High Freight Rates Unfavorable to Agricultural and Industrial Development in Utah

By V. L. ISRAELSEN

UTAH is unfavorably situated in relation to the large consuming centers that provide the principal markets for agricultural products. Whether the Utah farmer moves his produce to these markets by rail or by motor truck, his costs of transportation are heavy and will have an important bearing on his net income.

In the postwar period there have been successive increases in freight rates. These have been similar to increases following World War I, except in this latter period they started from a considerably higher level than after the first World War. A second factor of importance for the Utah farmer is that the increases in rates have been on a percentage basis. Thus the spread between the cost of transporting commodities from this area to market compared with the costs of the more favorably situated producers has been further widened. Since he is in direct competition with producers who are more advantageously located, these differential costs will have to be borne largely if not entirely by the Utah farmer. These increased transportation rates have come since early 1946 and are generally now about 50 percent above the rate level at the end of the war. Increases in rates on agricultural products were not as great as those on non-agricultural commodities. The Interstate Commerce Commission now is considering a request by the railroads for an additional increase of 13 percent. Hearings on this request were conducted in Salt Lake City on April 4, 5, 6, 1949. Of the 13 percent requested, the Commission has granted a 5 percent interim increase pending its decision on the full amount of the request.

During 1947 there were shipped from Utah 5,217 carloads of certain fruits and vegetables. In 1948 the corresponding figure was 4,183. The index of freight rates on these commodities together with the gross revenue derived from them by the railroads for the period 1913 through 1948 is shown in fig. 1. It is of interest to note that while the rates rose rapidly following World War I the subsequent decline, though rather sharp from 1920 to 1922 was, from the latter year to 1946, gradual, percent above their prewar level while the prices of produce fell more than 30 percent below that level. For these reasons freight rates are much more burdensome and will take a larger share of the farmers' gross product in periods of low prices than in periods of high prices.

A second important fact presented in the chart pertains to railroad revenue. Revenue derived by the roads depends not only on the level of rates charged but on the volume of traffic, the length of haul, and certain other factors. Revenues increased substantially during the second World War period even though the rate remained almost stationary. The chart further indicates that the substan-

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THE poultry research work of the Utah Station is being moved from the campus to two new farms, one for chickens and one for turkeys. These two farms are separated to prevent the spread of disease from the chickens to the turkeys and vice versa. The turkey farm will be featured in a later issue of Farm and Home Science.

The new chicken farm is about one mile directly north of the College campus in North Logan. The buildings are nearing completion and some of the research work has already started. The large office building (shown in the picture) has a basement and two floors. Cold storage facilities are provided in the basement along with rooms for egg quality work. The main floor provides a farm office and a room for class instruction. Another room is designed to house the incubators and three new Jamesway incubators are being installed. These incubators have a combined capacity of 7500 eggs and are completely automatic. The top floor will be used for student quarters. Students majoring in poultry husbandry will be required to live at least one quarter at the farm. During this time they will be given practical training in the different types of work to be done on a poultry farm.

The front part of the second building is used for a residence for the plant superintendent so that he may keep a close check on the research work and the stock on the farm. In the back of this building is the killing and dressing laboratory. This is equipped with a mechanical chicken picker, thermostatically controlled hot water, scalding vats, and tables for eviscerating and preparing poultry for cold storage.

This building also provides a research laboratory for hen batteries. Ten batteries with a capacity of 18 laying hens per battery are constructed so that each hen has its own compartment approximately 12 by 18 inches. Individual records on egg production, feed consumption, and efficiency of food utilization can be kept on 180 hens housed in these batteries.

The third building contains a combination brooder and battery research laboratory. A hot water brooding system has been installed. There are 14 (Continued on page 7)
Adequate nutrition is an important asset in maintaining animal health. Nutritional diseases are often caused by a failure of the ration to supply sufficient quantities of one or more of the essential nutrients, or to a failure of the animal to utilize these nutrients. In cases where a ration is deficient in several nutrients, all of them must be supplied before optimum results will be obtained.

Many laboratory methods have been perfected for the detection of nutritional deficiencies, but the recognition of specific symptoms in animals is still the most widely used means of diagnosis. In this short review only a few of the important nutritional diseases can be discussed.

Vitamin A Deficiency

Farm animals of all ages may suffer from vitamin A deficiency, but young animals are particularly susceptible. Newborn calves have low vitamin-A reserves since the pregnant mother, even on a high carotene intake, does not supply vitamin A to the fetus much faster than it is needed. Cows receiving an insufficient amount of vitamin A may abort or have calves that are weak or blind at birth. Such calves may die within a few days; however, the cows themselves often appear normal, except for a possible increase in number of retained placentas. Diarrhea (occasionally constipation), pneumonia, blindness, dilated pupils, convulsions, kidney damage, incoordination, rough coat, failure of appetite, and a slow growth or weight loss followed by death are characteristic of vitamin-A deficiency in calves.

One of the first symptoms of vitamin-A deficiency that can be detected by a careful observer is night blindness, or an inability to see well in dim light, such as during the late evening. This can be detected by driving animals about in a corral and noting if they stumble over, or bump into, objects placed in their way.

Dr. L. L. Madsen, head of the Department of Animal Husbandry, is an authority on animal nutrition and nutritional diseases. He did research in these fields both at Michigan State College and at the U. S. Research Center at Beltsville, Maryland, before coming to Utah State.

Various degrees of night blindness can be detected, and the condition usually gets progressively worse. Night blindness may progress to permanent blindness, caused by optic nerve injury, if the deficiency continues in young animals. Blood analysis for carotene and vitamin A also proved to be of value in diagnosing vitamin-A deficiency in cattle.

Bulls may lose their reproductive ability in severe vitamin-A deficiency, but damage to sexual organs is not always permanent. In a recent study, young beef bulls were subjected to a period of vitamin-A depletion by feeding a ration low in carotene. It was found that sexual activity and ability decreased rapidly with the development of symptoms of vitamin-A deficiency. Semen samples, collected as the depletion progressed, showed marked increases in percentage of abnormal spermatozoa and cellular debris with progressive decline in motility.

Fattening and breeding cattle often develop swelling of the legs, shoulders, brisket, hindquarters, and elsewhere when suffering from advanced vitamin-A deficiency. The swelling disappears quickly when a good source of carotene or vitamin A is provided.

Sheep also develop night blindness from vitamin-A deficiency and pregnant animals may abort or give birth to weak offspring which die shortly afterward. Other symptoms in sheep are loss of appetite, poor condition, and weakness.

Swine show incoordination and convulsions similar to calves on a vitamin-A-deficient diet. They also may have impairment of vision. Vitamin-A-deficient sows may fail completely in reproduction or give birth to blind or eyeless pigs. Other congenital abnormalities noted in young pigs born to vitamin-A-deficient sows are cleft palate, harelip, accessory ears, misplaced kidneys, and subcutaneous cysts.

Horses on vitamin A deficient rations have rough, scaly hoofs, a rough coat, and develop night blindness.

A lack of sufficient carotene in the diet is the most common cause of vitamin-A deficiency in farm animals. Conditions under which this deficiency appears most frequently in cattle are (1) on the range during drought; (2) in the feedlot when consumption of concentrates is high and the supply of roughage is either low or of poor quality; (3) wintering animals on low grade roughages such as straw or poorly cured hay; and (4) calves fed skim milk or calf meals without good hay or other source of vitamin A. Good pasture or properly cured hay of the current season's crop during drylot feeding will prevent or cure this deficiency. The National Research Council recommends 5.5 mg. of carotene or 3,000 I.U. of vitamin A daily per 100 pounds live weight.

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Straw is an inadequate winter ration. This animal is dying from vitamin-A deficiency. Three to five pounds of good hay in addition to straw would prevent this condition.
RESEARCH IN IRRIGATION AND SOIL MANAGEMENT

A NEW project on soil management and irrigation was started last spring as part of the western regional research project in which all the western states and the U. S. Department of Agriculture are cooperating. The work is supported largely by funds appropriated under the Agricultural Research and Marketing Act.

The new experiments are being conducted on the Greenville Farm where the early irrigation and soil management experiments were started almost fifty years ago by Dr. John A. Widtsoe, then chemist and agronomist in the Experiment Station, and continued for some twenty years by Dr. W. W. McLaughlin and Dr. Franklin S. Harris, who was then agronomist in the Experiment Station and is now president of the College.

These early experiments contributed much to our knowledge of the use of water by plants and of the most efficient methods of applying it. The use of organic matter, animal manures, and fertilizers was also studied in these investigations. The experiments were among the first of their kind in the United States and the results have served as a guide to better farm practice for many years.

