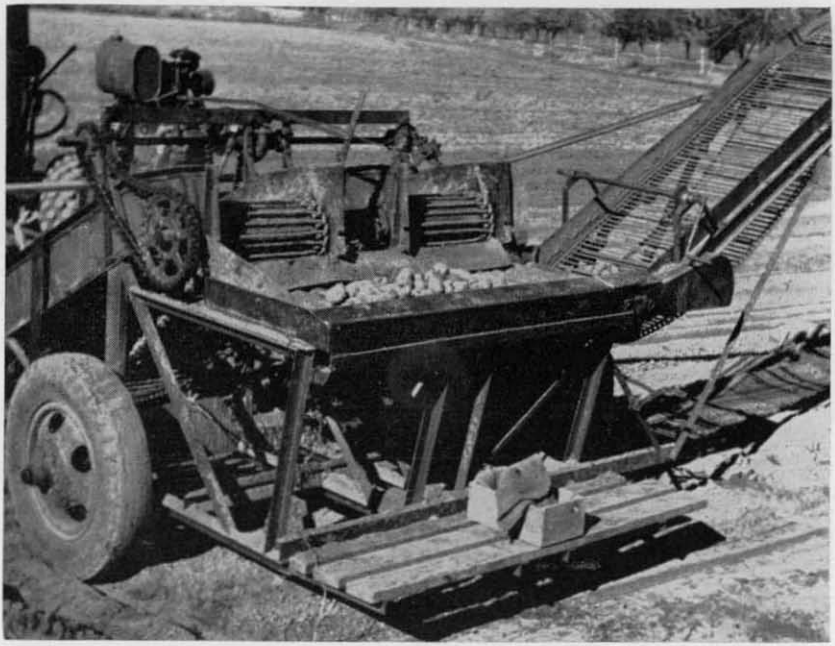


Figure 16.—Close-up of rubber roll assembly and elevator on two-row light-duty bulk handling harvester.

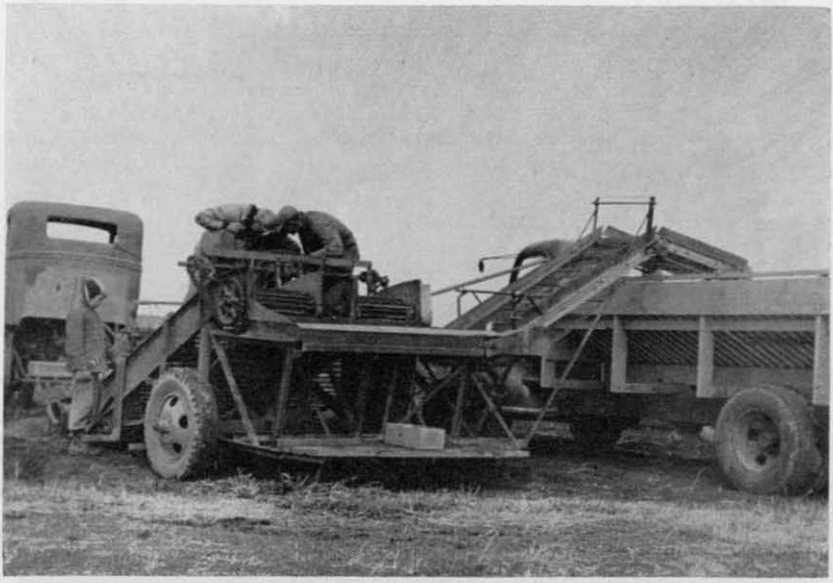


Figure 17.—The two-row light-duty bulk handling potato harvester ready for field operation.

1. Keep field speeds of harvesting machinery down to 1½ miles per hour or less.
2. Keep digger chain speed down to 132 to 150 feet per minute.
3. Use a digger chain with rubber-covered links if soil is sandy or dry. It is even advisable to keep two chains, one rubber covered and one standard steel chain.
4. Shield the digger chain link ends with old belting or operate with link ends turned in. It is necessary to increase the size of the bottom idler to a 4" diameter when the chain is operated with the link ends turned in.
5. Keep a layer of soil between potatoes and chain if possible.
6. Place padding under the sack in which the potatoes are harvested.
7. Pad truck beds, especially the edges. They may be padded with rubber cushioning, straw, or sacks.

Truck-to-bin transfer.—Records taken in 1948 indicate that over 3 per cent of the No. 1 potatoes were reduced in grade in transferring them from the truck to the bin. The following recommendations, if put into practice, will reduce this loss.

1. Pad the piler hopper with rubber cushioning.
2. Reduce piler chain speed to 50 feet per minute.
3. Keep elevator delivery close to the pile to avoid a long drop. Try to keep the potatoes from dropping more than 6 inches.
4. Keep the piler clear of the pile so that it does not drag potatoes back down.
5. Handle the sacked potatoes carefully.

Yield and Grade of Potatoes Affected by Spacing Within the Row

STUDIES on planting distance were conducted by Walter Sparks and Ejnar Larsen, Horticulture; and Ralph Knight, Aberdeen Branch Station, in 1948. Similar work was carried on by R. C. Ladeburg, Horticulture, in 1949.

Sets weighing from 1½ to 2 oz. were planted at spacings of 8, 16, 24, and 32 inches. All rows were 36 inches apart. The results are shown in Table 11.

TABLE 11.—Effect of spacing on yield and grade of Russet Potatoes

Spacing (inches between plants in the row)	Total yield cwt/A	Per cent knobby tubers	Per cent malformed tubers	Per cent No. 1's	Per cent below 2" min.
in.					
8	278	2.9	23.1	47	27
16	251	8.0	25.0	51	16
24	260	13.1	21.9	52	13
32	252	19.8	20.2	50	10

That production of knobs was associated with spacing and size of sets was demonstrated by J. E. Kraus and L. W. Nielson, Horticulture, in previous years. The results obtained in 1949 were satisfactory from the standpoint of reduction of knobby tubers. The wider the spacing, the greater was the proportion of knobby tubers. Total yield and percentage of No. 1's was not significantly affected by spacing in the 1949 work. This may best be explained as follows:

Early dying was severe in 1949; therefore, many tubers failed to make No. 1 size in the case of the closer spacings. This would tend to reduce both total yield and percentage of No. 1's. The set was lighter where wider spacings were used and the percentage of tubers making No. 1 size was higher, but due to knobby tubers, many of the larger potatoes failed to make grade. This resulted in approximately the same total yield and yield of No. 1's regardless of spacing. An examination of the data in Table 11 makes it obvious that knobby tubers in the case of wider spacings were balanced by more potatoes under a 2-inch minimum in the case of closer spacings.

Had early dying not been such a factor, closer spacing would surely have shown to great advantage over wider spacing in yield of No. 1 potatoes. Work done in previous years has shown this to be the case.

Light-greening of Potatoes May be Avoided

THE housewife, in buying potatoes, shows a dislike for tubers that have a greenish color. This off-color, according to Ejnar C. Larsen, Horticulture, is caused by prolonged exposure to light. Both natural daylight and electric light will cause it. The green color develops readily in potatoes on display in retail stores and may also appear in storage where electric lights are used for sorting or other purposes.

Studies carried on by Larsen have shown that the rate of greening is directly related to temperature. Below 40° almost no green color develops. If storage cellars can be held below this temperature there should be little difficulty from greening during sorting operations. Display of potatoes in refrigerated show cases might offer a means of preventing greening in retail stores.

There is a difference in the amount of green that develops under different colors of light. Using this knowledge, Larsen experimented with different colors of cellophane used as screens over potatoes exposed to daylight comparable in intensity to that of an average grocery store. Under both green and blue screens it required about 10 days longer for the tubers to become objectionably green than it required under full daylight. It thus seems possible to reduce greening by covering the potato tubers with either blue or green cellophane screens in places where it is desirable that they be open to inspection for a considerable period of time, as in store displays. The results also suggest the possibility of using green or blue cellophane windows in paper bags used for consumer packs.

