Weber Basin Project Will Conserve Wasting Water Resources For Irrigation and Municipal Use in Five Utah Counties

Under Full Development All Water Resources Will Be Used Giving Full Water Supply to All Irrigated Land and Providing for Municipal and Industrial Growth

By FRANCIS M. WARNICK

All elements of multiple-purpose use of water have been considered and integrated into a coordinated plan of development.

More Irrigation Water

Urgent need exists for irrigation expansion in the Weber Basin Area. The rapidly growing population has greatly increased the demand for locally produced foods and for other agricultural products. About one-fourth (30,000 acres) of the presently irrigated lands require supplemental water. Large acreages (70,000 acres) have not been developed for lack of water and irrigation facilities. Still another 39,000 acres in need of a full or supplemental water supply requires drainage for full productivity.

Dependable Supplies of Municipal Water

An equally urgent need exists for dependable supplies of municipal water. Population increases far beyond the growth expectations of a decade ago have overtaxed present municipal supplies. In 1940 the total population in the project area was about 80,000; it is now estimated to be 130,000. Fortunately, nature was benevolent during the 1940’s by maintaining the annual precipitation at or above normal for ten consecutive years. Even with the abnormal circumstances, late season water shortages are annual occurrences in the rapidly growing communities of Davis and Weber Counties.

Hydro-electric power plants are planned for construction at the proposed Perdue and Magpie damsites (see general map for location). By expanding the snow survey program, and using recently devised forecasting procedures, the project reservoirs will be operated for flood control without impairment to water conservation. Wherever justifiable, stream flows will be maintained at a specified minimum level for fish propagation. Seepage water intercepted by project drains will be directed to the marsh lands adjacent to Great Salt Lake to enhance bird refuge conditions. Project reservoirs will provide excellent recreational opportunities, and the plans for each reservoir include items for recreation development. The Bureau will assist the Public Health Service and the Utah State Health Department in publicizing the need for stream pollution abatement.

The water supply needed to accomplish the comprehensive plan for Weber Basin development is presently wasting into Great Salt Lake, frequently causing flood damage and always aggravating drainage problems. By further storage regulation of the fluctuating flows of Weber River, more effective utilization of natural flows from Wasatch slope streams, and development of usable return flows and ground water, the project will increase the useful water supply of the area at canal and aqueduct heads by an average of 285,000 acre-feet annually.

Of this total supply, 345,000 acre-feet will be utilized for irrigation and 40,000 (Continued on page 40)
New Greenhouse for Study of Virus Diseases
(See page 44 for story)

Upper left, Dr. B. L. Richards, head of the Department of Botany and Plant Pathology in charge of the stone fruit virus disease work in Utah, examining western-x diseased cherry trees in temperature control chamber following an experiment on virus inactivation by heat. Left, Dr. Bryce N. Wadley, plant pathologist, Bureau of Plant Industry, placing cherry trees inoculated with western-x virus into one of the plant propagating chambers. This propagator is used to force rapid development of the disease. Circle, Dr. G. W. Cochran, associate professor of plant pathology, studying symptoms in a seedling peach produced by the western-x virus.

Right, graduate students in entomology, Gerald L. Dean, left, and Marvin W. Nielsen, right, of the Bureau of Entomology and Plant Quarantine, transferring insects from western-x infected peach trees enclosed in insect cages.

Left, George H. Kaloostian, entomologist of the Bureau of Entomology and Plant Quarantine in charge of the insect vector research in stone fruit virus diseases in Utah, observing leafhoppers in insect rearing cage.

Right, a graduate student in plant pathology, Lewis G. Weathers, using dodder, a parasitic plant, to transfer the western-x virus from infected peach trees to carrots, tomatoes, and other herbaceous plants.

Left bottom, greenhouse supervisor, Otto Riehtmann, preparing sweet cheery trees to be inoculated with the western-x or other viruses.

Right bottom, the stone fruit virus research team, Wadley, Kaloostian, Cochran, and Richards, left to right, comparing virus disease symptoms in Elberta peach trees.
Salt Lake Growers' Market Provides Economical Means of Bringing Buyer and Producer Together

JOHN D. BAKER and V. L. ISRAELSEN

Of each dollar you spent for food in 1949, 48 cents found its way back to the farmer who produced the food, and 52 cents was absorbed along the line to pay the marketing costs. In other words, less than one half of your dollar got back to the producer of the food.

To provide a means through which the farmer can get nearer to the consumer and reduce these marketing costs and at the same time provide the consumer with fresher and better quality produce is one of the primary reasons for the existence of the Growers' Market in Salt Lake City. Economic institutions arise and develop out of needs and for the existence of the Growers' Market Company. Such an institution is the Growers' Market Company.

This article is based on a study of the market made in 1949. The study was an attempt to examine some of the market's operations to determine, in part at least, how well some of these functions are being performed. It was not possible with the time and resources available to examine all of the operations of this market nor to follow those operations covered through an extended period of time. Therefore attention was given to the activities and the produce of those farmers, fruit and vegetable growers, in and near Salt Lake County who used the facilities of the market as an outlet for their produce. For these growers this market provides an important outlet. Approximately one third of the fruits and vegetables, excluding potatoes, produced in Salt Lake and Davis Counties was sold through the Growers' Market. The average person would be greatly impressed if he were to see ten railroad freight trains of 45 cars each with a placard on each car bearing the words "Filled with fresh fruits and vegetables produced in Utah." That is the approximate amount of produce sold on the platform of the Growers' Market by farmers during the period June through September of 1949. For the fruits and vegetables so marketed the growers received almost a million dollars.

In addition to the produce sold over the so-called platform this market provided an outlet for farmers to sell directly to wholesalers and retailers, including the chain stores, and others. No estimate was obtained of the volume of commodities moving through these latter channels though it is known to be large.

Facilities of the Growers' Market

Certain aspects of this market extend as far back as 1890. The market moved to its present location between 4th and 5th South on West Temple Street in Salt Lake City in 1919. In addition to the two platforms, which can accommodate roughly 250 trucks of growers, the market owns and leases space to some 20 wholesale merchants. It has another building devoted to office space, a restaurant, and sundry other uses. Other business firms servicing the buyers and sellers frequenting the market are conveniently located.

The wholesale houses and produce merchants are provided with rail as well as truck facilities.

Size of Farms and the Growers' Market

Because of the small average size of the farms in Salt Lake and adjacent counties and consequently the limited number of acres harvested per farm, intensive cultivation is a necessity. In 1945 there were in the four counties of Salt Lake, Davis, Weber, and Utah, 9,417 farms of which 4,103 or almost 44 percent harvested less than 10 acres each. In the balance of the state, only 10 percent of the farms harvested less than 10 acres each. Some details on number of farms and number of acres harvested are presented in table 1.

Thus the small producer who has only an acre or two and who could not attract a large buyer nor sell in carlot has available the Growers' Market where he may, if he chooses, sell directly to the consumer. In any event he has an assured market outlet within convenient travel distance from his farm.

Moreover, the market offers an alternative means of trading to retailers, truckers, to other buyers, and to the other producers of fruits and vegetables should existing wholesalers and jobbers exact profits that are too high or render poor service. Competition between the produce companies themselves also tends to prevent inefficiencies and excessive profits.

Volume, Loads, and Sales on the Market

An estimated 2,307 tons of fruit valued at $406,000 and 7,629 tons of vegetables valued at about $440,000 were sold over the market platforms during the four months of this study. Loads averaged about 3,390 pounds in weight and about $130 in value, but there was great range in weight and value. There were some loads of 200 or 500 pounds worth $10 or $12 as contrasted with some loads of 6 of 7 tons valued at $300 to $700.

A larger volume of produce by weight and value was sold on Mondays and Thursdays than the other days of the week. These were the days that truckers hauling loads out of the city to points in and out of the state brought their loads and many growers catered to this trade.

