Recommended Agricultural Production Program for Utah for 1948

Continued High Production Levels of Most Crops with Increases in Barley, Winter Wheat, Corn for Silage, Sugar Beets, Truck Crops for Processing, Dairy Cows, Sheep and Chickens Advised

By W. P. THOMAS and GEORGE T. BLANCH

THE national and the world food situation warrants increased agricultural production in Utah for 1948. Recommendations for an increase were made after study of the problem by members of the staff of the Utah State Agricultural College and the Bureau of Agricultural Economics, and after a view of the problem by an advisory committee representing state and federal agricultural agencies. The suggested agricultural program for Utah represents the judgment of all agencies working on this problem.

In arriving at these conclusions, the following factors were taken into consideration: the nature, extent, and adaptability of Utah's agricultural resources; the local, national, and international demand for agricultural products; and the adjustments that may be necessary to meet changing economic conditions in the future. It was fully recognized that adjustments from a war to a postwar economy will be necessary. However, for the immediate future, there is a demand for food and fiber which warrants a high production for 1948.

During the period 1920-1934 prices and precipitation were not favorable for agricultural production in Utah. During war and postwar periods agricultural production increased to an all-time high or about 25 percent above prewar level. Precipitation and prices have both been favorable for agricultural production during these years.

Utah is characterized by a relatively small amount of good cropland in relation to the amount of grazing land and to the amount of farm labor. The cropland is divided into relatively small farms, which makes it economically desirable to intensify crop and livestock programs as much as possible. During the period 1941 to 1946, Utah's population increased 86,000, while California's increased 2,700,000. These increases were entirely in non-farm population. This trend is expected to continue. These changes in population mean changes in the markets for Utah farm products and, to an extent, in the kinds of products that should be produced.

The recommendation for continuing agricultural production on a high level was based primarily on the continued high demand for food and fiber both here and abroad. Food is important for world peace and national security. The proposed rehabilitation of European and Asiatic countries by the United States will aid in maintaining industrial employment in the United States and provide funds for foreign countries to purchase agricultural products from this country.

The proposed agricultural program for Utah for 1948 calls for an increase in grain production (table 1) in barley and (Continued on page 21)
Research staff in Home Economics consult on problems connected with the expanded program. Left, Dr. Ethelyn O. Greaves, dean of the School of Home Economics; center, Marie Sorensen, who is working on rural housing, and right, Dr. Ethelwyn B. Wilcox, in charge of nutrition research. Dr. Greaves has been dean for the past two years. She came to Utah State from the University of Utah where she was head of the Department of Home Economics for a short time. Before that she headed the Farm Security Administration in Utah. She is the wife of Dr. J. E. Greaves, formerly head of the Bacteriology Department and now emeritus professor. They are joint authors of a general bacteriology text. Miss Sorensen has just returned from graduate study at Columbia University and joined the staff in September. She is a native of Idaho and graduate of Utah State. Dr. Wilcox has been a member of the Station staff since 1943. She received both her undergraduate and graduate training at Iowa State College and is a native Iowan.

**Research in Home Economics Expands**

HOME economics research is being given an impetus by the allocation of funds under the Agricultural Research and Marketing Act. Research work in nutrition will be expanded to include a project on "Nutritional status of population groups" in the eleven western states. This project is in cooperation with the United States Public Health Service and the Bureau of Human Nutrition and Home Economics. A mobile unit, composed of a public health officer from the U. S. Public Health Service, a public health nurse, a dentist, a bacteriologist, a nutritionist, and laboratory assistants, in cooperation with the state agencies will make the field surveys of the population groups selected. This mobile unit will start working in Oregon soon after January 1, 1948. It is expected that all eleven western states will be surveyed within a period of two years. If nutritional deficiencies are found within the population, their causes will be investigated. Environmental factors, such as the soil and the nutritive value of the food raised on the soil, and food habits will also be studied.

The effect of diets which contain high or low amounts of calcium and/or phosphorus on the biological availability of carotene is another project which will soon be started.

Research studies on the nutritive value of Utah-grown fruits and vegetables as well as lamb are in progress in the Foods and Nutrition Department of the Utah Station. This work is under the direction of Dr. Ethelwyn B. Wilcox. The different varieties of freezing and canning peas have been analyzed for their vitamin content and the canned or frozen samples scored for quality. The effect of different fertilizer treatments on the vitamin content of peas has also been studied. Similar studies in cooperation with the Vegetable Crops Department were made on different varieties of sweet corn. Results of these experiments will be used in the selection of the best varieties adapted to this climate and altitude.

Lambs obtained from the experimental herds at Cedar City are being used in a study of the vitamin content of the raw, pan broiled, frozen, and stored frozen chops. The raw and cooked stew meat as well as the raw meat of the legs and shoulders are being tested for their vitamin content.

In addition to the nutritional research work, a new project on the improvement of "Rural housing in Utah," which is a part of a regional and national project, has been outlined with Marie Sorensen as project leader. There are five western states participating in this regional project: Utah, Colorado, Washington, Oregon, and California. The objectives of the project are: (1) to collect and analyze basic information concerning rural families and their environmental conditions that are required in the development of house plans suited to the areas studied, (2) to establish the

(Continued on page 20)

Farm and Home Science
Disease Problems in the Production of Tomato Plants in the Moapa Valley

Disease Free Plants Essential to Successful Commercial Tomato Production

By H. LORAN BLOOD

The Moapa Valley in southern Nevada is becoming a center for the production of tomato plants which are shipped to Utah, Colorado, and other western and midwestern states which produce tomatoes on a commercial scale. Because of the mild winters this section of Nevada is especially adapted to the growing of tomato plants. The increasing importance of this industry in the Moapa Valley and the desirability of healthy tomato plants as a necessary part of successful commercial production has led to an informal cooperation between federal and state researchers in tomato crop production, in tomato pests and diseases, and in soils and fertilizers at the Utah Agricultural Experiment Station and the Moapa county agent to investigate the factors essential to healthy tomato plant production.

One of the most important factors in the production of high quality, vigorous tomato plants for the commercial trade is disease. Plants must be grown under conditions that will assure freedom from disease if they are to survive the shock of transplanting and produce vigorous high-yielding vines.

Seedlings that appear weak and sickly at the time they are harvested or transplanted are usually discarded. On the other hand, seedlings that appear healthy and vigorous still may be struggling with an initial infection of some type, or carrying disease in a stage of incubation. Or, even though not directly infected, they may carry the germs of disease on their roots, stems, or leaves. These germs readily enter the plant through injuries occurring in harvesting and transplanting and become established while the plants are in a weakened condition.

Plants, whether obviously diseased, carrying disease in a state of incubation, or harboring disease-producing germs are equally dangerous for shipment and a risk to both the plant producer and the commercial grower. The most desirable plants come from fields in which no seedlings in any of these conditions may be found.

The presence of an obviously diseased plant, even though it can be discarded in the plant-pulling process, is an indication that other plants are probably infected with the same disease in a stage of incubation, which will develop and become destructive after the plants are set into the field. When infected seedlings are found, portions of, or even entire plant fields, depending upon the nature of the disease and the extent of the infection, have to be condemned as unfit to be harvested. Such action will, in a measure, protect the commercial producer, but it puts a heavy burden upon the plant grower who loses his crop and work for the year.

Plants appearing healthy, but harboring disease in a state of incubation, and those that come from fields where the conditions of growth favor contamination by disease-producing organisms are dangerous to use. Regardless of whether they die or begin to grow following transplanting, they become sources of infection, either through their contact with healthy plants during the harvesting and transplanting procedure or through the avenues of disease transmission in cultivated fields. They are

Dr. H. Loran Blood, plant pathologist, U.S. Bureau of Plant Industry, Soils and Agricultural Engineering, has cooperated with the Utah Station for some time on the breeding of tomato varieties resistant to curly top and verticillium wilt.

Upper right: Canners inspecting tomato field in the middle of April.
Lower left: Crew harvesting celery in early May. Lower right: Harvesting tomato plants in early May. Logandale, Nevada

for December 1947
from the arid West with the assurance that they will be free of most of the troublesome diseases that have their origin in more humid seedbeds.

There are a few seed- and soil-borne diseases, however, that are potentially dangerous and should be taken into consideration in the development of a cultural program for the Moapa Valley. There are also many virus diseases that are not so sensitive to climate. These diseases thrive in the arid West and constitute perhaps the most serious threat to the development of a western tomato seedling industry.

**Seed and Soil Borne Diseases**

Of several bacterial diseases of the tomato, the one most likely to cause trouble is bacterial canker. The causal organism of this disease (*Corynebacterium michiganennes*) is disseminated on and within the seed. After it is once introduced into seedbed or field soils it persists for at least two years. But if the soil is summer fallowed following the production of the diseased crop the amount of disease that survives in the soil and is picked up by the seedlings during the following year probably will not be great enough to cause much concern. The most serious danger from this disease comes from planting infected seed. Crop failures have resulted in commercial fields planted with Moapa Valley plants grown from such seed.

The extent of the damage that may occur in commercial fields from canker depends upon the percentage of infected seed and such factors as the characteristics of the seedbed soil, the cultural processes used in the production of the seedlings, the amount of mauling the plants undergo during harvesting, shipping, and transplanting, and the characteristics of the soil into which they are planted. Sufficient investigations have not been conducted, however, to evaluate all these factors and bring them under control. Nevertheless, to avoid trouble, it is important that only clean seed be planted. If the disease has been introduced into the field, tomatoes should not be grown for at least two years in order to allow time for the pathogen to die.

If fusarium and verticillium wilt-producing organisms become established in Moapa soils, they will be serious enemies to the tomato industry. There is some indication that, under certain conditions, the fungi causing these wilt diseases may be carried on the seed. In this manner they could, and perhaps have been, introduced into the valley soils. Plants imported from California for the early summer market crop may also introduce the fungi. While the relatively short period required to grow any one crop of seedlings may not give sufficient time for the fungi to become firmly established, if seedling production is repeated year after year without a rotation system, the fungi could build up in the soil to the extent that the production of healthy seedlings of susceptible varieties would become impossible.

The practice of growing tomatoes for market could aggravate the wilt disease situation. A crop of commercial tomatoes grown through the hot summer months is much more effective in establishing the wilt-producing organisms in the soils than a crop of seedlings. The high summer temperatures, however, favor establishment of the fusarium wilt pathogen, while the temperatures that prevail during the seedling production period favor the establishment of the verticillium wilt organism. Persistent cultivation of seedlings in the same field and production of a summer market crop on soils intended for seedling production later are undesirable and dangerous practices.

The production of a summer market crop of tomatoes has other dangers to the seedling industry. It has been the practice, rather than the exception, to allow the tomato fields to grow up with weeds after the harvesting season. The hot, rather humid condition that develops over the surface of the soil in an abandoned field in the valley, when over-grown with weeds and grass, is favorable for the development of lesions of early blight. The fruit and vines remaining in these fields frequently have been observed laden with the early blight organism. Under favorable conditions, such reservoirs of fungus material could survive the mild, more humid winter months and serve as sources of inoculum for the spring seedling crop. While the presence of such inoculum would be of no importance to plants grown for the commercial crop in the arid West, it could be very serious on plants shipped to eastern growers.