With the development of modern techniques for measuring soil moisture, the movement of water in the soil, and with the trend toward the more general use of commercial fertilizers, it has been considered desirable to extend the studies of irrigation and soil management beyond those conducted earlier.

The significant thing about the new experiments is that they are designed to study the relation of many factors involved in the production of a crop. In this particular experiment alfalfa, sugar beets, potatoes, and barley are being studied. These will be rotated over the experimental plots from year to year in regular sequence. Each crop will receive applications of different commercial fertilizers alone and in combination. Some plots producing each crop and with each fertilizer treatment will be irrigated by sprinkling and others by furrow irrigation. Furthermore the soil of certain plots will be maintained at different moisture contents during the growing season. One can readily see that this type of experiment involves a large number of plots. In this case there are 1280 plots.

We might study the effect of phosphate fertilizer alone in a rather simple experiment, and with a small number of plots determine the effect of an application of phosphate on the yield of a certain crop. This would not tell us, however, what the effect would be on the yield of the other crops nor the effect on other crops grown on the same land in subsequent years. Neither would it indicate the maximum yield that might be obtained if nitrogen fertilizer were applied with the phosphate, nor would it tell us at what moisture content of the soil the maximum return could be expected from the use of these fertilizers. All of these factors affect the growth and yield of the crop, but the effects of each are not of a simple nature unrelated to those of the other factors. Thus all of these factors must be studied in combination in order to determine their true effects on plant growth and the possibilities of increasing crop yields.

FLY SPRAYS with oil base should not be used on livestock unless they have been proved not to be irritating or toxic to the animals. Too often fly sprays for livestock contain kerosene or distillate as their base. This kills the flies on which it is sprayed and repels others, but at the same time it causes a marked burning and severe irritation of the skin. Dairy cows will show an immediate decrease in milk production and in two or three days later the hair on the sprayed areas becomes raised, rough, and dry. Close examination will show the skin is thickened with a heavy rough scab under the hair and four to five days later the scab cracks making a large number of small open sores which are easily accessible to flies.

The owner of the cow pictured purchased some commercial fly spray for livestock. He sprayed thirty-two milk cows, three calves, two bulls, and two horses with a small hand pressure sprayer. At the next milking period he noticed all the cows were off four to six pounds of milk from what they had been giving and two or three days later noticed that wherever the cows had been sprayed the hair was raised, rough, and dry. On close examination the skin was found to be thick and covered with a heavy rough scab. All the animals were washed with soap and water, but it was over four weeks before they came back to their previous milk production.—Wayne Binns.
How Shall Peach Trees Be Pruned?

By S. W. EDGECOMBE, R. K. GERBER, and ODEAL KIRK

At harvest time, the yield and size of peaches produced will show the grower the effectiveness of his pruning and thinning practices. If the pruning has been ideal the trees will have made long enough terminal growth so that there will be ample fruit buds for next year’s crop and the buds will be so distributed as to insure the maximum exposure to light. In addition, the present crop will be distributed over the tree so as to give the maximum exposure to light and the minimum breakage of limbs. While pruning results in some thinning of fruit buds, seldom is it extensive enough to insure the desired size of fruit without the aid of proper thinning. Hence, thinning practices can also be evaluated at harvest time. No thinning or poor thinning will be readily noted by a large number of undersized peaches.

As there is considerable controversy in Utah about how to prune peach trees, an experiment in pruning was begun at the Ogden Substation in the spring of 1948 to determine the method most (Continued on page 19)
Ranchers Have a Stake in Range Research
Superior Germ Plasm in Forage Plants as Important as Germ Plasm of Range Animals
By WESLEY KELLER

The livestock business is of tremendous importance in the western United States. It is founded upon the extensive areas of wild land whose chief value, by present standards, is for grazing by sheep and cattle. Since animals are dependent upon feed it is clear that the livestock business cannot rise in importance above the forage resources on which it is built. For the state of Utah these resources in round numbers include a little over a million acres of hay and farm pasture land, and between 40 to 50 million acres of unimproved range land. Most of the range land is utilized by beef cattle and sheep but a significant part of the hay and farm pasture is consumed by dairy cattle and horses.

Relatively few ranchers in Utah are now fully informed on the various research activities of federal and state agencies, which all have as their goal the improvement of the range. But the number is increasing, and those best informed are most enthusiastic. It will be an important day for range research when it has the full support of all the ranchers of the state. Forward looking ranchers everywhere have as much interest in the range as in their animals. They know many of the forage species, and are familiar with range improvement studies. They are watching for new strains of grasses and are ready to try out practices recommend by the research men. It is not wishful thinking to suggest that the greatest transformation in the agriculture of the western United States during the next generation may be found in the improvement of the range.

Much range land, particularly in the sagebrush zone, has been so heavily used that the perennial grasses have been eliminated. The removal of sage, followed by reseeding, is the only known means of quickly restoring these areas to grass and productivity. On other sagebrush ranges sufficient grass has survived, under the protection of the sage, to revegetate the area rather quickly when the sage is removed. Brush removal studies in recent years have contributed greatly to the improvement of forage resources. On many sites, controlled fire is highly efficient in the removal of sagebrush. A number of heavy machines have been developed that are effective in brush removal. Chemical sprays are effective in the eradication of some brush species.

Studies on the artificial revegetation of range lands were begun nearly 50 years ago, but it is less than 20 years since this phase of range research was expanded into a well-organized, comprehensive program. Anyone familiar with the large number of forage species and the diverse sites on which both species and reseeding techniques must be tested is aware of the complexity of the problem. Those also familiar with the progress that has been made realize that if present knowledge were put into use throughout the state our forage resources could quickly be greatly improved. Reseeded areas in the sagebrush zone, chiefly utilizing crested wheatgrass, have increased forage production 5 to 15 times (400 to 1400 percent). This emphasizes the large gap between present and potential productivity of many acres of range land. The Intermountain Forest and Range Experiment Station has taken the lead in this area in range revegetation studies, but other federal agencies and the Agricultural Experiment Station are also active on a smaller scale.

One of the more recent approaches to range improvement is through the breeding of superior strains. Every rancher recognizes the value of superior germ plasm in his range animals but few appear to realize the equal importance of superior germ plasm in their range forage plants. The over-all objective of grass breeders in their search for better forage strains is a consistently high yield. This objective may be realized by breeding for any of several such qualities as greater drought resistance, disease resistance, earliness or lateness, winter hardiness, leafiness, tolerance to heat or grazing, or ability to recover.

All the cultivated crops have a well developed plant breeding history which began many years ago. Most grasses are in the beginning stages now. All the grasses of value on the western ranges are highly variable. It is this variation that the grass breeder utilizes, either through the elimination of inferior types

Intermediate wheatgrass in rows 3 feet apart on the Rasmussen dry farm at Clarkston, Utah. There are 320 plots in this study of factors affecting seed production. Much needs to be learned about seed production of range grasses in order that growers can be interested in producing the quantities needed for reseeding

Dr. Wesley Keller is geneticist in the U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering and works cooperatively with the Utah Station and the Intermountain Forest and Range Experiment Station of the U. S. Forest Service. Dr. Keller is working on the breeding and selection of grasses both for irrigated pastures and for range areas.

Farm and Home Science
on the production of various sources of forage. The first is comparable to a rancher culling his herd or flock; the second to his choosing the best types for his breeding stock. Many more specialized points: (1) Strains of crested wheatgrass differ just as much in productivity (though probably not in conspicuous identifying characteristics) as the better known varieties of wheat or potatoes.

Several range species. Of twelve sources of crested wheatgrass in the test, the most productive strain exceeded the locally available commercial source by 71 percent. When the two strains were grown in combination with alfalfa, the better one exceeded the commercial by 56 percent. In combination with alfalfa, it was 84 percent more productive than when grown alone.

These data make clear two important

(2) On the better range sites adapted legumes may substantially increase forage production.

Ranchers of the west are receiving help on their most difficult problem, that of stabilizing and increasing production of grazing lands, from several state and federal research agencies. They have a big stake in range research.

POULTRY RESEARCH FARM

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pens with a capacity of 100 chickens per pen. One room will be equipped with ten heated battery brooders for housing chickens up to 4 weeks of age or until they are large enough to go without supplemental heat. A basement room is used for unheated chicken batteries. Young chickens will be transferred from the heated battery and grown to fryer stage in these unheated batteries.

The feed building, not shown in the picture, is a two story structure of re-enforced concrete faced with brick. It is designed to have all the grains stored on the second floor and all the vitamin and protein concentrates on the first floor. A large 1½ ton mixer has been installed for the mixing of experimental diets for chickens and turkeys. The building is also provided with grain spouts and sack chutes for convenience in handling bulk and sacked feeds.