As may be expected heavier volume by weight came on the market later in the season with September being the high month with 34 percent of the total weight for the four-month period. According to value of sales July and September were about equal with about 28 percent each of the total receipts for the four-month season. June was the low month both in weight of and in value of produce offered. Higher value per pound of products coming to the market earlier in the season accounts for the difference between value and weight.

JOHN D. BAKER made a study of the Farmers' Market as his thesis project for his MS degree from the USAC. He is now doing graduate work in agricultural economics at Purdue University. DR. V. L. ISRAELSEN is professor of agricultural economics. He wrote two articles on transportation of agricultural products in the last volume of Farm and Home Science.
Who Buys the Produce

Growers utilizing the market platform sold about one third of the produce they brought into the market area to wholesalers, about one fourth to truckers, and about one fifth to chain stores. City retailers, peddlers, platform retailers or curb marketers, and consumers purchased the balance. A large share of the produce sold to wholesalers and chain stores was delivered directly to these buyers without passing over the market platform at all. Inclusion of these sales which by-pass the platform would materially expand volume figures.

Costs in this Type of Marketing

It has already been observed that 52 cents of the 1949 consumer dollar was absorbed by marketing costs. Marketing costs for fruits and vegetables were much greater on the average than for commodities generally. This is shown by the fact that 64 cents of the dollar spent for fruits and vegetables went to pay for marketing costs while only 36 cents found its way to the farmer.

Principal costs for producers on the Growers’ Market are those of transportation, fees and stall rents, labor, and containers. The largest item is that for containers which often amounts to between 40 and 70 percent of the total costs. For cheaper produce new containers cost almost as much as the value of the produce contained in them. For example new lugs cost 30 cents while apricots sold on the market for as low as 62 cents including the price of container. Of course, second-hand containers are largely used for this type produce, but this is done at the expense of obtaining the best appearing pack. Except in the case of sales to the consumer who comes here to buy, further marketing costs are incurred. Producers having loads with a value under $100 had much higher selling costs per unit of sales than did those with loads valued at $300 or more. Sellers with small loads had sales averaging about $10 per hour spent on the market while those with large loads averaged about $80 sales per hour. There was a definite relationship between size of load and the dollar sales per hour. Likewise selling costs took a higher percentage of total revenue in the case of small growers with but little produce than for the larger grower. There appears to be definite economies associated with volume.

Quality of Produce and Selling

With as many independent producers as there were operating on the market, one would reasonably expect wide variations in quality of produce; and this expectation was fully realized. Some sellers catered to buyers who wanted quality produce. These sellers uniformly had high quality merchandise and were able to command top prices for it. Another fact of importance observed in this study of market operations was the rapidity with which the high quality products moved in comparison with the mediocre produce. More often than not the large producers had a better quality product than small producers. The reason for this was undoubtedly that the larger grower made it a full time, carefully managed, and supervised business while with the small producer more often than not it was a part time, on-the-side business.

Packaging and Grading of Produce

Noticeable on this market was the lack of standardization of containers in which farm products came to market. Perhaps an outstanding example of this was the case of snap beans. For these the most usual container was the burlap bag of which the assortment was almost without limit. Other containers used for beans were: lettuce crates, celery crates, cantaloupe crates, lugs, bushel baskets, one-half bushel baskets. There was a definite tendency for poor quality produce to appear in larger containers, good examples were tomatoes and peaches. High quality products were much more likely to be attractively packaged and command a premium price. To this general rule there were, of course, exceptions. There was a tendency for the larger growers to do a better job so far as standardization of containers was concerned. It appeared that this practice “paid off” in added buyer appeal. Grading likewise is susceptible to improvement. Growers who had established a reputation for uniformly graded produce had buyers who bought readily and with confidence. This fact eliminated much sales effort and reduced selling costs. The unethical person who grades “stove pipe fashion” adversely affects the reputation of the whole market.

Criticisms and Possible Means of Improvement

In attempting to evaluate the operations on this market from these few weeks of observation it is possible that errors of judgment may creep in because of insufficient time for observing operations or because factors other than those investigated may have an important bearing. However, certain lines of approach appear to give promise of savings to the growers and

Table 1. Number of farms harvesting certain acreages of crops in the state of Utah and in Davis, Salt Lake, Utah, and Weber Counties in 1945 

<table>
<thead>
<tr>
<th>Acres harvested</th>
<th>State No.</th>
<th>State Percent</th>
<th>Davis No.</th>
<th>Davis Percent</th>
<th>Salt Lake No.</th>
<th>Salt Lake Percent</th>
<th>Utah No.</th>
<th>Utah Percent</th>
<th>Weber No.</th>
<th>Weber Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-9</td>
<td>5956</td>
<td>24.9</td>
<td>483</td>
<td>36.0</td>
<td>1486</td>
<td>55.2</td>
<td>1439</td>
<td>40.6</td>
<td>695</td>
<td>37.8</td>
</tr>
<tr>
<td>10-19</td>
<td>3220</td>
<td>13.5</td>
<td>233</td>
<td>17.4</td>
<td>434</td>
<td>16.1</td>
<td>589</td>
<td>16.6</td>
<td>309</td>
<td>16.8</td>
</tr>
<tr>
<td>All others</td>
<td>15731</td>
<td>61.6</td>
<td>625</td>
<td>46.6</td>
<td>772</td>
<td>28.7</td>
<td>1515</td>
<td>42.8</td>
<td>837</td>
<td>45.4</td>
</tr>
<tr>
<td>Total</td>
<td>23907</td>
<td>.....</td>
<td>1341</td>
<td>.....</td>
<td>2692</td>
<td>.....</td>
<td>3543</td>
<td>.....</td>
<td>1841</td>
<td>.....</td>
</tr>
</tbody>
</table>

* U. S. Census of Agriculture, Utah and Nevada, 1945.
MINERALS are essential constituents of both plants and animals. They constitute from 3 to 4 percent of the live weight of the fowl and about 10 percent of the egg. Minerals are used in digestion, in respiration, in bone and egg shell formation, and in maintenance of muscle tone and nerve irritability. However, the importance of mineral supplements to the regular rations of laying hens has undoubtedly been exaggerated in many cases. Most of these mineral elements are supplied in adequate quantities by the ordinary feed stuffs that are included in the poultry ration. Only a few minerals need be supplied in special concentrated feeds. These are: calcium, phosphorus, sodium chloride, manganese, and in some cases, iodine, iron, and copper.

Calcium can be supplied by oyster shell or high grade limestone. These products are approximately equivalent in value for poultry. In Utah it is much cheaper to use high grade limestone. Both calcium and phosphorus can be furnished by bone meal or defluorinated rock phosphate. Sodium chloride and iodine can be supplied by feeding iodized salt, and manganese can be supplied in the form of manganese sulfate. Green feed, alfalfa meal, cereal grains, and the protein concentrates used in poultry rations usually provide a sufficient quantity of the minor mineral elements.

Grit may function as a source of mineral when it is provided in a soluble form. Limestone or oyster shell grit is generally fed free choice to producing hens. This is necessary, since the calcium requirement for each hen varies according to her rate of production.

Since the egg shell contains more than 95 percent calcium carbonate, high calcium, limestone, and oyster shell grits are superior to other types. Some of the soluble grits fed to poultry may have a depressing effect on egg production and on market quality of the eggs. Research conducted during the past three years at the Utah Agricultural Experiment Station has demonstrated that hens fed a high magnesium grit lay fewer eggs. A recent experiment has also shown that a high calcium grit is superior to a high silica grit.

The recently conducted experiment was as follows: two lots of laying pullets were fed and managed the same, except for the type of grit fed. The mash fed each lot came from a common batch mix, and the calcium content was equivalent to that recommended for egg production by the National Research Council. Egg production, pounds of feed required to produce a dozen eggs, mortality, and market value of the eggs were used as measures of the comparative value of the two grits.

The Logan Branch of the Utah Poultry and Farmers Cooperative Association cooperated in grading the eggs. The results obtained from this feeding trial are given in table 1.

The value of the eggs produced by the hens fed the high silica grit was considerably below that of the birds fed calcium carbonate grit. This may have been owing to the fact that the silica grit was palatable and consumed at the expense of the balanced mash feed. The grinding qualities of this grit were poor.

