In 1859, Horace Greeley, after making a trip across the continent, wrote these terse statements concerning the territory of Utah:

"In places the sage brush for miles in extent is dead and withering, seemingly parched by the all-pervading drouth . . . Frost is very destructive and occurs in every month of the year . . . The climate is severe and capricious . . . But little rain falls in the summer and that is speedily evaporated from the hot earth, leaving the clay as thirsty as ever . . . I fear it [the country] is doomed to perpetual barrenness . . . This land of desolation seems, therefore, utterly irredeemable."

Although the major part of Utah would still appear in midsummer to the weary traveler much as it did to Horace Greeley, this territory has developed into a thriving agricultural area.

Land Use

In Utah there are 52,700,000 acres of land, of which 90 percent is used for the production of agricultural products. Because of limited precipitation, unfavorable topography, and lack of water for irrigation purposes, 87 percent of the area is utilized through the production of livestock and livestock products. Only 3 percent of the total area is used for the production of harvested crops. Of this 3 percent, one-third is devoted to the production of dry-land wheat and miscellaneous dry-land crops. The other 2 percent, a little less than 2 million acres, is used for production of crops under irrigation. By way of contrast, several of the midwestern states cultivate more than three-fourths of their total land area.

Ownership of the Land

One of the major problems of land utilization in the state is related to the ownership of land. Sixty-eight and one-half percent of the total area is owned and administered by federal agencies. This sets a definite limit on use of the resources for production of agricultural products and also limits the revenue from taxation of lands. An additional 7 percent of the state is owned and administered by state and local governments. Private interests own 16½ percent of the area, which includes practically all of the cropland of the state. The balance (8 percent) consists of urban lands, lands utilized for roads, railroads, and unclassified uses.

The Irrigated Farms

Irrigated farms make up approximately 70 percent of the total number of farms in Utah (26,000). On these farms are produced practically all of the poultry and dairy products as well as the canning crops, sugar beets, potatoes, fresh fruits, and vegetables. There has been a definite tendency for dairy animals and poultry, including turkeys, to increase in numbers. This trend is economically sound and should continue. The surplus grains of northern Utah and southern Idaho can support a larger poultry industry than now exists. The expansion of dairy and poultry enterprises is the most feasible way of increasing the volume of business on the numerous small farms and thereby utilizing surplus labor of the farm family. Although the acreage of irrigated land is relatively small compared with the total area, more than two-thirds of the total agricultural income of the state originates on these general irrigated farms.

Dry Farming

Dry-land farming is practiced on about 10 percent of all farms. These farms are restricted to a few areas where the combination of soil and precipitation permits the production of (Continued on page 16)
A NEW seed cleaning laboratory has been built by the Utah Agricultural Experiment Station and is used cooperatively by the Department of Agronomy and Vegetable Crops and by the U. S. Department of Agriculture workers carrying on seed production studies with vegetables, flowers, grain, grass, alfalfa, and clover. These studies necessitate modern seed cleaning equipment adequate to handle experimental lots on a commercial scale, and yet small enough to be adaptable to the relatively small quantities obtained in such work.

The laboratory is in a special building with a concrete floor. It contains an onion seed thresher, an S. Howes Eureka No. 1 automatic 4-screen 2-air super-cleaner, a Hart Carter Disc cleaner, a Gravity separator, a Eureka testing cleaner, and a Ferrell Clipper cleaner. The building has also been equipped with special collapsible screen shelves along with screen-bottom trays so that large quantities of unthreshed experimental onion seed can be dried indoors with the aid of fans. Smaller equipment such as a portable electric blower, sets of sieves, a Boerner sampler, a bagon truck, and various types of scales, is also available to supply the larger machinery.

Supplementing the equipment in the laboratory, is a small threshing machine designed by Leslie R. Hawthorn of the U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering working cooperatively with the Utah Station. The thresher was especially built for use in the vegetable seed production investigations and has been in use since 1945. This machine, adapted from a large commercial combine, enables the workers to duplicate commercial conditions and yet harvest small plots. Through various adjustments the machine can handle nearly any kind of vegetable as well as many flower seeds.

A second model of the Utah thresher was constructed for the California Station in 1948, and in recent months enquiries concerning this machine have been received from a number of nationally known seedsmen, as well as universities and seedsmen in England and Canada. Detailed specifications for the construction of this machine will be supplied by the Agricultural Experiment Station.

Farm and Home Science
Should Range Heifers Be Bred As Yearlings?

By J. A. BENNETT, L. A. STODDART, and L. E. HARRIS

IN THIS STUDY
1. Calving first at two years of age did not stunt range cows that were well fed during the winter.
2. Conception rate was not high in yearling range heifers, especially smaller and younger individuals.
3. Heifers calving as two-year-olds had difficulties in calving.
4. When both groups were six years of age cows calving first at two years of age weaned an average of 1.03 more calves that were 10 pounds heavier than did cows that calved first at three years of age.

Results of this study suggest that if animals are small and if the operator cannot give them attention during calving, it is doubtful if the practice of breeding yearlings is desirable. Ranchers should not breed heifers as yearlings unless adequate feed supplies are available to grow the heifers out to large size at the time of calving.

Generally these were the older heifers that were early-spring calves rather than late-spring calves. It is not known whether the other heifers failed to breed or if they bred but failed to settle.

Calving as a two-year-old did not reduce the calf crop the next season, nor did it seem to have a bad effect in subsequent years. At the end of their fourth calving season these early-bred cows had produced an average of 3.71 calves or the equivalent of approximately 93 percent average calf crop per cow per year. The group that calved first as three-year-olds had at the same age completed three calving seasons with an average of 2.6 calves per cow, or approximately 89 percent calf crop per cow per year. Part of this advantage in favor of the early calving group may be the result of the individuals in this group possessing an inherent make-up for a higher level of fertility and partly the result of the influence of calving first at a younger age.

The early calving group had, in the fall when both groups were six years old, weaned an average of 1,236 pounds of calf per cow compared to 865 pounds of calf per cow for the group that calved first at three years of age. This difference of 371 pounds in favor of early breeding resulted from the cow raising an average of 1.03 more calves per cow and also from the calves averaging 10 pounds more in weight. This heavier weaning weight is difficult to explain since the two groups of cows were of the same quality. Perhaps, by chance, the early-bred group were somewhat heavier milkers, or perhaps these cows because of calving earlier in life settled more promptly and calved slightly earlier each season, as a group.

Early breeding did not, apparently, (Continued on page 9)
REGIONAL COOPERATIVE RESEARCH

A NEW and added procedure in agricultural research is that of regional cooperation provided by the Agricultural Research and Marketing Act. This Act was passed by the federal Congress in 1946 and has been popularly known as the Hope-Flannagan Act.

Title I of the act authorizes the expenditure of funds by state agricultural experiment stations for research into the basic laws and principles relating to agriculture in its broadest aspects. This is really an amendment to the Bankhead-Jones Act of 1935, not much different from the original act except that it provides for cooperation among states on the study of regional problems.

One-fourth of the funds authorized under the act may be allocated for the support of research projects where two or more states are cooperating.

