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Possibilities Of Controlling Annual Weeds In Seed Onions By Chemical Methods Indicated By Experiments

F. L. TIMMONS, L. R. HAWTHORN, and R. D. WEBBER

THE possibility of controlling late emerging weeds in seed onions by chemical methods is pointed to by results of recent experiments conducted at the Utah Agricultural Experiment Station. After a crop of onions begins to send up seedstalks, the control of weeds by either cultivation or hand hoeing rapidly becomes increasingly difficult, and within ten days to two weeks it is often impossible without serious injury to the seed crop. Weeds, if allowed to grow, compete with the onions for soil moisture and nutrients, and often reduce the yield of seed. They create a serious problem for the seed grower and any method of controlling them economically and without injury to the onion seed crop would be of great value to the onion seed industry.

Weeds in Seed Onions Difficult to Control

Weeds are difficult to control in onion seed crops by cultivation or hoeing because the onion foliage and particularly the seedstalks are unusually brittle so that sometimes only a slight pressure will snap them off. Most seed growers, therefore, avoid weeding onions after the seedstalks are well developed and thus under average conditions onion seed fields are often seriously infested with weeds.

Although onion seed is harvested by picking the individual heads by hand, it is almost impossible to gather the crop without bringing some weed seed along with it. Seed yields that have already been reduced by competition from weeds are thus often further reduced by the additional milling necessary to remove the weed seed.

Spraying with Chemicals

An exploratory study on the chemical control of annual weeds in a seed crop of Yellow Sweet Spanish onions was made in 1949. Immediately after the onions had been cultivated and hand weeded for the last time and furrowed for subsequent irrigation, a number of chemicals, including micronized 2,4-D acid, were applied at various rates to the soil both between and in the rows of a series of replicated plots. The plants were shielded from the sprays, except for 2 to 3 inches above the ground.

The results of these exploratory tests indicated that not only was 2,4-D effective in reducing the stand of broadleaved annual weeds by as much as 90 to 100 percent, but at the same time it caused remarkably little injury to the onions. No seed yields were recorded, but casual observations indicated that practically no differences resulted from the treatments. Later the seed from the onion plants in all treatments except one had a germination above 95 percent.

As a result of the preliminary findings in 1949, a rather comprehensive experiment was conducted in 1950 to test more thoroughly the practicability of using 2,4-D and certain other chemicals for controlling annual weeds in seed onions. Mother bulbs of the foundation stock of the Utah Station's strain of Yellow Sweet Spanish onions were planted April 8 at a uniform spacing of 6 inches in rows 30 inches apart. Plots 20 feet long and 4 rows wide were used during the season for comparing 12 different chemical and check treatments.

Control of Wild Oats

An application of IPC (isopropyl N-phenyl carbamate) at 4 pounds per acre was made on 4 lots to control wild oats on April 26 just as the oats were emerging and the onions were 2 to 4 inches tall. This treatment gave 87 percent control of the wild oats without apparent injury to the onions but did not reduce the stand of other annual weeds which emerged later in the season.

From the time the onions were planted until June 5 all plots were cultivated and hand weeded several times as conditions necessitated. Most
of the early weeding was necessary for control of wild oats and the plots treated with IPC required much less hand weeding than untreated plots.

Pre-Emergence Treatments

On June 5, when the onions were about 20 inches tall and just beginning to bolt, the plots were furrowed for irrigation. Immediately thereafter 6 different chemical spray treatments were applied between the onion rows and in the rows in such a manner as to cover all of the land surface but not get the spray higher on the onion plants than 1 or 2 inches.

A knapsack sprayer with a 2-nozzle boom covering a strip 30 inches wide was used for the treatments. The onions were not shielded from the spray but the applications were made when the air was quiet and there was no drift of the spray by wind. The treatments compared micronized 2, 4-D acid alone at 1, 1½, 2, and 3 pounds per acre and in combinations of 2,4-D acid at 1½ pounds per acre with two other experimental herbicides. A seventh treatment tested the effect of 2,4-D at 2 pounds per acre applied so that the spray contacted the onions 3 to 4 inches above the ground. Each of these treatments was applied in 40 gallons of water per acre.

Annual weeds frequently create a problem in seed onions as serious as that shown in the picture to the left. These weeds developed after cultivation was discontinued about June because of height of seed stalks. Photographed August 15 just ahead of seed harvest.

Post-Emergence Treatments

On June 23, after a crop of weeds had emerged following the final cultivation, two post-emergence treatments were applied in the same manner as the pre-emergence treatments made on June 5. The post-emergence treatments compared a carrot weedling oil at 60 gallons per acre and a dinitro selective weed killer at 6 quarts per acre in 80 gallons of water.

All of the 10 chemical treatments applied April 26, June 5, and June 23 were compared with untreated but hand weeded check plots and untreated check plots that were not hand weeded after June 5. The 12 different treatments are outlined in table 1 which presents the more important results.

The plots were irrigated only twice during the entire growing season, but this combined with rainfall on three.

(Continued on page 38)

Farm and Home Science
PARATHION, applied to alfalfa, sweet clover, and to other plants attractive to bees during the period of bloom, is poisonous to honey bees. This has been borne out in experiments conducted on the Utah Agricultural Experiment Station farms by entomologists and apiculturists of the Legume Seed Research Laboratory.

Experiments conducted during 1947 through 1949 clearly demonstrated the poisonous nature of parathion even when applied during evening and early morning hours when bees were not present in the fields. A sharp increase in dead bees at nearby experimental hives invariably followed in-blossom use of this agricultural chemical. This lasted for two days following field application, with lessened damage on the third day.

During 1949 half an acre of blossoming alfalfa in one corner of an experimental field was dusted with parathion. Nine acres of untreated alfalfa bloom in this and a nearby field were available to the bees. However, sharp increases in number of dead bees present around two nearby experimental bee yards occurred within a few hours. Bees continued to die in increased numbers for two days.

An average morning pickup in front of 16 experimental hives at a North Logan experimental farm had averaged approximately 250 dead bees each morning. The pickup of dead bees suddenly jumped to 1036 on July 17, 1950 and to 5,849 on the following morning. This loss followed immediately after the spraying of a portion of an apple orchard one-half mile away with a DDT-parathion spray. White sweet clover was in bloom beneath many of the apple trees. Spraying of the balance of this orchard was delayed until a 2,4-D weed spray was applied and the sweet clover blossoms wilted by it. Following elimination of the attractive cover crop subsequent spraying of the rest of the orchard did not cause serious bee losses.

A serious pea aphid outbreak occurred in the Delta-Sutherland portion of Millard County between July 20 and August 25, 1950. Two-spotted mites also were numerous in many fields of this area, where first crop alfalfa was left for seed. Commercial chemical companies recommended that parathion or tetraethyl pyrophosphate (TEPP) be used to control these pests. Knowing the deadly nature of parathion to bees, Utah State Agricultural College and U. S. Department of Agriculture entomologists warned against applications of parathion to blossoming alfalfa. The use of TEPP as an evening or early morning treatment was suggested where pea aphid control was imperative.

A survey of insecticide dealers in west Millard County indicated that approximately 69,600 pounds of 1 percent parathion dust and 1,936 pounds of 25 percent wettable parathion powder were sold and applied. About 880 gallons of 40 percent TEPP were sold and applied to alfalfa in this section of Millard County during 1950.

Most of these chemicals were applied by airplane while the alfalfa was in bloom, from July 29 to August 21, and some in the day time.

A study of the ensuing effect on the 13,600 colonies of bees which were distributed throughout the Delta Area indicated that at least 30 percent of the entire honey bee field force, serving to pollinate the seed crop in this concentrated alfalfa seed growing area, was destroyed by extensive field applications of these chemicals.