The higher percent of second grade and below grade eggs produced by the hens fed the high silica resulted from poor shell quality. This may be owing to the fact that some of the mineral elements in the high silica grit favored the formation of a calcium compound that was unavailable to the hen. This could cause an actual deficiency of calcium for the manufacture of good quality egg shell.

Pea gravel, granite, and quartz grits are frequently fed to laying hens. The purpose of feeding these types of grit is to assist in grinding the whole grains in the gizzard of the hen. These grits are classed as insoluble and do not supply additional minerals to the hen.

Supply Essential Minerals in Regular Rations of Hen and Not In Expensive Supplements

By C. I. DRAPER

| Table 1. Average egg production, efficiency of feed utilization, and grade of eggs laid by hens fed high calcium carbonate and high silica grits |
|---------------------------------------------------------------|-----|-----|
| Number of eggs laid per hen from December to August | 125 | 112 |
| Pounds of feed required to produce a dozen eggs | 8.1 | 9.7 |
| Percent of first grade eggs | 68 | 54 |
| Percent of second grade eggs | 23 | 28 |
| Percent below grade eggs (rots, trades, etc.) | 9 | 18 |
| Percent of eggs with cracked shells (poor shell quality) | 3.7 | 4.4 |

DR. C. I. DRAPER is head of the Poultry Department.
President F. S. Harris Accepts Mission to Iran

IN HIS second inaugural address, President Truman announced his now famous point 4 program which has become one of the corner stones of American Foreign Policy. "—to help free peoples of the world produce more of the goods they need—more food, clothing, housing, and mechanical power." To expedite this program, outstanding leaders throughout the United States are being called into service.

In furtherance of this program, President Franklin S. Harris has been invited to act as technical advisor to Iran, where he has been on two previous occasions.

In accepting the present call, Dr. Harris resigned his position as president of the College. The Board of Trustees, in recognition of his outstanding service, conferred the honorary degree of doctor of science at the 60th commencement exercises and gave him the title of president emeritus.

Dr. Harris first came to the college in 1907 as assistant chemist. In 1911 he was appointed head of the Agronomy Department, and in 1912 he was given the additional assignment as director of the School of Agricultural Engineering. In 1916 he was appointed director of the Agricultural Experiment Station which position he held until 1921 when he was chosen president of the Brigham Young University. He returned to USAC in 1945 as its seventh president, and has guided the affairs of the college since that time.

Among his outstanding contributions to USAC has been his sympathetic attitude toward research. During his five years as president, the college has acquired an electron microscope, an untracentrifuge, a large spectrograph, many new research laboratories, and greatly needed scientific equipment. He has been interested in having faculty members attend and present papers at scientific meetings in various parts of the country. He has created a climate favorable to research.

President Harris has numerous accomplishments and honors to his credit. Aside from his outstanding achievements as president of the BYU and USAC over a period of 29 years, his greatest achievements have probably been in his service to peoples and nations in other parts of the world. In 1946 he headed a mission to the Near East. Immediately afterwards he led an international group of experts to Greece for the Food and Agricultural Organization of the United Nations. He spent 1939-40 in Iran as agricultural advisor to the Shah.

He began his service on an international scale in 1926 as chairman of the agriculture section of the Pan-Pacific Science Congress which met in Japan. In 1929-30 he led a mission to Siberia to investigate the Soviet plan to colonize a tract on the Amur River with Jews. He traveled widely over Russia and Siberia. He was also chairman of the agriculture section, Pan-Pacific Scientific Congress in Mexico City in 1935.
THE new president of the USAC is Dr. Louis Linden Madsen, who has been head of the Animal Husbandry Department at the College, and who is an outstanding authority in animal nutrition.

Dr. Madsen joined the faculty of the USAC in 1945 as head of the Animal Husbandry Department. He did his undergraduate work here, graduating at the head of his class in 1930. He worked his way through college by acting as a herdsman and later as a laboratory instructor. His PhD degree in animal nutrition was awarded by Cornell University in 1934. He was given a National Research Council fellowship at the College of Physicians and Surgeons, Columbia University, and spent 18 months there in nutrition and biochemical research. He then became a member of the staff in agricultural chemistry of Michigan State College, going from there to the U. S. Bureau of Animal Industry as animal nutritionist.

Dr. Madsen has done research in the nutrition and production of all classes of farm animals and has specialized in the diagnosis of nutritional diseases and methods of overcoming them under practical conditions. At Cornell he worked on the fundamental food requirements of farm animals. At Michigan his work on the relation of nutrition to necrotic enteritis in swine gained him national recognition. At Beltsville for the Bureau of Animal Industry, his work was with beef cattle, swine, and sheep. He carried through experiments on vitamin A requirements of beef cattle for reproduction to the third generation. In these studies he worked out a method for the detection of vitamin A deficiency in cattle by means of blood analysis. This method has been widely applied by other investigators. He cooperated with the Texas Agricultural Experiment Station on feedlot problems with fattening cattle and the problem of furnishing mineral supplements, particularly phosphorus, to beef cattle under range conditions.

His work at the USAC has been concerned with breeding and nutrition problems of cattle and sheep on the range. He has had charge of both the range sheep and beef cattle breeding projects conducted both at Logan and Cedar City. This research is cooperative with the eleven western states and the U. S. Department of Agriculture. He has worked on the problem of mineral deficiency diseases among the cattle of Wayne County and surrounding areas, and the toxicity of DDT to farm animals.

The Utah State Agricultural College Institute of Nutrition, and the Utah State Agricultural College Research and Development Council were organized under his sponsorship.

Dr. Madsen is a member of the National Research Council and on the committee on animal nutrition. He also has membership in the American Institute of Nutrition, American Society (Continued on page 43)
Appraising Desert Range Forage for Sheep
Browse Plants of Higher Quality than Grass and Make Up Larger Part of Diet of Sheep

By C. WAYNE COOK, DAVID O. WILLIAMSON, LORIN E. HARRIS, L. A. STODDART and L. L. MADSEN

STUDIES of plants on the winter range made by the Utah Station indicate that browse plants are of higher quality than grass and that they generally make up a larger part of the diet of sheep.

Table 1. Comparative total protein in a few important desert range plants during the winter grazing season, dry basis

<table>
<thead>
<tr>
<th>Plant</th>
<th>November</th>
<th>January</th>
<th>February</th>
<th>March 7</th>
<th>March 27</th>
<th>April 17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black sage</td>
<td>8.99</td>
<td>9.30</td>
<td>9.44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shadscale</td>
<td>9.34</td>
<td>8.73</td>
<td>9.91</td>
<td>13.40</td>
<td>12.84</td>
<td></td>
</tr>
<tr>
<td>White sage</td>
<td>9.16</td>
<td>9.13</td>
<td>11.23</td>
<td>11.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curly grass</td>
<td>4.29</td>
<td>4.07</td>
<td>3.77</td>
<td>4.74</td>
<td>9.57</td>
<td></td>
</tr>
<tr>
<td>Rice grass</td>
<td>3.59</td>
<td>3.67</td>
<td>4.25</td>
<td>8.13</td>
<td>9.44</td>
<td></td>
</tr>
</tbody>
</table>

Grasses have been reputed over the world to be the ideal feed for livestock. Shrubs are often referred to as "goat feed." A recent publication states that on shrub ranges as soon as better animals are bred they will "demand a better plane of nutrition, and it will become economically advantageous to spend more in producing nutritious fodders. The superior animals will no longer be able to subsist on natural shrub range forage, and will use the range primarily for exercise."

These references to browse as a poor class of feed result from a misunderstanding or from the fact that, in the southwestern states, most browse species are not good feed. Actually, in Utah, it has been found that browse plants as a group equal or exceed grass in nutritive value at any season of the year. Browse plants, especially on desert winter range, are the greatest asset to Utah ranchers. Because of these plants, the Intermountain Area has less of a winter nutrition problem than most grazing regions in the United States.