Two laying houses 20 by 205 feet, designed for experimental work, are nearly completed. As many as 48 single male matings or a total of 1,000 hens can be cared for in these houses. A Dewdrop watering system, which has proved very satisfactory for poultry, is being installed. One of the houses will be equipped with glass windows and mechanical ventilation system, while the other will be ventilated through open windows in the front of the coop. The houses are designed with a large aisle in the back of the coop for convenience in gathering research data.

The farm has 20 acres of range land for growing pullets. Twelve range shelters have been placed in this range for housing the pullets (see picture).

Research conducted here will include projects on poultry nutrition, breeding, and management. Experiments are now under way to identify superior strains and breeds for meat production. Eighteen different straight bred and cross bred types of chickens are being raised under similar conditions of feeding and management to identify those that make the fastest gain on the least amount of feed.

Improved egg production and quality is the objective of the breeding work. This work involves trap nesting of laying hens, pedigree hatching of chickens, and comparison on a family basis rather than on an individual hen basis.
EARLY spring vegetables are at a premium both for the home table and on the commercial market. Fall planting of such crops as lettuce, onion, spinach, and endive assures a much earlier harvesting of these vegetables than spring planting.

Of course, all vegetables cannot be overwintered; however, experiments have been conducted on lettuce and onions and small trials have been made on spinach and endive with satisfactory results. Where proper methods are followed these crops have shown little loss from freezing weather during most winters, and excellent market crops have been harvested in the spring. These trials have been conducted on lettuce at both Farmington and Logan with equally good results, but with onions they have been conducted only at Farmington. The Farmington area is typical of the area in Utah, Salt Lake, Weber, and eastern Box Elder Counties.

**Lettuce**

The correct planting date is important for lettuce, for in our experiments it has been found that planting lettuce too early results in a large plant in the fall which does not overwinter well. Rotting of the foliage and stems in the spring is usually severe, resulting in a poor crop. Likewise, a poor crop results if the plants are too small when they go into the winter. Such plants may not withstand the winter freezing, but if they do usually they will be heaved out of the ground by the late winter freezing and thawing. We have found best results where the plants are approximately 2 inches high at the beginning of winter. In order to get plants at this height, planting should be done from the fifth to the tenth and not later than the fifteenth of September in the Farmington area, and the first to the fifth of September in Logan.

A good stand of lettuce to go through the winter prevents heaving of plants, which usually results if they are spaced more than 2 or 3 inches apart. In our experiments, it has been more satisfactory to plant the seeds on ridges or beds. Wide ridges, which would allow about 22 inches between rows, are more satisfactory than narrow ones, as less winter injury has resulted. Where the rows run east and west, planting is better on the north side of the bed; and if the rows run north and south, the seed should be drilled in the center of the bed.

**Seeding Rate**

In general, the seeding rate should be from $1/2$ to 2 pounds per acre, or $1/2$ ounce per 100 foot row. The seed should be merely covered, or never planted more than a half inch deep. The seed bed must be kept moist until all of the seed has germinated, which normally requires a week, or not more than ten days. Following this it is necessary only to keep the plants in good growing condition in the fall. Cultivation will depend on the prevalence of weeds. It should be remembered, however, that if there is any cultivation in the fall, the lettuce should be furrowed out before the plants go into the winter.

Thinning of the crop 12 inches apart in rows should be done as early as the plants begin to grow in the spring. The first cultivation can also be given at that time.

**Fertilizers**

If the soil requires fertilization, the fertilizer should be applied in the spring, the amount depending to a considerable extent on the fertility of the soil. In general, the application of 150 to 300 pounds of a 10-20-0 fertilizer per acre,
or 3½ to 7 pounds per 1,000 square feet, can be recommended. This fertilizer is best applied as a side dressing to the lettuce row.

**Varieties**

All varieties of lettuce appear to go through the winter equally well, but the Great Lakes variety has produced a better quality head than most in the spring. Other varieties that have produced good quality heads are Cornell 456, Imperial 152, and Imperial 44. Heads of these varieties should be ready for market by the end of the first week in May.

**Onions**

Experiments have been conducted at Farmington for several years on overwintering of onions. While most of these studies have been to determine the correct planting date for seed production, some valuable information on the ability of some varieties to produce marketable bulbs in the spring has been obtained. Where the onions were planted as early as May, some winter injury resulted. However, with all varieties, little loss occurred from plantings from the middle of June until the middle of August. Plantings made after the middle of August showed considerable loss from heaving.

All varieties tried show a high percentage of bolters when planted early in the spring. However, excellent bulbs were developed from the San Joaquin variety from the August 1 and August 15 plantings. Few bolters occurred in the August 1 planting. The Sweet Spanish, White Portugal, and Crystal Wax bulbs showed a fairly high percentage of bolters even on the August 15 planting. Bulbs of the San Joaquin variety have usually been ready to harvest by the first of June. However, larger bulbs have been obtained from the August 1 planting.

We have not found spacing in onions to be quite as important as in lettuce. Less heaving results where plants are spaced several inches apart. However, it is still highly important to obtain a good stand. Again the same precautions mentioned for lettuce should be taken. The seed should be drilled at a rate of about 2½ to 3 pounds per acre, or 1 ounce per 100 foot row, the amount depending upon the distance between rows. In general, best results have occurred from rows spaced no closer than 18 inches and preferably around 22 inches apart. This allows for some soil to be plowed up around the plants before they go into the winter. The seed should be drilled about one-half inch, and the bed kept moist until all the seed is germinated. A week to ten days will be required for germination.

Sufficient cultivation should be given to kill all weeds.

Normally, some fertilization will be required in the spring. The amount will depend on the general fertility of the soil, but the recommendation given for lettuce applies also to onions. The fertilizer should be drilled in as a side dressing at the time of the first cultivation in the spring.

**Spinach and Endive**

In the small trials run on spinach and endive, we have found that both of these crops follow closely the recommendations given for lettuce. With spinach, if any fertilizer is to be applied it is highly important to apply it early in the spring.

The seeding rate on endive is one-half to three-quarter ounce per 100 foot row, or 3 pounds per acre. Spinach should be planted 1 ounce per 100 foot row, or 10 pounds per acre.

**SOIL MANAGEMENT AND IRRIGATION RESEARCH**

(Continued from page 4)

The cost of conducting this type of experiment is greater than that of conducting single factor experiments. But the information that can be obtained from it is also vastly greater, and perhaps of equal importance, the results are more reliable. For this reason the experiment stations of the eleven western states have agreed to allocate a sufficient portion of their share of the Agricultural Research and Marketing funds to Utah Agricultural Experiment Station to conduct this experiment for the western region. Cooperating in the investigations are the Irrigation Division of the Soil Conservation Service and the Bureau of Plant Industry, Soils, and Agricultural Engineering. The Amalgamated Sugar Company, the Utah­Idaho Sugar Company, and the Beet Sugar Development Foundation are contributing generously to the support of the project. This is because of the great possibilities these companies see for increasing the yield of sugar beets on irrigated lands when the proper combination of growth factors is obtained.—R. H. Walker.
Cooperative Research Speeding Solution of Weed Control Problems

By F. L. TIMMONS

Research on weed problems under irrigation in Utah has been expanded considerably in 1948 and 1949 through the development of a cooperative program between the Utah Agricultural Experiment Station and the United States Department of Agriculture. The project in Utah is part of a regional program of weed research being conducted in the eleven western states by the U. S. Bureau of Plant Industry, Soils and Agricultural Engineering in cooperation with the U. S. Bureau of Reclamation and four state experiment stations. The project at Logan was started in June 1948, while field projects at Phoenix, Arizona; Meridian, Idaho; and Prosser, Washington, were established early in 1947. Logan has been designated as regional headquarters for the cooperative program and the work is being coordinated from this station.

Three Types of Weeds Investigated

Three principal types of weeds that cause losses on irrigated lands are being investigated in the cooperative program. First, there are the aquatic weeds that grow in the water itself. Some of them, such as the pond weeds, grow entirely submerged and obstruct the flow of water through canals to thirsty lands or through drains from areas that may become water-logged when drainage is checked. Western irrigation farmers spend millions of dollars every year to control these weeds (commonly called moss) in canals and drains. Other aquatics, such as cattail, tule, and watercress, grow emergent from slow-moving shallow water at the edges of canals and reservoirs and in drains. Besides obstructing the flow of water these weedy plants are extravagant users of water, transpiring astonishing volumes of it into the dry air. Fortunately, the latter group of aquatic weeds are not a serious problem in most sections of Utah.