Dead worker bees were strewn in great numbers over the ground about hives in bee yards where poisoning was severe (fig. 1). In many cases, dead bees covered the ground in front of hives, often being several bees thick in depressions and where grass or weeds grow in front of the affected hives. The honey intake stopped immediately whenever the field force of bees was killed. Only lightly affected bee yards recovered field force strength in time to harvest any additional honey crop.

**PARATHION KILLS HONEY BEES**

By GEORGE F. KNOWLTON

Field bees that died in front of hives following parathion application to nearby blossoming alfalfa field
DEATH OF PROFESSOR BYRON ALDER BRINGS CLOSE TO LONG SERVICE TO USAC AND POULTRY INDUSTRY OF STATE

THE passing of Professor Byron Alder on April 7 closed nearly forty years of service to Utah State Agricultural College and to the poultry industry of the state. He had seen the development of the poultry industry in Utah from small flocks of chickens to supply the family needs on the farm to an industry that is our chief source of agricultural income. He was among the pioneers of the industry and his work has been a major contribution to its success. The results of his research in poultry nutrition and the use of home grown products in poultry feeds have saved the industry millions of dollars in feed costs. He has also done research in poultry breeding and management. In addition he has been an able teacher and a wise counselor both to his college students and in extension work.

Prof. Alder, a native of Manti, Utah, graduated from the USAC in 1912, taught mathematics for a year at the high school in his home town, and then returned to the college to take over the poultry work. For the first 14 years he was the only member of the department, taking care of the research, teaching, and extension.

One of his earliest contributions to the industry was his research on the use of calcium carbonate grit. Poultry producers were importing oyster shell from the coast while mountains of limestone in the state remained untouched. Prof. Alder's research proved that when this material was ground it was equal to the more expensive oyster shell as grit. Thus not only the poultry raisers were benefited, but a new industry was developed.

He did extensive research on the composition of poultry feeds. He showed that a low protein ration was equal to one of higher protein content in egg production and condition of birds. As protein is the most expensive constituent of the ration, this meant a large saving in feed costs.

He also demonstrated that home grown grains are equal to the more expensive imported corn in the ration when combined in proper proportions and with other required nutrients.

Probably his most important contribution to the industry was his studies on the use of alfalfa meal in the feeding of chickens and turkeys. Alfalfa meal of good quality is usually abundant in Utah and at a price from one to two dollars per hundred pounds less than the price of wheat and barley and at times as much as three dollars less than corn. As a result of Prof. Alder's work most of the large turkey growers in the area are using mashes containing from 20 to 40 percent of alfalfa meal instead of the much smaller amount previously used. Replacing 15 to 20 pounds of grain with a similar amount of alfalfa meal has resulted in a saving of 20 to 60 cents on each hundred pounds of growing mash or from 10 to 30 cents in the feed cost of each turkey produced, or a saving of more than a quarter of a million dollars yearly to the turkey industry.

Use of alfalfa meal in chicken rations has raised the vitamin and mineral content of the ration in addition to lowering the cost of the feed. However, Professor Alder found that chickens would not tolerate as large a percentage of alfalfa as turkeys.

Professor Alder's work has become known mostly through his direct contacts with poultrymen throughout the state and also through his teaching activities at the college, rather than through publications. He was an effective speaker and a superior teacher. His extension trips took him into every part of the state where he explained the results of his work to poultry raisers. He had the ability to explain technical work in the language of the people with whom he talked. His friendliness and pleasant manner won him friends wherever he went.

He was a good teacher and took a personal interest in the welfare of his students, and through his encouragement and financial help by providing work at the poultry plant, he was able to keep many students in school who would otherwise have become discouraged and left. Among such students was the present president of USAC, Dr. Louis L. Madsen.

One of his last accomplishments at USAC was the planning and development of the new college poultry farm which includes buildings for incubation, brooding, egg production, and other research studies. It is one of the most modern in the country and provides facilities for poultry teaching and research.

Prof. Alder died at his home in Logan April 7 following a serious illness. He leaves a wife and two children, a son Horace B. who is a dentist in California, and a daughter Dorothy (Mrs. Ralph W. Porter) who lives in Logan.

FARM AND HOME SCIENCE

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More detailed information on the subjects discussed here can often be found in Station bulletins and circulars or may be had through correspondence.
Single plant of Utah no. 16 lima bean. This strain produces heavy yields of high quality beans. The pods are thin walled and easily shelled.

**LIMA BEANS, POSSIBLE NEW CROP FOR UTAH**

By LEONARD H. POLLARD

While lima beans have only been grown to a limited extent in Utah, the crop appears to offer considerable possibility, providing a suitable variety can be obtained for this region. In the past, growers and processors have been somewhat reluctant to grow lima beans because of the uncertainty of the crop. Many failures occurred either because of low yields or late maturing crops being frozen before they could be harvested. In nearly all cases, the lateness was the result of a poor set, apparently caused by high temperatures at blossoming time. As a result, only one or two pods might be set on a plant and the main crop would result from a second blossoming period approximately three or four weeks following the first.

**Developing Adapted Varieties**

In order to develop a variety which would yield well under Utah conditions, a breeding program was started in 1947. The plan of the program was to combine high yielding capacity with earliness and good quality and to develop a variety which could be planted earlier in the spring. If such a variety could be obtained, growers might safely plant lima beans the first part of May. Beans planted at that time begin to bloom before the temperatures are high enough to be harmful and, consequently, good crops can be obtained.

In 1950, 32 breeding lines were tried along with 4 commercial varieties to determine their relative value. The results of this trial were encouraging, as two of the lines developed by the Utah Station were outstanding and several others were worthy of further trial. While the commercial varieties ranged in yield from 1,400 to 2,800 pounds, several of the breeding lots averaged around 2,800 pounds, and in all cases these lines were ready to harvest before any of the commercial varieties. The two outstanding varieties produced 3,500 and 4,400 pounds per acre. The highest yielding of these, Utah No. 16, also produced the highest yield in 1949.

**Non-Rotting Seed**

In another experiment designed to develop a lima bean, the seed of which would not rot under adverse conditions in the spring, 59 breeding lots were tested along with 5 commercial varieties in 1950. The beans were planted on April 15 and cool weather prevailed for the two weeks following. The highest germination of all lots (54 percent) was obtained from the variety Hastings Red Butter Pea, a variety grown in the Southern States. The variety Clark's Bush, commonly grown in this area, only gave 2.85 percent germination. Several of the lines which had shown good results in preceding years gave germination of 34 or 35 percent. A large number gave 25 percent germination. Hybrids have been produced between Hastings Red Butter Pea and some of the better germinating lines to see if additional adaptation to Intermountain climatic conditions can be incorporated into these lines. Unfortunately, Utah No. 16, while giving a higher germination percentage than Clark's Bush, did not withstand the adverse conditions of this early planting as well as several of the lower yielding lines. Its performance was, however, encouraging.

From the results of the breeding program so far, Utah No. 16 appears to show considerable promise for production in this area. It will be tested again this year, and if the results are similar to those obtained in the past, it will be increased to a point where it can be released to seedsmen. It is planned to combine the high yielding and good quality of Utah No. 16 with resistance to rotting of some of the other lines.