**Virus Diseases**

Virus diseases constitute the most serious threat to tomato plant production in Moapa. Two types of virus diseases are of concern, namely, the

(Continued on page 19)
A comprehensive study of pasture mixtures for dairy cattle, on fertile, well-drained, irrigated land, and under rotation grazing, has revealed the relatively low production of the standard mixture planted quite generally over the state. (See Farm and Home Science for November 1945 and March 1947.) Throughout the course of the study, begun in 1943, mixtures in which certain species were well represented regularly gave high yields. Other species, if abundant, were regularly associated with significantly lower yields. Under the conditions of these investigations it has been possible to classify smooth brome, orchard, tall fescue, reed canary, red clover, ladino clover, and alfalfa as relatively high producing species, while Kentucky blue, meadow fescue, perennial rye, meadow foxtail, strawberry clover, and common white clover have proved relatively unproductive. Tall oatgrass, which could not be classified in the plantings of 1943 (owing to unsatisfactory stands) gave excellent stands in a 1946 planting and is clearly among the high producers. The position of alsike clover and timothy is still uncertain.

Under the conditions of this study all the high producing species have satisfactory palatability except tall fescue, one of the most productive grasses. Recent experience has shown that if the proportion of tall fescue in the mixture is reduced sufficiently to make the overall palatability acceptable, it makes no significant contribution to the total yield.

In a study begun in 1943 (experiment A) mixture 22, containing an abundance of tall fescue, has yielded significantly more during 4 years than any of the 35 other combinations. This mixture rated only moderate to low in palatability, and was neither eagerly grazed nor fully utilized by the dairy herd. One of the objectives, therefore, when experiment D was planned, was to replace tall fescue with some species which would maintain yield and at the same time improve palatability.

Experiment D contains 32 mixtures in plots 22.5 feet square, each replicated 12 times. The field was planted April 18, 1946, under ideal conditions. Barley was uniformly drilled as a nurse crop at the rate of approximately one bushel per acre. The pasture mixtures were then broadcast by hand, after which the field was culti-packed. The following month was very dry, and the pasture seeds lay dormant in the surface soil. However, the barley which was seeded into moisture, germinated promptly and made its customary rapid development. In mid-May the entire field was given a careful but thorough irrigation, and this was followed by several rainy days. Subsequent irrigations were applied as deemed necessary. Good germination and establishment of nearly every species resulted. The field was grazed 4 times.

(Continued on page 16)
Disease Threatens Celery Industry in Utah

If Utah Celery Is to Maintain Its Reputation for High Quality Disease Control Measures Must Be Adopted

By E. L. WALDEE

The celery industry of Utah, though small in acreage and limited to a few highly specialized areas, is of considerable importance to the state. The quality of the crop ranks high in the leading markets of the country. The reputation of Utah celery is well established so as to assure a steady demand from year to year. But celery is beset by a number of destructive diseases as well as by insect pests. These diseases not only reduce yields, but frequently result in the rejection of the product by the market because of grade defects or spoilage. If neglected, severe epidemics of these diseases can permanently eliminate the celery producing areas of Utah from profitable markets. To stabilize costs of production and standards of quality, it is essential to do something about the wastage caused by disease.

The Utah Agricultural Experiment Station in cooperation with the U. S. Department of Agriculture began an intensive research project in 1947 to determine the causes and control of disease and insect losses in celery. Plant pathologists and entomologists are cooperating closely in these studies. This paper is a preliminary report of the first season’s observations. The findings herein reported are offered only as a tentative guide to growers for combatting the most serious diseases of celery. Much remains to be learned concerning the critical points in the developmental cycle of these diseases. This will require much detailed experimental work, not only in the field but in the laboratory as well. This work is in progress.

Celery Disease Losses in Utah in 1947

In recent years disease has become an increasingly important factor in celery production in Utah. In 1947 western celery mosaic, late blight, blackheart, western yellows, yellow spot, and calico were observed in the celery fields of the state. Western celery mosaic and late blight caused serious damage. The estimated disease losses in 1947 are summarized in table 1. Assuming these estimates to be reasonably accurate, this means a cash loss of nearly $250,000. If this is true, the potential income from Utah’s 1947 celery crop was reduced by about $200 or $300 per acre by disease. Diseases frequently become a limiting factor, resulting in material financial losses to growers.

Western Celery Mosaic

Western celery mosaic was the most serious disease of celery in 1947. This disease has been observed in the state for more than 20 years, but it was not until 1938 that it was positively identified as the same mosaic disease reported from California. Western celery mosaic is readily recognized in the field by the dull, gray-green, waxy appearance of infected plants instead of the rich green luster characteristic of healthy plants. The first symptoms usually appear in the heart leaves which tend to become stunted and not marketable unless special means are taken to force heart growth. But even though the hearts of mosaic-infected celery are sufficiently developed to make a satisfactory pack, the infection imparts a distinctive unpleasant acrid flavor to the celery and tends to render the stalks stringy with a noticeable lack of crispness. The leaflets of the heart leaves become distorted, twisted, and cupped, and more or less distinct mottling becomes apparent on leaves (fig. 2). This mottling becomes more distinct with age. In severe cases infected plants may assume a rosette habit of growth.

Western celery mosaic may affect only a few plants in a field, but if mosaic is present at all, usually large areas will show symptoms. The disease may spread from one or more sides of the field, but frequently mosaic spots will appear scattered throughout the field.

The cause of western celery mosaic is an aphid-disseminated virus, that is, a specific, submicroscopic, easily-transmitted, disease-producing agent, the exact nature of which is unknown. No one has ever seen a virus, even under the most powerful microscope, but...
scientists have discovered several important facts concerning it by elaborate experimental methods. Recently with the aid of the electron microscope scientists have been able to observe electronic shadows of virus particles which suggest that viruses may be some new kind of chemical substance capable of multiplying inside living cells and disrupting normal growth. Viruses are usually carried from diseased to healthy plants by sucking insects (such as aphids and leafhoppers).

The western celery mosaic virus is known to attack only celery and carrots in the field. Many species of aphids have proved capable of carrying the virus from diseased to healthy plants. Apparently the virus does not live over winter inside the bodies of aphids. This means that the principal means of overwintering of the western celery mosaic virus must be in living celery or carrot plants. It is believed that aphids, breeding prolifically in weeds surrounding celery fields in early spring, feed first on diseased overwintered celery or carrot plants where they pick up the virus and then move to celery plants in newly planted fields, carrying the virus with them as they migrate from plant to plant. Several weeks later the symptoms of mosaic appear, often long after the aphids have disappeared. Observations of plant pathologists and entomologists and many celery growers in 1947 have provided strong evidence indicating that the outbreaks of western mosaic in Utah originated from: (1) diseased celery plants or roots that lived over winter in the fields, (2) pitted celery containing diseased stalks that was not marketed until after the new crop was planted, or (3) mosaic-infected plants that were held over for seed. There is no reason to believe that the original infection was brought into the state from field-grown plants in 1947.

**Septoria or Late Blight of Celery**

Late blight, or Septoria leaf-spot of celery, has been observed from time to time in Utah for more than 25 years. It is probable that this disease has been present in the state nearly as long as celery has been grown. Late blight is caused by a microscopic fungus which spreads rapidly under cool and moist weather conditions. The technical name of the fungus is *Septoria api-apraveolens* Dorogen. The fungus does not attack any plants other than celery and celery. It is particularly destructive to vigorous, rapidly-growing, succulent plants. Not only does the disease stunt infected plants in the field, reducing yields, but it also necessitates severe trimming before infected celery can be marketed. It is dangerous to ship celery with even a small percentage of the stalks infected, because of the possibility of rot in transit. Septoria-infected celery does not ship well, nor does it keep well in storage. At least one car of Utah celery was lost in transit in 1947 because of Septoria blight. In other celery-growing areas in the United States it is considered to be the most destructive of all celery diseases. If preventative measures are not taken promptly, it may also become the most serious hazard to celery in Utah.

Late blight of celery can be readily recognized by the brown to black dead spots on the leaves and stems (fig. 2). The size of the spots varies from one-sixteenth to one-eighth inch in diameter on the leaflets. The lesions usually become much larger on the stems. Inside the dead areas of these spots can be seen tiny black specks. These are the openings of the fruiting bodies of the fungus. The fungus grows inside the tissues of the plants causing the cells to shrivel and die (fig. 2). Tiny flask-shaped fruiting bodies of the fungus develop inside the plant tissue with only the mouths protruding. Inside each fruiting body are produced from 2000 to 3000 spores, or fungus seeds, which are disseminated by splashing rain, by wind, by insects, or on the clothing of celery workers. These spores usually die within three years. Each spot will have from 6 to 200 fruiting bodies. One plant may have as many as 3000 spots. It is possible, therefore, (Continued on page 12)
THE poultry industry has experienced its most significant and far-reaching changes during and immediately following the years this nation has been at war. This is especially true of the recent war. It is the changes in the marketing of poultry products in the Mountain and Pacific Coast states resulting from this war which will be discussed in this article.

Marketing of Eggs

The number of chickens and eggs produced in these areas has increased during the war and postwar periods. Statistics compiled by the U.S. Bureau of Agricultural Economics, indicate that the number of chickens on farms January 1 in these areas increased from 39,427,000 in 1940 to 44,203,000 in 1946, while the human population increased from 13,843,465 in 1940 to 17,532,746 in 1946. This is an increase of 12 percent in the chicken and 26 percent in the human population. It is estimated that the population in the Pacific Coast states alone, i.e. California, Oregon, and Washington, increased by 3,281,000 people from 1940 to 1946. The increase in poultry population has not kept pace with the increase in the human population especially in the three Pacific Coast states during this six-year period.

Some increase in the number of dual purpose breeds of chickens has occurred during the last few years but Single Comb White Leghorn is still the principal variety of chicken raised in the Mountain and Pacific Coast states. A large percentage of these chickens is kept in commercial-sized flocks of 1000 to 5000 birds and the producers spend most or all of their time taking care of their birds and receive fifty or more percent of their income from the sale of poultry products. Most of the chickens in these flocks are housed or raised in rather close confinement twelve months of the year. Well-balanced feeds are fed and the fresh high-quality, white-shelled eggs produced are assembled, graded, packaged, and most of them are marketed cooperatively in carlot quantities through producer-owned associations.

The data available indicate that 355,583,333 dozen eggs worth $79,650,666 were produced in the Mountain and Pacific Coast states in 1936 compared with 479,333,333 dozen eggs valued at $171,179,000 in 1946. Prior to World War II most of the eggs produced in the five surplus egg producing states, i.e. in California, Oregon, Washington, Idaho, and Utah were shipped east to the Atlantic Coast states where they were sold at a premium in competition with white-shelled eggs received from other parts of the world.

When war broke out in the Pacific, enormous quantities of eggs and other foodstuffs were needed by our armed forces in the Pacific and also by the rapidly increasing civilian population employed in the industrial plants and war industries which were greatly expanded in the Mountain and entire Pacific Coast areas. The western part of the United States soon became a deficit area and large quantities of eggs produced in the Middle West and in the states farther east were purchased by the government and shipped into the Mountain and Pacific Coast states and to distant points in the Pacific. Even though hostilities in this war zone have ended, poultrymen in the West are able to supply only about two-thirds of the eggs now being utilized by these Pacific Coast markets.