Prior to the passage of the Agricultural Research and Marketing Act there was no specific authorization in any of the research acts that permitted or provided a way for cooperation among states on regional studies. During the past three years the state agricultural experiment stations have been developing procedures for regional cooperation; and, although some difficulties have been encountered, in the main, the stations are finding that many problems having regional significance can be studied most effectively through cooperative effort.

In the past research workers have recognized the fact that certain agricultural problems could not be studied comprehensively within the boundaries of a single state. For example, in studies on the marketing of agricultural products, the workers within a state could study the grading, packing, and selling of a product within that state; but little or no information could be obtained about what happened to the product in shipment to markets, and in the subsequent disposal of the product in the wholesale and retail markets, and even consumer acceptance of the product in other states. Many other types of study have also been found to lend themselves to regional cooperation.

Most agricultural problems require research into basic scientific laws and principles. Obviously it is not necessary for each state agricultural experiment station to make these basic investigations. Through regional cooperation these studies can be made at one center.

From there, the results can be taken to other states in the region and there applied in the solution of the problems under local conditions. In this manner, research effort on the basic problem can be concentrated and the problem investigated with greater efficiency. It is also more likely to be solved in a shorter period of time, and at less expense. Furthermore, duplication of effort is avoided.

Another advantage of regional cooperative research is the benefit derived from research workers of different states in a region getting together to discuss their problems to determine which ones are really significant and how they can best be attacked.

The provision for regional cooperation in research has made it possible for experiment stations to undertake problems of regional significance which go beyond state lines. It has had the effect of pooling the best trained manpower and scientific equipment in the solution of problems. And it has also tended to promote friendly working relationships, to avoid competition, and unnecessary duplication of effort in research. It is a new innovation in agricultural research that is proving worthwhile.

AARON FRANCIS BRACKEN

ARON FRANCIS BRACKEN, professor of Agronomy at Utah State Agricultural College, died at his home in Logan, Utah, May 4, 1949.

Prof. Bracken was widely recognized for his contributions to dry-land agriculture. His research covered almost the entire range of production problems with winter wheat. His many publications include data and recommendations of wheat varieties for dry-farming conditions, methods and time of plowing, continuous versus alternate cropping, green manure and rotation crops for dry-farm lands and the seeding of range grasses on abandoned dry-farm lands. In recent years, he had studied intensively the problems of nitrogen and organic matter depletion and maintenance in dry land soils, and the related problems of increasing yield and protein content of wheat by rotation with alfalfa and the use of commercial fertilizers.

Professor Bracken was distinctively gifted as a teacher. Patience, sympathy, tolerance, humility, and an intense devotion to duty were gifts he possessed to an unusual degree. He inspired many young people to take advantage of educational opportunities. His students in all parts of the world mourn his passing as the loss of a friend and counselor as well as of a great teacher.

He was born October 11, 1890, at Freedom, Wyoming, and received his early education in that high mountain valley and later at the Fielding Academy at Paris, Idaho. He entered Utah State Agricultural College in 1910 and received his B. S. degree in 1914. The master of science degree was awarded him in 1924. Later he did graduate work at the University of Minnesota in agricultural chemistry, and at Iowa State College in statistics.

Because of his distinctive accomplishments as a student, he was given a position on the Utah State Agricultural College staff immediately following graduation with the B. S. degree. During nearly 35 years of service with the college, Professor Bracken has held many positions. He was appointed foreman of the Dry-Land Experiment Station at Nephi, Utah, in 1914. From 1917-1919 he served as county agricultural agent in Summit and Morgan Counties. In 1919, he resumed charge of the research program at the Nephi Station, serving as superintendent of the work there until the time of his death. In 1924 and 1925, Professor Bracken was land plan-

(Continued on page 19)
CONSUMERS prefer their peaches ripe. This was the conclusion from surveys in a number of markets in the middle west made last year. Consumer preference studies for Colorado and Utah peaches of different stages of maturity were conducted in Minneapolis, Des Moines, Kansas City, and Denver during the 1948 season.

Test lots of Elberta peaches were loaded as parts of standard carloads in producing districts for each market except Denver where a different procedure was used. Each shipment contained separate lots of each stage of maturity. The maturities shipped were hard, firm, and firm ripe at shipping point. The various maturities were determined by a combination of pressure tests and observations of ground color. The fruit, graded to U. S. No. 1 requirements, was certified as to grade and stage of maturity by federal-state inspectors. The fruit was also inspected for condition and maturity by federal-state inspectors upon arrival at the terminal market. The inspection certificate indicated that the peaches in most of the shipments advanced about one stage in maturity during transit. Thus a large part of a lot that was loaded as "firm ripe" was "ripe" when it arrived on the market; that shipped as "firm" arrived "firm ripe"; and that that was "hard" when loaded arrived "firm." There were some exceptions to this noted at a later point.

Peaches were displayed for sale at one or two stores in each city. The display and pricing methods followed were similar to those used in the regular course of business in the stores. In each market test lots of the three maturities were sold at a uniform price. This price was sometimes changed from day to day, but at any particular time the price was the same for all three maturities. Fruit considered as unsalable was sorted out and discarded. Fruit of the different maturities was displayed side by side on the retail counters or in bins. As sales were made, the display spare was refilled as long as the supply of test fruit of each maturity was available. When the test fruit of any one maturity became low, the test was closed.

Two test shipments of peaches in boxes were made from Colorado to Minneapolis. The first test was closed at the end of the first day when nearly all of the peaches of the most advanced maturity had been sold (table 1). The second test, consisting of a much larger shipment, was in progress three and one-half days. During both tests, peaches of the most advanced maturity sold at a much faster rate than did the harder fruit. The quantities discarded during the test sale period as unsalable because of softness, bruising, or decay were greater from the fruit of more advanced maturity than from the harder fruit. However, no record was made of any subsequent loss from the fruit not sold when the test sales ended. Additional losses from the harder fruit doubtless occurred before all of it was sold. During the test sale period the greatest loss of about 14 percent occurred on the fruit that was firm ripe at shipping point, while the least loss of only about one percent occurred with those peaches that were shipped as hard.

One shipment of Colorado peaches in boxes was made to Des Moines. This test lasted only one day as the most fully matured fruit (shipped as firm ripe) was nearly all sold at the end of that day. Seventy-four percent of the peaches sold that day were of the firm ripe maturity at shipping point (table 1).

Two test shipments were made to Kansas City, one from Colorado and one from Utah. Both were packed in bushel tub baskets. Each lot in the Colorado shipment advanced almost two stages in maturity during transit. This was caused, at least in part, by the high internal temperature of the fruit when loaded. Peaches shipped as firm ripe

(Continued on page 14)
Lining of Canals and Reservoirs Saves Land as Well as Water
Excess Ground Water Responsible for Low Production, Abandonment of Large Acreages, and for Installation of Costly Drainage Systems
By C. W. LAURITZEN and O. W. ISRAELSEN

LINING of canals and reservoirs is primarily justified as a means of saving water, however, it saves land as well. It does this by decreasing the contribution to ground water. Excess ground water is responsible for low production, the abandonment of large acreages, and for the installation of costly drainage systems in an even larger acreage to maintain productivity. Lining of canals also facilitates water deliveries, saves labor, contributes to weed control, prevents erosion, and adds beauty to irrigated regions. Considering these additional benefits, much is to be gained by increasing the effectiveness of the water we now have at costs less than developing new supplies. The future of the West depends as much, or more, on the efficient conveyance and use of water as it does on the development of greater water supplies through additional storage. Lining of canals and reservoirs is the best means of increasing the efficiency of conveyance and storage of water.