Dr. Leonard H. Pollard is head of the Department of Vegetable Crops. His chief interest has been developing cash crops for Utah farms, especially the small farms near the larger population areas.
Planning The Dairy Barn Arrangement

Proper Setup and Hard Surfacing of Yards, Feed Platforms, and Mangers are Essentials of Successful Open Shed Housing

By GEORGE Q. BATEMAN

One of the most satisfactory and economical housing methods for dairy cows in Utah is the open shed. When this type of shelter is used it is important that yards, feeding platforms, and areas around the watering trough be hard surfaced so that the dairy cows can be kept clean. Hard surfaced yards also improve the efficiency of manure removal by reducing the amount of labor required for cleaning and conserving the liquid portion of the manure that is lost in the ground when the yard is not hard surfaced.

Through careful planning in the placement of mangers, feed platforms, watering facilities, and the salt-mineral box, with relation to the bedded area under the open shed, it is possible to feed the herd efficiently and protect the bedded area from traffic lanes across it. A desirable arrangement is to have the manger run parallel to the open shed, then the cows move in a direct line out to the manger with a minimum of traffic under the shed. Where the manger is at right angles to the shed the cows tend to travel lengthwise of the shed and then out to the manger, following somewhat the same pattern as they go back under the shed to lie down. This causes considerable disturbance of the bed and of the cows already bedded down.

By placing the water supply out in the yard and a covered salt-mineral box on the fence, the open shed will be used only as a lounging area which will save on bedding and result in cleaner cows.

The gate leading from the yard to the milking unit should be so located that the cows will not move lengthwise of the shed when going to and from the milking unit.

Hard Surfacing

Before hard surfacing the yard the ground should be graded to assure drainage away from the milking barn, mangers, water trough, and open shed to the most desirable side of the corral, where the drainage from the yard can be collected and placed on the land.

Hard surfacing of feed platforms and yards pays dividends in many ways. There is less possibility of injury or infection to the udder from clean surroundings. Hard surfacing keeps cows out of the muck, thus saving time in their preparation for milking; it conserves fertility by preventing leaching of the liquid manure into the ground, and reduces the number of loads of manure that are hauled, because when yards are hard surfaced no soil is mixed with the manure.

Area Required by Cows

The area recommended in the yard when hard surfaced is 150 square feet per cow. This includes the area at the feed platform and manger. Cows can be held on less yard space than this; however, the smaller the space allotment, the more frequent will it be necessary to clean the yard, to keep it in satisfactory condition for the production of quality milk.

Space at the manger for each cow should not be less than 30 inches, an allowance of 36 inches is still more desirable.

A space allotment of 50 square feet per cow under the shed is adequate, however, space in excess of this is satisfactory unless prohibited by additional costs.

Hard surfacing of feed platforms and yards with cement can be done in two ways: by using a regular cement mixture run to a thickness of approximately 4 inches, or by using a combination of cobbles covered with cement. When regular cement is run it will require about 9 bags for each 150 square feet of surface covered 4 inches thick. When cobbles are used and covered with a mixture of 1 part cement, 3 parts sand, and 4 parts pea gravel, 150 square feet of surfacing will require about 9 1/2 bags of cement. Large spaces between rocks should be tamped full of gravel. This will save on the amount of cement required. The cement should be left approximately 4 inches, or by using a combination of cobbles covered with cement.

Hard surfacing of feed platforms and yards with cement can be done in two ways: by using a regular cement mixture run to a thickness of approximately 4 inches, or by using a combination of cobbles covered with cement. When regular cement is run it will require about 9 bags for each 150 square feet of surface covered 4 inches thick. When cobbles are used and covered with a mixture of 1 part cement, 3 parts sand, and 4 parts pea gravel, 150 square feet of surfacing will require about 9 1/2 bags of cement. Large spaces between rocks should be tamped full of gravel. This will save on the amount of cement required. The cement should be left approximately 4 inches, or by using a combination of cobbles covered with cement.

A suggested plan for thirty cows showing arrangement of milking unit, lounging shed, manger, and feed storage with relation to hard surfaced yard and direction of drainage.

GEORGE Q. BATEMAN, associate professor of dairy husbandry, is superintendent of the Dairy Experimental Farm.
In sections of Utah where cobblestones are abundant they can be used efficiently and reduce the cost of hard surfacing. At the Dairy Experimental Farm cobblestones 3 to 6 inches thick were laid as close together as possible on a graded packed surface, then covered with about 2 inches of cement. After thirteen years these hard surfaced areas are in good condition.

NEW PUBLICATIONS


This bulletin lists the composition and quality of the irrigation waters of the state. It discusses the causes of low quality waters and gives recommendations for irrigation, soil management practices, and crop selection where such waters must be used.

Bul. 347. The life history and management of the mountain whitefish in Logan River, Utah, by William F. Sigler, Department of Wildlife Management.

This bulletin outlines the life history of the whitefish or herring as it is commonly called in this area. This fish is taken by few fishermen because it counts toward a legal creel limit the same as trout. However it is considered palatable. The bulletin recommends that the creel limit be modified and the legal season be lengthened.

Single copies of these publications may be obtained free from the Utah Agricultural Experiment Station, Logan.

In many sections of the state ready mix concrete is available, delivered to the farm at a price ranging from $10.80 to $13.80 per cubic yard, for a 5 bag mix, depending upon distance of haul. When 150 square feet is hard surfaced to a depth of 4 inches the cost of concrete will range from $20.00 to $25.00 per cow for solid cement, and considerably less where the concrete is spread over a suitable base of cobbles.

The total cost of hard surfacing is not great and the investment will pay dividends in the saving of labor, the conservation of fertility and in aiding in the production of milk of high quality.

Adequate Bedding

Another most important item for successful open shed housing is an adequate supply of straw for bedding the cows under the shed. The amount of straw needed per cow will range from 1200 to 1600 pounds. The upper limit should be provided when possible. An economical way to acquire a supply of straw is to grow it along with the grain supply that is to be fed the herd. Data on production of barley at the Dairy Experimental Farm show that when a ten year average of 86 bushels of barley was produced per acre the straw harvested amounted to 3206 pounds. At this yield, one acre of barley supplies enough straw to bed 2 cows. Straw aids in open shed housing in the following ways: It keeps the cows clean, gives them a comfortable bed, and protects the udder from injury and cold, soaks up and helps conserve the liquid portion of the manure, and adds humus to the soil when the manure is applied to the land.
Mechanical Harvesting Of Sugar Beets Economical When Machines Are Used To Capacity

By E. M. MORRISON and L. H. DAVIS

With mechanical harvesters, it cost about $1.04 to harvest a ton of sugar beets in Utah in 1950. Cost records from operators of 12 trailer type harvesters in Cache and Box Elder Counties during 1950 were analyzed. These harvesters harvested 818.5 acres and 12,156 tons of sugar beets. No machine harvested less than 50 acres and none more than 88.5 with an average of 68.2 acres per machine, and average yields of 14.8 tons per acre. All machines were employed to perform custom work and worked an average of 24 days during the harvesting season, at an average rate of 2.8 acres per day. The harvesting operations included pulling, topping, and loading the beets for delivery to the receiving station.

Cost of Operation

The cost of labor to operate the harvester and the power unit was the largest single item of cost accounting for 34 percent of the total (table 1). All machines were depreciated at 10 percent of the beginning inventory value. It is interesting to note that the non-cash items including allowance for depreciation, interest on investment, and storage account for more than a third of the total cost. Maintenance and repairs amounted to only 5 percent of the total costs, indicating the machines are reasonably well perfected against the numerous mechanical difficulties of earlier days. The average amount of time lost from mechanical breakdown was less than one hour per day and averaged 20 hours per machine per season. The delay in harvesting because of weather was 2 days per machine.

Extent of Adoption

The extent of adoption of mechanical harvesting varied by area. In some communities no mechanization exists while in others mechanization ran as high as 80 percent in 1950. In some areas sugar beet processors have been actively encouraging the adoption of mechanical harvesters to insure the necessary power for the growing and harvesting of the crop. In these areas the percent of mechanization is higher than in others.