Ditchbank Weeds

Ditchbank weeds are a second group that cause serious trouble along irrigation canals and drains. These include herbaceous annuals and perennials of many kinds, tall perennial grasses such as Johnson grass, and woody species like willow, wild rose, and salt cedar. The ditchbank weeds interfere with canal maintenance operations, often fall into the water and obstruct the flow, and always siphon off tremendous quantities of precious water — all of which are needed by the crops.

Farm Land Weeds

The third class of weeds that thrive under irrigation are the annual and perennial farm land weeds that compete directly with the crops for water, soil nutrients, and sunlight. What to do about these three groups of "star boarders" has been, and still is, a problem second to none in irrigation agriculture.

Research by the Utah Station and several other western state experiment stations has developed improved methods of controlling weeds, especially farm land weeds, on irrigated lands. The available information, however, on some phases of weed control is far from adequate. The objective of the cooperative program is to supplement the weed research work already being done in Utah and other parts of the western region with emphasis on weed problems that have received little or insufficient attention heretofore.

Aromatic Solvents in Control of Aquatic Weeds

Progress of the new program has been rapid. In the summer of 1947 investigations by technicians of the Bureau of Reclamation and the Bureau of Plant Industry, Soils, and Agricultural Engineering in Denver revealed the toxicity of aromatic solvent compounds —ordinarily used as paint thinners—to submerged aquatic weeds. Field tests of
the aromatic materials emulsified in irrigation water were made late in 1947 and demonstrated their effectiveness and economy in killing the leaves and stems of submerged water weeds in irrigation ditches. After a few early trials in November 1947, officials of the Imperial Irrigation District in California enthusiastically adopted the method. Most of the district’s worst infested canals and drains were treated several times in 1948. Aromatic solvents were tested extensively also in Utah and other areas and a total of more than 100,000 gallons was used in 1948. Results were satisfactory and costs averaged considerably less than for other methods on small and medium sized canals and drains.

Field trials with aromatic solvents were continued in 1948 at the Meridian, Prosser, and Phoenix stations and on many Reclamation projects. The results from 84 field trials in all parts of the western states were assembled and used as the basis for a publication, “Controlling submerged aquatic weeds with aromatic solvents,” issued jointly by the two cooperating federal agencies early in 1949.

Questions that arise immediately when one is considering the use of chemicals to control aquatic weeds in irrigation water are: What affect will the treated water have on crops? Must all of it be wasted into drains and streams? Greenhouse tests at Prosser, Washington, and field experiments at Meridian, Idaho, in 1948 showed no damage to such crops as beans, lettuce, potatoes, corn, wheat, and Ladino clover from single or repeated irrigations using water treated with two or three times the concentration of aromatic solvent necessary for controlling water weeds. Only when the concentration was increased to four or more times the necessary weed killing dosage did injury to crops result. This indicates that it may be safe to use treated water for irrigating some crops but caution should be exercised to avoid use of water in which an extremely high concentration of aromatic material is present. Field experiments have been continued in 1949 at Meridian, Idaho, and Phoenix, Arizona, to obtain additional information on the toxicity of irrigation water treated with this chemical to various crops.

Aromatic solvents have proved deadly to crayfish, fish, frogs, snails, and other types of aquatic animal life in treated water. No definite information is available on the effect on livestock or poultry of drinking water treated with aromatic materials. No reports of ill effects have been received. It is believed that the strong odor and disagreeable taste makes it unlikely that animals would drink treated water.

Mechanical Removal of Water Weeds

Other methods of removing water weeds from irrigation ditches include laborious manual removal and various mechanical “demossing” operations using horses or tractor-drawn chains, disks, and harrows. Chaining is a common method that is always expensive, but is often the most economical one on large canals where the volume of water requires excessive quantities of chemicals for treatment. Chaining has the added advantage of controlling cattail and other weeds that grow in the edge of the water, but it can be used only on canals with roadways on one or both sides, and where trees, fences, and structures do not interfere. Drying out canals periodically for several days to check water-weed growth has proved an economical method where the practice can be fitted into the irrigation program. “Benoclor,” an effective but rather expensive chlorinated hydrocarbon chemical, has been used quite extensively for treating submerged water weeds in Utah and some other western states.

Emergent Aquatic Weeds

The emergent aquatic weeds as a group have stubbornly resisted efforts to develop effective methods of control. A comprehensive experiment on the control of cattail was started at Logan in June 1949. Rather extensive areas of cattail in the lowlands of Cache Valley afford an excellent opportunity for developing methods of controlling this weed which is so troublesome in many irrigated areas.

Ditchbank Weeds

Rapid advances in improving methods of controlling ditchbank weeds have been made during the period 1947-49.
Fortunately, many of the broadleaved species have proved susceptible to 2,4-D. Even woody plants such as willows and salt cedar are defoliated by single applications and frequently killed out entirely by repeated treatments. Extensive spraying of ditchbank weeds with that chemical is rapidly replacing older methods of hand cutting and chopping, mowing, and spraying or burning with oil. However, spraying with 2,4-D is far from a complete solution of all ditchbank weed problems. All of the grasses, including quackgrass and the tall growing annual and perennial grasses found on ditchbanks, are resistant and some broadleaved weeds such as wild rose and "professor" weed cannot be effectively controlled by it. Much remains to be learned about the effectiveness and safety of using 2,4-D on ditchbank weeds that are susceptible to it. More information is needed on the relationship of formulation dosage, gallonage, stickers, stage of growth, and many other factors to the killing power of the treatment.

Aromatic weed oils and diesel fuel have proved effective in controlling miscellaneous weed growth in small farm ditches used periodically for irrigation. In experiments conducted at Meridian, Idaho in 1948, two spray applications at 120 gallons per acre, plus burning 2 weeks later, in each case were sufficient to keep the ditches free of obstructive weed growth during the entire irrigation season. The two spray applications were made at intervals of 6 weeks. Similar experiments with aromatic weed oils and diesel fuel are being carried on in Cache Valley in 1949.

Experiments on control of willows, wild roses, and other troublesome woody plants are a major phase of the cooperative investigations at Logan. Results from exploratory spray treatments of wild rose and two species of willow in early August and mid-September of 1948 have not been determined in de-

Fig. 4. (upper) The canal on the left is nearly clogged by a growth of submerged water weeds. On the right is the same canal three days after it had been chemically treated. No water weeds are in evidence. 5. (center) Willows and other woody plants growing along irrigation ditches pump off tremendous quantities of water into the air, interfere with canal maintenance, and usually greatly reduce the flow capacity of the canal. 6. (lower) The capacity of this irrigation ditch is greatly reduced and maintenance operations hampered by a rank growth of broad-leaved weeds, grasses, and woody plants. Photographs courtesy U. S. Bureau of Reclamation
large boxelder trees. Ammate applied the same way gave fair to good results on boxelder, but had little affect on willow. Treatments applied in holes bored in the trunk gave better results than those applied in shallow cups chopped into sapwood.

Treatments of 2,4,5-T, and ammate applied to 16 freshly cut stumps of Boliana, Carolina, and Lombardy poplars at various times during the winter at Logan gave rather disappointing results. Similar treatments applied last fall in holes bored into living wood of sprouting stumps of poplar trees that had been cut down a year or more gave effective kills in most cases. As soon as conclusive information has been obtained on the effectiveness of different treatments on trees, stumps, and brushy growth of undesirable woody species, a full report will be presented giving complete recommendations as to chemicals, dosages, methods of application, stage of growth and other factors.

**Killing Trees**

Treatments with the esters of 2,4-D and 2,4,5-T made in the fall of 1948 in shallow cups or holes six inches apart around the trunks of trees near the base gave fair to good kills of large black willow trees but had little affect on growth. In general the amine form of 2,4-D was much less effective than the ester at equivalent spray concentrations. Neither form of 2,4-D had any significant effect on wild rose. The ester of 2,4,5-T was no more effective on willow than the ester of 2,4-D, but did give a good top kill of wild rose in 1948. However, considerable regrowth of wild rose is present this year on 2,4,5-T plots, especially on those receiving concentrations less than 1125 parts per million.

**Weeds in Onions**

Nine different pre-emergence chemical treatments applied 14 days after planting and 3 days before emergence of onions killed most of the weeds that had emerged but so many weeds emerged immediately afterwards that hand weeding time was reduced but little. Only one of five chemicals tested in post-emergence applications gave satisfactory control of annual weeds without serious injury to the onions.

Preliminary results from pre-emergence treatments with TCA and IPC and post-emergence dinitro sprays to control annual weeds in seedling alfalfa have been somewhat disappointing in an experiment started in the spring of 1949 at Logan.