Potato Rot Nematode

THE potato rot nematode, *Ditylenchus destructor*, infected sugar beets when inoculated in pot (2-gallon glazed crocks) culture. Infected sugar beets have not been collected from infested fields, but the amount of infection in potatoes following sugar beets in infested

plots suggests that this plant is a host. Early symptoms are bluish-black, slightly depressed areas near the crown of the beets. The tissue under this area is pitted and honey-combed, and contains the nemas. Later the infected areas become brown, rugose patches that culminate in complete destruction of the root.

The beets were grown in 2-gallon glazed crocks. They were started in the greenhouse. Several days before making inoculations they were placed outside with the crocks imbedded in soil. Inoculations were made by C. E. Dallimore, Plant Pathologist, State of Idaho Crop Pest Control and Research Commission, and Gerald Thorne, Nematologist, Bureau of Plant Industry, Soils and Agriculture Engineering, U.S. Department of Agriculture, by pouring water containing the nematodes, fresh from infected potato tissue, over the crown of the beet, and by placing an infected piece of potato tuber in the soil several inches from the beet root and one inch below the surface. Both methods of inoculation were successful. At the time of inoculation the beet roots were approximately one inch in diameter. Infection was not observed until late in the growing season. Thus, sugar beet is to be added to the host list with potato *Solanum tuberosum* L. and dandelion, *Taraxocum officinal,* Weber.

New Potato Improvement Program Gets Underway

IN cooperation with the U.S. Department of Agriculture, a new potato improvement program was begun at the Aberdeen Branch Station under the leadership of John G. McLean. Principal objectives are to obtain strains or varieties of potatoes which are resistant to leaf roll and verticillium wilt. Several thousand seedlings and breeding lines were grown in 1949 at Aberdeen. Several lines were grown near Rexburg to test them for resistance to verticillium. While this is a long-time project and may require several years to achieve the objectives, it is one of major importance to the Idaho potato industry. The work will be expanded in 1950.

Fruits

Cheaper Ways of Thinning Peaches

THINNING peaches by hand is a costly operation. Experiments designed to find cheaper ways to do this have been in progress in Idaho for two years. Chemical thinning of blossoms, now used successfully with apples, has given such variable results with peaches that it cannot yet be recommended.

Experiments carried on by Leif Verner, Horticulture; and D. F. Franklin, Parma Branch Station, with pole thinning of peaches in 1949 gave promising results. As practiced in Idaho in recent years, this kind of thinning has been accomplished by the use of a light pole with a short piece of spray hose attached to the end. In these experiments a different type of thinning pole, introduced in Cali-

fornia recently, was used. Instead of the piece of hose on the end of the pole, a loop of V-shaped fan-belt is fastened to it. The belt is first cut across and then shortened to the desired length. A small loop is made with it and the two ends of the belt are fastened to the end of the pole with their flat sides next to it. They can be fastened with small bolts. The loop should extend from about 3 to 5 inches above the end of the pole, according to the preference of the grower.

The fruit is thinned with this pole by striking clusters or individual fruits, or a single peach can be removed by catching it in the loop and giving a quick twist or jerk. In a test plot in which this method was used in 1949 on J. H. Hale peaches, pole thinning did fully as good a job as hand thinning and required only half as long.

Little Cherry and Western X Surveys in Idaho for 1948 and 1949

SURVEYS of Idaho cherry and peach orchards were made during the summers of 1948 and 1949 to determine the presence of Little Cherry and Western X virus diseases. Cooperating in the surveys were the University of Idaho Agricultural Experiment Station, the Idaho Crop Pest Control and Research Commission, and the Idaho State Department of Agriculture. Directing the surveys was Carl Nichols, Plant Pathology.

In 1948, 901 cherry trees out of 59,173 inspected were found infected with the Little Cherry disease. These infected trees were on 43 of the 201 properties inspected. During 1949, 70,531 cherry trees were inspected on 329 properties. A total of 1,657 infected trees were found on 134 of these properties. Of the 1,657 infected trees, 896 were reports of new infections and 761 were reported the year before. The greatest amount of infection was found both years in Nez Perce, Payette and Gem counties. Little Cherry was also found in Adams and Canyon counties in 1948. Ada, Idaho, and Washington counties were added to this list in 1949. No infected trees were found north of Nez Perce County or east of Ada County either year.

In 1948, 29,376 peach trees were inspected on 78 Idaho properties. A total of 1,664 of these trees on 56 properties were found to be infected with the Western X disease. In 1949, 3,406 peach trees out of 121,685 inspected were infected with the disease. These infected trees were on 150 of 220 properties inspected. Of the 3,406 infected peach trees, 2,540 were not known to be infected in 1948 and 866 were reported in 1948. In 1948 Western X was found in Canyon, Gem, Latah, Nez Perce, Payette, and Washington counties. Ada, Gooding, Idaho, and Twin Falls counties were added to this list in 1949. No infection was found north of Latah County in 1948. This area was not reinspected in 1949.

Publications available—Circulars on these two virus diseases may be obtained at any county agent's office or by writing to the Agricultural Experiment Station at the University of Idaho. *Little Cherry Disease Threatens Idaho Orchards,* University of Idaho Ag-

ricultural Experiment Station, Circular No. 113, contains a brief history, a description, and colored pictures of the disease. A supplement to this is entitled *Survey in 1949*. This supplement contains the results of the 1948 survey and an announcement of the 1949 survey.

Western X Disease of Peaches in Idaho, University of Idaho Agricultural Experiment Station Circular No. 115, contains a brief history, a description, and colored pictures of this disease. The circular also contains the results of the 1948 survey in Idaho. The plates for these colored illustrations of Western X disease were kindly loaned by the Washington State Department of Agriculture and the U.S. Department of Agriculture.

Throughout the 1948 and 1949 surveys removal of virus-infected trees was recommended. This is necessary to protect trees from the sources of infection.

Material assistance was given in these surveys by E. C. Blodgett of Washington State College, who assisted in training the field workers in 1948 and who gave valuable suggestions at various times. Mr. E. L. Reeves of the U.S. Department of Agriculture also assisted in the study of these diseases in the field.

Grasses and Legumes

Improved Intermediate Wheatgrass in Prospect

INTERMEDIATE wheatgrass is a vigorous, aggressive, sod-forming grass introduced from Russia by the U.S. Department of Agriculture. It has been tested extensively both in the Great Plains area and in the Pacific Northwest. The common strain makes a very satisfactory pasture grass. One of the outstanding characteristics of this grass is its ability to remain green 2 to 3 weeks longer than most of our common grasses, thus furnishing an abundance of late and palatable pasturage. The seeding habits of intermediate wheatgrass are only fair when compared to some of the other grasses. At times considerable seed losses result from shattering. Intermediate wheatgrass produces a high yield of forage and is consequently a heavy feeder on the soil nutrients. As a result, yields of forage are low on poor, infertile soils. It is not as drought-resistant as some of the other wheatgrasses, requiring a minimum of about 18 inches of rainfall. It has about the same moisture adaptation as smooth bromegrass.

Although intermediate wheatgrass has been used in the past primarily as a pasture grass, it is showing more and more promise as a hay plant, particularly in mixtures with alfalfa. In a test of various alfalfa-grass mixtures harvested as hay, the mixture including intermediate wheatgrass outyielded all others with an average of 6.40 tons of hay per acre for a 4-year period.

All yields were high, as shown in Table 12. The land used for this test was at a high level of fertility, and, in addition, climatic condi-

tions were favorable. Two crops of hay per year were harvested the first three years of the test; only one cutting was obtained in the fourth year due to a shortage of moisture during that season.

In 1948, J. L. Chapman selected from this observation nursery promising plants of several types. Two dwarf types, one bluish-green and the other a dark green showed considerable promise for pasture purposes. Two tall-growing types, one bluish-green and one dark green in color, appeared promising for use in mixture with alfalfa for hay or pasture purposes. These selections were set out in isolated test blocks.

Figure 18.—Left, one of the tall-growing bluish-green, and right, one of the tall, dark green intermediate wheatgrass types. These strains are high yielding and show considerable promise for use in mixture with alfalfa for hay or pasture purposes.