Published reports indicate that the shipments of eggs from states within the Mountain and Pacific areas decreased from 3,656 cars in 1936 to 864 cars in 1946. The numbers of cars of eggs shipped from the principal far-western egg producing states in 1936 and in 1946, respectively, were as follows:

- California ........... 732 and 15 cars
- Oregon ............. 303 and 84 cars
- Washington .......... 1,647 and 75 cars
- Idaho ............. 236 and 162 cars
- Utah ............. 738 and 528 cars

Thirty-four hundred or 93 percent of the 3,656 cars of eggs produced and marketed by the producers in the above states were shipped to the Atlantic Coast states in 1936, while 694 or 81 percent of the 864 cars of eggs marketed by the same producers in 1946 were utilized within the Mountain States or shipped to rapidly expanding markets in the Pacific Coast states. Additional eggs were shipped by truck lines but the number transported in this manner is not available. Records of eggs exported from the Mountain and Pacific Coast areas to points in the Pacific outside of the United States likewise are not available for these years.

The six largest egg-receiving markets in this country now include the cities of Los Angeles and San Francisco. A total of 1,599,300 cases, the equivalent of 2,665 cars of eggs, were received at these two Pacific Coast markets in 1936, compared with a total of 2,787,851 cases or 4,646 cars in 1946. The equivalent of 2,662 cars or 99.8 percent of the egg receipts at these two markets came from the Mountain and Pacific Coast states in 1936, compared with the equivalent of 3,107 cars or only 66.8 percent in 1946. The eggs produced in the Mountain and Pacific Coast areas are large in size and of high quality. They are marketed in the shell on a graded fresh-egg basis.

Most of the eggs received at the markets in Los Angeles and San Francisco from Utah and the other surplus egg-producing states in these two areas in 1936 were shipped by rail, while practically all of the eggs shipped from these same states to Los Angeles and San Francisco in 1946 were shipped by truck lines. There are trucking companies now on the Pacific Coast who haul fruit and other products into the mountain states and return with a load of fresh eggs. It is practically over-night service to Los Angeles by motor freight from points in Utah and Idaho and the damage by truck is negligible. These are real advantages when it comes to marketing perishable food products. It is also well to remember that in times gone by, the price per dozen has dropped as much as five and six cents during an 8-day trip by rail from the western states to markets on the Atlantic seaboard.

So far as the future is concerned it is doubtful if the western producers will ever return to a year-around program of marketing shell eggs in the East or even attempt to market eggs through the eastern chains as a part of their cold storage deal. These are no longer profitable ventures for the Mountain and

THE IMPACT OF WAR ON THE FUTURE MARKETING OF POULTRY PRODUCTS IN THE WESTERN STATES

By CARL FRISCHKNECHT

Farm and Home Science
Increased Population
Improved Transportation Facilities
Have Changed Market Opportunities from East to West Coast

Pacific Coast shippers compared with the rich over-night markets in Los Angeles and San Francisco.

Headquarters for many of the major financial and industrial concerns are now being established on the Pacific Coast. Purchasing power is high and likely will remain high in this area. With increased population, consumption of more eggs per capita, and improved trucking facilities it looks as though the Pacific Coast markets will always be in a position to pay a premium price for all the high quality eggs that can be produced in the future in the Mountain and Pacific Coast States.

Egg production in the Western States is expected to increase. It is reported, however, that poultrymen on the Pacific Coast are confronted with: (1) high costs and differential on in-bound feed necessary for production; (2) a wage scale for handling eggs from the producer through the processing plant and retail outlet to the consumer that is 20 percent higher than in other competitive areas; (3) transportation costs greater than in other sections of the United States on account of geographical conditions and the distance to market.

It also appears that egg consumers are becoming more quality conscious; that the wartime pack of eggs is over; that government grades will be more widely used; that passage of state egg laws will be discouraged; and that better facilities and methods of handling, storing, and caring for shell eggs at the farm, in the channels of trade, and in the homes of consumers will be developed and used to market eggs in the future in the entire western area. It is doubtful if any egg drying plants will ever be established in this high quality commercial egg-producing area.

Marketing of Poultry

Significant changes have also occurred in the marketing of poultry in the Western States in recent years.

(Continued on page 20)
New Species of Grasses Show Promise as Forage Producers

Seeding Ranges to Grass

C. WAYNE COOK and L. A. STODDART

Most livestock men throughout the intermountain area are aware of the shortage of spring forage and the abnormally low production from their foothill ranges, and are showing an increased interest in rehabilitating these, depleted sagebrush areas and abandoned farm lands. The significance of this growing consciousness is suggested by the large acreage now being seeded by individual operators and federal agencies.

Artificial seeding on range lands is by no means a simple matter and should be applied first on the most productive and favorable areas such as abandoned farm lands or valley bottoms where moisture and soil accumulate. Even in these areas, careful and often costly soil preparation in addition to favorable weather conditions determine the success. The importance of range seeding is, indeed, a foremost problem and every one engaged in or associated with livestock production is anxious to obtain information that will aid in the assurance of increased range production.

The Utah Agricultural Experiment Station has for several years cooperated with the U. S. Forest Service, the U. S. Soil Conservation Service, and other agencies in studying establishment and management of grass on abandoned cultivated land at Benmore, Utah (fig. 1). This area, in southeastern Tooele County, receives about 13 inches of precipitation annually. The summers are dry, hot, and windy. The soil is extremely fine-textured, making it crust over or bake so that seedlings have trouble penetrating the soil during the intermittent dry periods in the spring and summer. For these reasons, range seeding is hazardous and method of seeding grass becomes an important research problem.

In 1943, research was begun to find how best to seed this land. For the first experimental seedings standard crested wheatgrass (Agropyron cristatum) and western wheatgrass (Agropyron smithii) were used. These were planted in all possible combinations involving early-fall, late-fall, and spring season; high, medium, and low intensity; shallow and medium depth; and an ordinary and deep-furrow drill. Seeding was done on fallow ground.

Analysis of these plots in the summer of 1947 showed some definite differences in success in the various methods. In all cases, spring seeding was superior to seeding at any other season, producing 30 to 50 percent more grass. About the same difference was found between the ordinary grain drill and the deep-furrow drill with the deep-furrow being distinctly superior under all conditions. Crested wheatgrass gave better stands under all conditions than did western wheatgrass and there seems to be no reason to select western wheatgrass in preference to crested wheatgrass under Benmore conditions. Medium depth of seeding (1 to 1½ inches) gave the same yields as did shallow depth (½ to 1 inch). Seeding at high intensity (7–9 pounds per acre) gave a higher yield than did seeding at low intensity (4–6 pounds per acre).
pounds per acre) but the differences were variable and are not considered significant.

The second seedings, made in 1944 and 1945, involved three new species of wheatgrass all of which are very promising plants for seeding dry ranges (fig. 2 and 3). These are *Agropyron elongatum* (tall wheatgrass), *Agropyron intermedium* (intermediate wheatgrass), and *Agropyron trichophorum*. Plantings were made of each of these in fall and spring; at shallow and medium depth; and at low and medium intensity. Growth on many of the plots was highly successful but others were failures. It is important, therefore, for ranchers to know how to insure good stands.

Under all conditions, the best stand was obtained from *Agropyron trichophorum*, and the second best from *Agropyron elongatum*. All three species, however, gave excellent stands under proper seeding methods. *Agropyron trichophorum* and *Agropyron intermedium* both were spreading rapidly by underground stems, and hence, may produce a denser stand than *Agropyron elongatum*, which does not produce underground stems. However, *Agropyron elongatum* is a larger plant, and it may continue to produce as great a total yield of forage (fig. 1). Both *Agropyron elongatum* and *Agropyron intermedium* are later growing plants than *Agropyron trichophorum* or crested wheatgrass and they remain green and succulent well into the hot summer, even in dry years. Mixtures of early growing species with late growing species would produce a pasture with a longer grazing season than would either type planted alone.

Shallow planting and high intensity planting generally gave better results than did deep planting or low intensity planting but the differences were not great and were not significant.

Season of planting, however, had great significance. Again, early spring planting far outyielded fall planting and produced more than three times the number of plants.

In recent years, there has been an increased interest in improving depleted ranges by seeding introduced grass species. The three new wheatgrasses used in the second seeding are showing great promise as forage producers and in reclaiming abandoned farm lands and impoverished ranges. These grass species are closely related and most livestock operators know nothing of their general

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**Summary.** Although these studies have not been in progress long enough to produce conclusive results, they indicate that excellent stands can be obtained from all four species if they are correctly planted. Spring seeding was more reliable in every case than fall seeding. Spring seeding must be done early. Ground should be prepared in the fall and seed should be drilled just

---

*Fig. 3. Mature seed heads of* Agropyron cristatum, Agropyron smithii, Agropyron intermedium, Agropyron elongatum and Agropyron trichophorum, from left to right.
as soon as the drill can be put in the field in early spring.

New species of wheatgrass are all large-seeded and so can be seeded deeper than the small-seeded crested wheatgrass. Even these new species, however, should not be planted over 1½ inches deep and preferably less. Crested wheatgrass should be drilled as shallow as possible. To do this, the ground must be firm and the drill should never follow right after the plow since the plow leaves soil too loose for shallow seeding. Always let the ground settle several weeks and seed preferably after a few rains have fallen to firm the soil.

The new wheatgrasses, *Agropyron intermediate* and *Agropyron elongatum*, offer great hope in range seeding as soon as seed becomes available. They are very drought resistant (fully as much so as crested wheatgrass), livestock graze them well, and they stay green in the hot summer when crested wheatgrass is dry. *Agropyron trichophorum* is also a desirable range species but is more like crested wheatgrass as a forage.

### DISEASES OF CELERY (Continued from page 7)

for one badly diseased celery plant to produce more than 600 million spores of the celery late blight fungus, enough to spread the disease over a wide area. It is evident that an organism which reproduces itself on such a scale is very difficult to control and may become a dangerous menace.

The late blight fungus lives from one season to the next in the fruiting bodies occurring in infected debris left in the field. Frequently fruiting bodies also develop in the outer coat of the seeds (fig. 2), enabling the fungus to become established in the plant bed. The first infection is started when these seed-born spores sprout and penetrate the tender tissue of the germinating seedlings. Within two weeks after the fungus has entered the host it develops fruiting bodies producing a multitude of spores. These are then carried to healthy plants which, in turn, produce another crop of spores. Every two weeks, under cool and humid conditions, a new and increased crop of spores is produced. Original infections may start as readily from infected celery debris left in the soil.

Late blight has not heretofore been a serious disease in Utah because of the dry, hot weather that usually prevails during the growing season. In 1947, however, because of unusually cool and cloudy weather the fungus was able to spread widely. Because of this, it is probable that there is now present in Utah celery fields more overwintering Septoria spores than has been present at any time heretofore. Extraordinary measures should be taken, therefore, to minimize the danger of spread to the 1948 celery crop.

**Recommmendations for Control of Celery Diseases in 1948**

On the basis of information now available concerning celery diseases in Utah, some specific recommendations can be made for 1948. The measures recommended are all directed towards prevention. By the time a dangerous disease can be seen in the field it is usually too late to apply effective control measures.

**Fall plowing:** Plow celery fields deeply as soon as possible after harvest to kill all celery roots and to bury Septoria-infected debris. Disk at least once in the fall to insure killing of all celery roots. One overwintered mosaic-infected root is enough to spread a dangerous infection.

**Rotation:** Fields in which late blight was present should not be planted to celery for at least two years to allow the Septoria fruiting bodies and spores to die before celery is planted again. It is also desirable to rake up and burn or bury Septoria-infected celery debris as soon as harvest is completed.