**Eradication of Quackgrass**

An extensive experiment on the eradication of quackgrass with TCA and sodium chlorate applied at different dosages and at various stages of growth was started at Logan in October 1948 and has been continued through 1949. The experiment is located in a field of alfalfa which makes possible a study of the effects of the chemicals on the stand and yield of alfalfa, as well as on quackgrass. Preliminary results in this experiment are not as favorable for TCA as most of the reports that were published early in 1949. Final results probably will be available in 1950.

Many of the experiments at the Meridian, Idaho, and Prosser, Washington, stations on control of farm land weeds probably will yield results that will be applicable in Utah. One study at Meridian compares the effectiveness of several different combinations of competitive cropping, intensive tillage, and spraying with 2,4-D on whitetop and is planned to develop improved and inexpensive methods of controlling that common weed on irrigated lands. Another has revealed a promising chemical treatment for perennial ground cherry which is increasing on irrigated land in Idaho and Utah, and which has thus far proved a particularly stubborn weed to subdue by either cultural or chemical methods.
At the Irrigation Experiment Station, Prosser, Washington, extensive investigations are under way on the control of Canada thistle and quickgrass in orchards. Other experiments are being conducted on control of weeds in asparagus, alfalfa, onions, and sugar beets. A study that was recently started at Prosser on the duration of viability of different kinds of weed seeds when submerged in fresh water undoubtedly will give information that will be of interest in Utah.

HIGH FREIGHT RATES IN UTAH
(Continued from page 1)

tial increases in rates in the postwar period were accompanied by a relatively much smaller increase in revenue from these commodities.

Freight Rate Territories
Freight rates of the country have grown up on a regional basis. They were originally established by the roads within an area with relatively little consideration to the patterns in other regions. Rates therefore exhibit regional differences both in levels as a whole and in their application to specific commodities.

There are five major rate territories: the eastern or official, southern, western trunk-line, southwestern, and mountain-Pacific. Western and southwestern territories are divided into zones extending generally from north to south and numbered from east to west. Zones I and II are confined to western trunk-line territory, while zones III and IV extend over into southwestern territory. A rough outline of these territories is shown on the map, fig. 2.

Classification and Class Rates
In discussing rates it is necessary to distinguish between class and commodity rates. Class rates apply to a limited number of classes into which all articles are grouped. This grouping took place at an early date by agreement of the railroads operating within a region or territory. As a result of Interstate Commerce Commission action three official freight classifications are currently recognized and used. These classifications are eastern or official, southern, and western. Under this arrangement articles are grouped into 10 or 12 classes according to some rough measurement of value and ability to bear transportation costs. Each of the classes below the first bears some fixed rate percentage relationship to the first, within a given rate making territory. A few articles are rated higher than first class and carry some multiple of the first class rate. These cases, however, are rare.

Freight rates charged on class rate shipments are governed primarily by two factors: (1) the classification of the article, and (2) level of rates and their graduation based on length of haul. However, these two factors may, and usually do, vary between each of the classification territories. An article may be rated in class 4 in one territory, class 5 in a second, and class 6 in a third. The graduation of the charge based on distance likewise varies. Thus shipments moving across territorial lines on class rates will, if grouped in different classes, move from lower to higher rated territory or vice versa. Under certain conditions the movement from a lower to a higher rated territory is similar in its effect to a tariff barrier which tends to restrict the free flow of goods. The effects of the classification into which a given commodity is grouped may be modified by what are called "exceptions to the classification." Under the "exception" a rate somewhat lower than the applicable classification rate may be applied. In territories other than the mountain-Pacific there are large numbers of exceptions to the classification. It is estimated that more than 2½ times as much traffic moves on exception ratings as moves on the regular classification. These exceptions result in reductions ranging from approximately 20 to 25 percent below the rate under the regular classification. Again on branch lines where traffic is light, higher charges than those regularly applied may be imposed through the use of "arbitraries" which represent some percentage increase over the regular rate.

The second factor of vital importance in determination of the charges that a shipper will pay for transporting his commodities if they move on class rates is the actual level of first class rates and the percentage relationship of other classes to the first class. Some territories have distinctly higher first class rate than others. This is the case with the western territory where the level of first class rates is substantially higher than official or southern territory.

Freight Rate Level in Utah
Prior to the postwar rate increases, which have narrowed these differentials somewhat, the relative levels of class rates, after differences in classification and exception ratings are taken into consideration are as follows: official territory, 100; southern territory, 133; western trunk-line, 127, 145, 160, and 183, in zones I, II, III, and IV, respectively; southwestern territory, 153. While an exactly comparable figure for mountain-Pacific territory is not available, a closely related and nearly comparable figure shows mountain-Pacific territory to be 166 percent of the rate level in official territory. Utah lies partly in zone IV and partly in mountain-Pacific territory. Thus rates here are at the very top.

To get uniformity in class rates, two things would be necessary. First, there must be a uniform classification of freight for all territories. Secondly, the level of first class rates must be placed on the same basis and all other classes must bear the same percentage relation to first class in each of the territories. Complete uniformity may not be practical nor possible since cost considerations by the railroads may preclude such uniformity. However, the opinion is widely held that classification of commodities should be uniform with such adjustments in the class rate levels necessary to compensate for actual differences in cost resulting from operating conditions.

Commodity Rates
Distinction must now be made between class and commodity rates. It has been explained that class rates are those based upon classification of the commodity plus the distance of the haul. The transportation charge progresses as the length of the haul increases. The progression, however, is not strictly proportional to distance since it is recognized that on a mileage basis short hauls cost more than long hauls because costs of terminal facilities must be spread over the shorter distance.

In contrast to class rates, commodity rates are established for specific commodities. These are competitive rates and in many instances distance of haul is of secondary importance. It is here that numerous combinations and arrangements appear in the determination of the rate. The matter is too involved and complex for discussion here, but an example or two may be helpful in pointing up the principle involved. Competition with water carriers induces railroads to make favorable rates that will attract business. Hence coastwise shippers between port cities usually enjoy favor-
able transportation costs over the rails. The San Francisco area is an important sugar refining center but is far removed from the principle consuming centers of the East. Rail transportation eastward is subject to water competition principally from the Gulf Coast ports. As an example, the commodity rate on sugar from Crockett, located across the bay from San Francisco, to Chicago prior to recent increases was 70 cents per 100 pounds in carload lots with a minimum of 80,000 pounds. The rate reaches its maximum just east of Ogden, retains that level to the Mississippi River and then drops about 10 cents per hundred. It is seen, therefore, that it costs the shipper less to send sugar from San Francisco to Chicago than from San Francisco to Evanston, Wyoming. In other words, the railroads charge more to haul sugar from Crockett to a point east of Ogden which is 757 miles, than is charged to haul it from Crockett to Chicago, a distance of 2,174 miles.

One more illustration, frequently the rails charge more to haul a good in one direction than is charged to move the same good over the same line in the opposite direction. This is illustrated in the case of wine. California is a heavy producer of wine while the principal consumption centers lie east of the Mississippi. Prior to the late increases the rate on this commodity from Fresno, California, to all points east of Salt Lake City and the eastern border of Arizona was 99 cents. From Salt Lake City this commodity could move more than 2,000 miles eastward without additional charge to the shipper. However, to move the same commodity from the east coast to the west coast costs $2.08 per 100 pounds in carlot shipments. Thus the rate in moving from east to west over a transcontinental journey is more than double the rate moving from west to east over the same lines in a similar journey. Other commodities have similar variations though not so extreme as that of wine. It is of course true that in many cases the reverse situation from wine exists and the movement east carries a higher charge than the movement west.

Studies have shown that approximately 85 percent of all freight moves on commodity rates. It is therefore of extreme importance to shippers the kind of commodity rate structure under which they operate.

![Fig. 2. Railroad freight rate territories of the United States](image)

Table 1. Freight rate index for fruits and vegetables and prices received by farmers for fruits in the United States*

<table>
<thead>
<tr>
<th>Year</th>
<th>Freight rate index</th>
<th>Prices received by farmers for fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1913</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1914</td>
<td>125</td>
<td>151</td>
</tr>
<tr>
<td>1925</td>
<td>162</td>
<td>165</td>
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<tr>
<td>1927</td>
<td>146</td>
<td>146</td>
</tr>
<tr>
<td>1930</td>
<td>145</td>
<td>135</td>
</tr>
<tr>
<td>1932</td>
<td>144</td>
<td>68</td>
</tr>
<tr>
<td>1935</td>
<td>133</td>
<td>76</td>
</tr>
<tr>
<td>1940</td>
<td>132</td>
<td>68</td>
</tr>
<tr>
<td>1945</td>
<td>130</td>
<td>204</td>
</tr>
<tr>
<td>1948</td>
<td>171</td>
<td>145</td>
</tr>
</tbody>
</table>

*Comparable data on vegetables are not available.