The chief reason so few canals are lined is the high cost of lining. The day is approaching, however, when the unlined canal will be the exception. Costs are relative and as the demand for more water with which to expand our agriculture and industrial development increases, lining of canals will become more general despite the cost. The eventual lining of the canals of the West will involve substantial expenditures. Information which will lead to reductions in the cost of lining with improved methods and materials will result in substantial savings to the people.

Linings for Canals
Portland cement concrete constitutes more than 90 percent of the lining in the irrigation canals of the United States and it appears that this material will continue to hold first place. One material, particularly asphaltic concrete, gives promise of competing with Portland cement concrete. Wood, metal, and stone masonry have been used to a limited extent but in general are more costly and less satisfactory. In order to lower the cost of lining, such materials as earth, soil-cement, oil, asphaltic membranes, and fabrics have been employed experimentally. It has been demonstrated that these latter types of lining can be installed at a lower initial cost but it is doubtful if the annual cost of these materials will be less when the cost of maintenance and replacement is considered.

Concrete Linings
Thickness and Subgrade
Concrete linings differ widely in thickness, type and extent of reinforcing, mix, and finish. These factors likewise determine the initial cost and to some extent the durability. The thickness necessary to provide durability depends on many factors, some of which are difficult to evaluate. Concrete lining should not be less than 2 inches thick and need not be thicker than 4 inches. The thickness as well as the need for reinforcing steel is governed chiefly by the climate and the character of the subgrade on which the lining is to be placed. In mild climates the permissible minimum thickness of a lining is less than in severe climates although much depends on the character of the sub-

DR. C. W. LAURITZEN is soil technologist with the Soil Conservation Service, Division of Irrigation and Water Conservation. He works cooperatively with the Utah Station. DR. O. W. ISRAELSEN is professor of irrigation and drainage and in charge of the irrigation research.

Fig. 1. Concrete lining in process of construction. Alternate panels have been completed and the reinforcing and form members are in place in readiness for receiving the mortar in the connecting panels. 2. Section of above lining after completion. 3. Slip form used by the Bureau of Reclamation in the installation of concrete lining on the Yuma-Mesa project. 4. Lining installed with slip form shown above. 5. Installing shotcrete lining in canal
grade. Probably 90 percent of slab breakage in concrete linings can be attributed to adverse subgrade conditions. Undesirable subgrade conditions are inherent associations of canal sites, although not infrequently they have their origin in construction practices used in the excavation and preparation of the subgrade. Where they are inherent the construction of a durable lining will necessitate a thicker slab with more reinforcing and, in certain instances, the installation of drains and other protective devices. More care in lining design and in the preparation of subgrades would do much to increase the durability of concrete linings.

Type of Canal Cross Section

Rectangular or semi-circular section concrete linings necessitate the use of forms to hold the concrete mortar in place until set. The most practical cross section for irrigation canals is the trapezoidal. Concrete may be placed without forms in canals with a trapezoidal section if the side slope is not steeper than 1 vertical to 1½ horizontal. If, however, the slope is kept slightly flatter, 1 vertical to 1½ horizontal, placement is simplified. Linings are poured in 10 or 12-foot panels as shown in figures 1 and 2. The alternate panels poured first serve as screed guides in the installation of the connecting panels. This method of installing concrete linings is best for small jobs when special equipment is not available and site conditions are favorable.

Slip Form Pavers

Shaping screeds or templates with supporting structures, and compartments for the concrete mortar, which is fed under the leading edge of the screed as it is propelled forward, are called slip form pavers. The pavers are often supported and guided by rails installed on the berm of the channel. The slip form shown in figure 3 consists of two templates in tandem with an opening between for supplying the concrete mortar to the subgrade as the form is pulled forward. A lining constructed with this slip form is shown in figure 4. A tractor operating from one side of the channel connected with the slip form by means of a cable is commonly used to move the form forward. It is desirable that the form be kept in continuous motion. This requires concrete mortar in volumes larger than can normally be supplied with available facilities for mixing. Other limitations of the slip form are that a particular form is generally limited to canals of the same cross section, and its use is restricted to unreinforced concrete linings.

Shotcrete Linings

Placing concrete mortar pneumatically, as shown in figure 5, to produce a lining commonly termed shotcrete or gunite has some advantage over other methods. The chief advantage is the elimination of forms and the adaptability of this method to fitting the lining to irregular surfaces.

Precast Concrete for Lining

Precast concrete slabs placed by hand for linings, as shown in figure 6, have been limited to a few experimental installations. The joints are sealed with a mastic. Information on the durability of this type of lining is limited. It may be more durable under certain conditions than cast-in-place concrete linings because of its flexibility, a feature which should protect it from damage by expansion and contraction of the subgrade caused by frost action, and wetting and drying of materials. This lining may provide an acceptable type for field laterals to prevent excessive seepage losses or protect the channel from erosion. It has the advantage of flexibility. The slabs can be produced commercially and can be installed without any special equipment; removed and re-used if this is desirable. A small field ditch lined with precast concrete slabs to prevent erosion is shown in figure 7. The old earth ditch on a slope of only 2 percent with a stream of 4 cubic feet per second had been eroded until it was 6 feet deep in places, 8 feet wide at the top, and very irregular in alignment.

Stabilized Earth Linings

A number of types of lining such as compacted earth, soil-bentonite mixtures, soil-cement, and earth treated with light oils are designated stabilized earth linings. All reduce seepage losses and involve a smaller initial cost. Considerable maintenance will be necessary to keep linings of this type intact. Earth and earth-bentonite linings require a protective non-erodible cover such as rock rip rap or a layer of gravel to prevent destruction by erosion. This adds to the relative cost. Canals lined with earth materials require nearly double the cross section and larger wetted surface, because of the lower stream velocity in comparison with concrete, to provide the same flow capacity, thus decreasing the spread even more. These factors all contribute to increasing the cost of lining with earth as compared (Continued on page 13)
2,4-D Reduces Yields of Sweet Corn and Potatoes

By D. C. TINGEY

Fig. 1. Sweet corn on morning-glory infested land

If used for controlling weeds in sweet corn and potatoes, 2,4-D may seriously reduce yields of these crops. Plants of both sweet corn and potatoes treated with 2,4-D were seriously injured. This injury reflected in lower yields.

These experiments, conducted at Logan in 1948, showed reduction in yields of sweet corn and potatoes as much as 25 percent as a result of spraying with 2,4-D. These reductions occurred on different varieties and with use of as little as ½ pound of 2,4-D per acre.