**Production of Plants:** Field-grown plants are the safest to use. These plants are inspected by experiment station plant pathologists and entomologists to determine their freedom from dangerous diseases and insect pests before they are accepted for use in Utah. The most dangerous plants to use are out-of-state hothouse-grown plants. Plants should be grown from three-year-old seed to insure freedom from Septoria blight, or from seed that has been treated with an organic mercury fungicide, such as semesan. Plants may be grown safely at home in a hot house, if the following precautions are taken: (1) Disinfect the house and benches thoroughly with formaldehyde, (2) Use only soil that has not grown celery previously, (3) Plant three-year-old or treated seed, (4) Do not carry over any celery plants from the field in the same house where plants are produced, (5) Allow no aphids to develop in the greenhouse, and (6) If late blight has been present in the community, spray seeding plants with 4-4-50 Bordeaux mixture at least once a week before they are set out.

**Celery Free Period:** Be sure that there are no celery plants from the previous season living after the first of February. In California, western celery mosaic is effectively controlled by a three-month celery-free period enforced by law. In Utah a celery-free period should be observed voluntarily by all growers in their own self interest. Celery seed should never be grown in the same area in which commercial celery is produced, but rather in isolated areas far removed from commercial fields. Do not carry over winter any living celery plants in commercial celery-producing areas.

**Weed Control:** Before setting out plants in the field destroy all weeds along fence rows and ditch banks surrounding celery fields, or spray these areas with an aphid-killing insecticide. Weeds around the fields are as much of a threat to celery as those in the field, because of their role in harboring disease-carrying insects.

**Spraying:** For late blight spray with 4-4-50 Bordeaux mixture every week or 10 days throughout the growing season, beginning as soon as the plants become established in the field. Spraying must be thorough and timely. Inasmuch as present insecticides and methods of applying them are not adequate to insure effective control of western celery mosaic, it is essential for all growers to observe a celery-free period of at least three months and to devote more attention to the control of weeds that harbor aphids surrounding celery fields.

Further information regarding celery disease control can be obtained by writing to the Department of Botany and Plant Pathology, State Agricultural College, Logan, Utah.

**CRANDALL TO JOIN STAFF OF STATISTICAL LABORATORY OF NORTH CAROLINA UNIVERSITY**

Professor Bliss Crandall, newly appointed director of the statistical laboratory at the Utah Station, will join the staff of the Institute of Statistics at the University of North Carolina at Raleigh for a six month period beginning January 1. While there he will assist with the consultant and analytical work in plant science research. This is a real opportunity to work with the leading statisticians of the country in the design of research projects and the analysis of data obtained. He will have opportunity to become acquainted with many new and improved statistical tools and their application to agricultural research.
Wild Bees in Relation to Alfalfa Pollination

By GEORGE E. BOHART

In most areas of Utah inadequate pollination appears to be one of the factors in low alfalfa-seed production. Since bees are the only alfalfa pollinators of importance, it has seemed advisable to initiate studies at Logan designed to increase the effectiveness of the species involved. According to available records, decline in seed yields since 1925 has been accompanied by a drastic reduction in wild bee populations. Consequently, although honeybees contribute an important share of alfalfa pollination and may be readily increased and moved about, it is probably necessary to conserve, increase, and utilize better populations of wild bees in order to obtain maximum seed yields.

Several thousand species of wild bees are found in North America and probably at least one thousand exist in Utah. The term "wild bees" is meant to include all except the honeybee (Apis mellifica). These studies are concerned with those species which include alfalfa in their host range. About forty such species were found last summer in the alfalfa seed-growing areas near Delta and Logan, Utah, and in southeastern Idaho. Many of these were rare on alfalfa although sometimes abundant on other plants. About seventeen species in the area studied seemed to be of actual or potential importance as alfalfa pollinators. Most of them were found to be considerably more efficient than honeybees in trippling, and thus pollinating, alfalfa blossoms. They usually gathered pollen as well as nectar from the alfalfa, whereas the honeybees were nearly always seeking only nectar.

In most fields the principle drawback to wild bees as pollinators of alfalfa is their scarcity. In many fields they are practically absent, and nearly the entire burden of setting a seed crop rests on the honeybees. The desirability of providing alfalfa-seed fields with a better supply of wild bees is therefore obvious. Three lines of attack present themselves: (1) To grow seed where satisfactory populations of the right kinds of wild bees already exist, taking care not to destroy the bees in the process, (2) to time the alfalfa crops so that maximum bloom and maximum bee population coincide, and (3) to increase the numbers of wild bees in existing seed-growing areas. The third

Details in the biology of the alkali bee (Nomia melanderi) one of the alfalfa pollinating wild bees: (A) Close-up of brood cells, left, cell with pollen ball and egg; right, cell with part of first pollen load. (B) Brood cells containing left to right, pollen ball and egg in normal position, pollen ball turned to show elliptical shape, developing larva and partially consumed ball, fully fed larva. (C) Larvae preparing for hibernation: upper left to right show change from full grown larva to prepupa (resting stage). (D) Despoiler of Nomia, left cell with Nomia prepupa, right cell with cuckoo-bee prepupa. (E) Imbibers of Nomia larva. Developmental series from left to right showing bee-fly maggot "drinking" the bee larva dry. Note "suction apparatus" on head of full grown maggot at right. (F) Parasite of adult Nomia: Upper row: Nomia abdomens distended with conopid fly puparia; middle row: parts of Nomia killed by other agencies; bottom row: Conopid puparium in Nomia abdomen and adult conopid
method appears to hold the most promise for the seed grower.

Increasing the numbers of wild bees calls for investigations of the living requirements of the various species and of the adaptability of agricultural practices to fit these needs. The critical factors in the environment of bees which are obviously related to agricultural practices include soil moisture and alkalinity, which are influenced by drainage, irrigation, and cropping practices; soil stability, which is influenced by soil cultivation and erosion; and vegetative cover, which is influenced by weed control and land use. Another factor to be studied is the effect on wild bees of the new insecticides which are certain to be used.

There are two possible methods for increasing the numbers of wild bees: (1) By preparing ideal nesting places which can be maintained as sanctuaries within range of seed fields. It may also be necessary to establish the bees. (2) By increasing the ranges of valuable species by introducing them into new areas, and at the same time taking care to exclude their parasites.

Choice of species to work with should be made upon the basis of ease of handling. For example, colonial bees, such as bumblebees, can be induced to nest in artificial domiciles, which can be readily transported. Gregarious species, such as Nomia, could also be concentrated within sanctuaries more easily than strictly solitary bees. Bees that nest in hollow stems could be easily moved or induced to concentrate where available stems are concentrated.

The easily observed facts concerning some of the wild bees are fairly well known, but details in the life histories of most species can only be guessed at by assuming that they are similar to those of better known relatives. Precise knowledge concerning climatic, soil and host-plant requirements is incomplete even for the species which have received the most study.

Certain basic habits are common to all bees. The adults visit flowers to feed on nectar and presumably also pollen. The larvae live within cells constructed by adults and feed on pollen and honey provided by the latter. Beyond such universal habits the study of bees becomes a sorting process. Arrangement of bees according to habits occasionally fits the taxonomic relationships, but more often seems to have no correlation with them. The cuckoo-like habit of laying eggs in cells prepared and provisioned by other species is found in several groups of bees. In many instances the "cuckoo" preys on a close relative, but one large group of cuckoo bees depends upon a wide assortment of hosts. These are the Nomadidae, or so-called nomad bees. Since these "cuckoos" do not gather pollen for their young, they visit alfalfa primarily for nectar and have rarely been seen to effect pollination.

The bees which do their own housekeeping and breading can be classified as follows, according to their social behavior: (1) Colonial, with separate queen and worker castes, division of labor, and progressive feeding of the larvae. Honeybees and bumblebees are examples. (2) Gregarious, but self-sufficient and not practicing progressive feeding. Many halictids, andrenids, and anthophorids belong here. Some of the halictids approach a colonial existence in that they maintain communal nest entrances. (3) Strictly solitary. Sometimes bees in this group may be found concentrated because the available nesting sites are limited. Tetralonia and Megachile belong to this group.

Bees construct nests and provide for their young in many ways. Many of them dig burrows in the ground and construct larval cells at the ends of branch burrows, but many utilize existing tubular spaces such as abandoned insect burrows, hollow stems, and nail holes. Special nest materials, such as leaf pieces, pitch, plant fibers and mud, may be used to fashion cells and protect nest entrances. Leafcutter bees, for example, may defoliate rose bushes in their quest for cell building materials.

Many kinds of bee nests may be recognized by special features of the entrances. They may be plugged with pitch, surmounted by a chimney or mound, or hidden under leaves. Provisions for the larvae are usually characteristic. Some are liquid and contained within a waxen envelope; others are round or oval pollen balls; still others are masses of nearly dry pollen. The common, widespread species generally gather pollen from many sources, but many restrict their choice to one or a few kinds of plants.

Life cycles of bees also differ widely. Some have several broods, the last of which passes the winter in a larval stage. Others produce males at the end of the season to fertilize the females which then hibernate. Still others have only one generation, which is in the spring, and their adult progeny remain within their cells the remainder of the year.

Evaluation of the pollinating efficiency of the various species requires long and tedious observation at many localities throughout the blossoming season. One must determine what proportion of the individuals are males and females, how many are collecting pollen, how many flowers are tripped per unit of time, and the length of a working day and of the effective season. There must also be an estimation of abundance and possibilities for increase.

In Utah and southern Idaho three species of Megachile (leafcutter bees) appear to be the best pollinators. However, they are strictly solitary and have been seen in abundance in only one field. One of them, M. brevis Say, nests in hollow stems and has possibilities for increase.

Four species of bumblebees are rapid pollinators in this area. A queen of one species set a record for our observations of 50 blossoms tripped in one minute. Unfortunately, as many as 50 percent in some fields were collecting only nectar. Since bumblebees can be induced to nest in artificial domiciles, it should be possible to establish colonies and move them about as needed. The colonies, however, are usually composed of not more than 50 working bees whereas a honeybee colony may have a field force of 20,000 or more.

The so-called alkali bees (Nomia melanderi Ckl.) are usually found nesting in moist, flat soil in large aggregations. Alalfa fields adjacent to such colonies are likely to be well pollinated. An interesting characteristic of these bees is their ability to migrate en masse to new areas. The impetus for such migration is not known, but cases have been seen this year where new areas of bare ground with a high water table attracted such colonies. Ground heavily infested with the brood of these bees can be moved to new areas. Several such moves have been tried, the results of which are not yet known.

Other significant pollinators in the area include: Tetralonia (long-horned bees), Osmia (metallic bees) and Halictus rubicundus (Chir.) (a species of sweat bee). These bees pollinate mainly first crop alfalfa although H. rubicundus works throughout the summer on other plants.
The Relationship Between Arsenic in the Blossoms of White Sweetclover and in the Soil

By WILLIAM P. NYE

An increase in the amount of arsenic in sweetclover blossoms grown on soils high in arsenic is shown in a recent study. This study did not show, however, that the amount found in the blossoms or collected from them by bees was sufficient to cause death. Other factors are also involved in the high death losses of honeybees in Utah.

The high mortality of honeybees in Utah over a period of years has caused grave concern to beekeepers, orchardists, and producers of agricultural seed. The problem is of such importance that the Utah Agricultural Experiment Station in 1939 began an investigation of the causes of the honeybee losses and of means of preventing them. In 1940 the U. S. Bureau of Entomology and Plant Quarantine apiculturists joined the entomologists of the Utah Station in the study. Dead bees, especially those from certain areas, sent to the laboratory for analysis often contained lethal amounts of arsenic. The question then arose: Where do the bees obtain the arsenic?

William P. Nye is another member of the staff of the Legume Seed Research Station. He is now working on the problem of domestic bees in relation to alfalfa pollination. He finished work for the M. S. degree during the past year at Utah State. The work reported in this article was part of his thesis problem.