The various selections were classified in 1949 by C. T. Brackney, Agronomy. The classification was based on date of maturity, seed production, disease reaction, rooting habit, and other agronomically important characteristics. Upon the basis of these observations, further elimination of undesirable types was made. Plans for 1950 include the testing of the polycross progenies of these plants. It is hoped that within 2 to 3 years enough information will be available from these tests so that the more desirable selections can be combined and a superior strain of intermediate wheatgrass be made available for release. Figure 18 shows two of the more promising selections. These grass plants are late in maturity and high in yield. Emphasis is being placed upon strains which show good seed yields

and which have resistance to seed shattering. Plants that do not have the excessive spreading habit characteristic of many plants of this species are most desirable.

TABLE 12.—Hay yields in tons per acre of six alfalfa-grass mixtures and two alfalfa varieties for a 4-year period, 1942-1945, inclusive, University Farm, Moscow.

Crop or Mixture	1942	1943	1944	1945*	Average 1942-1945
Alfalfa, Intermediate wheatgrass	6.63	9.98	5.40	3.59	6.40
Alfalfa, Orchard grass	5.67	8.58	5.62	4.36	6.06
Alfalfa, Sherman big bluegrass	5.76	8.94	5.45	3.68	5.96
Alfalfa, Tall fescue	5.49	8.62	5.72	3.63	5.87
Alfalfa, Tall oatgrass	5.95	8.21	4.72	3.49	5.59
Alfalfa, Manchar smooth brome	5.03	8.26	4.85	3.77	5.48
Alfalfa (Grimm)	4.72	6.76	5.26	3.86	5.15
Alfalfa (Orestan)	5.26	7.31	5.31	2.31	5.05

* Yields for 1945 represent only one cutting.

Alfalfa and Alfalfa-Grass Mixtures Increase Wheat Yields on Eroded Hilltop Soil

WHEAT yields can be materially increased by growing alfalfa and alfalfa-grass mixtures on eroded hilltops before planting wheat. This is the conclusion reached from a 12-year study carried on by G. Orien Baker and Roger Harder, Agronomy, at the Main Station at Moscow.

The experiment supporting this conclusion was started in 1938 on a steep eroded hilltop which was extremely low in fertility, as indicated by wheat yields of 15 bushels per acre. The soil contained less than .10 per cent nitrogen and roughly 2.00 per cent organic matter. Duplicate plots of alfalfa, alfalfa-grass mixture, and crested wheatgrass were planted in the spring of 1938. Spring wheat has been grown continuously on other plots to serve as a basis of comparison. At the end of the first 4-year period, in the fall of 1941, one plot each of alfalfa, alfalfa-grass, and crested wheat were plowed up and planted to spring wheat each year for the next 8 years, starting in the spring of 1942. The remaining legume and grass plots were allowed to grow for another 4-year period, or 8 years in all, and were then plowed up in the fall of 1945 and seeded to spring wheat in the spring of 1946. Four crops of spring wheat were then grown on this set of plots. The results are shown in Table 13.

Alfalfa and alfalfa-grass mixture are both excellent crops for restoring the productive capacity of eroded low-fertility soils. The results show no significant differences between alfalfa and alfalfa-grass mixture, either on total yield or total return per acre for the 12-year period. Alfalfa-grass, however, leaves the soil in a better physical condition to resist erosion.

Benefits from gypsum.—The application of gypsum is essential to obtain the greatest benefit from the legumes. This is shown by the higher yields obtained for the second 4-year period than during the first period. Gypsum was applied at the rate of 200 pounds per acre in the spring of 1941 and 1943 to the alfalfa and alfalfa-grass.

The first 4 years after plowing out of sod the average spring wheat yields of duplicate series of plots were 34.6, 33.2 and 20.9 bushels following alfalfa, alfalfa-grass, and crested wheatgrass, respectively. This compares to a yield of 14.7 bushels following spring wheat for the same period. Growing alfalfa, either alone or with grass, more than doubled the yields of wheat while grass alone only increased the wheat yields by about 40 per cent. The benefit of the alfalfa on the wheat was reflected by a greener color and increased yields for as long as 8 years.

The average yield of wheat during the second 4 years after plowing out of alfalfa and alfalfa-grass was about 6½ bushels per acre less than for the first 4-year period. The wheat yields for the second 4-year period after crested wheat were slightly higher than for the first 4-year period. This difference can be the result of the temporary tying up of the nitrogen during the decomposition of the grass roots, seasonal differences, or both.

Nitrogen fertilizer required.—The results obtained from the use of crested wheatgrass show clearly that supplemental commercial nitrogen fertilizer is required for the economical production of grass seed. The yields of grass seed were only 176 and 113 pounds per acre the first and second year of production, respectively. The maximum yield of grass seed after the first 2 years was 44 pounds per acre and most years not sufficient seed was produced to warrant harvesting. No supplemental nitrogen fertilizer was used in this study.

Wheat following grass should receive an application of supplemental nitrogen fertilizer. The grass does not add any nitrogen to the soil; furthermore, during the breakdown of the grass roots the nitrogen already present in the soil is tied up temporarily so the wheat crop cannot use it. Where the crested wheat was left for 8 years and received no supplemental nitrogen fertilizer, the return per acre for the 12-year period was $44 less than where continuous spring wheat was grown.

Summary of results.—The results of the study clearly show that the productive capacity of our severely eroded soils can be materially increased by the growing of alfalfa alone or in combination with grass. Because there is no economic difference between the benefits obtained from alfalfa and alfalfa-grass; and since grass makes an important contribution to erosion control, alfalfa-grass mixtures are recommended for the restoration of steep lands.

Certified Seed Production of Forage Crops Shows High Increases

SEED production is one of the important agricultural enterprises of the state. Table 14 shows the great increase in the production of certified seed of small-seeded legumes and grasses in Idaho during the past 6 years. The availability of seed of improved and superior varieties of forage crops has been an important factor in accounting for this increase in production.

TABLE 13. Influence of alfalfa and/or grass on spring wheat yields and on total income per acre for a 12-year period on a steep eroded hill-top soil in the Palouse area.

Cropping Practice	Continuous Spring Wheat	Four years alfalfa and/or Grass —eight years spring wheat			Eight years alfalfa and/or Grass —four years spring wheat		
Average Yield 1938-1941*	Sp. Wheat 15.1 bu.	Alfalfa 1.40 T	Alfalfa Grass 1.61 T	Crest. Wheat Seed 103 lb.	Alfalfa 1.60 T	Alfalfa Grass 1.75 T	Crest. Wheat Seed 89 lb.
Average Yield 1942-1945	Sp. Wheat 14.9 bu.	Sp. Wheat 30.8 bu.	Sp. Wheat 29.4 bu.	Sp. Wheat 19.7 bu.	Alfalfa 2.68 T	Alfalfa Grass 2.58 T	Crest. Wheat Seed 20 lb.
Average Yield 1946-1949	Sp. Wheat 14.5 bu.	Sp. Wheat 23.8 bu.	Sp. Wheat 23.0 bu.	Sp. Wheat 21.4 bu.	Sp. Wheat 38.4 bu.	Sp. Wheat 37.0 bu.	Sp. Wheat 22.1 bu.
Total Value of crops for 12 years Dollars	192.24	278.12	274.96	223.90	322.02	316.47	147.52
Increased return or loss per acre for 12 years compared to continuous spring wheat. Dollars	.....	+85.88	+82.72	+31.66	+129.78	+124.23	—44.72

* Only 3 year average for alfalfa and/or grass—one year required for establishment.

TABLE 14. Pounds of forage crops seed produced in Idaho for the six-year period 1944-1949.

Year	alfalfa	red clover	ladino clover	sweet clover	grasses
1944	122,947	115,165	11,701	3,254	.....
1945	170,856	239,953	20,242	.....	39,691
1946	174,747	388,122	36,853	14,900	11,784
1947	342,980	614,985	18,163	14,537	90,406
1948	488,541	759,480	92,415	178,248	177,862

Wheat, Oats, Barley

Idaho Club Barley Ready for Release

WINTER barley is an important crop for those parts of Idaho favored with relatively mild winters or where a protective snow cover can be depended upon. Unfortunately, no variety of winter barley has been found that is as winter-hardy as our best varieties of winter wheat. At Moscow, winter barley may be expected to winterkill one year out of five.

Idaho Club barley was developed as a selection from Winter Club. This new variety will be released in the summer of 1950. The Winter Club variety is also known under the name of White Winter Club.