The comparisons were made on land infested with morning-glory. Cultivated and hoed plots were used as checks. Under these conditions, potato varieties yielded about the same where morning-glory was allowed to grow as where 2,4-D was used to kill it. The competition from morning-glory just about offset the harmful effect of 2,4-D. Where morning-glory was kept out by cultivating and hoeing, yields were from 25 to 60 percent higher than where 2,4-D was used.

Sweet corn on plots where morning-glory was allowed to grow, however, yielded only 46 percent of that where 2,4-D was used. Thus it is a distinct advantage to use 2,4-D in corn fields rather than let morning-glory grow. However, the increased yield from cultivating and hoeing over 2,4-D treatments was about 25 percent.

On land infested with morning-glory, it is preferable to grow silage corn varieties or small grain, which are more resistant to 2,4-D, rather than sweet corn or potatoes.

Experiments on Sweet Corn

The experiments on sweet corn consisted of using 2 kinds of 2,4-D products applied at 3 rates on varying degrees of morning-glory infestation and 4 varieties of corn. Varieties used were strains of Golden X bantam. Two of the strains, J-5 and 219, were the early and late varieties, respectively, used by the California Packing Corporation in Cache County in 1948.

In addition to the above treatments, some plots were cultivated and hoed at 2 week intervals until the corn was harvested, in other cases morning-glory was allowed to grow without any treatment. Sodium salt and ethyl ester of 2,4-D were the products used. Each was applied at different rates, ½, 1, and 3 pounds of active material per acre.

Yields of sweet corn ears where morning-glory was allowed to grow were about 35 percent and where treated with 2,4-D, about 78 percent of what they were where morning-glory was kept out by cultivating and hoeing. Yields of corn stover were not reduced as much as the ear yields by 2,4-D treatments.

Experiments on Potatoes

The experiment on Bliss, Cobbler, and Russet potatoes was similar to the one on sweet corn except the rates of 2,4-D used were ½, 1, and 2 pounds per acre. Yields were rather low because of the heavy soil, which is undesirable for potatoes, and of low fertility. Where morning-glory was kept out by cultivating and hoeing, Bliss yielded 141 bushels of marketable potatoes, Cobbler 92, and Russetts 112 bushels. Where morning-glory was allowed to grow, the acre yields were 97, 74, and 66 bushels, respectively. On a relative basis as compared with the cultivated and hoed plots, the yield of Bliss was 69, Cobbler 80, and Russetts 59 percent. These data show how much injury morning-glory may cause if it is not controlled.

Plots treated with 2,4-D when compared with those cultivated and hoed yielded Bliss 73, Cobbler 65, and Russetts 54 percent for the sodium salt of 2,4-D; for the ethyl ester of 2,4-D the corresponding values were 67, 76, and 40 percent. From these data it appears that Russetts are injured more by morning-glory competition and by 2,4-D treatments than either Bliss or Cobblers. Yields of marketable tubers were less affected than total yield by the 2,4-D treatments. With the sodium salt of 2,4-D the acre yields were about the same for the different rates of application, but with the ethyl ester, the 2 pound rates yielded about 30 percent less than the ½ pound rate.

In 1947, the Bliss variety was treated with 2,4-D at 4 stages of growth and at rates of ½, 1, and 2 pounds of 2,4-D per acre with 6 different 2,4-D products. Land on which the potatoes were grown was not infested with morning-glory. Data from this experiment showed no reduction in yield or quality with either kind or rate of 2,4-D used. The reason for these different results in 2 years is not easily explained, but is typical of results frequently encountered in using 2,4-D. Since, however, definite injury has occurred on sweet corn and potatoes farmers should be cautioned in its use for general weed control in these two crops.

2,4-D Is Reasonably Safe, At Least on Certain Varieties of Silage Corn

Experiments on the use of 2,4-D for weed control in the silage variety of corn, Minnesota 301, in 1946, 1947, and again in 1948 (in 1948, the hybrid US52 was also grown) have shown little

D. C. TINGEY is professor of agronomy and in charge of the weed control research at the Utah Station.
or no injury from the 2,4-D treatments. However, it is advisable to keep the spray off the leaves of the corn as much as possible in making the application.

Control of Annual Weeds in Corn

Annual weeds in corn can be controlled more effectively by cultivation than perennials. Since 2,4-D may result in serious reductions in ear and fodder yields if used on sweet corn, the weeds should be controlled by cultivation. Sweet corn, being a late planted crop, provides an opportunity to control many annual weeds before the corn is planted.

The seedbed should be prepared ten days or more ahead of the time of planting. During this time weed seeds will sprout and can be controlled by harrowing one or more times before planting. Seedling weeds are easily killed by light harrowing with the teeth flat. Avoid working the soil deep after the seedbed is prepared, otherwise, additional weed seeds will be brought to the surface.

A second harrowing just before the corn emerges will destroy any additional weeds that have sprouted, and a third light harrowing or finger weeding after the corn is up, if necessary, will control most of the annual weeds. Any additional weeds that emerge later should be controlled by cultivating between the rows. Seedling weeds that come up in the rows can largely be controlled by using shovels on the cultivator that push the soil over the weeds in the row. Covering seedling weeds with soil kills them. If such tillage treatments are used most of the hand hoeing can be eliminated. The hand hoe is the most expensive weeding implement on the farm.

The procedure for controlling annual weeds in sweet corn is also recommended for controlling weeds in silage corn. However, the apparently greater resistance of silage corn to 2,4-D makes it possible to use it in controlling weeds. Seldom, however, is it possible to control all annual weeds in corn with 2,4-D. Therefore, some cultivation will be required even though 2,4-D is used.

Regardless of the method used annual weeds should be exterminated while they are mere seedlings.

Note—For copy of the methods recommended for controlling weeds in Utah in 1949 write to the Utah Agricultural Experiment Stations, Logan.

For June, 1949

Fig. 2. Sweet corn showing severe injury from morning-glory control treatments with 2,4-D. Morning-glory foliage was killed by the treatments, but corn leaves were severely rolled and yields greatly reduced.

Fig. 3. Sweet corn on morning-glory infested land where weeds were controlled by cultivating and hoeing. Note the thrifty growth and absence of leaf rolling.

BREEDING RANGE HEIFERS AS YEARLINGS

(Continued from page 3)

stunt the cows. The average mature weight of the cows that raised their first calf at two years was only 8 pounds less than the average for the cows that first calved when three years of age. These cows were all reasonably well cared for during the winter season. In most cases the cows at least maintained their weight or gained slightly during the period from about October first to June first. If adequate feed had not been available, early calving would have undoubtedly reduced the size of the cows.
Carp as a Protein Supplement

By WILLIAM F. SIGLER

AN INEXPENSIVE locally produced protein supplement for poultry and livestock would find ready sale in Utah. Non-game fish, especially carp, offer such a possibility.

Up to the present time, however, there have been few extensive attempts to utilize these fish in Utah. Poultrymen, fish hatchery men, and fur farmers have used fresh carp, suckers, and chubs as a protein supplement from time to time, but lack of adequate refrigerating or drying facilities has restricted this use to the short periods of easy availability. A few carp are sold to the West Coast fish markets for human consumption but the demand is limited.