For the past three years, the Utah Agricultural Experiment Station has conducted experiments on the nutritive value of plants on summer and winter ranges. These experiments include a study of the vegetative composition of the range, a determination of which plants make up the diet of grazing

C. WAYNE COOK is associate professor of Range Management. He will receive his doctor's degree from the Texas A and M in June. DR. L. A. STODDART is head of the Department of Range Management. DAVID O. WILLIAMSON is research instructor in animal husbandry. He made the chemical analyses on the forage species. DR. LORIN E. HARRIS is associate professor of animal husbandry, and DR. L. L. MADSEN, head of the Department of Animal Husbandry. This is a progress report on cooperative studies being conducted by the Departments of Range Management and Animal Husbandry with financial aid from Swift and Company.

Farm and Home Science
sheep, a chemical analysis of these plants to determine nutritive value, and actual feeding trials to see how sheep weight and production of wool and lambs respond to supplementing various feeds and minerals that appear deficient on the range.

Chemical analyses have been made of all of the important desert range plants at intervals throughout the winter grazing season. The accompanying tables show comparative percentage composition of the three most important desert browse plants and the two most important desert grass plants. Observations on these plants were made in the winter of 1946-47 west of Milford in Wah Wah, Pine, and Antelope valleys. Here black sage (Artemisia nova) made up about 11½ percent of the feed actually consumed, shadscale (Atriplex confertifolia) 12½ percent, white sage (Eurotia lanata) 45 percent, ricegrass (Oryzopsis hymenoides) 10 percent, and curly grass (Hilaria jamesii) 2½ percent.

These chemical data were obtained by analysis of the entire current year’s growth of both shrubs and grass. They do not represent exactly the portion consumed by the sheep since the animals select the leaves and more tender twigs. They do, however, serve as a rather accurate measure of seasonal trends and comparative levels of nutrients for browse and grass species.

According to the National Research Council, bred ewes require 5 percent digestible protein in the diet and .16 to .18 percent phosphorus. High fiber content generally is considered indicative of low nutritive value. For example, on a dry basis “leafy” alfalfa hay averages 29 to 31 percent fiber, “good” alfalfa averages 31 to 34 percent fiber, “fair” alfalfa averages 34 to 38 percent fiber, and “stemmy” alfalfa averages over 39 percent fiber. The protein of the range sheep’s diet has a digestibility of 42 percent. If this fact is considered the shrubs, black sage, shadscale, and white sage approach minimum requirements at all times. The grasses, curly grass and rice grass, are below minimum requirements at all times except possibly the last of March and April at which time young green growth raises the protein level.

(Continued on page 42)
CHEMICALS EFFECTIVE IN CONTROL OF BISCUITROOT IN WINTER WHEAT

By D. C. TINGEY

TO CONTROL BISCUITROOT

From these investigations it appears that chemicals can be used to advantage in the control of biscuitroot in winter wheat. The increased yields of wheat more than paid for the cost of the chemical and its application. One of the better treatments gave a net return of $8.12 per acre. For this treatment triethanolamine salt was used at the rate of 4 pounds active or about 2.5 pounds acid equivalent per acre. These returns are possible only if sprayings are made while the weed is still in the pre-bloom stage. Treatments made later are not recommended.

BISCUITROOT, Lomatium leptocarpus (T. & G.) (C. & R.) has become a troublesome weed in dry land wheat in areas of northern Utah and southern Idaho. This weed is native to this area and is known from northwestern Colorado to northern Idaho, south to northern Arizona, and northeastern California. It was first observed in dry land wheat by the writer in the low lands north and west of Smithfield, Utah, about 1925. Since then it has spread to much of the low lands used for winter wheat production, south to Benson, and north to Cove on into southern Idaho.

Table 1. Percentage density of biscuitroot after one and two years of differential treatments involving 2, 4-D products*

<table>
<thead>
<tr>
<th>2, 4-D</th>
<th>Data taken Apr. 25, 1949 rate-lb/acre (active)</th>
<th>Data taken Apr. 14, 1950 rate-lb/acre (active)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water gal/A 1/6 1/2 1 3 Avg. 1/6 1/2 1 3 Avg.</td>
<td></td>
</tr>
<tr>
<td>Triethanolamine salt</td>
<td>5 48 34 23 22 32 50 33 23 19 31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>80 45 35 33 23 34 39 35 28 23 31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Avg. 47 35 28 23 33 45 34 26 21 31</td>
<td></td>
</tr>
<tr>
<td>Ethyl ester</td>
<td>5 43 37 20 23 31 34 48 21 7 28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>80 48 30 29 18 30 43 24 31 12 28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Avg. 46 34 25 21 31 39 36 26 10 28</td>
<td></td>
</tr>
<tr>
<td>Sodium salt</td>
<td>80 43 39 31 22 33 41 37 28 18 31</td>
<td></td>
</tr>
<tr>
<td>Check — no treatment</td>
<td>40 40 40 40 40 40 40 40 40 40 40</td>
<td></td>
</tr>
</tbody>
</table>

* Each treatment an average of 4 replications except check which was an average of 20.
† See figure 2 for acid equivalent.

Fig. 1. Biscuitroot in bloom

Biscuitroot Mistaken for Wild Carrot

Biscuitroot is locally known as wild carrot. This is a case of mistaken identity since wild carrot is an entirely different plant. Biscuitroot and wild carrot are both members of the same family, however, but the characteristics of the two plants are greatly different. The leaves and flowers of biscuitroot resemble the wild carrot as well as the garden variety. Biscuitroot is a perennial with tuberous roots and frequently with two or more bulb-like corms attached in a series like a string of beads (fig. 1). The structure of the inside of the root is similar to that of a biscuit. The wild carrot is a biennial. The first year it develops from the seed and forms a rosette of leaves and a fleshy cone shaped root. Leaves and flower stocks develop the second year from this fleshy root and after seed is

Table 1. Percentage density of biscuitroot after one and two years of differential treatments involving 2, 4-D products*

<table>
<thead>
<tr>
<th>2, 4-D</th>
<th>Data taken Apr. 25, 1949 rate-lb/acre (active)</th>
<th>Data taken Apr. 14, 1950 rate-lb/acre (active)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water gal/A 1/6 1/2 1 3 Avg. 1/6 1/2 1 3 Avg.</td>
<td></td>
</tr>
<tr>
<td>Triethanolamine salt</td>
<td>5 48 34 23 22 32 50 33 23 19 31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>80 45 35 33 23 34 39 35 28 23 31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Avg. 47 35 28 23 33 45 34 26 21 31</td>
<td></td>
</tr>
<tr>
<td>Ethyl ester</td>
<td>5 43 37 20 23 31 34 48 21 7 28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>80 48 30 29 18 30 43 24 31 12 28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Avg. 46 34 25 21 31 39 36 26 10 28</td>
<td></td>
</tr>
<tr>
<td>Sodium salt</td>
<td>80 43 39 31 22 33 41 37 28 18 31</td>
<td></td>
</tr>
<tr>
<td>Check — no treatment</td>
<td>40 40 40 40 40 40 40 40 40 40 40</td>
<td></td>
</tr>
</tbody>
</table>

* Each treatment an average of 4 replications except check which was an average of 20.
† See figure 2 for acid equivalent.

Fig. 2. Fall wheat infested with biscuitroot. Left untreated weed in bloom stage. Right, sprayed before bloom with 2, 4-D at the rate of 4 pounds active or 2.5 pounds acid equivalent per acre. Sprayings when weed was in bloom stage or later were relatively ineffective and definitely less profitable.
formed the plant dies. Furthermore, the wild carrot the second year is from 2 to 3 feet tall, whereas the biscuitroot is about 12 to 18 inches tall. Flowers of wild carrot are white and those of biscuitroot yellow. Seeds of wild carrot resemble those of the garden carrot, whereas the seeds of the biscuitroot, except for being smaller and narrower, resemble those of the garden parsnip.