At the present time the sugar beet enterprise is in a period of transition from hand to mechanical methods for many of the growing and harvesting operations. While it always takes time...
for the complete adoption of any changed practice, the mechanical harvesting of sugar beets has proved both feasible and economical under favorable conditions. Mechanical harvesters are, no doubt, here to stay and further devices and methods to improve existing machinery can be expected to continue to be developed rather rapidly.

Greater Capital Investment

The mechanization of the harvesting process increases rather sizeably the amount of capital investment to produce a crop. The average investment per farm raising sugar beets where hand harvesting was used, exclusive of the land investment, was about $230 in 1945 and about $290 in 1950. When an investment in specialized mechanical harvesting equipment of from $2500 to $3500 is contemplated, many producers with small acreage will hesitate to adopt mechanization; but when the hand harvesting equipment is worn out and needs replacing the problem as to the advisability of replacing with mechanical equipment, hand equipment, or not replacing at all will have to be solved. How much yearly use must be had from a machine to make its operations economical will be an important consideration. The most desirable level of use from a cost standpoint under most conditions would be to use the machine to its capacity during the harvesting season. Mechanical harvesters operating in this area in 1950 harvested an average of 2.8 acres per day for a 24-day season. If every work day of the average season was used it perhaps would not exceed 30 to 35 days, making a maximum per harvester of not to exceed 108 acres. The average size of the beet enterprise per farm in Utah, however, is about 11 acres. The average use of a machine could, therefore, range between 11 and 108 acres.

Considering the actual cost of operating mechanical harvesters in 1950 and assuming the rates for topping and loading by hand as established by the U. S. Department of Agriculture for fields of varying yields, and allowing $4.50 per acre for pulling the beets prior to hand topping, the average mechanical harvester of the trailer-type must harvest about 36 acres of beets yielding 15 tons per acre to harvest as cheaply as could be done with hand labor. For each ton that the yield per acre exceeds 15 tons, the acreage needed could be reduced 1.4 acres and for each ton per acre that the yield is less than 15 tons, 1.8 acres must be added to bring the cost of mechanical harvesting to equality with hand harvesting. This assumes the same quality of harvesting work being done by each method. A study at the North Dakota Experiment Station found that 1705 pounds of beets, including whole beets of marketable size, broken beets, and excessive tissue remaining on the crown, were recovered per acre behind hand crews while 1115 pounds

(Continued on page 39)

Table 1. Cost of harvesting sugar beets with mechanical harvesters in Cache and Box Elder Counties, 1950

<table>
<thead>
<tr>
<th></th>
<th>Per harvester</th>
<th>Per acre</th>
<th>Per ton</th>
<th>% of total</th>
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<td></td>
<td>dollars</td>
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<td>percent</td>
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<tr>
<td>Harvester costs:</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Maintenance &amp; repairs</td>
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<td>.66</td>
<td>.05</td>
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<td>Taxes and insurance</td>
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<td>.50</td>
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<td>Storage facilities</td>
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<td>.02</td>
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<td>Total harvester costs</td>
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<td>7.11</td>
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<td>Tractor costs</td>
<td>209.79</td>
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<td>Labor costs</td>
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<td>5.23</td>
<td>.35</td>
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<td>Total harvesting costs</td>
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</table>

Average acres per machine       68.2
Average tons per machine       1013.0
Average yield/acre of beets    14.8
Average days harvester was in operation 24.0
Average tons harvested per day 42.0
Average acres harvested per day 2.8
Average hours broken down per season 20.
Above, Wayne Cook, associate professor of range management, herds experimental sheep on the winter range.

Right, Dale T. Drollinger, Farmers’ Grain Cooperative, Ogden (This company furnished the dehydrated alfalfa pellets, defourinated phosphate, and bone meal for these experiments) Wallace Wintch, who with his father, Wilford Wintch, owns the experimental sheep, and Lloyd Larson, secretary of the American Dehydrators Association of Chicago who gave a grant of $2000 toward the expenses of the research. Swift and Company and the International Minerals and Chemical Company of Chicago have also given financial support.

A BOUT 85 percent of the land area of Utah is range land grazed by sheep and cattle during a large part of the year. In the summer these animals graze on the high mountain ranges, in the spring and fall on the foothills. In the winter many sheep graze on the semi-desert ranges. These ranges have a diversity of soil, climate, topography, and vegetation.

Little has been known of the nutritive value of range forage, except that it is often borderline or deficient in essential nutrients. In order to obtain basic information on the nutritive content of this forage and the supplemental feed needs of sheep on the range an extensive study was begun about five years ago by the Animal Husbandry and Range Management Departments of the Utah Agricultural Experiment Station in cooperation with the Desert Range Experiment Station, U. S. Forest Service, and aided by funds from Swift and Company, the International Minerals and Chemical Corporation, the American Dehydrators Association, all of Chicago, and the Farmers’ Grain Cooperative, Ogden. Dr. L. E. Harris, Dr. C. Wayne Cook, and Dr. L. A. Stoddart have been in charge of the research. The project included studies of four phases of range nutrition: (1) factors that affect the chemical composition of a given range plant species, (2) the botanical and nutritive composition of the sheep’s diet, (3) supplementary feeding trials on a detailed experimental basis, and (4) supplementary feeding trials on a practical basis using the supplements.

(Continued on page 40)
The sheep were fed barley and soybean oil meal pellets individually every other day in buckets (Circle). They were weighed at monthly intervals to check gains (Right). The monosodium phosphate was dissolved in water and put in a small bottle. The sheep were eager to drink this solution (Lower). Temporary corral, pens, scales, sheep wagon, and other equipment used in the experiment.
CROSS-POLLINATION of alfalfa, which is essential for seed production, is accomplished in Utah by many species of wild bees. Since most of these wild species visit alfalfa primarily for pollen, they trip and thus cross-pollinate most of the flowers they visit. Bee for bee they pollinate alfalfa more efficiently than do honey bees, which more often than not visit the flowers only for nectar and avoid the tripping mechanism (see table 1).

Moreover, many of the wild bees, such as the leaf cutters and bumble bees, seem to have a special knack for gathering alfalfa pollen and trip more flowers per minute than do pollen-collecting honey bees (see table 2).

The principal difficulty with wild bees as pollinators of alfalfa is that they are rarely abundant enough to do a thorough job. Furthermore, their populations tend to fluctuate widely from year to year (see table 3). No reliable methods of increasing wild bees or even insuring the survival of existing populations have yet been devised. It is apparent that honey bees, despite their relative inefficiency, are in most areas more reliable for pollination. However, in limited areas, wild bees are doing an excellent job by themselves and are performing a useful supplementary role in most seed-growing districts.

Alkali Bee Most Important Wild Pollinator

The alkali bee (Nomia melanderi [Ck11]) is the most important wild pollinator of alfalfa in Utah and several other western states. Since it nests in large aggregations, relatively small areas of undisturbed land may support populations capable of effectively pollinating fields for a radius of a mile or more. This bee is confined to areas containing moist, alkaline soils, which usually support nothing but a sparse growth of bassia, saltgrass, and glasswort. Larger valleys are the most likely to have the proper habitats. Seepage areas favorable for nesting may be either natural or man-made as in the case of the sides of borrow pits along unlined irrigation canals. In Utah some of the best aggregations are located near Delta, in the Flowell district near Fillmore, and in Pleasant Valley near Duchesne. Previously thriving aggregations in Cache Valley have nearly disappeared. The nesting sites are usually on low hummocks or gentle slopes where the soil is kept moist from beneath but where flooding does not take place over extended periods.