With the anticipation of their utilization in animal feeding, studies on various phases of the life history of carp are now being conducted at Utah State Agricultural College. Nutritive tests on raw and cooked carp are being run to determine its value as a food for poultry and other domestic livestock including swine, mink, dogs, and foxes. Development of economical and practical methods of harvesting carp all seasons of the year are under way. This includes experimenting with gill-nets, drag seines, electric shocking machines, and various chemicals.

Carp Plentiful in Utah

Carp are present in most of the warm water areas of Utah. Almost all of the fresh water in the state that is too warm for trout will support carp. Although the range of trout and carp sometimes overlaps, it is generally for only part of the year, or in limited areas. Carp is, however, a more serious competitor of largemouth bass and other warm-water game fish. Most of the natural ponds at lower elevation will support carp if the ponds are three or more feet deep. This widely adaptable fish has been observed doing well in ponds only 30 feet square. Farmers in some sections of the state stock their water storage ponds heavily with carp in order to control excessive growth of aquatic plants. Large populations of carp (in some cases as much as 1,000 pounds per acre) do this effectively by keeping the water turbidity high, and by actual mechanical damage to the plants. In addition to acting as a plant control agent, the carp furnish a readily available source of food. At times when the water is drawn down, the carp can be easily captured. They are about the only fish in Utah that will survive, and even thrive under such adverse conditions.

Carp production can be increased by fertilizing the water, or by direct feeding with corn, wheat, table scraps, or ground meat. Many otherwise unproductive ponds can, in this way, become quite profitable. Probably no other fish can equal the carp in production of pounds per acre. The value of carp has long been recognized in both Europe and China, where it has been cultured for hundreds of years.

Artificial ponds should be constructed with gently sloping banks and even bottoms in order to insure success of removal. Construction that allows drainage of the pond has obvious advantages. Unless ponds are privately owned and stocked, harvesting must conform to the fish and game laws of the state. Seining permits for all public waters must be obtained from the State Fish and Game Department.

Preliminary work in a series of Cache Valley ponds indicate that these ponds will support at least 350 to 450 pounds of carp per acre. The fish population of an average Cache Valley pond is, by

Dr. William F. Sigler came to Utah State two years ago from Iowa State College as assistant professor of wild life management.
weight, about 90 percent carp. It is estimated that at least 100,000 acres of water in Utah is potential carp range.

Storage and Handling Facilities

Many farmers are interested in using carp as a feed on a small scale and with a minimum cash outlay. Since fresh carp spoil easily in warm weather, they must be fed a few hours after capture, unless storage facilities are available. Often-times a small pond or even a large tank can be used as a livebox where carp can be held until they are needed. Cooked carp keep somewhat longer than fresh ones. The most common method of preserving carp is by freezing; when properly handled they will keep for several months. Carp may also be processed into fish meal and kept almost indefinitely. At the present time, however, there is only one processing plant in Utah.

If carp were easily taken any time during the year, the storage problem would, in most cases, be easily solved. However, this is not the case. For although carp are taken in great numbers during the spring and early summer months, later in the year harvesting them often becomes difficult and costly. This means that if carp are to be widely used as a year-around feed, more economical methods of harvesting and storing them must be developed.

Probably the best method of removing all fish from ponds or small lakes is by killing them with chemicals. Rotenone, the most commonly used chemical, is inexpensive and the fish are still fit for human consumption. It is spread over the surface of the water with pumps or pails. The fish shortly come to the surface and can be picked up with dip nets.

Protein Content

Preliminary tests at Utah State Agricultural College indicate that carp have a protein content comparable to a good grade of beef steak. Many trout and fur farmers in Utah at present are using fresh carp as a protein supplement. Probably a warning note should be sounded here. The amount of fresh carp in the diet of domestic animals normally should not exceed 20 percent of the total volume, and it should be fed separately. The reason is this: there is a thiamine-destroying factor contained in carp presumably an enzyme, known as the chastex paralysis factor. While this factor is concentrated in the blood, gills, and viscera, it is also present in other parts of the body. If carp is fed in excessive amounts a thiamine (vitamin B₁) deficiency will result.

Much of the life history of a fish can be learned from its scales. Its age and size at the end of each year of life are calculated from rings on the scales. In some cases the spawning period, and even such hardships as disease or lack of food, can be determined from scales. A sample of 95 carp from Cache Valley grew on an average as follows: first year, 4 inches; second year, 8 inches; third year, 13 inches; fourth year, 18 inches. A carp 18 inches long weighs about 4 pounds. Carp are very prolific, a female, weighing 6 to 8 pounds, may produce more than a million eggs in a single season. Carp mature at about three years of age and probably produce eggs every year thereafter for several years. It is not unusual to find an 8 or 10 year old carp. Although their food is primarily small insects and crustaceans, some plant material is eaten.

By agricultural standards some of the Cache Valley ponds are low in nitrogen and phosphorus but have an adequate amount of potassium. It is a common practice in the southern states to fertilize farm ponds to increase fish production; little of this has been done in Utah. Ordinarily, an inorganic fertilizer is considered more desirable than an organic one. It is a general rule that a lake or stream will support approximately the same poundage of fish year after year.

Up to the present time, carp as a resource in Utah has been largely neglected. It appears to be a cheap and easily accessible source of protein, but methods of utilization and harvesting should be further investigated and developed. More definite values of carp as a protein supplement should be established, and the methods of feeding should be examined critically. A life history study, including an estimate of the standing and harvestable crop, should be continued.

NEW PUBLICATIONS

Bul. 337. The vitamin content of peas as influenced by maturity, fertilizers, and variety, by Ethelwyn B. Wilcox and Katharine E. Morrell. Department of Foods and Nutrition. 16 p.

This bulletin reports the effect of maturity on the vitamin content of canned and frozen peas, the effect of the use of different fertilizers and of variety on the vitamin content of fresh peas.


This circular pictures and describes 34 weeds that are or may become dangerous pests of Utah farm lands. It will be especially useful to farmers in identifying weeds.


The purpose of this report is to show the important relationship of additional irrigation water to the future of Utah's agriculture. It presents the present agricultural development in Utah, the present weaknesses and needs of Utah's agriculture, the economic trend that probably will affect the future of agriculture in the state, the land and water resources of the state and their uses, and the benefits that would result from the proposed irrigation development.

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

Carp taken from pond by use of retenone

for June, 1949
CRACKING OF CHERRY FRUIT
By F. B. WANN

CHERRIES are subject to considerable injury from cracking when rains occur during the latter part of the ripening period. Crop losses of 50 percent are not uncommon and they may reach 90 percent. Even relatively small cracking losses seriously increase the cost of marketing the crop because of the additional sorting required.

Little experimental work has been done on cracking in Utah owing probably to the sporadic and local nature of the trouble. However, in Idaho, Oregon, and some of the western cherry sections, efforts have been made to solve some of the problems relating to the cause and possible control of cracking. The following summary of the results obtained in these investigations should be of interest to the cherry growers of Utah.