The original selections resulting in the development of Idaho Club were made in 1941 by K. H. Klages, Agronomy. Reselections were made in 1945 and in 1948. The head-row materials from which the selections were made showed that the old Winter Club variety contained two types of plants, early and a later maturing type. The difference in the heading and maturity dates of these two types varied from 6 to 9 days, depending upon seasonal differences.

Field plots of the early and later types were established in the fall of 1948. The later maturing selections outyielded the early types by 12 per cent in 1949. Since 1949 was dry in May and June this indicated a definite superiority of the later maturing selections. In addition to the yield superiority the late maturing selections had better, more upright straw. The late maturing types trace back to selection No. 8 made in 1941. Seed of these types were bulked and seeded for increase in the fall of 1949.

Idaho Club rated among the most winter-hardy varieties of winter barley tested in the barley winter-hardiness nursery at Moscow during the past five years. It has the same winter-hardiness rating as Winter Club. The amount of seed available from Idaho Club has so far been too limited for the conducting of malting tests. These tests will be made on seed produced in 1950. Since Winter Club is classified as a malting barley there is every reason to believe that the Idaho Club will fall into the same classification.

Idaho Club is identical in appearance to Winter Club. It is a six-rowed, rough-awned, facultative winter barley. The heads are compact and distinctly six-rowed, the lateral spikelets do not overlap. The plants of Idaho Club are medium-tall, the straw is stiff and resistant to lodging. Idaho Club like Winter Club can be seeded in

spring provided such seeding takes place early in the season. The variety is, however, not recommended as a spring barley. Definitely, spring barley varieties are superior to it for spring seeding. When Idaho Club is seeded late in spring most of the plants will not produce heads. Idaho Club is recommended for the northern part of the State and in the Boise Valley. The crop has a place in the agriculture of the State, but it is necessary to point out that the growing of winter barley, regardless of the variety used, entails a greater risk from winter-killing losses than the growing of winter wheat.

Figure 19.—Visitors inspect cereal trial plots at the University Farm. In the foreground is a field of wheat being grown for foundation seed.

"Winter Killing" of Wheat

IN ORDER to more thoroughly study this problem, a series of 39 rotation plots were established at the High Altitude Branch Station, Tetonia, in May 1949, by J. M. Raeder, Plant Pathology, and W. A. Moss, Tetonia. It had previously been observed that the disease was not so destructive to wheat grown in rotation including a legume. Three rotations were established: (1) a 5-year rotation in which sweet clover appeared once and wheat twice, (2) a 6-year rotation in which alfalfa was grown for 2 years and wheat 2 years and (3) a 2-year rotation alternating wheat with fallow.

Japanese wheat growers have the same disease to contend with in their grain. They have succeeded in selecting resistant varieties

of both wheat and barley in their attempt to combat the trouble. Nineteen varieties of such wheats and 48 barley varieties of Japanese origin are now under observation at both Tetonia and Moscow. Others will become available at a later date. There are also 152 single plant selections of American varieties under observation. Their reaction to the disease is being studied. The latter were surviving plants in fields in the vicinity of the High Altitude Station, where the disease was severe.

Foundation Seed of Hannchen Barley will be Available

THE production of two-rowed, spring sown, malting barley has been increasing rapidly, especially in the northern part of Idaho. Two varieties are commonly grown, Hannchen and Hanna. In many instances production consists of a mixture of these two varieties. Because the malting trade has a definite preference for Hannchen, this variety was purified by reselection, 1,500 individual plants being grown in 1948. Of these, 141 plants were selected for plot tests in 1949. After 14 more additional selections were discarded because of being untrue to type the seed harvested from the remaining 127 selections was bulked to be increased in 1950 to provide foundation seed. This seed will be available for release to certified growers in 1951.

Foundation and Certified Seed Produced at Sandpoint

THE foundation and certified seed program carried on at the Sandpoint Branch Station by Merle Samson consists of growing certified seed grain and potatoes for farmers of this area and other parts of the State. The foundation seed program is set up to increase by field seedings the foundation stock of various varieties of grains.

In the spring of 1948, 400 pounds of foundation Overland oats were obtained from the Aberdeen Branch Station. Since that time, this seed has been increased and distributed to the farmers of the State. The amount available for distribution in the spring of 1950 was 3200 pounds.

In the spring of 1949, foundation Hannchen barley was purchased by the Branch Station from the Idaho Crop Improvement Association for increase. One thousand pounds of this seed was ready for distribution in the spring of 1950. Seven acres of certified Hannchen barley was grown under certification on the Sandpoint Branch Experiment Station in the 1949 growing season. This seed was available to farmers throughout the State who were interested in a source of clean certified barley seed for their 1950 crop.

Soils, Rotations, Fertilizers

Effect of Source of Phosphorus on Uptake of Phosphorus From the Fertilizer by Alfalfa

A FIELD experiment was conducted at the Aberdeen Branch Station on Declo loam to determine the effect of phosphorus

carriers on: (1) uptake of phosphorus by alfalfa, and (2) yield of alfalfa. Cooperating on this project were J. V. Jordan, Agricultural Chemistry; G. O. Baker, Agronomy; Ralph Knight, Aberdeen Branch Station; and S. R. Olsen, Western Regional Phosphate Laboratory, Fort Collins, Colorado. This project marks the first use of a radioisotope by the University of Idaho Agricultural Experiment Station.

Phosphate carriers were superphosphate, calcium metaphosphate, alpha tricalcium phosphate, and ammonium phosphate. They were applied at a rate of 40 pounds P_2O_5 per acre in a band 4 inches deep and 6 inches to one side of the row. There were six replications of each treatment in a randomized block design.

The radioisotope, phosphorus-32, was used to tag the fertilizers in order to determine the efficiency of the fertilizers to supply phosphate to the alfalfa under the experimental conditions involved. There were three sampling dates for yield and uptake of phosphate.

Results and interpretation.—Plant tissue obtained 6.25 per cent of its phosphorus from superphosphate; 5.03 per cent from ammonium phosphate; 3.66 per cent from calcium metaphosphate, and 1.69 per cent from alpha tricalcium phosphate. On a yield basis, the alfalfa utilized 68.9 per cent P_2O_5 of the superphosphate added and 44.8 per cent of the ammonium phosphate added in those treatments.

There was an interaction between uptake of fertilizer and sampling date. Superphosphate, ammonium phosphate, and calcium metaphosphate provided the highest percentage of P_2O_5 at the second sampling date while alpha tricalcium phosphate furnished the highest percentage of P_2O_5 at the third sampling date.

Yield samples were cut twice only, because sheep had consumed growth intended for the first yield samples. Based on two samplings, yields of alfalfa from the superphosphate, ammonium phosphate, and alpha tricalcium phosphate plots were not significantly different from one another. The calcium metaphosphate treatment produced significantly lower yields. Treble superphosphate treatment included in the experiment for yield data only produced significantly greater yield than did the check plots.

Commercial Fertilizers Give Economical Returns on Oats, Potatoes, and Sugar Beets

NUMEROUS inquiries have been received regarding kind and rate of fertilizers for various crops. Because very little information that would apply to southern Idaho is available on the subject, some preliminary work was conducted by Ralph Knight at the Aberdeen Branch Station in 1949. Several fertilizers, alone and in combination, were applied at three rates to second-year potatoes, to beets following two crops of potatoes, and to oats following two crops of potatoes and one of beets. The results may be summarized as follows:

1. No significant increases in yield were obtained from nitrogen or phosphorus alone. Medium and heavy phosphate applications hastened the maturity of the oats by approximately one week.

2. Sulfur alone and potassium in combination with nitrogen and phosphorus did not affect the yield.
3. A combination of nitrogen and phosphorus resulted in yield increases from all three crops.
4. The medium N-P rate gave the most economical returns on oats. With beets and potatoes, the rate of application had less effect on yield.

A comparison of the yields from the low and medium N-P rates and the corresponding check plots is given in Table 15.

TABLE 15.—Effect of two rates of a nitrogen-phosphate fertilizer on yields of oats, sugar beets, and potatoes.