The nesting sites of alkali bees should always be protected from such
disturbances as ploughing, trampling, or irrigation. Growers can readily learn to recognize these sites from July to September when the adult bees are active. Since new sites favorable to alkali bees may become occupied by thriving aggregations in a single season, it should be entirely practical for growers to encourage new nesting populations by creating favorable sites on untilled land.

Bumble Bees Need Spring Forage

Bumble bees are excellent alfalfa pollinators, but are usually present in effective numbers only on small acreages near much rough, untilled land with natural water courses and good cover. They may also be fairly abundant near the margins of towns, where garages, barns, and the like furnish many nesting places. In order to build up in numbers prior to the blossoming of alfalfa, bumble bees must have forage available continuously from early spring. In arid areas small irrigated stands of an early blossoming crop, such as hairy vetch, should tide them over the late spring period, which is usually deficient in natural bloom. That bumble bees need spring forage has been strikingly demonstrated in a small seed district south of Kanab, Utah, where bumble bees have generally been abundant and effective pollinators. In 1950 there was no spring bloom because of a drought and by the time the irrigated alfalfa came into blossom there were no bumble bees left to pollinate it.

Leaf-Cutting Bees Efficient Pollinators

Leaf-cutting bees, which are among the most efficient alfalfa pollinators, are generally present on seed fields, but usually in small numbers. In areas where these bees are common, people are usually aware of their presence because of the pieces they cut (Continued on page 37)
LIFE on earth depends on the activities of microorganisms in soils and water basins. Plants and animals, including man, could not survive long if these organisms were not present. They break down complex substances into simpler compounds and cause transformations which make carbon, nitrogen, sulfur, phosphorus, and other elements available for the nutrition of all forms of life.

We know that disease-producing germs, with a few exceptions, do not persist long in the soil. This is owing to the interrelationships between the pathogens and the non-disease-producing organisms. Organisms that live together affect each other favorably, indifferently, or antagonistically. Antagonisms between disease-producing organisms and non-disease-producing organisms eventually result in the eradication of disease germs foreign to the soils or water basins they contaminate.

Functions of Soil Organisms

Investigators now are finding that not only do these non-pathogenic microorganisms keep our world clean and provide us indirectly with food, but they also help us fight disease. Streptomycin, penicillin, and aureomycin are examples of disease-combating agents produced by these soil organisms.

Soil Organisms Antagonistic to Bacteria

The article “Utah soils potential sources of antibiotics” (Farm and Home Science, December 1950) showed that Utah soils contain many species of actinomycetes, soil organisms that are antagonistic to bacteria. Seventy-seven unknown species of antagonistic actinomycetes were isolated. Further research has been made using these 77 unknown organisms and two others found in the laboratory showing antagonisms to disease-producing organisms.

These were tested using five bacterial species that cause diseases in plants. It was found that 58, or 74 percent, of the antagonists were active against one or more of the plant pathogens; 35 percent of the 58 organisms were active against two, 21 percent against three, 16 percent against four, and 7 percent of the antagonists inhibited the growth of all 5 plant pathogens.

It was also found that 78 percent of the 58 actinomycetes inhibited the bacterium that causes canker in tomatoes. The organism causing soft rots in vegetables was inhibited by 57 percent of the antagonists. Forty-one percent of the unknown antagonists were active against the organism causing destruction of tissues in beans. Forty percent of the actinomycetes inhibited the germ that causes destruction to tissues in cabbages, cauliflowers, and rutabagas. The bacterium causing galls on various plants was inhibited by 26 percent of the antagonists.

Antagonisms to Plant Diseases

Among the plant pathogens studied, a few strains developed that were resistant to the action of 60 percent of the antagonists. The rest of the unknown actinomycetes completely inhibited the plant pathogens for which they were antagonistic.

Generally the causative organism of canker in tomatoes was inhibited to the greatest extent. The soft rot pathogen was next in susceptibility to the antagonists, while the bean, cabbage and gall disease-producing organisms followed in order of susceptibility.

Table 1. Comparison of the spectra of the unknown antagonist and Streptomyces griseus

<table>
<thead>
<tr>
<th>Test organisms</th>
<th>Gram stain</th>
<th>Antagonist S. griseus</th>
<th>zone in mm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. aerogenes</td>
<td>+</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Sarcina</td>
<td>+</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Al. fecalis</td>
<td>+</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>X. phaseoli</td>
<td>+</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>E. carotovora</td>
<td>+</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>X. campestris</td>
<td>-</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>C. michiganense</td>
<td>-</td>
<td>28</td>
<td>30</td>
</tr>
<tr>
<td>Ag. tumefaciens</td>
<td>+</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Pr. vulgaris</td>
<td>+</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>S. pyogenes</td>
<td>+</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Sh. alcalens</td>
<td>-</td>
<td>22</td>
<td>0</td>
</tr>
<tr>
<td>C. diptheriae</td>
<td>+</td>
<td>21</td>
<td>19</td>
</tr>
<tr>
<td>B. subtilis</td>
<td>-</td>
<td>17</td>
<td>20</td>
</tr>
<tr>
<td>Paracolo. sp.</td>
<td>-</td>
<td>4</td>
<td>17</td>
</tr>
<tr>
<td>E. coli</td>
<td>+</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>M. phlei</td>
<td>+</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>M. friedmannii</td>
<td>+</td>
<td>14</td>
<td>24</td>
</tr>
<tr>
<td>S. aureus</td>
<td>+</td>
<td>13</td>
<td>18</td>
</tr>
<tr>
<td>Ps. aeruginosa</td>
<td>-</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>S. typhosa</td>
<td>-</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>N. catarrhalis</td>
<td>-</td>
<td>8</td>
<td>19</td>
</tr>
</tbody>
</table>

*not tested
It was decided to conduct a more extensive test using one of the more active unknown antagonists. During this research, animal, human, and plant pathogens were used as test organisms. In this experiment the actinomycete which produces streptomycin was used to compare with the organism used in this study. The organism and the streptomycin-producing actinomycete were tested against the pathogens in exactly the same manner.

The figures accompanying this article show the results of the testing against some of the disease germs. The antagonist is located in the center of the plate either as a round colony or in the shape of a cross. In the clear area immediately surrounding the antagonist, no growth of the pathogen occurred. At the outer edge of the clear zone the pathogen was far enough from the antagonist not to be affected by it.

Results of the comparison of the unknown antagonist with the streptomycin-producing actinomycete are given in table 1. From the table it can be seen that under the conditions used in this laboratory the streptomycin-producing organism was more active against the gram negative bacteria (those not holding a purple dye when stained), while the unknown antagonist showed similar results against the gram positive organisms. It will be noticed that in two separate instances for each, the unknown antagonist and the streptomycin actinomycete each inhibited organisms which the other did not affect.

**Illustrations**

The illustrations which appear with this article show some of the results of the unknown antagonist against various pathogens. Fig. 1 (B) shows the action of the antagonist against the bacterium which causes strep sore throat, and which also may cause mastitis in cattle. Fig. 2 (E) illustrates the action of the antagonist on a normally non-pathogenic organism occurring in the intestinal tract.

Fig. 3 (F) shows the results of the behavior of the unknown antagonist against the plant pathogen causing a soft rot in vegetables. Fig. 4 (G) illustrates the activities of the unknown against a microorganism which experimentally causes tuberculosis in cold blooded animals. Fig. 5 (H) represents the reaction between the antagonist and a bacterium isolated from cases of dysentery. Fig. 6 (I) illustrates the action of the antagonist on the causative organism of canker.