Is it from agricultural sprays, from arsenic dusts, from smelter smoke or soil arsenic particles fallen on the plants visited by bees, or do certain plants absorb arsenic from the soil and pass it on to bees visiting their blossoms in search of nectar or pollen in quantities sufficient to cause death?

The study reported here is a phase of the larger investigation on bee losses and was started in 1946 to determine whether there is a relationship between the amount of arsenic in the soil and that present in the blossoms of white sweetclover, a plant that is frequented by bees in their collection of nectar and pollen. The studies were conducted during the winter and early summer of 1946 in the greenhouse at Logan.

Knowlton and associates had already demonstrated that arsenic was often present on white sweetclover grown in areas where the soils had a high arsenic content. In fact blossoms of sweetclover frequently contained so much arsenic that it was believed to be a possible cause of certain serious honeybee losses occurring in recent years.

In the experiments here presented, white sweetclover was grown on three types of soil (1) high arsenic content soils taken from several locations in the Jordan Valley of Salt Lake County, (2) native soils relatively low in arsenic, and (3) native soils to which various amounts of arsenic trioxide were added (table 1).

The soils in the first series varied in arsenic content from 3.3 to 203.0 micrograms of arsenic trioxide per gram of soil. These were placed in 8-inch flower pots. Each soil was replicated eight times making 48 pots in all. Hubam white sweetclover was planted in all pots. When the plants were about four inches tall they were thinned to 4 per pot.

The soils of the second series containing 4.26 micrograms of arsenic trioxide per gram of soil were placed in:

Correlation between the amount of arsenic in the blossoms and that in the soil

Flowe pots containing soil with varying amounts of arsenic in which the clover was grown in the tests reported here
24 one-gallon stone crocks and planted as in series one. Measured quantities of arsenic trioxide were gradually added to the irrigation water of five of the soil treatments over a six-week period after the plants had reached a height of 12 inches. The total arsenic trioxide added was 5, 10, 20, 40, and 80 micrograms, respectively, per gram of soil. Each treatment was replicated four times.

The soils used in series 3 of the tests was Hyrum silt loam containing 2.4 micrograms of arsenic trioxide per gram of soil. They were treated in a similar manner to those in series 2. The blossoms were harvested from all test plants in three general stages of growth, designated as early, mid, and late bloom. A total of 288 samples of blossoms was collected and chemically analyzed for arsenic. There was no significant difference in arsenic content of the blossoms between harvests. There was a direct relationship, however, between the amount of arsenic in the soil and that found in the sweetclover blossoms. The more arsenic in the soil the more in the clover blossoms. The blossoms harvested from soil 6 contained two or three times as much arsenic as did the blossoms from the other soils. The blossoms from soils 4 and 5 contained more arsenic than did those from soils 1, 2, and 3. There was no significant difference in the amount of arsenic in the blossoms harvested from soils 1, 2, and 3 or those from 4 and 5. Even though the data showed that the amount of arsenic in the blossoms harvested from the different soils was significant, there was no definite correlation between the amount in the blossoms and that in the soil (fig. 1).

It is doubtful that the sampling in this investigation was adequate to show conclusively that white sweetclover plants grown on soils high in arsenic absorbed quantities which might be deleterious to adult honeybees in Utah. The data do indicate that the white sweetclover plants absorb arsenic from the soil and deposit it in the blossoms. This agrees in general with the findings of previous workers on the occurrence of arsenic in plants.

The relationship found in this investigation between the amount of arsenic in the blossoms and that in the soil is believed to be owing, in general, to the amount of soluble arsenic present in the soil. The soluble arsenic is largely governed by the salts in the soil, the action of microorganisms, and the form in which the arsenic is applied. The action of certain salts on the arsenic may tie it up so that it is largely unavailable to the plants. Microorganisms may liberate small amounts of free arsenic from the soil in a gaseous form, and it is theoretically possible that they may change the more soluble trivalent form to a less soluble pentavalent form. Also the fineness and chemical form in which arsenic is applied to, or is present in the soil influences the amount of soluble arsenic that may be available to the plants.

The blossoms of white sweetclover plants grown from low arsenic soils, in general, contained lower quantities of arsenic than blossoms harvested from plants grown on soils high in arsenic. Blossoms harvested from the high arsenic soils in the Jordan Valley of Salt Lake County, during the past few years, often contained more than three times the amount of arsenic present in the flowers grown from the same soils and times during 1947, and prior to each grazing a quantitative measure of yield was obtained by weighing a mowed strip across each plot. The composition, yields, and percent clover of the 10 highest yielding mixtures and standard mixture no. 1 are recorded in table 1.

A statistical analysis of the entire experiment reveals that none of the 10 most productive mixtures differed significantly in yield, that is, differences reported in the table are too small, in relation to the experimental error, to be assigned to differences between the mixtures. All these listed, however, and 13 others, are significantly higher in yield than standard no. 1. The highest yielding mixture (2) contains no grass. It demonstrates the productive capacity of legumes alone, and emphasizes the importance of having legumes well represented in the mixture. Those mixtures, however, which have more than 60 percent legumes would probably present some difficult management problems in relation to bloat, and therefore are not recommended. Three of these mixtures (23, 32 and 6) are lacking in a rapidly developing grass so that the percentage clover the first year might not be subject to much correction by seeding more grass. Another factor of importance is that mixtures containing a high percentage of legumes usually have a lower percentage of dry matter than do mixtures which have a high percentage of grass. Thus the green weight yields do not give an entirely fair comparison when the percentage of legumes varies considerably. In mixture 23 reed canary is the only grass and it is much too slow in starting to be paired against rapidly developing legumes. This appears also to apply to timothy (mixture 32) and the brome-reed canary combination (mixture 6). In order to keep the percentage of legumes within safe management limits the first season it appears

### Table 1. The location, type, and arsenic content for each of six soils used in series 1 of this investigation (Arsenic expressed as M/gr. of As₂O₃ per gram of soil)

<table>
<thead>
<tr>
<th>Soil number</th>
<th>Location</th>
<th>Soil type</th>
<th>Arsenic content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pasture near college orchard, North Logan</td>
<td>Hyrum silt loam</td>
<td>3.3</td>
</tr>
<tr>
<td>2</td>
<td>1½ mi. S.W. of Midvale</td>
<td>Logan silty clay loam</td>
<td>10.2</td>
</tr>
<tr>
<td>3</td>
<td>College orchard, North Logan</td>
<td>Hyrum silt loam</td>
<td>37.0</td>
</tr>
<tr>
<td>4</td>
<td>8th W. and Bullion Sts., Murray</td>
<td>Welby fine sandy loam</td>
<td>102.0</td>
</tr>
<tr>
<td>5</td>
<td>2½ mi. N.W. of smelter, Murray</td>
<td>Logan loam</td>
<td>203.0</td>
</tr>
<tr>
<td>6</td>
<td>Soil 1 with arsenic added</td>
<td>Hyrum silt loam</td>
<td>722.0</td>
</tr>
</tbody>
</table>

PASTURE MIXTURES

(Continued from page 5)
necessary to have tall oat or orchard or
both in the mixture. Under different
conditions an entirely different propor-
tion of grass to legumes might be ob-
tained with no change in the seeding
rate. However, under very favorable
conditions, such as applied with experi-
ment D, it is believed that similar re-
sults would generally be obtained.

Ladino clover should be the basic legume
in any pasture mixture on highly
productive irrigated land. Ladino is de-
cidedly more palatable than either red
clover or alfalfa, and is the only one of
the three capable of spreading to im-
prove poor stands. Red clover will re-
main productive two full grazing sea-
sons, during which time it will contribute
both in the mixture. Under different
results would generally be obtained.

It is not known.

Table 1. Green weight yields of 4 harvests in 1947, and percent legumes in the 10
highest yielding mixtures and standard mixture No. 1 (experiment D, seeded April 1946).

<table>
<thead>
<tr>
<th>Mixture no.</th>
<th>Species and pounds of seed used per acre</th>
<th>Green weight yield in tons per acre for dates indicated</th>
<th>Percent legumes*</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Ladino clover (4), red clover (6)</td>
<td>6.70</td>
<td>19.52</td>
</tr>
<tr>
<td>24</td>
<td>Smooth brome (8), tall oat (8), ladino clover (2), red clover (3)</td>
<td>6.74</td>
<td>19.28</td>
</tr>
<tr>
<td>23</td>
<td>Reed canary (5), ladino clover (2), red clover (3)</td>
<td>6.85</td>
<td>19.25</td>
</tr>
<tr>
<td>12</td>
<td>Smooth brome (4), orchard (3), reed canary (3), tall oat (4), ladino clover (2), red clover (3), alfalfa (3)</td>
<td>7.63</td>
<td>19.19</td>
</tr>
<tr>
<td>22</td>
<td>Smooth brome (4), orchard (3), tall oat (4), tall fescue (4), ladino clover (2), red clover (3), alfalfa (3)</td>
<td>7.48</td>
<td>19.05</td>
</tr>
<tr>
<td>32</td>
<td>Timothy (4), ladino clover (2), red clover (3)</td>
<td>6.24</td>
<td>18.54</td>
</tr>
<tr>
<td>6</td>
<td>Smooth brome (10), reed canary (3), ladino clover (2), red clover (3)</td>
<td>5.90</td>
<td>18.38</td>
</tr>
<tr>
<td>31</td>
<td>Tall oat (16), ladino clover (4)</td>
<td>4.84</td>
<td>18.14</td>
</tr>
<tr>
<td>7</td>
<td>Smooth brome (4), orchard (3), tall oat (4), ladino clover (2), red clover (3), alfalfa (3)</td>
<td>6.43</td>
<td>17.28</td>
</tr>
<tr>
<td>9</td>
<td>Orchard (8), reed canary (3), ladino clover (2), red clover (3)</td>
<td>6.94</td>
<td>17.17</td>
</tr>
</tbody>
</table>

Table 2. First-year yields and percent clover in mixtures of one grass
grown with ladino clover. Each yield is based on 12 replications
in each of 4 harvests.

<table>
<thead>
<tr>
<th>Mixture number</th>
<th>Grass, and pounds per acre, seeded with ladino clover at 4 lbs. per acre</th>
<th>Green weight yield in tons on mixture Percent clover in the mixture</th>
<th>7-1-47</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>Tall oat (16)........ 18.14</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Orchard (12)........ 12.27</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Smooth brome (16)........ 12.92</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Reed canary (3)........ 12.82</td>
<td>74</td>
<td></td>
</tr>
</tbody>
</table>

*In this mixture there were 2 pounds ladino and 3 pounds alsike.

plots could tolerate significant additions
of red clover without the addition of
another aggressive grass. Experiment D
does not contain an adequate number of
such plots for demonstration, but owing
to the low first year production of red
canary, mixture 9 (table 1) serves to
illustrate this point. All these compari-
sions imply that very high production
would have been obtained from a plot of
tall oat (16), ladino clover (4), and red
clover (approximately 3), but such a
combination is not included in the study.
Furthermore, failure to obtain excellent
stands of tall oat (as occurred in experi-
ment A) would give a pasture with a
very high percentage of clover. The use
of another grass with tall oat appears
advisable, and, so far as first-year yields
are concerned, orchard is probably the
best choice. It should also be made clear
that before recommending that the grass
component of a pasture be built around
tall oat, its behavior in these dense
stands must be observed through sev-
eral more years.