Cause of Cracking

Some of the earlier observations on cracking assumed the injury to be caused by an excessive absorption of water either through the root system or through the fruit skin itself. That the primary cause of cracking is the absorption of water directly through the skin of the fruit and not through the root system has been demonstrated by a number of investigators. Attempts to induce cracking in Bing, Lambert, and Napoleon cherries by varying the frequency and duration of irrigation failed even though the soil moisture variations produced were greater than would be encountered under any normal irrigation practice. Cracking occurred only in the presence of rain or if the fruits were immersed in water. When portions of trees were protected from rain, no cracking occurred regardless of the previous irrigation treatment, whereas unprotected fruits on the same tree suffered much injury. A number of workers have observed that cracking may occur under a variety of irrigation practices and soil moisture conditions.

The absorption of water by the cherry is an osmotic process and occurs at the point of contact between the skin and the drop of water. Evidence for the osmotic absorption of water is obtained from the facts that (1) the weight and volume of the fruit increase upon immersion in water, (2) the rate of water absorption is proportional to the osmotic concentration of the juice, and (3) when immersed in sugar solutions, the volume increase and amount of cracking vary inversely with the solution concentration.

CRACKING IN BING AND LAMBERT CHERRIES AT DIFFERENT STAGES OF DEVELOPMENT, LEWISTON, IDAHO. PHOTOGRAPH COURTESY PROF. LIEF VERNER, IDAHO AGRICULTURAL EXPERIMENT STATION

Types of Injury

The injuries from cracking may vary from short breaks which are apparently only skin deep to larger ruptures extending most of the length of the fruit and involving the underlying flesh. Three general types are recognized: (1) cracks occurring in circles or semi-circles around the stem end; and (3) long irregular slits on the side. Types 1 and 2 are common since drops of water commonly hang on the fruit tip following rains and this part of the fruit is highest in sugar content, or water may collect in the cup around the stem end of the hanging cherries.

Factors Affecting Severity of Cracking

The severity of cracking depends upon a number of factors, chief of which are the variety, the stage of maturity of the fruit, and the length of the rainy period. In tests with eight varieties, it was found that the approximate susceptibility to cracking, starting with the most susceptible, was as follows: Bing, Tartarian, Napoleon, Lambert, Republican, Oregon, Waterhouse, Eagle. Attempts to relate susceptibility to cracking to morphological or structural features of the fruit have not been successful owing to the slight differences between varieties in these characteristics.

A correlation between susceptibility to cracking and volume was found, indicating that size is one of the factors influencing tendency to crack. There was no apparent relationship between cracking and firmness of fruit as determined by the Idaho pressure tester, though cherries of medium firmness seemed to be slightly less susceptible than either the softer or firmer varieties.

Attempts to establish a relationship between tendency to crack and the content of the fruit in soluble solids have yielded conflicting results. It seems probable that factors other than percentage of soluble solids are more important in determining the susceptibility to cracking of different varieties.

The stage of maturity of the fruit is a factor in cracking. Thus as the fruit matures the sugar (osmotic) concentration and soluble solids content increase and the cracking tendency increases. Maximum tendency to crack is reached at about the point of tree ripeness and

Farm and Home Science
may decrease if the fruit is left on the tree and a reduction in turgor occurs.

Local climatic conditions are important factors in the severity of cracking, particularly as they affect the rate and date of maturity of the fruit. In a study of the weather records for the Lewiston, Idaho, area, it was found that the total precipitation as well as the number of rains decreased toward the end of the period (June 16-July 7) during which Napoleon and Lambert were usually harvested. In the period June 8 to July 4, about 1 day in 4 may be expected to be rainy, but from July 5 to 31, only 1 in 10. The rains in the earlier period are also more prolonged and cause more damage than the later short rains. Varieties that mature after July 5 would thus be subject to less damage than earlier maturing varieties.

Methods of Reducing Losses

Losses resulting from cracking may be minimized somewhat by proper harvesting practices. The fruit should be picked as soon as it reaches maturity. When rain occurs, immediate harvesting is desirable since the longer cherries remain on the trees the greater the cracking injury. Although it has been thought that cracks may heal if the cherries are allowed to remain on the tree, it was observed that cork formation did not take place, and that "healing" was merely a process of drying out.

In 1937, it was observed that when Bings were sprayed with 2-3-40 bordeaux 5 or 6 weeks before picking, cracking was apparently reduced. When sprayed and unsprayed limbs of Lambert were dipped in water, there was less cracking in the sprayed fruit. Several calcium sprays—bordeaux, calcium hydroxide, and calcium acetate—were used on Bing and Lambert and it was found that bordeaux and hydrated lime reduced the amount of cracking. It was concluded that calcium is the active constituent of the sprays and is effective by reducing but not entirely preventing water absorption. A variety of soil sprays tested did not yield promising results.

In 1947 workers in Oregon found that calcium hydrate reduced cracking somewhat but that copper sulfate was much more effective. Bing cherries in water were 100 percent cracked at red ripening stage and 80 percent at full maturity after 64 hours submergence, but similar cherries immersed in an 0.25 percent anhydrous copper sulfate showed no cracking after 4 days. Immersion in 0.25 percent sucrose, fructose, sodium chloride, sodium oxalate, zinc sulfate, or arcosol had no effect on cracking. A 30-minute presoaking in 0.1 percent calcium hydrate reduced subsequent cracking in water to 16 percent while treatment with 0.1 percent copper sulfate reduced it to 2 percent. Similar results were obtained with Napoleon. The workers suggest that 0.1 or 0.25 percent copper sulfate could probably be included in the cherry fruit fly spray as a safeguard against cracking. How the copper functions was not determined but it is possible that it has a toughening effect on the skin. Because of the extreme toxicity of copper to plant tissue precaution must be taken not to exceed the concentration suggested above.

The possible relation of boron to cracking is indicated in reports from Oregon that soil applications of borax (30 lbs./acre) decreased cracking in cherries 25 to 30 percent and also improved foliage color. It is assumed that boron is effective by increasing the elasticity of cell membranes. However, cracking of cherries occurs frequently in Utah where no boron deficiencies have yet been observed.

Some attention has been given to the removal of water from the surface of the fruit following rains. Shaking water from leaves and fruit is suggested by various workers and the use of helicopters flown at tree-top heights to blow the water is reported.

From the long range viewpoint several writers point out that the breeding programs already under way may ultimately produce desirable cherries with lower susceptibilities to cracking.

General Conclusions

The evidence in general supports the contention that cracking is induced by the absorption of water directly through the skin of the fruit, that it increases in severity as the fruit approaches tree ripeness, and that it is affected by external climatic factors as well as by factors associated with the size, structure, and chemical composition of the fruit. Varieties differ considerably in their susceptibility to cracking but this does not appear to be correlated too well with morphological or chemical differences within the fruits. The swelling of fruit in water is regarded by most investigators as an osmotic phenomenon, though colloidal hydration may have a role in this. The varietal differences appear to depend in large part upon differences in one or more of the following characteristics: (a) permeability of skin, (b) capacity of skin to stretch, (c) toughness of skin. These skin characteristics are apparently altered in a favorable direction by the application of sprays containing calcium or copper and possibly by fertilization with borax. Losses from cracking can be minimized by harvesting immediately following a rain or by mechanically removing the rain water from the fruit.