Biscuitroot Ideally Adapted to the Area Infested

Biscuitroot begins growth in the fall and emerges the following spring soon after the snow has melted when it develops rapidly. In the two years that studies have been made, biscuitroot has nearly completed its growth by June 1. Heavy soils, on which it occurs, retain spring moisture and remain wet, thus it is difficult to operate tillage machinery on such lands during this time. In the early spring biscuitroot grows ahead of wheat and matures much earlier, thus the wheat gives little competition during the crop year and during the fallow year the weed has nearly completed its growth before spring tillage can start. Because of these conditions, biscuitroot has thrived and spread with little hindrance.

Experiments With Chemicals on Biscuitroot Control

Because of the difficulties of controlling this weed with cultural practices, experiments were initiated in 1948 and continued and enlarged in 1949 on the use of chemicals as a means of control. In 1948 the treatments were all made on one date when the weed was in the late stooling stage.

Yields of wheat and the quality of the grain from the 2,4-D treatments were no better than on plots receiving no treatment. On April 25, 1949, estimates were made of the density of the weed growth for the treatments made in 1948. Then on April 28, 1949, a re-treatment was made again when the biscuitroot was in bloom. The treatments were the same as those of the preceding year and on June 29 the area was roto-tilled in preparation for summer fallow. On April 15, 1950, estimates were again made of the density of weed growth. Data for the two years appear in table 1.

One and three pound rates of 2,4-D reduced the weed population from a third to a half of what it was on the untreated plots. The kind of 2,4-D or the amount of water used in applying the chemical did not influence the percentage reduction in weed population the first year. In the second year the 3 pound rate of the ethyl ester reduced the weed population more than the other treatments. In fact, this was the only treatment that reduced the weed population from what it was after the first year's treatment.

A new experiment was started in 1949 to make chemical treatments as early in the spring as possible and at various stages of growth as the biscuit-

Table 2. Net return per acre in dollars from the use of chemicals applied in the pre-bloom stage in the control of biscuitroot in winter wheat

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Rate—lbs/acre (active)</th>
<th>1/2</th>
<th>1</th>
<th>2</th>
<th>4</th>
<th>avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triethanolamine salt</td>
<td>1.51</td>
<td>2.84</td>
<td>4.96</td>
<td>8.12</td>
<td>4.36</td>
<td></td>
</tr>
<tr>
<td>Ethyl ester</td>
<td>1.95</td>
<td>-42</td>
<td>4.38</td>
<td>-1.32</td>
<td>1.15</td>
<td></td>
</tr>
<tr>
<td>2, 4, 5-T (Isopropyl ester)</td>
<td>-0.88</td>
<td>5.81</td>
<td>5.14</td>
<td>4.16</td>
<td>3.56</td>
<td></td>
</tr>
<tr>
<td>Mixture (75% E. ester, 25% 2, 4, 5-T)</td>
<td>3.46</td>
<td>1.68</td>
<td>5.16</td>
<td>2.94</td>
<td>3.31</td>
<td></td>
</tr>
</tbody>
</table>

* The net return as used here is the difference between the cost of the chemical and its application and the increased return for the wheat @ $1.80 bushel.
† See figure 2 for acid equivalent.

Fig. 3. Average acre yield of dry land wheat in 1949 and percentage regrowth of biscuitroot in 1950 from chemicals applied at various rates and at different stages of growth in 1949, Cove Utah

(Continued on page 42)

for June 1950
New Virus Disease of Sweet Cherries
Found in Utah's Dixie

Dixie Rusty Mottle Most Serious of Three Rusty Mottle Virus Diseases
Found in State

By B. L. RICHARDS, BRYCE N. WADLEY, and GEORGE W. COCHRAN

DIXIE rusty mottle is one of a group of three rusty mottle virus diseases of the sweet cherry in Utah. The other two diseases of the group, the necrotic rusty mottle and the Utah mild rusty mottle, are confined in their distribution to cherry orchards in northern and central parts of the state. The Dixie rusty mottle, on the other hand, is known to be present only in Washington County, Utah's Dixie, where it has become established as a destructive disease of the sweet cherry and possibly also of the peach. Subsequent to its discovery in 1944 the Dixie rusty mottle has been shown to be caused by a virus that is readily transmitted from diseased to healthy cherry and peach trees both in the orchard and in the greenhouse. Because of the destructive nature of the disease, also because of the ease with which the causal virus can be transmitted, Dixie rusty mottle must be considered a definite threat to the entire cherry industry in Utah. In the cherry the Dixie rusty mottle virus is a killer.

The Nature and Cause of Utah Dixie Rusty Mottle

Repeated transmission by budding in the greenhouse and in the experimental orchards has confirmed the fact that Dixie rusty mottle is a systemic disease induced by a readily transmissible virus. As with the necrotic rusty mottle, the incidence of transmission is high, approximately 100 percent. The incubation period of the virus in both peach and sweet cherry in the greenhouse may be as short as 4 to 6 weeks, although longer periods may be required in the orchard. Preliminary study indicates that the virus spreads from diseased to healthy trees in the orchard and that while this spread is rather slow in cherries, it appears to be rapid in the peach and may involve 100 percent of the living trees of any orchard. The relative importance of the various factors involved in orchard spread of the virus remains to be determined.

Host Range of the Virus

Dixie rusty mottle has been observed in orchards in Bing, Lambert, Napoleon (Royal Ann), and Black Tartarian. In 1949 what appeared to be Dixie rusty mottle in cherry was also found in peach trees growing adjacent to infected cherry orchards. By budding, the Dixie rusty mottle has been transmitted to all the foregoing varieties and to Windsor and Mazzard, also to two varieties of peach, producing in all these varieties symptoms characteristic of the disease as observed in the orchard.

Symptoms

Dixie rusty mottle like the necrotic rusty mottle is characterized by a number of dissimilar symptoms that develop in a rather definite sequence during the season. The exact expression of these symptoms however, may vary with the season and with the variety of the tree infected. In cherry varieties, especially in advanced stages of infection, the disease can be detected in the spring by retarded blossoming and by delayed leaf development, particularly when these features are associated with barren limbs and branches resulting from the killing effect of the virus on buds during the previous season or seasons. Leaves on diseased orchard trees in the spring appear normal in size, shape, and color for some 4 to 6 weeks, after which time
the older leaves show necrotic areas of varying size and shape and finally take on the appearance of premature senescence, turning yellow, orange, and reddish in color with the chlorophyll degenerating in varying patterns often of distinctive beauty (fig. 1. Compare with fig. 2). Leaves so affected invariably shed prematurely resulting in a leaf fall that under severe conditions, may practically defoliate the tree. The virus kills the axillary buds resulting finally in the death of their supporting branch (fig. 3). Even the larger limbs of the affected tree may succumb. As in the necrotic rusty mottle (fig. 4), the leaves, buds, and entire branch may be killed resulting finally in the death of the entire tree. In most cherry varieties the disease must be classed as a killer, however, the rate of tree degeneration following infection by the virus may vary with the variety, with the individual tree, and with the entire culture or orchard practice involved. Under the most severe conditions trees may survive in a diseased and weakened condition for 2 to 5 years and during such period serve as a reservoir of infective virus material from which healthy plants may become infected.

### Distribution and Economic Importance

No comprehensive orchard survey has been made to determine the exact distribution or the concentration of the disease in Washington County orchards; however, the disease has been observed in orchards in Leeds, Hurricane, Toquerville, and LaVerkin. Except for a single cherry orchard in Leeds the specific incidence of the disease and the degree of its destruction have not been determined. Data from this one orchard, however, may throw some light on the economic importance of the disease. In this orchard, now approximately 25 years old, 138 trees were originally planted. At the time of the study in 1949, 53 trees were missing or dead. Forty-one, or 48.3 percent, of the remaining living trees showed rusty mottle. It appears logical to assume from the observations made that the large percentage of missing and dead trees had succumbed as a result of the ravages of the Dixie rusty mottle virus.