Fertilizer and rate	Average yield per acre	
	Overland oats	
	bu.	
N-40 P_2O_5—80	132	
N-60 P_2O_5—120	147	
Check (no fertilizer)	106	
	Sugar beets	
	tons	
N-40 P_2O_5—50	24.5	
N-80 P_2O_5—100	28.3	
Check (no fertilizer)	25.1	
	Potatoes	
	Total cwt.	U.S. No. 1 cwt.
N-40 P_2O_5—40	223.5	142.9
N-80 P_2O_5—80	223.1	149.6
Check (no fertilizer)	193.4	121.7

In considering the results on potatoes, it should be noted that early dying, or Verticillium wilt, was very prevalent in 1949, and all vines were completely dead by late August, several weeks ahead of the first frost. There is no basis for determining the differential effect the disease may have had on the various fertilizer plots. It has been demonstrated at Aberdeen, however, that tubers increase very rapidly in size and weight between September 1 and the first killing frost. It is logical to assume that where fertility was at a fairly high level, tuber growth would have been proportionately greater than on the check plots during this period, and that yield differences would have been considerably higher had wilt not been present.

Another important point is that on all three crops it was necessary to balance the nitrogen with phosphorus to obtain significant increases in yield. From our present knowledge, however, there is no need to apply more than 80 to 90 pounds of P_2O_5 for maximum yields.

The amount of commercial fertilizer that a farmer should use for the most economical returns will depend upon the crop involved, past cropping history, and fertilizer practices on his various fields. For second-year potatoes or beets following potatoes, 60 to 80 pounds nitrogen and an equal or slightly larger amount of P_2O_5 is suggested. For the second consecutive cereal crop or a cereal following two row crops, such as potatoes or beets, 40 to 80 pounds of nitrogen properly balanced with P_2O_5 is recommended.

Effect of Boron on Nitrogen Fixation by Azotobacter

STUDIES are underway to determine what effect the minor element boron may have on nitrogen fixation by the important soil microorganism, *Azotobacter chroococcum*. J. V. Jordan, Agricultural Chemistry, and G. R. Anderson, Bacteriology, are conducting the work. Results so far indicate that soils deficient in available boron may carry *Azotobacter chroococcum* but the nitrogen-fixing ability of these soils is increased 100 per cent or more when the available boron is increased to a range of 0.5 to 1.8 parts per million. Nitrogen was determined on all samples by a modified Kjeldahl procedure.

Azotobacter chroococcum was plated on agar and cultured in broth for 7-, 14- and 21-day periods. The two media had been treated with boron varying from 0 to 50.0 parts per million. The 7-day cultures showed significant increases in nitrogen fixation, over the untreated checks, up to 7 parts per million total boron. Cultures carrying more than 7 parts per million total boron, or 3 parts per million available boron, fixed smaller amounts of nitrogen.

Nitrogen determinations of 14-day-old and 21-day-old cultures followed an irregular pattern. This phenomenon indicates a loss of nitrogen as ammonia from the cultures or suggests that the Kjeldahl method gave too low values for nitrogen. No loss of ammonia from the cultures could be demonstrated.

The work is being continued to determine the role of boron in nitrogen fixation and to establish a possible relationship between *Azotobacter chroococcum* and *Aspergillus fumigatus* which is enhanced in growth by culturing with *Azotobacter chroococcum* and which may have an inhibitory action upon the nitrogen-fixing organism.

Influence of Rotations on Soil Organic Matter and Nitrogen

A STUDY has been completed to date on the influence of rotations and management practices on the nitrogen and organic matter content of the soil by G. C. Lewis, Agricultural Chemistry; and G. O. Baker, Agronomy.

On the main station at Moscow some rotations were started in 1914 while other rotation and management practices were started in 1938. The work has been carried on for 20 years at the Aberdeen Branch Station, 12 years at Sandpoint Branch Station, and 11 years at the Tetonia Branch Station. Composite soil samples were taken at 5-year intervals from 400 individual plots representing 83 different rotation and management practices. Where either sweet clover, alfalfa, red clover, grass, or peas had been included in the rotation the nitrogen and organic matter content of the soil had been approximately maintained. Applications of barnyard manure also maintained the nitrogen and organic matter.

At the Moscow station, fallowing every other year depleted the soil of nitrogen and organic matter more than any other practice. Approximately 1,000 pounds of organic matter and 35 pounds of nitrogen per acre per year were lost from these plots.

Burning the straw and stubble in a continuous wheat rotation at the Moscow station reduced the organic matter at the rate of 700 pounds per year. About 70 pounds of nitrogen per acre per year was lost with this practice.

Soil Survey Program Reactivated

THE soil survey program, for the purpose of inventorying the soil resources of the State, was reactivated in August 1949 with the appointment of Maynard A. Fosberg to be in charge of the field work. The work will be cooperative with the Soil Survey Division, U.S. Department of Agriculture.

Soil survey in Idaho was first started with Latah County in 1915. Since that time fifteen different areas have been surveyed, and thirteen reports published. The Idaho Falls and Emmett Valley surveys are in the process of publication. The total area surveyed to date is about 5⅓ million acres, which represents only about one-third of the potential agricultural area of the state.

Mr. Fosberg started work in Canyon County in August and the entire county, 580 square miles, will be mapped. The survey is a basic detailed type made by series and types and will include delineation of slope, degree of erosion, degree of salinity and alkali, and land use. After preliminary work representatives from the Bureau of Reclamation and the Soil Conservation Service were invited to participate in setting up the legend. The objective of the soil survey is to gather as much data as possible that may be of use to agricultural agencies. About 20 square miles were surveyed this season.

Barnyard Manure Increases Yield of Old Pasture

THE application of barnyard manure to an 11-year-old grass pasture was studied at Caldwell Branch Station by R. H. Ross and Darrell Kerby, Dairy Husbandry.

The fields receiving a medium covering of barnyard manure produced 37.3 per cent more feed than the unmanured field. The manured field yielded more feed during the normal pasture season and the pasture season was extended a longer period of time by the manure.

Nitrogen fertilizer increased the early season yield of pasture.

Weed Control

Frequency of Cultivation Important in Bindweed Eradication

THE most important single factor in the eradication of perennial weeds by cultivation is the proper interval of cultivation. According to C. I. Seely, Agronomy, the wrong frequency of cultivation may materially increase either the number of cultivations or the time required for eradication. Figures 20 and 21, which give the average

results from three experiments started in 1937, 1938, and 1939, show that even small differences from the correct frequency may be important. The best frequency of cultivation tested was 12 days after first emergence of the bindweed. This frequency required both the least time and number of cultivations to bring about eradication. As the frequency was narrowed from 12 days after emergence to shorter intervals, the number of cultivations required for eradication rose rapidly with a relatively small increase in the time required.

A frequency of only 4 days narrower than the optimum of 12 days after emergence increased the number of cultivations required to affect eradication by 6, and 12 days too narrow increased it by 50. As the interval widened beyond 12 days after emergence the length of time required for eradication increased rapidly with a relatively small increase in the number of cultivations.

A frequency only 4 days too wide, that is beyond the optimum of 12 days, increased the time required for eradication by over a year, and 16 days too wide increased it 7 years. The narrowest frequency tested, cultivation at emergence or black fallow, required an average of 76 cultivations and 35 months for eradication while the widest, 28 days after emergence, required 42 cultivations and 104 months. The cultivation interval of 12 days after first emergence required only 26 cultivations in 27 months.

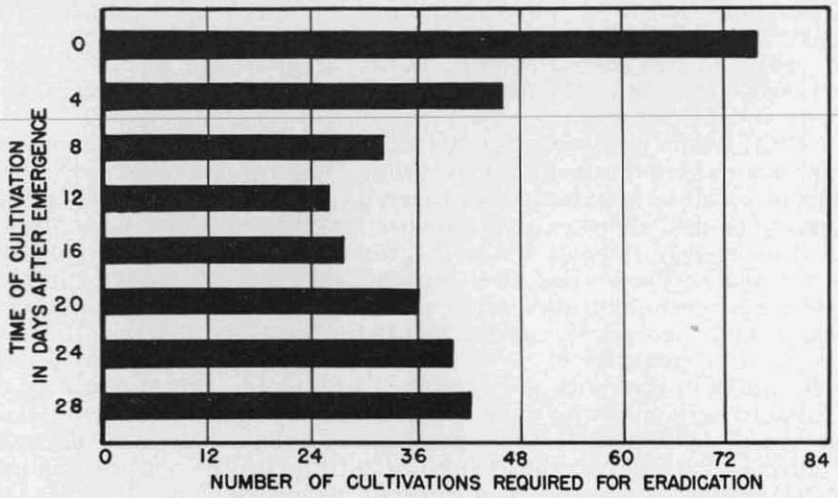


Figure 20.—The effect of eight intervals of cultivation on the number of cultivations required for eradication of bindweed.