**CANAL LININGS**

(Continued from page 7)

to concrete or other non-erosive materials.

Generally, fine-textured earth materials is less permeable (or more water tight) than coarse textured. Exceptions, however, are numerous and wide variation in permeability exists in materials of the same texture. It is essential, therefore, in selecting earth materials for lining, to make permeability measurements on the material. Most earth materials of medium texture or finer can be made reasonably water tight by compaction at optimum moisture. Unless the material has a low permeability, independent of its compaction, however, it will not be suitable for lining canals and reservoirs since frost action and wetting and drying cause expansion and contraction. The cracking that accompanied drying of an Oasis silt loam lining when the water elevation in the channel was lowered is shown in figure 8. The permeability of this material is low but the extensive cracking which accompanies drying seems to make it less satisfactory for lining than sandy loam bentonite mixtures which are nearly as water tight and less subject to cracking. Protective coverings, necessary to protect earth linings from erosion, will likewise minimize drying and in this way contribute to the effectiveness of the lining.

Rapid deterioration of soil-cement and oil treatments appears to be the chief objection to these types. Experimental studies designed to increase the durability of soil-cement, particularly, are continuing. It is possible that this material may be improved to a point where it can compete more favorably. Good concrete aggregate, however, is usually plentiful in Utah, making the
incentive to employ soil-cement less attractive than elsewhere. The term soil-cement refers to mixtures of soil and cement compacted at optimum moisture. Soil-cement mixed as a mortar is normally referred to as plastic soil-cement. The latter may be mixed and placed in the same manner as concrete, although a saving in cost can be effected by the use of a machine consisting of a loader and pugmill type mixer which picks up the aggregate from material windrowed on the bank of the canal. Standard soil-cement is more durable but since its installation necessitates compaction it presents a construction problem, because at present satisfactory equipment for compacting side slopes is not available.

Asphaltic Linings

The use of asphalt for lining canals is not new but its use has not been entirely satisfactory. This probably can be attributed: (1) to lack of information on the prerequisite properties of asphalt to be serviceable when employed as canal linings, and (2) to an attempt to employ construction practices used in other types of asphalt construction with but slight modification. Research in recent years has developed information that promises to provide an asphalt lining that will be competitive with concrete.

Numerous asphalt mixes have been used for lining canals. Most promising at this time is asphaltic concrete lining consisting of a sand-gravel aggregate and 50 to 60 penetration asphaltic cement mixed, placed, and compacted hot. A 2-inch asphalt hot-mix lining without soil stabilization has been installed by the Bureau of Reclamation at 79 percent of the cost of 2-inch Portland cement concrete and 87 percent of the cost of a 1 1/2-inch shotcrete lining.

Problems of Construction and Lining

Selection

Regardless of the type of lining selected, it is important to make a careful study of site conditions and delivery requirements. Frequently a saving can be made by relocating the canal. Likewise, it may be more economical to fill an old canal and re-excavate to provide the smaller cross section that will be required as a result of lining. At Richmond, Utah, the relocation of a canal section resulted in a reduction in the length to be lined from 2,233 to 1,732 feet or 22.4 percent. The cost of preparing the existing channel for lining would have been as great as the cost of relocation. The reduction in length, therefore, represents a net saving both in initial cost and in maintenance. The seepage loss in the old 2,233-foot section was 51 percent in late season. The lining installed in 1948 consisted of short sections of several types of lining material.

The type of lining selected for a canal should be governed by the size of the canal, subgrade conditions, the costs of materials, and the availability of equipment, skilled labor, supervisory personnel, and other factors. Where bentonite and other low-permeability earth materials are available in the immediate vicinity these should receive consideration. The chief justification of lining canals with earth materials is the low initial cost. Earth materials are better adapted to the lining of reservoirs. Where they are used for reservoirs the side slopes should be protected with an erosion-resistant covering through the vertical distance of the fluctuation in water surface-elevation.

In many cases, the major part of the water lost from a canal through seepage can be saved by lining small portions. Many irrigation companies divert water at the mouth of a canyon, and the canal from the point of diversion for some distance transverses a highly permeable gravely fan such as is shown in figure 9. It is here that water losses are commonly heaviest and largest saving will be effected by lining. A program of lining short sections of the canal each year will eventually get the job done, and where finances are limited, will prevent the necessity of incurring heavy indebtedness. It is important in initiating a canal-lining program to prepare detailed plans for lining the entire canal in advance to insure continuity and efficiency as the program progresses. The lining of canals and reservoirs represents a large capital investment and should be planned with care.

RIPE PEACHES PREFERRED

(Continued from page 5)

At Denver the peaches were sorted into the various maturities after arrival at the retail stores rather than at the shipping point.

Table 1. Retail sales of Colorado and Utah peaches related to maturity, 1948

<table>
<thead>
<tr>
<th>Maturity at time of shipment</th>
<th>Minneapolis 1st lot</th>
<th>Minneapolis 2nd lot</th>
<th>Des Moines 1st lot</th>
<th>Kansas City 1st lot</th>
<th>Kansas City 2nd lot</th>
<th>Denver* 1st lot</th>
<th>Denver* 2nd lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard</td>
<td>14</td>
<td>6</td>
<td>6</td>
<td>10</td>
<td>6</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Firm</td>
<td>40</td>
<td>37</td>
<td>20</td>
<td>50</td>
<td>94</td>
<td>26</td>
<td>13</td>
</tr>
<tr>
<td>Firm ripe</td>
<td>46</td>
<td>57</td>
<td>74</td>
<td>40</td>
<td></td>
<td>63</td>
<td>84</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

* At Denver the peaches were sorted into the various maturities after arrival at the retail stores rather than at the shipping point.
† There were no firm ripe peaches included in this shipment.
Utah Born Students Have More Decayed, Filled and Missing Teeth Than Out-of-State Students

Study Shows That Girls Have More Decayed Teeth and Eat Poorer Diets Than Boys

By ETHELWYN B. WILCOX, FAWN D. WALKER, and DELBERT A. GREENWOOD

STUDENTS born and raised in Utah have more decayed and filled teeth than their classmates from other states. This information was discovered in a study of the teeth of 794 freshman students of the Utah State Agricultural College in the fall of 1948. In this study, Utah men averaged 14.1 decayed, missing, and filled teeth; Utah women 17; while out-of-state men averaged 12.3 and out-of-state women averaged 15.3 decayed, missing, or filled teeth. Similar studies in Oregon showed 14 DMF teeth for both men and women. Other studies in Hagerstown, Maryland, San Francisco, and New York City showed 8 DMF teeth for both sexes. In the Utah study at all age levels the women had a higher incidence of DMF teeth than men.

Although large-scale studies in the United States show that dental decay occurs in 90 to 98 percent of the general population, studies among the same age groups of people living in different geographic areas have shown that the incidence of dental caries varies among them.

A number of factors have been found that influence the development and maintenance of good teeth. Among these are diet starting with the prenatal diet, the consumption of sweets or fermentable carbohydrates, oral hygiene, the use of fluorine, and inheritance. Current research work is broadening our knowledge of the relationship or inter-relationships of these factors to the prevention of dental caries.