### Control

In control of Dixie rusty mottle two items must be kept in mind: (1) That trees once infected do not recover. The virus remains in an active state in the living protoplasm as long as the tree survives and the only way such viruses can be eliminated is by roguing out and destroying the infected plants. (2) That only by planting virus-free varieties and virus-free understock can the introduction with resultant spread be prevented. Peach and sweet cherry nursery stock should not be purchased from nurseries within the area in which Dixie rusty mottle is prevalent. It is entirely possible that other varieties of stone fruits may be susceptible to infection by this virus although we do not have information supporting this possibility at the present time. Further research may provide knowledge by which local nurseries may produce virus-free stock in infected areas.

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Dr. E. L. Waldee, associate professor of plant pathology, will leave USAC July 1 to accept a position with the Office of Foreign Agricultural Relations in Korea. Dr. Waldee spent some time with the occupation government in Japan before coming to Utah State.

DeVere R. McAllister, who is completing the requirements for the Ph.D. in agronomy at Iowa State College, will become assistant professor of agronomy July 1. McAllister received both his B.S. and M.S. degrees from the USAC. He has worked for a number of years for the Soil Conservation Service.

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*Fig. 3. Tree affected with Dixie rusty mottle virus. Both the lateral and terminal buds are killed, and in a relatively short time entire branches succumb. This virus is a more rapid killer than necrotic rusty mottle.*

*Fig. 4. Tree affected with the necrotic rusty mottle virus. The virus kills the lateral buds on the older wood, producing barren branches. Leaves are produced almost entirely on the young terminal growth.*
CERTAIN potato diseases have spread so rapidly during recent years that it is becoming increasingly difficult to produce satisfactory seed of non-resistant varieties, such as the Bliss Triumph. Pontiac and Katahdin have been grown to a limited extent in the northern part of the state as a substitute for Bliss Triumph; however, Pontiac has no disease resistance and Katahdin has not been entirely satisfactory. There is a need for disease-resistant varieties adapted to the soil and climatic conditions of Utah.

Old potato varieties are rapidly being replaced by new varieties in many of the potato areas in the eastern part of the United States. This is apparent by the fact that for the period 1942-1946 Cobbler was leading Katahdin in production of certified seed by 3,473,455 bushels. Bliss Triumph was second in production and Katahdin third. By 1948 Katahdin was leading in the production of certified seed and exceeded Cobbler by 5,871,280 bushels.

New potato varieties warrant careful consideration and testing under Utah conditions. More than 35 new potato varieties have been developed and released since the National Potato-Breeding Program was organized in 1929. Katahdin was the first variety released under this program. Prior to its development, potato breeding was restricted because of insufficient viable pollen. Only two of the older varieties of commercial importance in the United States at the present time (Bliss Triumph and Green Mountain) were developed as a result of controlled hybridization. Katahdin, which produces viable pollen and develops seed balls abundantly, has contributed greatly to the development of new potato varieties. This variety is either the male parent or is one of the ancestors of many of the better new varieties. Many new varieties have resistance to one or more potato diseases, and varieties have been released that are resistant to injury from insects such as leafhoppers and flea beetles.

Tests Made on Six Varieties

To determine how some of the new varieties would produce under Utah conditions, six potato varieties were grown during the 1949 season. Four red tuber and 2 white tuber varieties were tested; namely, DeSota, Bliss Triumph, Kennebec, LaSoda, Progress, and LaSalle. The following is a brief description of the varieties:

DeSota is a cross between Bliss Triumph and Katahdin. The tubers are round to slightly oblong and the skin varies from red to pinkish red. This variety is medium early in maturity, is resistant to mild mosaic and was introduced by the Louisiana Agricultural Experiment Station.

Bliss Triumph is an old red tuber variety and one of the few important varieties first developed by artificial hybridization. It is claimed to be a cross between Peerless x Early Rose.

Kennebec was recently released by the United States Department of Agriculture and the Maine Agricultural Experiment Station. It is a vigorous, high-yielding, late-maturing variety and has been judged good to excellent for baking or boiling. It has high resistance to late blight in both foliage and tubers. The tubers are elliptical to oblong, with a smooth creamy buff skin and white flesh.

LaSoda is a cross between Bliss Triumph and Katahdin. The tubers are bright pinkish red with smooth skin. The variety is early to medium early. It has also been introduced by the Louisiana Agricultural Experiment Station.

Progress is a red tuber variety released in 1948 by the Nebraska Agricultural Experiment Station. Its chief advantage over Bliss Triumph is that the tubers do not crack so readily during harvesting operations.

LaSalle is a cross between Chippewa and an inbred seedling of Triumph. It is a medium early, white tuber variety, resistant to mild mosaic. It was introduced by the Louisiana Agricultural Experiment Station.
How the Potatoes Were Grown

These six varieties were planted in 4 row plots 20 feet long and 12 feet wide. The center two rows were harvested for yield data. The varieties were replicated ten times with the exception of Kennebec which was replicated only seven times because of a shortage of seed. The potatoes were grown on a Nibley clay loam soil, a soil not too well suited to potato production; however, yields were good. There was no commercial fertilizer applied, although the land had previously been growing alfalfa. The potatoes were planted May 6, 1949, and harvested October 15th.

Because of the limited quantity of seed of some varieties, the tubers were cut to approximately 0.7 ounce seed pieces. The average size of seed planted was 0.64, 0.67, 0.70 and 0.70 ounces for Bliss Triumph, LaSoda, Progress, DeSota, Kennebec and LaSalle, respectively.

**Variations in Stand, Maturity, and Yield**

The stand in general was good, although there was some variation in varieties. Kennebec and LaSalle were more irregular in emergence and the stands were poorer. The stand count of LaSoda was similar to Kennebec and LaSalle; however, the growth was more uniform. The average number of plants on the two 20-foot rows harvested was 35.6 for Progress, 35.0 for each of DeSota and Bliss Triumph, 30.7 for LaSalle, 30.4 for LaSoda, and 29.5 for Kennebec. There was a striking difference in the size of the vines and stage of maturity of the varieties. The smallest vine growth and the earliest maturing variety was Progress. The vines were definitely smaller than Bliss Triumph. Although the LaSalle vines were irregular in growth because of disease, many of the healthy plants were larger than the Bliss Triumph. The LaSoda vines were larger and later maturing than LaSalle or Bliss Triumph. The DeSota vines were medium to large, erect, and larger and later maturing than LaSoda. The Kennebec vines were exceptionally large, erect, and later maturing than the other five varieties. In fact the tubers of this variety were immature at time of harvest.

The maturity of the varieties corresponded to the size of vines, the larger vines were later maturing. By September 9th, the vines of Progress and Bliss Triumph were yellow and the leaves were dying. The LaSalle vines were nearing maturity, the DeSota were beginning to mature, and the Kennebec vines were large, upright, and green.

The DeSota variety significantly out-yielded the other five varieties both in total yield and yield of U. S. No. 1 tubers. The total acre yield for this variety was 493 bushels and the yield of U. S. No. 1 potatoes was 422 bushels per acre. Kennebec was second in total yield and yielded 67 bushels per acre less than DeSota. Kennebec was only fourth in yield of U. S. No. 1 potatoes and the yield was not significantly different from Progress and LaSalle, the lowest yielding varieties. The low yield of U. S. No. 1 Kennebec tubers resulted from a large percentage of misshapen and sunburned tubers, the majority of which would be classified as culls. The total yield for LaSoda was 16 bushels more and the yield of U. S. No. 1's was 10 bushels less than Bliss Triumph; neither of which is significant. Although LaSalle produced both the lowest total yield and yield of U. S. No. 1 tubers, this test is not a fair appraisal of the variety because the seed was inferior. This resulted in poor stands and high disease. With the exception of the LaSalle variety diseases were relatively low during the growing season. Of the LaSalle plants 24 percent showed leaf roll symptoms August 3 and a few plants developed bacterial ring rot symptoms later in the season. Progress, the second lowest producing variety, yielded only 199 bushels per acre of U. S. No. 1 grade potatoes compared to 206, 323, 333 and 422 bushels, respectively, for Kennebec, LaSoda, Bliss Triumph, and DeSota.