(Continued on page 40)
THE 1950s mark a century since the introduction of alfalfa into Utah and other western states. During the past 75 years it has probably been the most important forage crop in the state, having been grown on approximately one-half of the irrigated acreage. To save importing the seed, the early settlers attempted to grow it, and were successful beyond expectations. Utah thus became an important source of seed. From 1900 to 1925 Utah produced one-fifth of the world’s supply of alfalfa seed and from one-third to one-half of the crop grown in the United States.

Origin and Early History

So-called “Common alfalfa” is believed to be native to southwestern Asia. It was probably planted and cared for by half-civilized men ages before any history was written, but since the beginning of recorded history it has played an important part in the development of many cultures and civilizations. It was an important forage plant in the ancient kingdoms of the Medes and Persians, and was carried by them into Greece at the time of their invasion of that country in 490 B.C.

The Romans knew of the value of alfalfa and its great yielding power, and its habit of growing rapidly after cutting, and its quick response to soil moisture. They understood its need for a well prepared seedbed and of the importance of keeping down weeds during the first year of its growth. They also knew of its tendency to produce bloat in cattle and of its ability to enrich the soil.

The Arabs spoke of alfalfa as a plant that thrives best with its head in the sun and its feet in the water. This was their way of telling of its special adaptation to regions of intense sunlight, and of its ready response to irrigation. It was carried by the Arabs into Spain at the time of their invasion of that country in 711 A.D., and later by the Spaniards into South America and Mexico, where it gained prominence as a field crop.

The Arabs brought alfalfa to Spain during their invasion of that country in 711 A.D., and later by the Spaniards into South America and Mexico, where it gained prominence as a field crop. But since conditions there were not conducive to its growth, it did not become firmly established. Alfalfa is a dry climate crop. For this reason it

thrived well in California and Utah after its introduction in 1850.

According to Hamilton Gardner in his history of Lehi, as reported by Alter in 1920, alfalfa was first brought to Utah by Isaac Goodwin in 1859. As a member of Captain Samuel Brannan’s company Goodwin had landed at San Francisco in 1846. He later came to Utah bringing with him a little alfalfa seed which he planted in Lehi in 1860. From this seed seven plants were grown and cared for with patience and perseverance. At last he was able to produce sufficient seed to enable him to sell some of it to his neighbors for one dollar per pound from which plantings were established for the production of hay. Alfalfa may also have been brought into Utah prior to this time by immigrants from Europe, since the plant was well known during the early years of its culture in Utah by its European name of “lucern.”

An apt description of what followed the introduction of alfalfa into Utah is given by an early writer in one of the yearbooks of the United States Department of Agriculture, as follows: “Where a spring or mountain stream moistened a bit of the desert, the pioneers planted their precious seeds. When the summers dried up the springs, many of the tender crops brought from the old home died, but the alfalfa lived. With the tenacity bred by a thousand rainless summers in its native home, its roots followed the retreating moisture into the earth and held on. Alfalfa supplied the feed for the herds when they came home from the summer range, and in turn the herds have sustained the people.” Thus from the beginning alfalfa has played a vital part in the establishment of almost every community in the state.

Alfalfa Seed

In 1909, according to the census, the commercial growing of alfalfa seed was restricted chiefly because of unfavorable climatic conditions, to Utah, Kansas, Nebraska, California, Arizona, Colorado, Oklahoma, Idaho, Montana, and Wyoming, named in the order of total production. A varying seed acreage was reported else-

Continued on page 39
WILD BEES AS POLINATORS OF SEED ALFALFA
(Continued from page 33)

Table 1. Percent of pollen collectors on alfalfa—various bees in Utah

<table>
<thead>
<tr>
<th>Species (all females)</th>
<th>Bees observed</th>
<th>Pollen collectors number</th>
<th>percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honey bees</td>
<td>5232</td>
<td>0.6*</td>
<td></td>
</tr>
<tr>
<td>Wild bees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bombus occidentalis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(workers in August)</td>
<td>42</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>Bombus huntii</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(workers in September)†</td>
<td>61</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Bombus fervidus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(workers in August)</td>
<td>9</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Megachile spp.</td>
<td>many</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Nomia melanderi</td>
<td>420</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Halictus rubicundus</td>
<td>16</td>
<td>100†</td>
<td></td>
</tr>
<tr>
<td>Tetralonia edwardsii</td>
<td>24</td>
<td>96</td>
<td></td>
</tr>
</tbody>
</table>

*An average of many counts in Cache and Box Elder Counties. Percentages of pollen collectors have been seen to range as high as 30 in some fields in Millard County.
†Bumble bees tend to become nectar collectors at the end of the season.
§Tripping rates vary from 0 to 6 per minute.

out from leaves of rose bushes and of certain other shrubs in order to line their brood cells. Their destructive
ness is actually minor when balanced against their efficient services as pollinators. The several species of
leaf-cutters that are valuable in Utah nest in the ground and are solitary in their habits. Apparently
they need large areas of untilled nesting grounds to develop effective populations. Although their season of
activity does not begin until late spring, a crop producing attractive bloom at this time, such as hairy vetch, would probably help them to build up to useful numbers by midsummer.

Growers can take best advantage of the available populations of wild pollinators by timing the blooming of the
crop to be pollinated with the bees' period of greatest activity. For example, the alkali bee does not
generally appear until second-crop alfalfa (or a grazed-back first crop) begins to bloom. On the other hand, several
types of wild bees, such as Osmia, Tetralonia, and Halictus, are most abundant at the time of first-crop bloom. Growers can get help on this problem by sending examples of their more abundant pollinators to the

Utah Agricultural Experiment Station.

Prospective seed growers, especially those planning to raise certified seeds for which isolation is required, should establish seed fields in areas that have or are likely to have good populations of alfalfa-pollinating species of wild bees. Small acreages surrounded by uncultivated land, especially if near water courses and a varied terrain, are the most likely to be well supplied with wild bees. Limitation of the acreage in bloom at any one time may be necessary to keep the available populations from spreading too thinly over the crop to be pollinated.

Avoidance of bloom-stage applications of insecticides is important to the survival of wild bees. Observations and experiments to date indicate that populations of wild bees are even more susceptible than honey bees to decline following the use of insecticides on blossoming plants. The grower must also recognize that, once wild bees are drastically reduced in number or destroyed in an area, it may be difficult or impossible to bring them back.

Table 2. Tripping rates on alfalfa—various bees in Utah*

<table>
<thead>
<tr>
<th>Species (all females)</th>
<th>No. observed</th>
<th>Total minutes observed</th>
<th>Avg. flowers tripped/minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honey bees (nectar collectors)</td>
<td>21</td>
<td>126</td>
<td>0.14</td>
</tr>
<tr>
<td>Honey bees (pollen collectors)</td>
<td>4</td>
<td>28</td>
<td>7.4</td>
</tr>
<tr>
<td>Wild bees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bombus morrisoni (queens)</td>
<td>3</td>
<td>6</td>
<td>2.4</td>
</tr>
<tr>
<td>Bombus morrisoni (workers)</td>
<td>2</td>
<td>5</td>
<td>16.8</td>
</tr>
<tr>
<td>Megachile dentitarsis</td>
<td>6</td>
<td>13</td>
<td>18.2</td>
</tr>
<tr>
<td>Osmia secunda</td>
<td>4</td>
<td>9</td>
<td>16.6</td>
</tr>
<tr>
<td>Nomia melanderi</td>
<td>9</td>
<td>34</td>
<td>11.8</td>
</tr>
<tr>
<td>Halictus rubicundus</td>
<td>6</td>
<td>19</td>
<td>3.6</td>
</tr>
<tr>
<td>Chlora dentithorax</td>
<td>many</td>
<td>—</td>
<td>0.0</td>
</tr>
<tr>
<td>Andrena prunorum</td>
<td>2</td>
<td>4</td>
<td>3.1</td>
</tr>
<tr>
<td>Tetralonia edwardsii</td>
<td>4</td>
<td>9</td>
<td>14.6</td>
</tr>
</tbody>
</table>