Mixure 22 in experiment A was the
highest yielder over a 4-year period. The
dominant grass in this mixture was tall
fescue. The same mixture in experiment D
contains only a small amount of tall
fescue. In contrast, tall oat is abundant
in mixture 22 of experiment D, but was
sparse in the same mixture in experi-
mence A. The high first-year yields of
mixtures 24, 12, 22, and 31 suggest that
tall oat, if abundant, may replace tall
fescue without loss of yield but with
significant increase in palatability of the
mixture.

Some recent foreign literature reports
favorably on the practice of grazing the
nurse crop periodically during the seed-
ing year. In experiment D six replications
(of the 32 mixtures) were grazed
during 1946 while the remaining six
replications matured a crop of barley.
The effect of these two treatments on
1947 forage yield is reported in table 3.
This one experiment suggests that pas-
tures can be satisfactorily established

for December 1947
under successive grazings of the nurse crop, but that it is not likely to be as profitable as maturing a grain crop unless a farmer cannot meet his current pasture feed requirements in other ways.

The first-year results from experiment D have agreed with and strengthened the conclusions reached from the much more extensive data obtained over 4 years from experiment A, supplemented by data from experiments B and C, also started in 1943. From these earlier plantings the higher producing species have been isolated and interest has now centered on obtaining these species in the most compatible and productive combinations. During the course of study it has become increasingly evi-

### Table 3. Yields from 4 harvest dates in 1947, of mixtures that were grazed in 1946, in percent of the same mixtures that matured a crop of barley in 1946 (from 32 mixtures replicated 6 times)

<table>
<thead>
<tr>
<th>1947 harvest date</th>
<th>Relative yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-9</td>
<td>122.4</td>
</tr>
<tr>
<td>7-1</td>
<td>111.3</td>
</tr>
<tr>
<td>8-12</td>
<td>99.7</td>
</tr>
<tr>
<td>9-22</td>
<td>94.0</td>
</tr>
<tr>
<td>Entire season</td>
<td>109.8</td>
</tr>
</tbody>
</table>

dent that certain fundamental problems are not being adequately investigated. For example: Young and succulent forage has a high protein content, but also a high water content. As the plants mature dry matter increases but percentage protein and other valuable nutrients decreases. At what stage in the development of a pasture plant should it be grazed so that the yearly yield of nutrients will be greatest? Do the various high producing species which are recommended for a mixture all reach this highest production of nutrients at approximately equal recovery periods following each grazing, so that they are logical components of a mixture? The solution of these problems is fundamental to the most efficient use of farm lands devoted to pastures. A vigorous attack will be launched on these problems during the next several years.

**Milk Borne Diseases**

**By WAYNE BINNS**

There are a number of human diseases which may be transmitted by the medium of milk. There are also a few animal diseases which are infectious to man. To prevent these diseases, all communities should support a program which aims at controlling the health of animals, the sanitation of dairies and milk plants, and the health of dairy employees.

Since milk-borne diseases are for the most part the result of drinking contaminated raw milk, or raw milk from diseased cows, it is obvious that the added safeguard of pasteurization should be superimposed on clean milk from healthy cows.

The important objectives of a milk-sanitation program are the control of the production and processing of milk to such an extent that epidemics of milk-borne diseases will not occur in man, and to improve the keeping qualities of the milk. The microorganisms which are responsible for human diseases may be of two general types: first, those which are primarily of animal origin; second, those which are of human origin, gaining entrance to milk supplies by passage to the udder of the cow or by direct contamination of milk and milking equipment.

Some of the milk-borne diseases occur in epidemic form while others do not. The organisms causing epidemics usually are those which undergo some multiplication in the milk. The organisms of typhoid fever, paratyphoid fever, septic sore throat, scarlet fever, gastroenteritis, and diphtheria are typical examples. Undulant fever and tuberculosis are not often found in epidemic form.

**Typhoid and Paratyphoid Fever**

Typhoid fever is the most common milk-borne disease. Many people remain as immune carriers of the organism after having had the disease. The contamination of water supplies by the discharges from patients sometimes occurs. Milk often becomes contaminated by washing the utensils in water containing the organism or the utensils may be contaminated by the carrier if he is not careful in his personal hygiene. Flies may also carry the organism to the milk and milking utensils. In 1938 an epidemic of typhoid fever in England was reported as caused by cows wading in a stream of water in which untreated sewage flowed.

Paratyphoid fever is relatively rare but those epidemics which have occurred were spread by methods similar to typhoid fever.

**Septic Sore Throat and Scarlet Fever**

There have been numerous milk-borne epidemics of these two diseases. Research work has shown that there probably is not much to distinguish these two diseases when they occur in epidemic form. Both are caused by the same streptococcus organism and during an epidemic about one-half of the cases are typically scarlet fever, while the other half are typically sore throat. It is generally admitted that scarlet fever is nothing more than septic sore throat plus rash.

As in typhoid fever, the active case and immune carrier are the chief sources of the infection. These diseases are unique, however, because the udder of the cow may be infected by the carrier or active case. This organism may produce typical mastitis. It is difficult to eliminate the infected cow from the herd and usually requires a bacteriological examination of the milk from each quarter of all cows in the herd. If a bacteriological examination reveals the presence of a streptococcus organism which produces a marked hemolysis of blood agar, one should be suspicious of an organism of human origin. The streptococcus organism that commonly causes mastitis and is of bovine origin is not as hemolytic as the streptococcus of human origin.

**Gastroenteritis or Food Poisoning**

Acute food-poisoning epidemics have been traced to milk supplies. The causes are variable. Generally speaking, there are three agents which may cause this: first, and most common, is the toxin of *Staphylococcus aureus*; secondly, infection with *Salmonella enteritidis* or other Salmonella microorganisms; third, poisoning by the alkaloid, trematol, which causes trembles in cattle and which is derived from two plants, the white snake root and the ragless goldenrod.

The toxin of *Staphylococcus aureus* is by far the most common cause of milk-borne food poisoning. This toxin is pro-

*Dr. Wayne Binns is head of the Department of Veterinary Science.*

18

**Farm and Home Science**
duced in milk and milk products while standing in containers and may also be produced in the udder of a cow infected with the organism. The toxin produces diarrhea two to three hours after consuming the contaminated milk. Many of these epidemics have been traced to one or two cows in the dairy herd. Since mastitis in cows caused by the staphylococci does not spread rapidly through the herd, individual cows that are infected may go undetected. It is probable that staphylococcal mastitis is more prevalent than has been suspected and some surveys have indicated that such is the case.

Undulant Fever

Numerous cases of undulant fever occur in the United States every week which have originated from drinking raw milk from infected cows. However, not all cases are contracted through drinking raw milk, but some in handling the aborted fetus of cows and pigs with the bare hands. The organism localizes in the genital tract and udder of the infected cow. When the animal is heavily infected and the blood test shows a positive reaction in the 1:200 dilution she is likely to give off the organisms in the milk.

All cows supplying milk to be consumed in its raw state should be blood tested at least every six months and found to be free of the disease. Every consumer of dairy foods is justified in insisting that this protection be afforded him.

Tuberculosis

As a result of the continued efforts of the United States Bureau of Animal Industry and state agencies, bovine tuberculosis is becoming eradicated from the cattle herds of the nation. But continued vigilance must be practiced to keep the disease from cattle herds. Herds will quickly become infected with this disease if they are not checked at yearly intervals. The dairy industry can contribute a great deal to public health by insisting that all dairy animals be free of tuberculosis. The human tubercle bacillus may be discharged into the milk by tubercular people if they are allowed to work around dairies.

Miscellaneous Diseases

Diphtheria was at one time spread by milk supplies. The milk was usually contaminated by an infected person. This disease is becoming so rare in man that cases contracted from infected milk have not been reported for a number of years.

Cowpox may at times infect the hands of milkers and may even become general over the body. Cases of smallpox in humans have been known to cause the disease in cows and be transmitted back to the milkers.

DISEASE PROBLEMS IN TOMATO PLANT PRODUCTION

(Continued from page 4)

The transmission of rabies through milk is doubtful. Experiments with rabbits have shown that it does not occur.

There is some evidence that infantile paralysis may be spread through milk; therefore, special care should be given the milk to protect it from contamination during epidemics of the disease in a community.

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There is some evidence that infantile paralysis may be spread through milk; therefore, special care should be given the milk to protect it from contamination during epidemics of the disease in a community.
2. Adopt a sound system of soil management and crop rotation. Soil used for seedling production should be allowed the summer preceding its use and the rotation and cropping system should be of such a nature and of sufficient duration to prevent the building up of toxic elements and of pathogenic fungi that will render the use of the soil unprofitable in years to come. Plantings should not be located near potato fields or large beds of perennial ornamentals. Rotation periods should be as long as possible, but in no case shorter than five years if the wilt-producing, soil-inhabiting pathogens are to be held permanently in check.

3. The production of commercial market tomatoes in the Moapa Valley should be discouraged. Such crops are a means of carrying over diseases and pests that the summer-fallowing practice is intended to eliminate and they also serve to contaminate the following spring crop of seedlings.

4. Fence lines and ditch banks should be cleared of all plants that are likely to serve as hosts of fungi and viruses.

5. Workers who use tobacco should not be employed in tomato fields in any capacity, unless the use of tobacco is definitely circumscribed and measures employed to clean the hands after using tobacco and before contact with seedlings.

6. Clean implements should be used in tomato fields at all times and care should be taken to make sure that water from an infested field is not used to irrigate a growing crop of seedlings.

Undoubtedly these recommendations will be clarified or perhaps modified, and others formulated as results are obtained from the plant production research program which is to be set up in the valley in cooperation with the canning-crop-producing states of the West and Middle West. Information on most of these matters should become more extensive and the understanding of what constitutes good cultural practice should become more clearly defined as the research program progresses. But, until that time, the tomato plant grower cannot be too persistent in applying the most rigid sanitary measures and in using the most refined methods of cultivation and harvesting known at present.

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HOME ECONOMICS

(Continued from page 2)

lish basic planning data (space, equipment, utilities) for specific household functions, (3) to develop and appraise house plans for selected sets of conditions that utilize the above information to the fullest possible extent for the purpose of (a) making plans available for public use and (b) carrying on further research.

Field studies will be made to obtain information on rural family living patterns (activities, storage, ways of using homes) and the goals in housing improvement.

The first part of the study is the compilation of existing information which influences rural housing. This includes such factors as topography, climate, distribution of population, farms, types, sizes, productivity, irrigation, soil, electric power distribution (existing and proposed), familiar (size and composition) local structural materials, industrial developments in production of houses, parts of houses, equipment and materials.

The Bureau of Human Nutrition and Home Economics is participating in the Regional project and will contribute personnel and funds for editing survey studies. The completion of such a study will give to rural families functional house plans, meeting their particular needs.

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NEW HEAD OF HORTICULTURE DEPARTMENT APPOINTED

Dr. Samuel W. Edgecombe was appointed head of the Department of Horticulture, December 1. Dr. Edgecombe received his Ph.D. in horticulture from Iowa State College in 1936. His undergraduate work was taken at the University of Manitoba. He has worked on staffs of the University of Manitoba and Iowa State College. He comes to Utah State from the W. Atlee Burpee Company where he was vice president and director of research.