Emergence time varies.—The time required for emergence of bindweed after a cultivation varies with temperature, moisture, plant vigor, and the depth of cultivation. In these experiments, where the depth of cultivation was always 4 to 5 inches, the number of days to emergence varied from 4 to 30 days. The average days

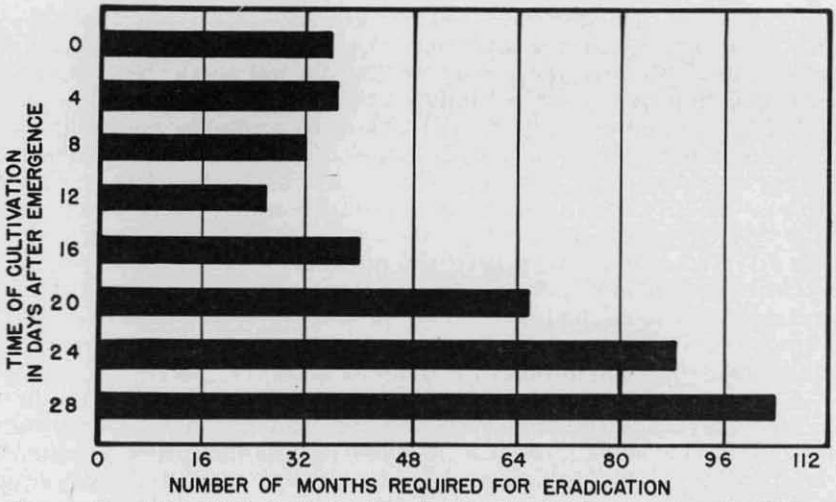


Figure 21.—The effect of eight intervals of cultivation on the length of time required for eradication of bindweed.

to emergence for all frequencies the first season of cultivation was 7.1 days, the second season 8.4 days, and the third season 13.3 days. This means that the 12 days after emergence frequency ranged from about 16 to 42 days between cultivations depending upon the time of year and the season of cultivation. It averaged about 19 days between cultivations the first season, 21 days the second season, and 25 days the third season.

Cultivation is a root starvation process and the way in which the various frequencies affect the bindweed roots is shown in Figures 22 and 23. It is apparent from these data, which were taken at the end of the first three cultivation seasons, that the first year of cultivation merely reduces the percentage of available carbohydrates in the roots. The second and third seasons further reduce the percentage of carbohydrates, but root death starts during the second season and becomes the major factor by the third season. If these two factors, quantity of roots and the percentage of available carbohydrates in the roots, are combined to give the actual quantity of available carbohydrates in a unit volume of soil a relatively true picture of the entire process is obtained. This has been done in Figure 24, which gives the amount of carbohydrates per unit volume of soil as a percentage of the uncultivated check.

The values obtained at the end of the second season of cultivation forecast rather accurately the relative time that would be required for eradication by the several frequencies. From this estimate of time a fairly close approximation to the number of cultivations could be obtained. The better frequencies reduced the available carbohydrates to about 15 per cent of the check by the end of the first season and to about 3 per cent by the end of the second season. By the end of the third season the quantities frequently were too small to measure accurately but averaged less than one-tenth of one per cent.

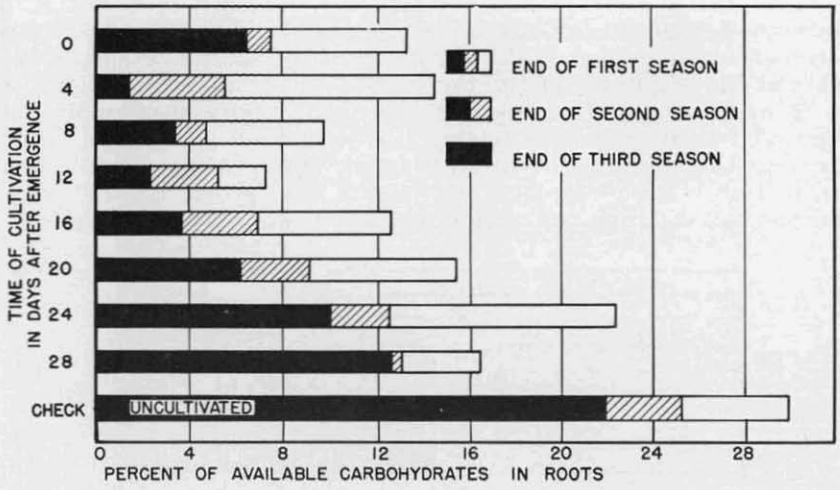


Figure 22.—The effect of eight intervals of cultivation on the percentage of available carbohydrates in bindweed roots. Average of three experiments.

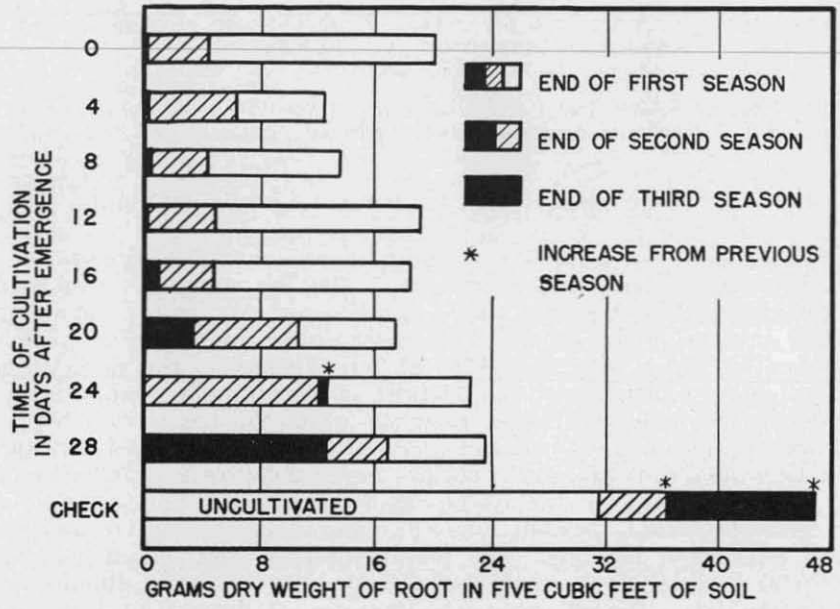


Figure 23.—The effect of eight intervals of cultivation on the amount of live roots of bindweed in the soil.

Eradication slow process.—Because root death does not occur until the second season of cultivation, stands of bindweed are usually as thick or thicker at the beginning of the second season as they were at the beginning of the first season but the plants are only 15 per cent as strong. Little progress is usually noticed in cultivating bindweed until some time during the second season. When stands start to thin progress is usually rapid. Eradicating bindweed by cultivation is a slow process but a sure one, providing the proper method is used from the beginning to the end of the program.

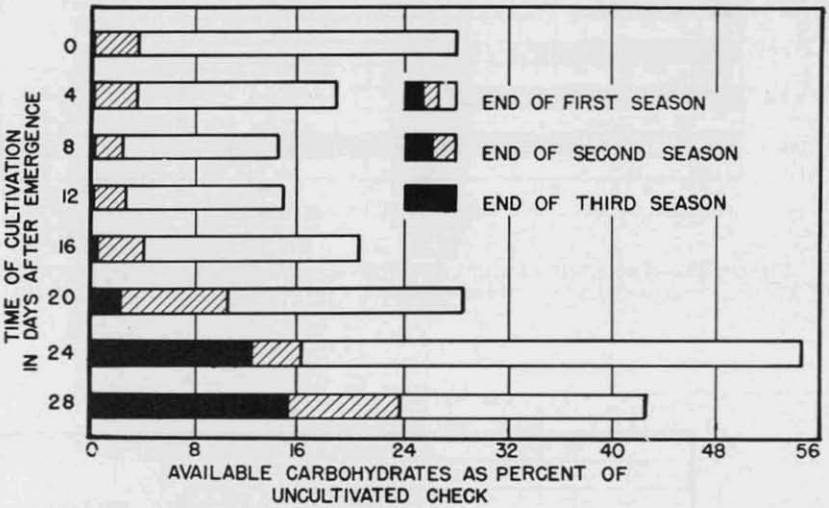


Figure 24.—The effect of eight intervals of cultivation on the amount of available carbohydrates in the roots of bindweed.