**Costs of Providing Transportation Service**

It is fundamental that the charges for transportation service be sufficient to cover the total costs of the service, including a return on capital investment. Figures have been given above showing the relative levels of class rates within the various territories. Comparable levels for commodity rates are not available at the time of writing. The level of class rates in the western territory is materially higher than comparable rates in eastern territory. Mountain-Pacific rates are second only to rates in zone IV of western trunk lines territory.

Studies reveal relatively small differences in the fully distributed costs of various classes of freight service. Dr. Ford K. Edwards of the Interstate Commerce Commission's staff gathered the figures presented in table 2. From this table it will be observed that while costs of providing service in the far west are only about 10 percent above the eastern level the class rates were about 66 percent higher in the west than in the east.

The Interstate Commerce Commission in 1947 and 1948 gave recognition to the large differentials in class rate levels and the small differences in costs by making the rate increase in eastern territory 50 percent greater than in western territory outside of zone I.

It is the declared purpose of national transportation policy that "freight rates and charges shall be such as to move the greatest volume of traffic, while providing adequate and efficient transportation at the lowest cost consistent with the furnishing of such service." Two

Table 2. Relative fully distributed costs of carload traffic by classes of equipment based on actual average load, haul of 300 miles, in principal territories, 1939 (United States average=100)

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Eastern</th>
<th>Pocahontas*</th>
<th>Southern</th>
<th>Western</th>
</tr>
</thead>
<tbody>
<tr>
<td>Box-car traffic</td>
<td>102</td>
<td>68</td>
<td>97</td>
<td>108</td>
</tr>
<tr>
<td>Gondola &amp; hopper car traffic</td>
<td>100</td>
<td>63</td>
<td>102</td>
<td>115</td>
</tr>
<tr>
<td>Stock car traffic</td>
<td>106</td>
<td>86</td>
<td>97</td>
<td>102</td>
</tr>
<tr>
<td>Refrigerator car traffic</td>
<td>105</td>
<td>74</td>
<td>102</td>
<td>102</td>
</tr>
<tr>
<td>Tank car traffic</td>
<td>101</td>
<td>67</td>
<td>99</td>
<td>109</td>
</tr>
<tr>
<td>Flat car traffic</td>
<td>113</td>
<td>68</td>
<td>100</td>
<td>107</td>
</tr>
</tbody>
</table>

*The Pocahontas region is comprised largely of the West Virginia-Kentucky coal region. It is normally included in the southern territory.
primary principals theoretically underlie the construction of freight rates. These are: (a) cost of service and (b) value of service. To what extent these two principals actually govern rate making is difficult to determine. Bargaining between railroads and the shippers is known to play an important role. As a result shippers or industries with a greater bargaining power may get relief from the general basis. Smaller shippers, or industries attempting to establish themselves, particularly if their operations will not be extensive, labor under the disadvantage of a rate basis from which the more fortunate have obtained relief.

There can be no doubt but that the general level of freight rates in an area is an important determining factor in the development of agriculture and the establishment of industries. Where producers are far removed from principal markets there is added reason for processing products if the conversion losses in weights result in any appreciable saving in transportation costs. For example, the weight loss in converting 100 pounds of milk to butter or cheese is far greater than converting the same quantity of milk to evaporated milk.

It is difficult to say just how much the intermountain region in general and Utah in particular may have suffered from an unfavorable rate structure. Our rates have been among the highest in the nation. It is unquestionably true that these differentials have often placed this state and neighboring states at a competitive disadvantage with those who have enjoyed a more favorable rate structure. Our agricultural development has undoubtedly been retarded by high transportation costs.

Our primary objective should be to get facts on our freight rate structure and to determine where inequities and discriminations exist. When these facts are known relief should be sought from the carriers. Failing here the interested parties should carry their case to the Interstate Commerce Commission. Concerted action by the agricultural interests in this and neighboring states may be the means of getting adjustments in rates that would be impossible through individual or isolated action.

**Alfalfa Meal in Turkey Rations**

**By Byron Alder**

**Turkey** production in Utah is on a commercial basis. The average size of flock is about 3,000 turkeys which are usually purchased as day-old poults from hatcheries or as started poults at 6 to 8 weeks old. Many growers raise two or more flocks each year. Turkey production in Utah developed rapidly in the early thirties and reached the peak in 1945. Data obtained from Agricultural Statistics, published by the U. S. Department of Agriculture, show that from 1934 to 1945 the number of turkeys produced in Utah increased from 223,000 in 1934 to 2,109,000 in 1945, or over nine times. During this same period production in the United States increased only about 2.1 times from 21,312,000 in 1934 to 44,000,000 in 1945. Since 1945, United States production has decreased to 34,648,000 in 1947 to 31,732,000 in 1948, with probably a proportional decrease in Utah.

Since feed cost per pound of turkey produced represents about 60 percent of the cost of producing turkeys this is an important factor in determining profit. As a general rule locally produced feeds are cheapest and therefore should be used as much as possible. The use of good pastures supplying an abundance of fresh, succulent, green feed will usually save from 10 to 20 percent of the feed consumed per bird during the growing period.

On dry, barren range or with birds grown in confinement, or in the fall after succulent feeds are no longer available on range, alfalfa meal can be used in the growing mash up to one-third of the total weight of the mash without loss of quality in the mash as measured by rate of growth, finished condition of birds, pounds of feed consumed per pound of gain, and percentage mortality.

**Byron Alder** is now professor emeritus of poultry husbandry. His work on amounts of alfalfa meal in turkey rations has saved turkey raisers of the state many thousands of dollars.
Sun-cured alfalfa meal of excellent quality is produced in this area and is usually available at a price considerably lower than the price of grains, which it can replace in turkey mash.

Studies were started in the spring of 1940 to determine the maximum amount of alfalfa meal that can be economically used in turkey mash. At the time the studies were made the amount of alfalfa meal used in farm flocks varied from 5 to 10 percent for both starting and growing mashes. All turkeys used in these studies were of the broad-breasted bronze breed, and were purchased as day-old pouls from a local hatchery.

These studies have indicated that in starting mashes used up to eight weeks of age the amount of alfalfa for best results was from 15 to 18 percent of the mash by weight. Mashes containing amounts of alfalfa meal within these limits gave slightly better results when measured by rate of growth and percentage mortality than similar mashes containing more or less than these amounts.

The studies on growing mashes fed to turkeys from 8 weeks old to 29 weeks and repeated on similar lots of turkeys each year for the first three years contained 10, 15, 20, and 25 percent alfalfa meal. In the mashes containing the higher levels of alfalfa five pounds of alfalfa meal replaced five pounds of mixed ground grains. The percentage of all other mash ingredients remained constant in all mashes. The alfalfa meal used was all locally produced, sun-cured and ground medium coarse by a portable mill. The results are given in table 1.

There were replicas of three pens of turkeys on each level of alfalfa each year. During the last two years, mashes containing from 15 percent up to 50 percent of alfalfa meal were used. The formulas for these mashes are given in table 2.

The summary of the data obtained is given in table 3.

Conclusions

Birds on rations up to 40 percent of alfalfa meal all averaged about the same weight and showed good fleshing and finish conditions at 29 weeks.

The turkeys on the 50 percent alfalfa meal mash were smaller and not nearly so well fleshed and finished as other birds showing quite conclusively that they were handicapped by this ration. This was especially noticeable in the toms.