**Size of Tubers**

Varieties varied considerably in the size of tubers produced. The U. S. No. 1 tubers of each variety were divided into two sizes: 1 7/8 to 3 inches and over 3 inches in diameter. The percentage of tubers by weight over three inches in diameter was 67 for LaSoda compared to 4 for Progress. Kennebec was 63, Bliss Triumph 61, LaSalle 50, and DeSota 42 percent.

**Quality of Tubers**

Specific gravity, one of the best measures of starch and dry matter in potato tubers, was determined for the six varieties. The DeSota, Bliss Triumph, LaSoda, and LaSalle varieties could be classed as very mealy since the specific gravity was 1.100 or higher. Kennebec and Progress, although slightly lower, had a high specific gravity and should be mealy.

Since the above data represent only one year's test, these results, although significant, should not be considered as a final appraisal of the six varieties tested. These results do indicate, however, the possibilities of new varieties replacing varieties now being grown.

- Dr. James L. Mielke, formerly forest pathologist, of the southwestern region, U.S. Bureau of Plant Industry, Soils, and Agricultural Engineering, at Albuquerque, New Mexico, has been transferred to Logan. He will cooperate with the Utah Station in a study of forest diseases in this area.
- Dr. Mielke is a native of Minnesota, received his B.S. and M.S. degrees at Oregon State College and his Ph.D. at Yale. He has worked for the U.S. Department of Agriculture in forest pathology since 1924.
- Dr. D. A. Greenwood, professor of biochemistry, was elected president of the Utah Academy of Sciences, Arts and Letters at the spring meeting of the academy.
- Marjorie Bennion has been appointed research instructor in household administration. Her full time will be spent on the western regional project on rural housing. She will make a detailed investigation of the most efficient kitchen arrangements through time and motion studies.
- Mrs. Bennion received her master of science degree at the USAC this spring. She did her undergraduate work at Iowa State Teachers' College.

*NEW PUBLICATION*


This bulletin describes the extent of iron, manganese, and zinc deficiency in orchard trees in Utah, also the symptoms of these deficiency diseases and their treatment.

Single copies of this publication may be obtained free from the Utah Agricultural Experiment Station.

*For June 1950*
acre-feet will be available for municipal purposes in communities in Davis and Weber Counties.

The development of the plan will not interfere with existing water rights. Only flood flows and otherwise wasting surface and subsurface flows will be claimed for the project.

Plan for Development

The basic plan for the development includes further regulation of the flows of the Weber River by means of upstream reservoirs and an offstream reservoir at the Willard site on the east shore of Great Salt Lake. The major facilities, capacities, and their estimated costs are listed in table 1.

The project area is divided into two major areas, the high level lands lying above the service area of Willard Reservoir, and low level lands lying within the area. Upstream reservoirs will regulate stream flows to satisfy irrigation and municipal requirements of the high level lands, and when surplus storage is available, will also supply a portion of the low level land irrigation requirements. Flows that cannot be regulated upstream will be diverted from the Weber River at a point common to the lowest existing diversion and stored at the Willard Reservoir. Water will then be pumped from the reservoir as needed to meet the remaining irrigation requirements of the low level lands.

In all, 418,000 acre-feet of new storage capacity is required. The major conveyance facilities will extend more than 100 miles in length and will consist of closed aqueducts, canals, tunnels, and siphons. In addition to the major works, there will be several hundred miles of laterals constructed independent of federal assistance.

A system of approximately 115 miles of open drainage channels and waterways will be constructed as a part of the project. These major drainage channels will give comprehensive protection and provide outlets for hundreds of farm drains. Nearly all of the energy generated by project power plants will be required for irrigation pumping. The pumping plants will serve the high bench lands and facilitate the use of Willard Reservoir storage water.

It is planned to construct the project within a 12-year period. The needs for water have been carefully analyzed, and the initial features will be constructed for the areas most urgently in need of water. All features, however, will be constructed as rapidly as an orderly construction schedule permits.

Table 1. Major features of the Weber Basin Project with their estimated costs and capacities

<table>
<thead>
<tr>
<th>Feature</th>
<th>Construction cost</th>
<th>Operation &amp; maintenance</th>
<th>Capacities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perdue Reservoir</td>
<td>$9,400,000</td>
<td>$6,000</td>
<td>50,000 A.F.</td>
</tr>
<tr>
<td>Enlarged Pineview Reservoir</td>
<td>$2,450,000</td>
<td>$4,000</td>
<td>92,000 A.F.</td>
</tr>
<tr>
<td>Jeremy Reservoir</td>
<td>$3,400,000</td>
<td>$5,000</td>
<td>35,000 A.F.</td>
</tr>
<tr>
<td>Lost Creek Reservoir</td>
<td>$3,550,000</td>
<td>$5,000</td>
<td>20,000 A.F.</td>
</tr>
<tr>
<td>Magpie Reservoir</td>
<td>$9,350,000</td>
<td>$6,000</td>
<td>60,000 A.F.</td>
</tr>
<tr>
<td>Willard Reservoir</td>
<td>$11,000,000</td>
<td>$4,000</td>
<td>205,000 A.F.</td>
</tr>
<tr>
<td>Weber Aqueduct</td>
<td>$7,000,000</td>
<td>$4,800</td>
<td>435 S.F. (max.)</td>
</tr>
<tr>
<td>Four diversion dams</td>
<td>$1,000,000</td>
<td>$2,800</td>
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</tr>
<tr>
<td>Davis Aqueduct</td>
<td>$9,800,000</td>
<td>$5,300</td>
<td>350 S.F. (max.)</td>
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<tr>
<td>Four canals</td>
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<td></td>
</tr>
<tr>
<td>Two power plants</td>
<td>$1,500,000</td>
<td>$82,900</td>
<td>3,000 KW (each)</td>
</tr>
<tr>
<td>Four pumping plants</td>
<td>$2,500,000</td>
<td>$62,700</td>
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</tr>
<tr>
<td>Drainage system</td>
<td>$3,000,000</td>
<td>$17,000</td>
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<tr>
<td>Lateral system</td>
<td>$1,400,000</td>
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<td></td>
</tr>
<tr>
<td>Compensation to U.P. &amp; L.</td>
<td>$300,000</td>
<td>$44,300</td>
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</tr>
<tr>
<td>Miscellaneous</td>
<td>$1,800,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
*Upstreams reservoirs         | $70,000,000       |                        | 275,000    |
Repayment Schedules

The irrigation water users will have 60 years to repay their allocated costs, while the municipalities will be required to repay their allocation in 40 years. Municipal payments will continue at the same rate for an extra 20 years in lieu of interest charges. Preliminary agricultural economic studies have shown that the following irrigation charges are within the ability of the water users to repay. Dairy-field cropland can repay at the rate 92 cents per acre foot for construction and 47 cents per acre-foot for operations and maintenance; dairy-cash cropland can repay at the rate of $1.72 to $1.94 per acre-foot for construction and 91 cents per acre-foot for operations and maintenance; and fruit-truck land can repay at the rate of $3.15 per acre-foot for construction and 91 cents per acre-foot for operations and maintenance. Municipal charges will be $11.72 per acre-foot for construction and 54 cents per acre-foot for operations and maintenance. Total estimated revenues over a 60-year period are:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation water</td>
<td>$30,102,000</td>
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<td>Municipal water</td>
<td>28,116,000</td>
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<tr>
<td>Power</td>
<td>1,626,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$59,844,000</strong></td>
</tr>
</tbody>
</table>

Upper right, drained and furnished with an adequate water supply, these lands will be productive farms. Lower left, wasting spring floods will be regulated to supply irrigation and municipal water. Lower right, a heavily laden orchard reflects the value of an adequate water supply.

Cooperating Agencies

Compiling the preliminary data for this project has been a cooperative undertaking by federal, state, and local...
Phosphorus is deficient in all species at all times. It is important to note, however, that browse plants contain 2 to 3 times as much phosphorus as do grasses. Phosphorus, like protein, increases in the spring when new growth begins.