*All counts made by the author

Table 3. Populations of wild bees on alfalfa from 1947 to 1950, South Logan

<table>
<thead>
<tr>
<th>Species</th>
<th>1947*</th>
<th>1948†</th>
<th>1949‡</th>
<th>1950§</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halictus rubicundus</td>
<td>6.3</td>
<td>0.0</td>
<td>0.0</td>
<td>1.4</td>
</tr>
<tr>
<td>Megachile peritha texana</td>
<td>2.1</td>
<td>2.0</td>
<td>0.7</td>
<td>1.7</td>
</tr>
<tr>
<td>Osmia secunda</td>
<td>3.2</td>
<td>0.3</td>
<td>0.0</td>
<td>0.6</td>
</tr>
<tr>
<td>Bombus occidentalis morrisoni</td>
<td>0.0</td>
<td>0.3</td>
<td>2.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Halictus huntii mormonorum</td>
<td>3.2</td>
<td>0.7</td>
<td>1.4</td>
<td>0.3</td>
</tr>
<tr>
<td>Total</td>
<td>20.1</td>
<td>12.4</td>
<td>6.6</td>
<td>4.9</td>
</tr>
</tbody>
</table>

*Total of 95 square yards counted on July 15, 28
†Total of 297 square yards counted on July 15, 19, 27, August 3
‡Total of 288 square yards counted on July 28
§Total of 360 square yards counted on July 12, 19, August 9

for June 1951
occasions encouraged a heavy weed growth after June 5 on untreated check plots. The weeds consisted mostly of green foxtail grass, redroot pigweed, and mustard. The pre-emergence treatments made June 5 eliminated 86 to 98 percent of the broadleaf weeds and 40 to 79 percent of the weedy grasses as compared to untreated checks. Micronized 2,4-D alone at 3 pounds per acre gave the best weed control followed closely by the combination of 2,4-D and Endothal (disodium-3,6 endoxohexahydrophthalate). These reductions in stand of weeds by treatments made June 5 held throughout the remainder of the season.

The two post-emergence treatments made June 23 were much less effective in controlling weeds. Carrot wedding oil reduced the first crop of broadleaf weeds 76 percent and weedy grasses 70 percent while the dinitro weed killer reduced broadleaf weeds 78 percent and weedy grasses only 25 percent. Neither of these chemicals appeared to have any residual effect in the soil and a heavy stand of annual weeds, especially grasses, developed late in July. None of the pre-emergence treatments made June 5 or the post-emergence treatments made June 23 were effective in controlling the few perennial weeds present and the wild oats that had escaped cultivation and hand weeding.

The untreated, hand weeded check plots were hand weeded only once after June 5. This hand weeding was done June 28 and required 46 man-hours of hand labor per acre. A second crop of small weeds developed late in the season on these plots but was not hoed out because of the danger of breaking the brittle onion stalks and because the weeds did not appear to be competing seriously with the onions or threatening to interfere with onion seed harvest. However, the small weeds did produce considerable mature seed.

Injury to Crop from Weed Sprays

No matter how effective a treatment may be in the control of weeds, it is of little value if it injures the seed crop or reduces the yield of viable seed in any way. As early as June 27 it was apparent that the 2,4-D treatment applied as high as 3 or 4 inches up from the base of the onion plants has reduced their vigor by 7 percent. On the other hand, 2,4-D applied only 1 to 2 inches up from the base, at both the same and higher rates, did not reduce the vigor of onions. It was also observed on the same date that the carrot weed oil had reduced the onion plant vigor by 7 percent.

Seed Yields

Seed in all plots was harvested in early September, and after drying was threshed and cleaned by equipment and methods entirely comparable to commercial milling operations. Only the 2 inner rows of each plot were used for harvest records. As can be seen from the data in table 1, the onions in the plots which received an applications of 3 pounds per acre of 2,4-D acid produced for all practical purposes as high a yield (394 pounds), as was obtained from the plants in the hand weeded plots (404 pounds). The lowest yield in the entire series was 273 pounds per acre from the untreated plots in which the late emerging weeds were allowed to grow after June 5. Onions subjected to several treatments, including the dinitro herbicide and the lowest amount of 2,4-D (one pound per acre), performed but little better than those in the treatment where the weeds were allowed to grow. 2,4-D when sprayed on the onion plants 3 to 4 inches above the ground also reduced yields to about the same extent. Endothal, where combined with 2,4-D, resulted in 376 pounds of seed per acre, only 28 pounds below the highest yield.

Success of 2,4-D Acid

The satisfactory performance of 2,4-D acid at a rate as high as 3 pounds per acre points the way to a possible program of great promise for onion seed growers. The 2,4-D at this rate not only controlled annual weeds better than did hand weeding and at only a fraction of the cost, but had no adverse effect on either the yield of onion seed or its viability. Actually, for all practical purposes, none of the herbicides caused serious losses of viability, as the lowest average germination was 96 percent.

Table 1. Control of annual weeds in seed onions at Logan, Utah, 1950

<table>
<thead>
<tr>
<th>Treatment — chemical &amp; rate per acre</th>
<th>Weeds per sq. ft., June 27</th>
<th>Yield of onions cleaned seed/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Broadleaf</td>
<td>Grasses</td>
</tr>
<tr>
<td>A. Applications made June 5 immediately following final cultivation and furrowing for irrigation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,4-D acid, 1 lbs. in 40 gals. water</td>
<td>1.0**</td>
<td>22.6**</td>
</tr>
<tr>
<td>2,4-D acid, 1.5 lbs. in 40 gals. water</td>
<td>.2**</td>
<td>14.3**</td>
</tr>
<tr>
<td>2,4-D acid, 3.0 lbs. in 40 gals. water</td>
<td>1.5**</td>
<td>11.8**</td>
</tr>
<tr>
<td>2,4-D acid, 2.0 lbs. in 40 gals. water</td>
<td>.2**</td>
<td>5.8**</td>
</tr>
<tr>
<td>2,4-D acid, 2.0 lbs. in 40 gals. water applied to hit 3-4&quot; up on the onions</td>
<td>.7**</td>
<td>12.6**</td>
</tr>
<tr>
<td>2,4-D acid, 1.5 lbs. + STCA, 2 lbs. in 40 gals. water</td>
<td>.7**</td>
<td>12.0**</td>
</tr>
<tr>
<td>2,4-D acid, 1.5 lbs. + Endothal, 2.0 lbs. + NH4SO_4, 10 lbs. in 40 gals. water</td>
<td>.6**</td>
<td>8.1**</td>
</tr>
<tr>
<td>B. Applications made June 23 after first crop of weeds had emerged following final cultivation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carrot weed oil at 60 gals/A</td>
<td>2.3**</td>
<td>11.4**</td>
</tr>
<tr>
<td>Dinitro weed killer at 6 qts/A in 80 gals. water</td>
<td>2.1**</td>
<td>28.5*</td>
</tr>
<tr>
<td>Untreated check — not hand weeded</td>
<td>9.4</td>
<td>40.8</td>
</tr>
<tr>
<td>Untreated check — hand weeded, June 28</td>
<td>9.5</td>
<td>35.4</td>
</tr>
<tr>
<td>C. Applications made April 26 just after onion bulbs were planted and as wild oats emerged.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isopropyl N-phenyl carbamate (IPC) at 4 lbs. + Aerocyanate at 10 lbs. in 60 gals. water</td>
<td>8.1</td>
<td>36.2</td>
</tr>
</tbody>
</table>

( The data are averages of 4 replicates for each treatment. )
**Superiority to untreated check, not hand weeded, is significant.
*Superiority to untreated check, not hand weeded, is highly significant.
Although the results of these experiments are encouraging, considerably more information is needed before definite recommendations can be made to growers for the use of 2,4-D or other chemicals to control annual weeds in seed onions.