Table 1. Summary of turkey data for growing period 8 to 29 weeks old, mashes containing from 10 to 25 percent of sun-cured alfalfa meal

<table>
<thead>
<tr>
<th>Alfalfa meal in mash</th>
<th>Mortality</th>
<th>Average weight of turkeys at 29 weeks of age</th>
<th>Feed consumed per pound gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>percent</td>
<td>pounds</td>
<td>Toms &amp; hens</td>
<td>pounds</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>-----------</td>
<td>------</td>
</tr>
<tr>
<td>10</td>
<td>8.50</td>
<td>21.11</td>
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<td>15</td>
<td>8.60</td>
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<td>4.80</td>
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<tr>
<td>25</td>
<td>7.60</td>
<td>21.31</td>
<td>14.04</td>
</tr>
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</table>

Table 2. Mash formulas used in this study

<table>
<thead>
<tr>
<th>Percent</th>
<th>Bran</th>
<th>Ground wheat</th>
<th>Ground barley</th>
<th>Alfalfa meal</th>
<th>Limestone</th>
<th>Bone meal</th>
<th>Salt</th>
<th>Grain</th>
<th>Mash</th>
<th>Alpafa meal</th>
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<td>22</td>
<td>23</td>
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<td>1</td>
<td>1</td>
<td>15</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>3 &amp; 8</td>
<td>18</td>
<td>22</td>
<td>23</td>
<td>15</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>15</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>5 &amp; 11</td>
<td>18</td>
<td>22</td>
<td>23</td>
<td>15</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>15</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>2 &amp; 10</td>
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<td>23</td>
<td>15</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>15</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>4 &amp; 12</td>
<td>18</td>
<td>22</td>
<td>23</td>
<td>15</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>15</td>
<td>12</td>
<td>10</td>
</tr>
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<td>2</td>
<td>1</td>
<td>1</td>
<td>15</td>
<td>12</td>
<td>10</td>
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</table>

Table 3. Summary of turkey data for growing period 8 to 29 weeks old, mashes containing from 15 to 50 percent of sun cured alfalfa meal

<table>
<thead>
<tr>
<th>Alfalfa meal in mash</th>
<th>Mortality</th>
<th>Average weight of turkeys at 29 weeks of age</th>
<th>Pounds of feed consumed per pound gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>percent</td>
<td>pounds</td>
<td>Toms &amp; hens</td>
<td>pounds</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
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<td>------</td>
</tr>
<tr>
<td>15</td>
<td>2.38</td>
<td>19.14</td>
<td>13.53</td>
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<tr>
<td>20</td>
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<td>3.31</td>
<td>19.37</td>
<td>14.11</td>
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<tr>
<td>35</td>
<td>2.84</td>
<td>19.37</td>
<td>13.88</td>
</tr>
<tr>
<td>40</td>
<td>3.73</td>
<td>19.63</td>
<td>13.77</td>
</tr>
<tr>
<td>50</td>
<td>2.32</td>
<td>17.48</td>
<td>13.08</td>
</tr>
</tbody>
</table>

There was no significant difference in percentage mortality in any of the lots.

There was a slight increase in feed consumed per pound of gain on the higher alfalfa meal mashes. This increase was owing to a slightly higher consumption of grain. Mash consumed per pound of gain decreased slightly as the percentage of alfalfa meal increased.

There is no special advantage in using these high percentages of alfalfa meal in growing mashes unless the price of alfalfa is enough lower per pound than the price of the grains to give an actual saving in feed cost.

NUTRITIONAL DISEASES OF FARM ANIMALS

(Continued from page 3)

weight for cattle for moderate storage and reproduction.

Vitamin B Complex

The number of recognized components of the vitamin B complex has increased steadily since 1926. Much is known concerning the essential nature and deficiency symptoms of these vitamins in the diet of laboratory animals and poultry. Recent studies have also shown that most of these factors are essential for normal growth and health of swine, and that a deficiency of these factors produces typical symptoms. A definite dietary requirement for the individual vitamin has not been established for cattle, sheep, and goats, however.

Studies on the vitamin-B complex requirement and effects of this deficiency in swine have been carried out largely with purified or restricted diets. A need for thiamin, riboflavin, niacin, pantothenic acid, pyridoxine, choline, and several other factors has been established.

Thiamin Deficiency—Thiamin deficiency can be produced in young pigs by feeding rations deficient in this vitamin. Symptoms appear after the pigs have been on the diet for several weeks. The animals first refuse food, may vomit occasionally, and finally be-
come emaciated. There is also a marked lowering of body temperature and pulse rate. Death usually occurs within a few weeks unless thiamin is given. On autopsy, a flabby heart and liver damage are often found. Some individuals have excessive fluid in body cavities and pathologic changes in the gastrointestinal tract. Changes have been reported on the heart and liver. Studies reveal a lowered heart rate.

Thiamin is also needed by sows for successful reproduction. Results of recent studies at Washington State College with sows on thiamin-deficient diets may be summarized as follows: Gilts farrowed nine to eleven days prematurely, high mortality in newborn pigs, weak leg condition in pigs at birth, and unthrifty pigs and low weaning weights.

It is fortunate that practical swine rations are usually well fortified with thiamin when they contain a large proportion of whole grains and grain by-products.

Riboflavin Deficiency—Riboflavin deficiency has been produced experimentally in swine by feeding rations low in this factor. The following symptoms have been noted: slow growth, frequent scours, walking with difficulty owing to a crippled condition of the legs, and rough skin and coat. Failure in reproduction was also noted by the Washington State College workers. They report that riboflavin-deficient gilts farrowed four to sixteen days prematurely: a loss of appetite with poor gains during gestation; pigs died at birth or failed to survive more than forty-eight hours; and abnormalities such as enlarged front legs, generalized swelling, and hairlessness were evident in baby pigs.

Riboflavin may be supplied to swine in milk by-products such as skim milk, buttermilk, and whey. Green pasture and well-cured alfalfa are also good sources. Grains are relatively low in this factor but liver meal, yeast, and dried distillery solubles are rich sources.

Niacin (Nicotinic Acid) Deficiency—Swine require niacin, but recent findings indicate that they can apparently get along without this vitamin if the ration contains adequate amounts of the amino acid, tryptophane. Niacin deficiency is characterized by poor appetite, slow growth, frequent diarrhea, necrotic lesions in the large intestine, and a high mortality if the deficiency continues.

Barley usually contains more niacin than corn. Fresh liver, liver meal, and yeast are good natural sources of the factor. Successful use of pure niacin in the treatment of necrotic enteritis in swine has been reported by Michigan and Pennsylvania workers and by several practicing veterinarians, but the problem is still controversial. More work needs to be done in this field in order to define more clearly the interrelationship between diet and susceptibility of swine to organisms causing necrotic enteritis.

Pantothenic Acid, Pyridoxine, and Incoordination in Swine—As early as 1916, Wehrbein, of Iowa, described a posterior paralysis and incoordination in swine. Work in recent years by the U.S. Bureau of Animal Industry demonstrated that the incidence and severity of the disease could be increased by heating the ordinary swine ration to 115 to 120 degrees F. for thirty to forty hours. Later work showed that pantothenic acid was the preventative factor that was destroyed by heat treatment. Studies with purified diets demonstrated this relationship further and revealed that another B vitamin, known as pyridoxine, was also involved. Symptoms of pantothenic acid deficiency are striking. Pigs lose their appetite, slow up in gains, then lose weight, and die. They also have severe diarrhea (frequently bloody), loss of hair, weakness, and incoordination.

Pyridoxine must also be present to prevent nerve degeneration in pigs on a synthetic diet. This factor, however, does not seem to be the limiting one in natural diets.

Barley, oats, liver, brewers' yeast, and concentrated milk products contain protective factors against nerve degeneration in swine. Treatment of pigs with incoordination is usually unsuccessful because nerves with this type degeneration do not repair themselves to any great extent.

Choline Deficiency—Choline deficiency has not been reported in swine fed natural rations, but from studies with purified diets it is obvious that a deficiency of this factor can readily be produced. The most striking symptom is the development of a fatty liver. Work from Washington State College demonstrates conclusively that choline is needed for successful reproduction in swine. When gilts were maintained on choline-deficient diets they farrowed on schedule but there was a heavy death loss among the pigs and those that survived for a time showed leg weakness, muscular and nervous incoordination, subnormal weaning weights, and, at autopsy, typical fatty livers were found.

Phosphorus Deficiency

Beef and dairy cattle and sheep show symptoms of phosphorus deficiency in many areas and under various feeding conditions in the West. Typical manifestations of phosphorus deficiency include depraved appetite, emaciation, stiff joints, irregular estrus, small calf drop, and low weaning weights on calves. Studies at the Utah Station show that parturient hemoglobinuria or nutritional red water, in high-producing dairy cows, responds to intravenous injections of disodium phosphate and to drenching with this material or bone meal. Reports also show that beef cattle on feed are responding to phosphorus therapy in cases of nutritional red water. This type of red water should not be confused with the highly fatal, infectious bacillary hemoglobinuria.

Livestock men in the West are beginning to depend on phosphorus supplements such as bone meal or a mixture of equal parts of bone meal and salt to prevent phosphorus deficiency.

A story about one Utah sheepman illustrates this point. In 1940, he took over a sheep outfit which had failed financially. He soon noted ulcerative arthritis in his lambs. Losses varied from 50 to 100 lambs per 1,000 ewes. Losses from poisonous plants, particularly sneezeweed (Helenium hoopesii), also made it necessary for him to move the herd to browse about every three weeks and stay there for three or four days. He was advised to feed a mixture of equal parts of bone meal and salt. Within five or six days, losses among lambs stopped and many of the cases of ulcerative arthritis cleared up. Bone meal feeding continued and, in succeeding years, it was noted that the lamb crop increased, weaning weights were heavier, ulcerative arthritis disappeared, and gradually it became evident that it was no longer necessary to go to browse to control poisoning from sneezeweed. The sheep became more contented, grazed more uniformly, and were in better condition.