MARKETING OF POULTRY

(Continued from page 9)

Statistics published by the Bureau of Agricultural Economics indicate that 3,500,000 broilers were produced in the Mountain and Pacific Coast States in 1936, compared with 17,609,000 in 1945. The sale of mature chickens on farms in the Western States amounted to 29,650,000 birds in 1936 and to 37,654,000 in 1945. This is an increase of 436 percent in broiler production and an increase of 27 percent in the number of mature birds sold during this period. Officials from the Production and Marketing Administration at San Francisco report that there is a definite change in demand from small broilers to large fryers and roasters, also increased demand for all classes of eviscerated poultry in retail outlets on the Pacific Coast. Even so, a large percentage of the mature chickens and broilers marketed in the Western States are Single Comb White Leghorns.

The Western States also have a substantial turkey industry. In fact it is the largest turkey producing area in this country. Data from the Bureau of Agricultural Economics indicate that 6,775,000 turkeys were produced in the Mountain and Pacific Coast states in 1936, compared with a total of 13,370,000 in 1945. This is an increase of 97 percent. A large percentage of these turkeys are the large, Broad-breasted Bronze variety for which there was so much demand by members of the armed forces during World War II.

Even though the production of turkeys has decreased somewhat in all parts of the United States during the last two years, receipts of dressed poultry at the Los Angeles and San Francisco markets have increased from 25,418,848 pounds in 1936 to 50,732,766 pounds in 1946. Ninety-one percent of the total pounds of dressed poultry received at these two markets in the Pacific Coast was produced and shipped from the Mountain and Pacific Coast states in 1936, compared with only 48 percent from these same states in 1946. Even though war hostilities have ended, the receipts of dressed poultry at Los Angeles and San Francisco are almost twice as large today as they were ten years ago and the volume of dressed poultry received at these two Pacific Coast markets from the Mountain and Pacific Coast states is 43 percent less than it was ten years ago. Part of this increase in the demand for poultry is
caused by population increases and by consumer's inability to obtain red meats at prices which they can afford to pay.

For the past several years there has been a short supply of spring chickens in the Western states. Because it is becoming increasingly difficult for producers in the Middle West to sell "box-packed" spring chickens along the Atlantic seaboard in competition with "fresh" eastern chickens—even at a cent or two less per pound, a large part of the dressed chickens produced in the Midwest is now being shipped to the West Coast markets or to eviscerating plants in the territory where they are produced.

One of the more recent and startling developments is the shipment of live chickens from Arkansas to the Pacific Coast. Consumers are paying more for these live chickens from Arkansas than they are willing to pay for dressed chickens produced in Iowa and Kansas.

Poultrymen in the Western States are studying this situation and plans are already being made by them to supply as much of the West Coast demand as possible. Because of the competition from the Middle West and the handicaps already mentioned for eggs with which producers on the Pacific Coast are confronted, it appears that it will be several years before western producers can produce sufficient meat-type chickens to supply the markets in the western area.

Large quantities of hatching eggs, poults, and Broad-Breasted Bronze, New York dressed turkeys produced in the Western States are still being shipped to markets in the east. The length of time this can be continued depends upon such factors as: (1) the cost at which turkeys can be produced, (2) the price of competitive food products, (3) the purchasing power of the consumer, and (4) the ability of the producer to merchandise turkeys in a more efficient and attractive manner. Marketing officials in California are predicting that in less than three years the Mountain and Pacific Coast areas will be a deficit turkey producing area.

A new era in the marketing of poultry is beginning. Instead of continuing to sell chickens and turkeys with the head and feet attached and the offal still in the body cavity, most of the chickens and turkeys in the Western States before long will be eviscerated and sold ready-for-use in attractive containers either fresh or in a hard-frozen condition. This will make it possible to reduce freight and storage costs, and to salvage and utilize more of the by-products and even reduce the price of the finished product to the consumer.

The production and sale of cut-up and canned chicken and turkeys will also be increased; the quality of the meat will be improved; new grades and better methods of grading will be devised; inspection of all poultry processing plants will be required; and modern facilities and improved methods will be developed for marketing all sizes and classes of poultry.

Even though the production of poultry products in the Western states is still increasing and practically all the surplus poultry products produced here are now shipped by truck instead of by rail to markets on the Pacific instead of to markets on the Atlantic Coast, the volume of shell eggs and meat chickens is still not sufficient to satisfy the demand for these products in the Mountain and Pacific Coast areas. Industrial expansion, marked increases in population, improved transportation facilities, and greater consumption of poultry products per capita in the Mountain and Pacific Coast areas during the war and postwar years, are largely responsible for the changes in the marketing of poultry products which have already occurred. Additional changes in the marketing of all kinds of poultry products must be made in these areas if a fair share of the consumer's dollar is to be obtained in the future by the western producer.

**PRODUCTION PROGRAM**

*Continued from page 1*

winter wheat and decreases in wheat on irrigated land and in oats. Recognizing the need of forage for livestock, an increase in forage production for next year is also recommended. The changes recommended in the production of irrigated crops are primarily an increase in sugar beets and in truck crops for processing. Increases in numbers of dairy cows, sheep, and chickens were made, with decreases in numbers of horses and beef cattle (tables 2 and 3).

**Crops**

Since in Utah there are approximately 50 acres of grazing land for each acre of cropland, the need for livestock feed ranks high as a factor in determining the use of cropland.

**Feed Crops**

The major livestock feeds can be grouped into three classes: (1) forage produced on range lands; (2) forage, largely hay, produced on cropland; and (3) feed grains. The last two are usually produced in such quantities as tend to complement the first. Thus, the amount of range forage available tends to determine the amount of the other feeds produced and the acreage of cropland used for feed crops.

**Range forage:** This feed is used almost exclusively by beef cattle and sheep. The amount of this forage is closely related to the amount and distribution of precipitation, which during the past several years, has been more abundant than normal. The outlook for the coming months is more favorable than normal. The average annual precipitation for the state for the period 1920 to 1946, inclusive, was 14.06 inches. Since 1936, however, it has averaged 13.6 inches and only two years were below the long-time average. However, from 1923 to 1935 the average was only 11.5 inches, and only 3 of the 14 years were above the long-time average. The major problem at present is the uncertainty of future precipitation. A production program based on the assumption of a continuation of the relatively high precipitation of recent years involves considerable risk.

**Hay crops:** Alfalfa makes up about three-fourths of the total hay acreage in the state, and more than three-fourths of the hay produced. It is recommended that for 1948 the acreage of alfalfa should be 430,000, as compared to 408,000 in 1947. For other hays it is recommended that the acreage remain essentially the same as in 1947. While the higher than average hay yields of 1947 will likely provide a total supply of hay that will be relatively adequate for the coming year, a larger acreage is thought desirable to insure an adequate future supply.

**Feed grains:** Chickens, turkeys, and hogs are heavy consumers of feed grains in Utah. Of the total farm grains fed, probably about half is wheat, while barley and oats make up the other half. Utah is not self-sufficient in production of feed grains. The deficit is largely obtained from southern Idaho. While it is not usually feasible to ship hay long distances, grain can be shipped to advantage.

For 1948, 35,000 acres of oats are...
recommended compared to 59,000 for 1943. The recommendation for the 1948 barley acreage is 150,000, compared to 113,000 acres for 1947. The reason for this increase in barley and decrease in oats is that under most Utah conditions barley yields considerably more feed nutrients per acre than oats. The average 1936-1945 yields were: oats, 40.7 bushels; barley, 43.6 bushels. This difference means about 791 pounds more of barley per acre.

Probably most of the spring wheat produced in Utah is grown as a livestock feed. Most of it is grown on irrigated lands and competes with other irrigated crops. While 71,000 acres were planted in 1947 only 60,000 acres are recommended for 1948. Barley usually yields more feed nutrients per acre than wheat. However, most of the reduction recommended in wheat acres probably should be used for more intensive crops.

The recommended increase in corn acreage from 25,000 in 1947 to 30,000 in 1948 is mainly for areas where corn is grown in the state. Assuming that the price of beets will be as favorable as in 1947, the recommended acreage will undoubtedly be economically desirable.

Potatoes: It is recommended that 17,000 acres of potatoes be planted in

Table 1. Crop acreage in Utah for 1947 with recommended acreage for 1948

<table>
<thead>
<tr>
<th>Use of land</th>
<th>1947</th>
<th>1948</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>acres</td>
<td>acres</td>
</tr>
<tr>
<td>Oats, planted</td>
<td>99</td>
<td>35</td>
</tr>
<tr>
<td>Barley, planted</td>
<td>113</td>
<td>150</td>
</tr>
<tr>
<td>Winter wheat, planted</td>
<td>248</td>
<td>260</td>
</tr>
<tr>
<td>Spring wheat, planted</td>
<td>71</td>
<td>60</td>
</tr>
<tr>
<td>Rye for grain, harvested</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Adjustment for multiple use</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total grain*</td>
<td>492</td>
<td>506</td>
</tr>
<tr>
<td>Alfalfa hay</td>
<td>408</td>
<td>430</td>
</tr>
<tr>
<td>Other tame hay</td>
<td>48</td>
<td>55</td>
</tr>
<tr>
<td>Wild hay</td>
<td>105</td>
<td>100</td>
</tr>
<tr>
<td>Alfalfa seed, harvested</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Red clover seed, harvested</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Adjustment for multiple use</td>
<td>51</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total all hay</td>
<td>561</td>
<td>585</td>
</tr>
<tr>
<td>Corn, all</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>Sugar beets</td>
<td>47</td>
<td>55</td>
</tr>
<tr>
<td>Potatoes</td>
<td>14.3</td>
<td>17</td>
</tr>
<tr>
<td>Beans, dry</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>93.3</td>
<td>111</td>
</tr>
<tr>
<td>Peas</td>
<td>10.5</td>
<td>10</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>8.3</td>
<td>9</td>
</tr>
<tr>
<td>Sweet corn</td>
<td>4.2</td>
<td>6</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total truck crops for processing</td>
<td>23.4</td>
<td>25.3</td>
</tr>
<tr>
<td>Total truck crops for fresh market</td>
<td>5.27</td>
<td>6.30</td>
</tr>
<tr>
<td>Sugar beet and vegetable seed</td>
<td>1.20</td>
<td>1.20</td>
</tr>
<tr>
<td>Orchard and small fruits</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Total intertilled crops</td>
<td>143.17</td>
<td>163.80</td>
</tr>
<tr>
<td>Total grain and hay</td>
<td>1,060</td>
<td>1,098</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total cropland used</td>
<td>1,196.17</td>
<td>1,254.80</td>
</tr>
</tbody>
</table>

*Total grain does not include corn

Table 2. Number of livestock in Utah, 1947 with recommended numbers for 1948

<table>
<thead>
<tr>
<th>Numbers</th>
<th>1947 number</th>
<th>1947 number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horses, mules and colts</td>
<td>73</td>
<td>70</td>
</tr>
<tr>
<td>Cattle and calves, all</td>
<td>555</td>
<td>535</td>
</tr>
<tr>
<td>Milk cows, 2 yrs. +</td>
<td>117</td>
<td>120</td>
</tr>
<tr>
<td>Other cows, 2 yrs. +</td>
<td>157</td>
<td>154</td>
</tr>
<tr>
<td>Sheep and lambs, all</td>
<td>1,646</td>
<td>1,800</td>
</tr>
<tr>
<td>Ewes, 1 yr. +</td>
<td>1,312</td>
<td>1,500</td>
</tr>
<tr>
<td>Hens and pullets</td>
<td>2,870</td>
<td>2,900</td>
</tr>
</tbody>
</table>

Table 3. Livestock production in Utah 1947 with recommendations for 1948

<table>
<thead>
<tr>
<th>Production</th>
<th>1947 number</th>
<th>1948 number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sows farrowed, spring</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>Sows farrowed, fall</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Chickens raised</td>
<td>4,516</td>
<td>4,500</td>
</tr>
<tr>
<td>Commercial broilers produced</td>
<td>200</td>
<td>300</td>
</tr>
<tr>
<td>Turkeys raised</td>
<td>1,263</td>
<td>1,500</td>
</tr>
<tr>
<td>Cattle put on feed</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Sheep and lambs on feed</td>
<td>128</td>
<td>125</td>
</tr>
</tbody>
</table>

1948. This is an increase from the 14,300 planted in 1947 and the 15,500 of 1946, but is less than the acreage of 1943, 1944, and 1945. The United States Department of Agriculture production control program limited the 1947 acreage and may also curtail the 1948 acreage below that recommended. However, in view of local production conditions and the favorable market on the west coast, it appears that the recommended acreage is desirable. However, some shift from early to late varieties is recommended for the northern producing areas of the state.