A rain measuring .51 inch, which occurred 3 days after the pre-emergence applications on June 5, 1950, provided ideal conditions for making the chemical effective on germinating weeds without injuring the growing onions. It is doubted that results would have been as good if no rain had come for several weeks after the chemical applications. It remains to be determined whether a furrow irrigation will accomplish the same purpose as adequate rainfall soon after the pre-emergence chemical treatment.

While the onions were not shielded from the spray during the experiment at Logan in 1950, it is believed that suitable equipment for preventing the chemical spray from coming in contact with the onions above the lower 1 or 2 inches would be necessary in any field or commercial applications with power sprayers. Shielding equipment reported to be satisfactory on a field scale for application of chemicals in onions has been devised recently by C. E. Peterson and associates at the Iowa Agricultural Experiment Station, Ames, Iowa.

A comprehensive experiment is being conducted at Logan in 1951 comparing different commercially available formulations of 2,4-D with the micronized 2,4-D acid which gave good results in 1949 and 1950. The 1951 experiment also includes a wider range of rates of 2,4-D than has been previously tested. A series of spray treatment was made immediately after the onion bulbs were planted in 1951 to determine whether 2,4-D and certain other chemicals can be used effectively and safely as pre-emergence treatments to control annual weeds early in the season as well as later after the onions have started to bolt. It is hoped the 1951 experiment will provide sufficient information upon which to base definite recommendations for use in the 1952 growing season.

**ALFALFA IN UTAH**
*(Continued from page 36)*

where over the United States, but in the humid regions the plant set a fair quantity of seed only in the occasional years of extreme drought. In Kansas good seed crops were harvested in seasons marked by the general failure of other crops because of drought.

The alfalfa seed crop was looked upon as being exacting in its environmental requirements. As one observer stated, "the crop is never assured until the seed is in the bags"; and another, that even after the seed is in the bags the success of a season could not be fully realized until the effects of the weather on the seed crops of other states were known.

In Utah in the early days of seed production crop failures were attributed to hot winds or to periods of cloudy sultry weather with little or no wind. However, untimely frosts seemed to be the cause of the greatest losses in production and was the factor about which early seed growers were most concerned.

**Seed Yields and Production Trends**

The high peak in production of alfalfa seed in Utah was attained in 1925 with a total output of more than 23 million pounds and an average acre yield of 320 pounds. It is estimated that approximately 14 million pounds of this crop was grown within a radius of about 15 miles of Delta in Millard County, and about 7 million pounds within a similar distance of Myton in Duchesne County. Production seems therefore to have been restricted at that time to a few areas of the state which for some reason seemed to be best suited to this crop. At this time more than 40 percent of the irrigated acreage of the state was growing alfalfa with from 10 to 20 percent of it being devoted to the growing of alfalfa seed.

Yields and total production of alfalfa seed in Utah declined rapidly from 1925 to 1932. Drought and economic distress added to the troubles of seed growers, and many were forced to liquidate their holdings. More than one-third of the alfalfa seed acreage in the state was lost or abandoned.

With the decline of seed yields, scientists at the Utah Agricultural Experiment Station began to study the causes. After much research came the important discovery that lygus bugs were a major factor causing the low yields. When this discovery was made it was found that there were no insecticides then available that would give economic control of this pest. It was not until the development of DDT and the other new organic insecticides that successful control measures for this pest could be worked out.

Since 1945 there has been a notable improvement in yields and total production of alfalfa seed in Utah and other western states. But it has been found that although alfalfa will not produce adequate yields of seed without the control of lygus bugs, there are other factors important to the production of high seed yields, among which are soils and soil moisture, variety of alfalfa, cultural and management practices, and insect pollination. Many factors are involved and these require the attention of workers in various branches of agricultural science.

**MECHANICAL HARVESTING OF SUGAR BEETS**
*(Continued from page 29)*

of beets were recovered behind mechanical harvesters. No effort was made to measure the effects of the two harvesting methods on the condition of the land. Where more than 36 acres of 15-ton beets are harvested per machine each season, saving in harvesting costs can be made by use of mechanical harvesters on the basis of 1950 cost relationships.

The findings of this study are much the same as those found by the Colorado and the North Dakota Experiment Stations when differences in cost levels, rate of depreciation, and size of enterprises are taken into account.

Dr. Ellis W. Lamborn, assistant professor of agricultural economics, who has been on leave the past year, has resigned to accept a position in New York.
in tomatoes. Fig. 7 (K) shows the action of the unknown actinomycete on a non-pathogenic organism found in soils, dust, and hay, belonging to the same family as the tuberculosis organisms.

This work is still in an early stage but when this research has been completed the toxicity of the substances toward plant, animal, and human life will have been more fully determined. These substances, if non-toxic, could be used to combat diseases: plant, animal, or human, that constitute large economic losses.

SHEEP NUTRITION STUDIES

(Continued from page 30)

found most valuable in various combinations, amounts, and seasons.

Work on the first two phases of the study has already been completed and the results published in Utah Agricultural Experiment Station bulletins 342 and 344. The illustrations here show the experimental equipment used in the third phase of this study.

The main consideration that has prevented large scale supplementary feeding experiments in the past is the cost of fencing a sufficient number of pastures to make an adequate measure of the benefits. For this work the project leaders have devised individual portable pens for feeding the sheep on the range. These permit all experimental animals to graze together normally on open range and eliminate the cost of pasture fencing. The sheep are herded on the open range every day, corralled at night, and fed every other day in individual portable pens. The sheep are numbered and fed supplements from a paper bag similarly numbered. At the conclusion of this research, it should be possible to make general recommendations to sheep raisers on the supplements needed for the most efficient production of wool and lamb.

FACTS ABOUT UTAH LANDS

Ownership: percent  Land use: percent
Private 21.0  Cropland 3.3
County and municipal .2  Range land open for grazing 87.8
State 5.3  Special use 6.1
Federal 72.3  Barren land 1.6
Not accounted for 1.2  Not accounted for 1.2

CONTRIBUTIONS TO RESEARCH

February 15 to May 15, 1951

$2000 for research on soils and irrigation Utah Idaho Sugar Company
$1200 for research fellowships in cereal breeding Ogden Grain Exchange
$100 for study of synovitis in turkeys Dairy and Poultry Division
$600 for work on Heptachlor, new chemical for insect control Swift and Company
800 pounds 5 percent chlordane dust for studies Velsicol Corporation
4 gallons Heptachlor emulsion on insect control Shell Chemical Corporation
30 pounds Heptachlor wettable powder Hercules Powder Company
15 gallons 75 percent chlordane emulsion Rohn & Haas Company
1 gallon aldrin for studies Geneva Steel Division
2 gallons shell dieldrex 15 United States Steel Company
20 gallons emulsion concentrate containing 6 pounds toxaphene per gallon Fertilizer Division
2 gallons 25 percent emulsion concentrate Anaconda Copper Company
8 tons ammonium sulfate for research E. I. Du Pont de Nemours Co.
4 tons treble superphosphate for fertilizer research Wasatch Oil Company
560 pounds Nu Green fertilizer research
6 samples of road oil for weed control research

FARM and HOME Science