Decreasing death losses from poisonous plants among both cattle and sheep on the range by feeding bone meal and salt appears to be a fact from practical experience. Carefully controlled studies are needed, however, on this interesting observation.
PRUNING OF PEACH TREES (Continued from page 5)

profitable for Utah peach growers. Four types of pruning were practiced in an Elberta peach orchard planted in the spring of 1945. The trees had been trained to the modified leader system. They had been planted on the contour, given clean cultivation, proper irrigation, and in 1947 had been given an application of nitrogen fertilizer. The trees varied from ones slightly below normal size for their age in the upper part of the orchard to trees much above normal size in the lower part of the orchard. The crop of 1948 was the first commercial crop. Since the trees varied in size, each pruning treatment consisted of three trees, and each treatment was replicated five times.

The trees made excellent growth in 1948. They were given an application of 0.6 pounds of ammonium nitrate per tree and were irrigated frequently so that they did not lack moisture at any time.

Four Types of Pruning Used

The type of pruning employed and the resultant wood growth in 1948 are shown in the figures. A careful study of figs. 1, 3, 5, and 7 will show the growth that followed each type of pruning, and figs. 2, 4, 6, and 8 show the manner in which each type of pruning was done. One can see that in the case of the "corrective" pruning method, shown in fig. 1, there is ample terminal growth of the right character for production in 1949. The same is true with the other types of pruning shown by the "long" method in fig. 3, the "conventional" method in fig. 5, and the "severe" method shown in fig. 7. However, in figs. 5 and 7 it is evident that the wood growth was excessive. Much of the new growth is too long and does not carry fruit buds near the base on the main terminal growth. In these latter two types of pruning, the trees produced wood growth in place of fruit.

Fruit Thinned

All the trees in the experiment with the exception of those in the "severe" type of pruning were thinned soon after the June drop. The standard used in thinning was to leave enough peaches on the tree to size up properly (following a standard of 1200 peaches to a mature tree).

At harvest time, the fruit was picked at the firm ripe stage. This necessitated three pickings on most of the trees. The individual fruits were sized.

Yields

Yields are shown in table 1. The larger yield from the "corrective" type of pruning is significantly greater than yields where other types of pruning were used. The difference in yield between "long" and "conventional" pruning is highly significant. Corrective, long, and conventional pruning produced highly significant yields over the severe pruning.

Table 1. Effect of system of pruning on total yield of 4-year-old Elberta peach trees

<table>
<thead>
<tr>
<th>Type of Pruning</th>
<th>Total Yield of 15 Trees</th>
<th>Yield on Basis of 100 Trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrective</td>
<td>1020.25**</td>
<td>6801.6</td>
</tr>
<tr>
<td>Long</td>
<td>806.71*</td>
<td>5385.6</td>
</tr>
<tr>
<td>Conventional</td>
<td>584.12</td>
<td>3894.1</td>
</tr>
<tr>
<td>Severe</td>
<td>354.06</td>
<td>2360.4</td>
</tr>
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</table>

*Least significant difference .05 level 155.17
**Least significant difference .01 level 217.6

Size of Peaches

The percentage of each size group in the total yield for each type of pruning is shown in table 2. The data, when treated statistically, revealed that the corrective pruning resulted in a peach that was slightly smaller than with the severe method.

Ripening Dates

The difference in time of picking between corrective and severe methods of pruning is shown in table 3.

The data in tables 1, 2, and 3 indicate that the lighter pruning treatments produce yields which tend to ripen earlier and which are likely to be smaller in size. Apparently, thinning should have been heavier on these treatments to reduce the number of fruits smaller than 2 inches in size.

What Happened

The data presented in tables 1, 2, and 3, show that the lighter the type of pruning, the heavier the total yield of fruit. When trees are pruned by the severe method, the crop is greatly reduced. It is true that no thinning was done on these trees. But the reduction in yield is so great that it would be better to prune less severely and thin properly. The net returns from the heavier types of pruning represent a financial loss to the grower as compared with the lighter types.

In 1949, a count of the number of peaches removed in thinning each tree was made. Approximately twice as many peaches were removed from the corrective and long pruned trees as with the conventional pruned trees. It may be fairly assumed that the same situation was true in 1948. The larger crop with the first two types of pruning would more than pay for the additional thinning costs.

In 1948 and again in 1949, it was noted that the corrective and long systems of pruning resulted in a complete distribution of fruits over the entire tree. When thinning was done, the fruits were easily spaced over all the tree. With the other two types of pruning, the fruits were clustered and in some parts of the tree were absent.

The importance of thinning is again emphasized from these data. Pruning alone to reduce the set of fruit is unsatisfactory. Proper thinning must be used with peaches to insure the desired size of fruit. Light pruning methods result in a heavy set of fruit. If unthinned or under thinned, these trees cannot size up the fruit. Each tree must be examined and thinned to the number of fruits that will properly size.

Lighter pruning does result in earlier maturing fruit. This may or may not be important, since time of marketing in some years may be such that the early crop will bring the best prices, while in other years, the later crop may bring higher prices. But if the crop may be harvested in two pickings instead of

Table 2. Effect of pruning treatment on size of peaches

<table>
<thead>
<tr>
<th>Type of Pruning</th>
<th>1½ x 2&quot;</th>
<th>2 x 2½&quot;</th>
<th>2½ x 3½&quot;</th>
<th>3½ x 4½&quot;</th>
<th>Avg. Size Peaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrective</td>
<td>7.2</td>
<td>38.8</td>
<td>46.2</td>
<td>7.6</td>
<td>0.1</td>
</tr>
<tr>
<td>Long</td>
<td>2.2</td>
<td>33.0</td>
<td>53.5</td>
<td>19.3</td>
<td>1.9</td>
</tr>
<tr>
<td>Conventional</td>
<td>4.0</td>
<td>26.0</td>
<td>41.0</td>
<td>21.6</td>
<td>6.6</td>
</tr>
<tr>
<td>Severe</td>
<td>1.1</td>
<td>20.1</td>
<td>53.9</td>
<td>23.8</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Table 3. The effect of pruning treatments on time of picking

<table>
<thead>
<tr>
<th>Type of Pruning</th>
<th>1st Picking</th>
<th>2nd Picking</th>
<th>3rd Picking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrective</td>
<td>49.4</td>
<td>49.2</td>
<td>1.3</td>
</tr>
<tr>
<td>Long</td>
<td>25.4</td>
<td>65.6</td>
<td>8.8</td>
</tr>
<tr>
<td>Conventional</td>
<td>14.2</td>
<td>60.0</td>
<td>25.6</td>
</tr>
<tr>
<td>Severe</td>
<td>21.0</td>
<td>58.7</td>
<td>20.3</td>
</tr>
</tbody>
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Three Staff Members Attain Emeritus Status

PROFESSORS Byron Alder, Willard Gardner, and Charles J. Sorenson became emeritus professors at the beginning of the fiscal year. These men will continue some of their research work, but will retire from administrative duties.

Prof. Alder has been on the faculty since 1913 when he became head of the Poultry Department. For the first 14 years he was the only member of the Department, carrying on the teaching, research, and extension work. He has seen the poultry industry in the state grow from a small beginning to the most important source of farm income. The results of his research in poultry nutrition and the use of home grown products in poultry feeds have saved the poultry industry millions of dollars in feed costs.

He has been an able teacher and a wise counselor both to his college students and in the extension program.

Dr. Willard Gardner, professor and head of the Department of Physics came to the college in 1918. Since that time he has gained world-wide reputation for his work in soil physics. His picture hangs with five others in the Rothamsted Agricultural Experiment Station in England, representing the men who have done most toward the advancement of agricultural science.

He applied the Darcy velocity law to find the manner in which water moves into drains, into well networks, and into the water table from water-bearing strata. This has completely changed the general concepts of soil-water-plant relationships. Many of his students are now among the leading soil physicists of the country.

Charles J. Sorenson, professor of entomology, is the man who discovered that lygus bugs were a major factor in the low alfalfa-seed yields in Utah. He worked out the life history of these insects and methods for their control.

Professor Sorenson has also worked out the life history and control measures for the pale western cut worm, and the oblique banded leafroller, a dewberry fruit pest, and the peach twig borer.

He is the author of a number of bulletins and technical articles on insect control in grain and forage crops and on fruit trees.

Prof. Sorenson has been a member of the staff since 1914 with the exception of six years when he was employed by the State Department of Agriculture.

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