On winter range, fiber is generally lower in browse plants than in mature grasses. Generally the browse collections contained under 30 percent fiber, being comparable to good alfalfa hay. On the other hand, the grasses generally contained 30 to 40 percent fiber, indicating a poorer quality of forage than the browse.

Table 3. Comparative crude fiber levels of a few important desert range plants during the winter grazing season

<table>
<thead>
<tr>
<th>April 17</th>
<th>March 27</th>
<th>February</th>
<th>January</th>
<th>November</th>
</tr>
</thead>
<tbody>
<tr>
<td>36.80</td>
<td>36.30</td>
<td>36.80</td>
<td>26.83</td>
<td>29.60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>24.12</td>
<td>30.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>24.90</td>
<td>30.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>21.32</td>
<td>30.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>29.78</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>29.12</td>
</tr>
</tbody>
</table>

CONTROL OF BISCUITROOT

2,4,5-T and the mixture of 2,4-D and 2,4,5-T when applied early both gave consistently higher wheat yields and reduced the weed population more than the salt and esters of 2,4-D. The acre yields of wheat from treatments made at the early stage with triethanolamine salt, 2,4,5-T, and the mixture at the 4 pound rate were more than double those on the untreated plots. The increase in yield of wheat was over 10 bushels per acre. The reduction in weed population was greater than the increase in yield of wheat for higher rates of application of the chemical.

Data from the two experiments on the use of the salt and ester of 2,4-D applied in the bloom stage in both years gave similar results. There was little or no effect on yield of wheat from 2,4-D when applied in the bloom stage, though there was a reduction in the weed population for the heavier rates.

Chemicals if Used Properly Can Be Highly Profitable in the Control of Biscuitroot in Wheat

It is too early to draw conclusions on the time required for the complete eradication of biscuitroot with chemicals, but if used in combination with...
tillage it seems rather certain that the weed can be completely eliminated.

Roots dug up from some of the plots that showed little re-growth indicated that many were still alive and some showed well developed sprouts, healthy in appearance. However, the increased yield of wheat by the proper use of chemicals more than justified the cost of application of chemicals (table 2).

Triethanolamine salt at 4 pounds of active ingredient (2.5 acid equivalent) per acre gave a net return of $8.12. Of the rates used the 4 pound rate was the most profitable. To apply 4 pounds of active triethanolamine salt to the acre would require about 2.5 quarts of the chemical at a cost of about $2.75 an acre. It should cost less than a dollar an acre to apply it. Even though the use of 2,4,5-T and the mixture gave higher yield of wheat and a greater reduction in weed population, their costs are much higher so that the triethanolamine salt seems to be the best choice with the data available at the present time.

NEW PRESIDENT (Continued from page 31)

of Animal Production, Phi Kappa Phi, Alpha Zeta, Sigma Xi, Society for Experimental Biology and Medicine, and the American Association for the Advancement of Science. He has published more than fifty scientific articles and bulletins including several contributions to recent yearbooks of agriculture.

Dr. Madsen has not only made a name for himself in professional circles, he is widely known and respected by the farmers and livestock men of the state for his interest in and assistance in helping solve their problems.

The new president is firm in his belief in the philosophy of the land-grant college system which provides for a liberal and practical education.

Dr. Madsen becomes the eighth president of the college. Most of the former presidents have had some connection with the Experiment Station. Pres. J. W. Sanborn and Pres. J. H. Paul were both directors of the Experiment Station at the same time they served as president of the College. Dr. J. A. Widtsoe, the fifth president, was director of the Station from 1900 to 1905 before he became president in 1907. Dr. E. G. Peterson, sixth president, was assistant entomologist on the Station staff during 1906-1907. Pres. F. S. Harris was director of the Station from 1916-1921. Dr. Madsen has been in charge of the animal husbandry research in the Experiment Station for the past five years. These men have all been interested in the development of the agricultural research program as one of the major services of the College to the state. Under Dr. Madsen's leadership it is anticipated that the agricultural research program will go forward toward the successful solution of many of the perplexing problems facing the agricultural industry of the state.

GROWERS' MARKET (Continued from page 28)

of making the market an even more serviceable institution than it is at present. These lines of approach apply first to the grower and second to the marketing facilities supplied by the Growers' Market.

There is no substitute for quality produce. It would appear that with many of the growers more care in the production and presentation of their produce on the market platforms would pay dividends. The costs of marketing low quality produce are greater than with high quality products and the returns are much lower. Quality of produce has a direct bearing on marketing costs and returns to the grower.

More uniformity in and standardization of containers, grading, and packaging would undoubtedly facilitate the marketing job. Perhaps cooperative handling of containers would be one method of solving the container problem.

There appears to have been a strong tendency in recent years for growers to consolidate loads or to turn their produce over to commission dealers. This matter of consolidation of loads for several small producers would seem to hold real possibilities for economy in marketing, especially if rather uniform and good quality could be achieved by these small growers. The sale in pounds per hour is several times as great for the large as the small loads.

The changes in actual market facilities that would improve marketing and benefit the grower appear to be two in number. First, the retail facilities to serve the consumer buyer appear to be inadequate. Provision of a convenient, well organized retail section would undoubtedly attract more consumers. This would facilitate movement of produce too ripe for distance hauling but prime for immediate consumption or canning.

Second, provision of adequate storage facilities to permit carry-over from days of slow trading would be a real asset to the market and to the growers. Great losses occur from quality deterioration when slow trading compels produce either to remain on the platform or to be hauled back to the farm. Proper storage space could avoid much of the loss now occurring from deterioration in the 95 degree heat.

The operator of the modern large refrigerator truck with capacity approximately equal to the railroad car has some real problems in handling his vehicle in the market area. Perhaps a third improvement would be provision of more adequate facilities for these operators. They are an important outlet for the produce of these growers. Catering more to their needs would likely be mutually beneficial to all parties concerned.

The future will undoubtedly bring many changes that cannot be foreseen or anticipated at the present time, but the future of the Growers' Market Company and its use as an important cog in the system of marketing in this area which it now serves seems to be well assured.

H. P. BARSS REVIEWS STATION RESEARCH

Improved pastures, both dry land and irrigated, were the thing that most impressed H. P. Barss, experiment station administrator from Washington, D. C. on a trip through the state.

One of the best investments that the state has made has been the investment in research on improved pasture grasses and legumes, methods of range seeding, and pasture management practices, said Mr. Barss on his return. Areas that ten years ago were practically devoid of vegetation are now producing high yields of palatable forage for range cattle and sheep. Poor pastures that hardly produced enough feed for one dairy cow have now been replanted to high yielding, palatable grass and legume species. More adequate feed supplies should stimulate the range livestock as well as the dairy industry in the state, he said.
GREENHOUSE FOR STUDY OF VIRUSES

(See page 26 for pictures)

VIRUS disease of stone fruits is a problem demanding year-around study. This is made possible in the new virus 6 compartment greenhouse located on the campus. Viruses that cause serious losses in stone fruit trees in Utah are being studied here by scientists of the Utah Agricultural Experiment Station and the United States Department of Agriculture. Symptoms of stone fruit virus diseases, experimental virus transmission by budding and grafting, dodder transmission of viruses from trees to herbaceous plants, virus inactivation and other properties of viruses are studied in the greenhouse which provides an area of 2500 square feet. Virus-infected plants are provided for study with the electron microscope and the ultracentrifuge.

Virus transmission by insects is studied by entomologists in special compartments of the greenhouse. Insects are fed upon virus infected trees and then transferred to healthy trees in attempts to transmit the virus to the healthy trees.

Virus inactivation is studied in a large combination refrigeration-heat control chamber located in a laboratory-headhouse attached to the greenhouse. This laboratory also houses plant propagating chambers for forcing plant growth, laboratory tables, potting benches and other equipment and facilities for study of virus diseases.

The addition of the greenhouse makes the facilities for virus disease study among the best in the nation.

Carol C. Watkins, research instructor in chemistry, will resign July 1 to accept the position of home demonstration agent in Washington County.

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