2, 4-D Treated Soils and their Action on Leguminous Plants

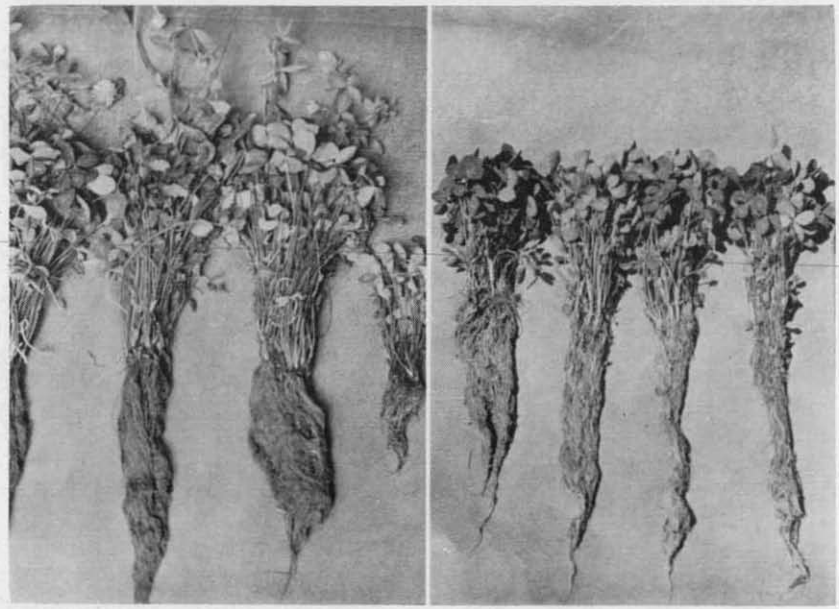
STUDIES on 2,4-D in the soil and its consequent effect on plant life have been carried on since 1948 by Guy R. Anderson, Bacteriology; G. O. Baker and R. W. Harder, Agronomy. Previous work has shown the sensitivity of leguminous plants to usual field application rates of 2,4-D (Fig. 25-A). However, the percentage of nitrogen fixation per unit weight of leguminous plants is not reduced except in the higher rates of 2,4-D soil treatment. Applications up to 6 pounds per acre of 2,4-D showed decreased nitrogen fixation only in beans and that at the highest rate of treatment.

Residual action of the 2,4-D was determined in the greenhouse by reseeding 2,4-D treated soils one year after application and the first seeding of legumes. The results indicate that usual field applications of 1 to 3 pounds of 2,4-D salts on soils should not interfere with the plantings of leguminous crops the following year. No indication of residual action of the herbicide was noted in the leguminous plant growth from 2,4-D treated soils stored

at 70°F. and kept either moist or unmoistened (Fig. 25-B). Slight residual action of the herbicide was noted only in moist soils that were stored at 37°F.

Examination of the action of the herbicide on soil microorganisms indicate that inhibition of microbial growth is quite transitory. It was noted, however, that Gram positive organisms were inhibited to a greater extent than were the Gram negative ones. Further studies are being continued in the laboratory on the role of soil microorganisms in the breakdown of 2,4-D. An important phase of the work is concerned with the possible identification of specific microorganisms capable of destroying the toxicity inherent in 2,4-D.

Field plots treated with 2,4-D last fall will be seeded to leguminous crops this spring and the possible residual action of the 2,4-D noted. The results of this study will serve as a check on the greenhouse experiments. The influence of the herbicide on the nitrogen-fixing abilities of the leguminous plants also will be determined.



0 1 3 6 0 1 3 6

FIRST CROP SECOND CROP

A B

Figure 25.—Effect of the ammonium salt of 2, 4-D on the growth of red clover. Numbers refer to treatments in pounds per acre in 60 per cent of the moisture-holding capacity of the soil. The first crop was grown immediately after treatment, and the second crop was grown 1 year after treatment.

Yields of Crops Grown on Soil Treated with 2,4-D Influenced by Irrigation and Seedbed Preparation

PERENNIAL weeds are generally not affected by conventional pre-planting treatments of 2,4-D as applied for the control of annual weeds. Furthermore, no satisfactory selective herbicide has been developed for the control of perennial weeds in non-grass crops. There is need for a system whereby some control of perennial weeds occurring in broad-leaved crops can be obtained. Therefore, a modified system is now being studied whereby perennial weeds, such as field bindweed, are treated with 2,4-D in the spring after they emerge and before the land is worked. The land is plowed from one to three weeks after the weeds are treated and thereafter the seedbed is prepared and planted. Under this system many new problems arose. These had to be understood and solved before the system could be used.

Because the many problems could not be studied in a single year, a project was outlined whereby the different phases could be studied progressively over several years. The major phases are as follows: (1) How long would the residual toxicity of 2,4-D in the soil persist under dryland and irrigated conditions? (2) How would the 2,4-D toxicity affect the germination, growth, and yield of the different major crops? (3) How could this toxicity to crops be reduced or shortened? and (4) What efficiency in perennial weed control could be expected? Although the objective of the system is weed control the effects upon the crops must first be established.

Five crops studied.—The study was started at Murtaugh, Idaho, in 1948 by Lambert Erickson, Agronomy, and Harry Gault, Twin Falls County Weed Supervisor, using five different crops for indicator plants. Figure 26 shows that in dry soil, 2,4-D persisted throughout the growing season, and that there was as great a toxicity at 45 days as at 15 days after treating.

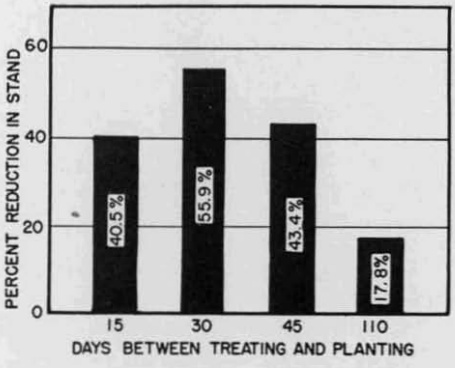


Figure 26.—Average reduction in plant stands based upon four dates of planting as influenced by the 2,4-D persisting in dry soil.

After the crops were planted and irrigated it was noted that the toxicity disappeared within a few weeks. It was also found that different crops varied widely in their sensitivity. Alfalfa was super-sensitive and no plants survived. The plants of beans, oats, corn, and potatoes each survived at stands equal to 30, 50, 90, and 90 per cent respectively as compared with the non-treated checks.

Since information had been obtained on the residual effect and persistence of 2,4-D in dry and irrigated soil from these studies in

1948, the work in 1949 was devoted to finding ways of breaking or reducing the toxic effect of 2,4-D to crop plants. Two areas of one acre each were treated with 2,4-D. One area was irrigated following the treatment while the other was not irrigated until after planting. Four additional treatments were superimposed in strips upon the 2,4-D treatment on both areas. This yielded five treatments, (a) non-treated check, (b) treated check, (c) treated and disced, (d) treated and fertilized, (e) treated and plowed. The same five crops were planted in 1949 as in 1948.

Analysis of results.—The results show: (1) that the block irrigated following the treatment produced higher average yields than the block not irrigated until after planting, (2) No supplemental treatment was effective in the establishment of alfalfa, (3) beans, corn, and oats were aided in their establishment by the superimposed deep plowing, while this procedure was detrimental to potatoes.

Several farmers in Twin Falls and Jerome counties are using this so-called pre-soil-preparation system for the control of bindweed and other perennial weeds when growing beans or potatoes. The 2,4-D treatment retards the weed growth and permits the crops to become better established before the weeds again emerge. Thus these crops get a growth advantage over the weeds.