Truck crops for processing: In 1947 approximately 23,500 acres were planted to truck crops for processing. This was slightly less than the acreage grown during the war years, but somewhat more than the 1935-39 average. For 1948, 25,300 acres are recommended. The recommendations are for fewer can...
ning peas and green beans, and for more tomatoes and sweet corn.

Truck crops for fresh market: The prewar acreage of these crops was about 4,500. The 1947 acreage was 5,280. For 1948, 6,300 acres are recommended. The recommended increase is largely in cabbage, celery, and onions.

Alfalfa seed: For 1948, it is recommended that 50,000 acres of alfalfa be harvested for seed. This is somewhat more than the acreage of the war and prewar years but much below the peak and is the same as the 1947 acreage. While the supply of alfalfa seed from the southwest is large, there is still a strong demand for high quality seed, particularly of new varieties.

Livestock

The association between the total number of each kind of livestock and the kinds and amount of feed available within the state is close. The amount of feed produced in the state sets the approximate limit to the number of livestock raised.

Cattle

It is recommended that the number of all cattle in Utah be reduced from 555,000 as of January 1, 1947, to 520,000 at the close of 1948. The average number for 1935-39 was only 424,000. The reduction is recommended because the present number is considerably above the long-time average, and it is thought also above the long-time or normal feed supply. Should precipitation return to normal, the feed supply would likely be inadequate at the level of feeding considered desirable. Furthermore, with high prices for beef this is a good time to liquidate excess numbers.

Beef cattle: It is recommended that the entire reduction in all cattle numbers be made in beef cattle because the largest increase has been in beef cattle and also because a lowered range forage yield resulting from lowered precipitation would primarily affect cattle production. There is evidence that reduction in numbers is now under way. Cattle slaughter is high and includes more calves, heifers, and steers of lighter weights.

Dairy cattle: The number of milk cows for January 1, 1948 was recommended at 120,000 and for January 1, 1949, 124,000. This is compared with 117,000 as of January 1, 1947, and 126,000 on January 1, 1945. The recommendation for increasing milk cows is based on a favorable outlook for dairy products and the need for an intensive forage consuming livestock enterprise on Utah farms.

Sheep

Total sheep numbers should increase from the 1,646,000 of January 1, 1947, to 2,000,000 head at the close of 1948. The 1947 number is the lowest for the past 20 years. The increase is based on the belief that some range lands in Utah now used by cattle are better adapted to sheep. Over a long-time period the resources of the state adapted to sheep production are adequate to carry between 2½ and 2½ million head.

Cattle, Sheep and Lamb Fattening

In general the harvested livestock feeds in Utah can be used to better advantage for feeding dairy cattle, poultry, and breeding herds and flocks than in fattening cattle or sheep. However, some cattle and lambs are fattened every year. The number fluctuates with price relationships. However, the trend is downward. In 1947, an estimated 30,000 cattle and 125,000 sheep and lambs were fattened. The same numbers are suggested for 1948.

Chickens

For the beginning of 1948, 2,900,000 hens and pullets are recommended for Utah farms. For 1949, 3,000,000 are recommended. These numbers are above the 2,870,000 for 1947, but are slightly below the 1944, 1945, and 1946 numbers. Favorable marketing conditions, a favorable egg-feed price ratio as compared to other commercial egg producing areas, and the excellent way in which this enterprise fits into the organization of many farms in Utah led to the recommendation for increasing chickens. It is also recommended that sufficient chickens be raised each year to replace the death losses and cullings in the laying flocks. The number recommended for 1948 is 4,500,000, which is essentially the same as for the two preceding years.

Turkeys

The number of turkeys raised in Utah increased rapidly from 1935 to 1945. In the latter year the number exceeded 2,000,000 birds. The number raised this year is estimated at 1,263,000. Feed shortages, the risk from high feed prices, and labor shortages are given as the reasons for the decline. For 1948, 1,500,000 turkeys are recommended. This enterprise fits well into the organization of many farms, marketing facilities are established, the production environment is good, and since turkeys largely consume grains which can be obtained at prices comparable with competitive areas, it is believed that this increase is justified.

Hogs

In 1947 there were about 14,000 sows which farrowed in the spring and about 8,000 in the fall. This is about the average over a number of years. For 1948 the recommendation is for an additional 2,000 sows to farrow in both spring and fall. The intent of this recommendation is to provide a farm meat supply for more farm families and not to increase the production of slaughter hogs for sale.

An Economic Program for Farmers

The immediate future will be a period when farmers should take advantage of relatively high prices and save funds to improve the farm when materials are available and when they may be obtained at lower costs. Utah farmers should proceed in a cautious manner by planning the farm program on a short-time basis. It is a time to take advantage of the relatively favorable price level for agricultural products without making long-time commitments or major adjustments. The immediate future is the time to produce, to sell, and to pay off indebtedness or save the profits for a period when an adjustment in prices will be made.

NEW PLANT PATHOLOGIST APPOINTED TO STUDY VIRUS DISEASES OF STONE FRUITS

The research program on virus diseases of stone fruits of the Station is to be greatly enlarged during the coming year through a three-agency cooperative agreement. The Bureau of Plant Industry Soils and Agricultural Engineering, and Bureau of Entomology and Plant Quarantine and the Utah Station will each employ a scientist to work with Dr. B. L. Richards, Station plant pathologist, on the causes and control of fruit tree diseases.

The first of these scientists, Dr. George W. Cochran, will join the Station staff, January 1. Dr. Cochran did his undergraduate work in pomology and plant pathology at the University of Kansas. He took his Ph. D. at the Cornell University in Plant Pathology. He has worked for two and one-half years at the Rockefeller Institute with virus diseases of stone fruits.

GRANT FOR STUDY OF ANIMAL NUTRITION

The Utah Agricultural Experiment Station has received a $3,000 grant from the International Minerals and Chemical Corporation. This grant-in-aid is to help support studies relating to the nutrition of range animals with special attention directed to the role of phosphorus in animal nutrition under range and farm conditions.
THE UTAH AGRICULTURAL EXPERIMENT STATION IN THE SERVICE OF UTAH

A THREE-FOLD educational approach through teaching, research and extension makes Utah State Agricultural College a vital force in the life and progress of Utah. In its research division, Utah Agricultural Experiment Station, the funds and facilities of federal, state, and private agencies are directed and correlated toward the solution of major agricultural problems of the region. Here problems in their relationship to the agricultural economy of the state are studied by specialists in many fields, each bringing his contribution toward the solution of the problem involved.

All agencies concerned in research are realizing that concentration of effort brings more rapid results with smaller expenditure of money. Consequently the United States Department of Agriculture is concentrating much of its research at state experiment stations. Private companies are giving funds to the experiment stations to strengthen work in the fields in which they are interested. Thus the agricultural experiment station, through its increased facilities, can better serve the agricultural interests of the state.

At present approximately 100 trained scientists are working on the Utah Agricultural Experiment Station staff to solve problems peculiar to the agriculture of this area. This research is in many fields. Work is going forward on approximately 110 projects at the present time.

The advantages to Utah agriculture of cooperative research on a regional basis will become more apparent as results are obtained from the new research provided by the Agricultural Research and Marketing Act passed by Congress in August, 1946, and put into operation a year later. In the western region emphasis will be given to studies of the marketing of such products as livestock, turkeys, wool, dairy products, apples and peaches. Other cooperative studies will involve nutritional deficiency surveys, rural housing, dairy farm structures, beef cattle breeding, dairy cattle breeding, and turkey breeding. The $14,654.56 received by the Utah Station for 1947-48 will be used to help support a beef cattle breeding project begun previously on a $10,000 gift from the Sears Roebuck Foundation; insect control and disease of celery; the effect of chemical composition of soils and plants upon the nutrition of animals and man; functional requirements of rural housing in Utah; and the housing of dairy cattle.

In the research on the marketing of livestock and of peaches, the Utah Station will direct the work of the other western states. These projects and also the two on the improvement of rural housing and of dairy barns will receive additional regional funds from the $146,000 apportioned to the western region.

The Agricultural Experiment Station serves as a coordinating agency for the effective and efficient promotion of the research work. The outside aid from federal and private agencies implements the Station program through financial assistance and through the assignment of trained specialists who spend their time in the investigation of pressing problems which threaten the stability of Utah agriculture.

○ DIET FOR YOUNG FOXES

Information on the building of a balanced diet for young foxes is available to Utah fox raisers by request from the Utah Agricultural Experiment Station.

CORRECTION

In an article entitled "Fluorides offer new hope for sound teeth," on page 7 of volume 8, no. 3 of this publication, Evanston, Illinois, should be substituted for Evanston, Wyoming. So far as is known Evanston, Wyoming, is not adding sodium fluoride to its water supply.

![Staff and collaborators of the Legume Research Station sponsored by the U. S. Department of Agriculture in cooperation with the Utah Station.](image)

IN THIS ISSUE

<table>
<thead>
<tr>
<th>Article</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended agricultural production program for Utah for 1948,</td>
<td>1</td>
</tr>
<tr>
<td>by W. P. Thomas and G. T. Blanch</td>
<td></td>
</tr>
<tr>
<td>Research in home economics expands</td>
<td>2</td>
</tr>
<tr>
<td>Disease problems in the production of tomato plants in the Moapa Valley</td>
<td>3</td>
</tr>
<tr>
<td>by H. L. Blood</td>
<td></td>
</tr>
<tr>
<td>New grass-legume pasture mixtures are high producers, by W. Keller,</td>
<td>5</td>
</tr>
<tr>
<td>G. Q. Bateman and J. E. Packer</td>
<td></td>
</tr>
<tr>
<td>Disease threatens celery industry in Utah, by E. L. Walder</td>
<td>6</td>
</tr>
<tr>
<td>The impact of war on the future marketing of poultry products in the</td>
<td>7</td>
</tr>
<tr>
<td>Western States, by Carl Frischknecht</td>
<td></td>
</tr>
<tr>
<td>Seeding ranges to grass, by C. W. Cook and L. A. Stoddart</td>
<td>8</td>
</tr>
<tr>
<td>Wild bees in relation to alfalfa pollination, by G. E. Bohart</td>
<td>10</td>
</tr>
<tr>
<td>The relationship between arsenic in the blossoms of white sweetclover</td>
<td>13</td>
</tr>
<tr>
<td>and in the soil, by W. P. Nye</td>
<td>15</td>
</tr>
<tr>
<td>Milk borne diseases, by W. Binns</td>
<td>18</td>
</tr>
<tr>
<td>The Utah Agricultural Experiment Station in the service of Utah</td>
<td>24</td>
</tr>
</tbody>
</table>

Farm and Home Science