Our results show that the 2,4-D treatments are detrimental to the development or yield of all the crops used. However, some of the harmful effects can be reduced by additional management practices. Irrigating between the 2,4-D treatment and planting reduced the toxic effects of 2,4-D to the stand and yield of beans, corn, and oats. Deep plowing also aided these crops, and by combining irrigation before planting and deep plowing before seeding, beans, corn, and oats produced higher yields. On the contrary, both irrigating and deep plowing between treating and planting increased the toxic effects of 2,4-D to potatoes. When these two treatments were combined the lowest yields were obtained. Probably this adverse effect upon potatoes is due to moving and concentrating the 2,4-D at the soil depth at which the seed pieces are planted. Alfalfa is so sensitive that no stands were obtained if 2,4-D was applied to the soil prior to seeding. The toxic effects to beans are reflected in reduced stands and delayed maturity. Triumph potatoes are more resistant to 2,4-D injury than the Gem variety.

This project will be continued to further establish the influences of these superimposed practices upon crop stand and yield. In addition, information will be obtained on the effects of these treatments and practices upon the control of perennial weeds.

Aquatic Weeds and White Top on Irrigated Land Investigated at Meridian

A WEED Control Experiment Station was established at Meridian, Idaho, in 1947. The establishment of this station was made possible through the cooperation of the Ada County Weed Control

office; The Bureau of Reclamation, U.S.D.I.; The Bureau of Plant Industry, U.S.D.A.; and The University of Idaho.

The station is concerned with two primary objectives: (1) To develop methods for the control of aquatic weeds in irrigation systems and, (2) to develop combination systems of cultural, chemical, and cropping practices for the control of white top. Jesse M. Hodgson, Agronomist, U.S.D.A. is in charge of the station.

Many benefits have already been derived from this station. A bulletin was issued in 1949 entitled, "Controlling submersed water weeds in irrigation systems with aromatic solvents." This bulletin, issued jointly by the Bureau of Reclamation and the Bureau of Plant Industry, contains information on the results obtained at this station and likewise recommendations for the control of weeds in irrigation ditches in Idaho.

Many other studies are in progress at Meridian. Some, for example, will determine: (1) what crops can be grown to best advantage where white top competes for moisture, soil nutrients, and sunlight, (2) can white top be controlled and eradicated by combining certain crops and 2,4-D sprays? (3) what degree of control or eradication of white top can be obtained by combining selected cropping and cultural practices, and (4) what combinations of cultural, chemical, and cropping practices can be used to best advantage and profit.

Results to date show that white top can be controlled by using certain agronomic practices. Some crops compete well with white top while others do not. Early seeded spring wheat has proven to be one of the poorest competing crops. Late seeding of rapidly maturing, short season crops, such as barley shows promise.

Several new studies will be started at the Meridian station in 1950. In addition several of the studies in progress will be expanded.

Weed Investigations at the Sandpoint Branch Station

WEED control investigations were conducted by Merle Samson, Sandpoint Branch Station; and Lambert Erickson, Agronomy, on several weeds common to this area and to the Station. Nonselective weed control studies were set up on tansy, quack grass, and Canada thistle, while selective weed control treatments were applied in grain for the control of horse tail, German knotweed, and spurry.

The project for the control of weeds in grain was conducted on a seeding of Elgin winter wheat during the 1949 growing season. In this study four selective herbicides were used; the amine and butyl ester forms of 2,4-D and a combination form applying equal parts of 2,4-D and 2,4-5-T in the isopropyl ester form. The treatments were applied at ⅓, ⅔, and 1 pound acid equivalent per acre.

The most spectacular feature of this work was the excellent control of horse tail (Equisetum) by almost all the treatments, but especially by the 2,4-D and 2,4,5-T combinations. The wheat yields were 1.5 and 5.2 bushels greater per acre, respectively, for the butyl ester, and amine 2,4-D forms as compared to their non-treated

checks—while the wheat yields were 5.2 bushels less per acre where the 2,4-D and 2,4,5-T combinations were applied. This would tend to indicate that only in extreme instances should 2,4,5-T be used as a selective herbicide in grain.

A series of 62 plots was established to test the merits of various chemical compounds for quack grass control. Each plot covered an area of ½ square rod. The materials used on these plots were: NaTCA in ½ gallon of water, NaTCA plus 1 quart of water plus one quart Shell 20 oil plus 10cc Dupont Spreader, and various rates of ethyl xanthate, and dichloral urea in water and oil emulsions. All the base materials mentioned above were applied at various amounts on the 62 different plots.

Although the results of the various chemical applications appear very promising, it is difficult to determine the effect of these compounds at such an early date. The value of these treatments must be weighed over a period of more than one year to determine their true merits. This investigation will be continued in following years.

A series of plots for work on tansy was established on some vacant lots on Ella Street in Sandpoint which were owned by Frank Sanders. These plots were selected because there was a very uniform infestation of tansy present. The plots were treated with Polybor chlorate at the rate of 2, 4, and 6 pounds per square rod; Polybor Borax, 2, 4, and 6 pounds per square rod; Amine, 2,4-D, 1, 2, and 3 pounds per acre; Isopropyl Ester, 2,4-D, 1- 2, and 3 pounds per acre; Amine 2,4,5-T, 1, 2, and 3 pounds per acre. Some very promising results were obtained the first year on the various applications. However, it is difficult to determine the value of the applications until the second year observations are made.

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300 Comparison of Weight Losses and Flavor Score of Cheese Wrapped in Parakote, Pliofilm and Paraffin When Ripened at 40°, 50° and 60°F.—H. C. Hansen, L. C. Elkins, and J. C. Boyd

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FINANCIAL STATEMENT OF THE IDAHO AGRICULTURAL EXPERIMENT STATION

Fiscal Year July 1, 1948—June 30, 1949

	Federal Funds						State Appropriation	Other Funds	
	Hatch	Adams	Purnell	Bankhead Jones	Research & Marketing 9(b) 1-2	Research & Marketing 9(b)3		Sales	Research Grants
Balance, July 1, 1948	.00	.00	.00	.00	4,727.50	.00	28,018.11	8,413.53	3,134.39
Receipts	15,000.00	15,000.00	60,000.00	16,589.81	23,143.22	16,500.00	176,497.13	79,570.43	49,514.29
Total	15,000.00	15,000.00	60,000.00	16,589.81	27,870.72	16,500.00	204,515.24	87,983.96	52,648.68
Expenditures	15,000.00	15,000.00	60,000.00	16,589.81	26,679.38	16,447.94	197,700.61	73,374.33	30,803.12
Balance, June 30, 1949	.00	.00	.00	.00	1,191.34	52.06	6,814.63	14,609.63	21,845.56
Expenditures by Items									
Personal Services	7,047.48	12,507.30	40,504.17	12,232.10	9,434.63	11,383.09	133,598.70	25,890.88	17,952.89
Supplies and Materials	1,670.04	1,069.83	10,907.55	1,408.65	8,255.95	3,012.85	27,075.35	19,138.40	6,932.37
Communication Service	280.57	19.03	341.31	32.23	176.84	44.42	1,015.00	150.00	175.00
Travel Expenses	2,045.20	343.34	3,091.94	294.72	1,146.61	1,724.78	3,590.54	3,409.46	1,400.00
Transportation of Things	27.49	7.11	148.26	79.15	261.20	.00	500.00	50.00	110.00
Printing and Binding	3,662.94	.00	.00	.00	.00	.00	300.00	400.00	.00
Rent and Utility Service	.00	5.60	86.33	.00	71.00	.00	500.00	500.00	150.00
Equipment	146.60	381.81	4,425.39	1,691.81	4,756.49	282.80	12,281.02	16,935.59	4,002.86
Other Contractural Services	119.68	665.98	432.84	310.23	308.14	.00	300.00	500.00	80.00
Land and Structures	.00	.00	62.21	540.92	2,268.52	.00	18,540.00	6,400.00	.00
Total Expenditures	15,000.00	15,000.00	60,000.00	16,589.81	26,679.38	16,447.94	197,700.61	73,374.33	30,803.12