A program of cooperative research between the Utah Agricultural Experiment Station and the dentists of the First District Dental Society has been started, to improve the dental health of the young people in Utah. This project is a part of a regional study on the nutritional status of population groups in selected areas of the west in which 11 western states are participating under the Regional Research and Marketing Act. As objective data on the conditions of the teeth of Utah young people were not available, a survey of the condition of the teeth of USAC freshmen was made in September, 1948, at the time of their regular physical examination, by 15 dentists of the First District Dental Society. Not all of the out-of-state freshman students were examined.

The number of decayed, missing, and filled (DMF) teeth and surfaces, the condition of the gums, and the presence of mottled enamel were charted. The source of the home water supply was checked so that the presence of fluorine in the water could be related to the condition of the teeth.

The food habits of 174 of these freshmen who were born and raised in Utah were studied to determine, if possible, any relationships between the condition of the teeth and the diet or food consumed.

In the interview with each student the previous day's diet including everything eaten between meals was listed. Then the number and size of servings per week of the foods eaten were listed to determine the food pattern of each student. The foods were grouped as follows: (1) milk, (2) eggs, (3) meat, fish, poultry, cheese, legumes, nuts and peanut butter, (4) citrus fruits, tomatoes, strawberries or cantaloupes, (5) green and yellow vegetables and fruits, (6) potatoes, (7) other vegetables and fruits, (8) butter or fortified margarine, and (9) cereals and bread. The intake of each food group was scored from 1 to 4 on a rating of poor to very good in terms of the average number of servings. The consumption of candy, gum, soft drinks, and cake, pie, and cookies was grouped separately.

Results

The condition of the teeth as measured by the average number of DMF teeth of 794 freshmen students is reported by specified age and sex groups in tables 1 and 2. Of the group of 425 freshmen who were born and raised in Utah 65 percent were from northern Utah, with 31 percent from Cache County, 12 percent from Box Elder County and 12 percent from Salt Lake County. The 18 year old men and women numbering 293 from this group had an average of 15 and 17 DMF teeth, respectively. The average for all ages of the Utah students was approximately the same as for the 18 year old group.

The Utah-Idaho group included freshmen who had lived part of their lives in each state. The DMF values for the 18 year olds were similar to those of the Utah group of students. A group of Idaho students had values that were slightly better with an average of 12 DMF teeth for men and 14 for women. Three students from Utah, five from Idaho, and one each of the foreign and out-of-state students had perfect teeth (no DMF teeth) exclusive of their third molars. Out-of-state students other than Idaho had values similar to the Idaho students. The few foreign students in the 18 year old group had a DMF value of 5.

In a comparison of the average number of unfilled cavities per student (table 3) the men ranked highest with an average of 4.2 as compared to 2.5 cavities for the women of the Utah group. The other groups had similar values. The women had higher DMF values but less cavities needing filling than the men which shows that the women were taking better care of their teeth at least after the cavities appeared.

The dental condition of the 174 students whose food habits were studied

---

ETHIELWYN B. WILCOX is professor of foods and nutrition. FAWN D. WALKER, student in nutrition, interviewed the students to find their food habits. DR. DELBERT A. GREENWOOD is professor of biochemistry. The dentists who donated their time in making the survey are Drs. Glen L. Allan, D. C. Gunnell, Clark Huskins, E. L. Larson, W. W. Merrill, H. J. Milligan, N. E. Marsh, D. O. Porter, C. C. Randall, and C. P. Smith of Logan, and Drs. Wynn Anderson, Bruce Harmon, and Mary Reeder of Brigham City.

for June, 1949
Table 1. Number of students in each age group by sex and home locality

<table>
<thead>
<tr>
<th>Freshman students</th>
<th>Age in years last birthday</th>
<th>All ages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Men</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utah</td>
<td>15</td>
<td>47</td>
</tr>
<tr>
<td>Idaho</td>
<td>6</td>
<td>33</td>
</tr>
<tr>
<td>Utah-Idaho</td>
<td>6</td>
<td>21</td>
</tr>
<tr>
<td>Foreign</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Out-of-state</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utah</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>Idaho</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>Utah-Idaho</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Foreign</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Out-of-state</td>
<td>9</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 2. Average number of DMF teeth per student

<table>
<thead>
<tr>
<th>Freshman students</th>
<th>Age in years last birthday</th>
<th>All ages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Men</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utah</td>
<td>11.6</td>
<td>14.7</td>
</tr>
<tr>
<td>Idaho</td>
<td>13.8</td>
<td>12.0</td>
</tr>
<tr>
<td>Utah-Idaho</td>
<td>11.2</td>
<td>14.6</td>
</tr>
<tr>
<td>Foreign</td>
<td>5.0</td>
<td>13.3</td>
</tr>
<tr>
<td>Out-of-state</td>
<td>11.2</td>
<td>11.7</td>
</tr>
<tr>
<td>All men</td>
<td>12.0</td>
<td>13.9</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utah</td>
<td>15.3</td>
<td>17.0</td>
</tr>
<tr>
<td>Idaho</td>
<td>13.8</td>
<td>14.4</td>
</tr>
<tr>
<td>Utah-Idaho</td>
<td>19.2</td>
<td>15.8</td>
</tr>
<tr>
<td>Foreign</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>Out-of-state</td>
<td>16.3</td>
<td>15.2</td>
</tr>
<tr>
<td>All women</td>
<td>15.4</td>
<td>16.4</td>
</tr>
</tbody>
</table>

Table 3. Average number of teeth with unfilled cavities

<table>
<thead>
<tr>
<th>Freshman students</th>
<th>Age in years last birthday</th>
<th>All ages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Men</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utah</td>
<td>3.5</td>
<td>4.2</td>
</tr>
<tr>
<td>All men</td>
<td>3.2</td>
<td>4.9</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utah</td>
<td>3.2</td>
<td>2.5</td>
</tr>
<tr>
<td>All women</td>
<td>2.6</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Table 4. Diet pattern of freshman students

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very good</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Good</td>
<td>53</td>
<td>23</td>
</tr>
<tr>
<td>Fair</td>
<td>40</td>
<td>64</td>
</tr>
<tr>
<td>Poor</td>
<td>2</td>
<td>14</td>
</tr>
</tbody>
</table>

was representative of the larger group of Utah-born and raised freshmen. The average number of DMF teeth for the boys was 14 and for the girls 17.

Although the average previous day's diet of the boys and girls who were interviewed for their nutritional histories was fairly good, many more boys ate breakfast regularly than girls (85 percent as compared to 54 for the girls). When the diet pattern was evaluated for each student more boys rated in the average to very good category than girls (table 4). Seventy-eight percent of the girls had poor or fair diets. The boys ate about twice as many eggs and used more milk and cereals or bread with slightly more meat. The two groups of students consumed approximately the same amounts of fruits and vegetables including potatoes.

The foods that were disliked so much that the students wouldn't eat them were checked. The vegetable mentioned most often as disliked was cooked cabbage, while liver was the most frequently mentioned kind of meat. Several other vegetables were mentioned at least once. Possibly better methods of preparation of cooked vegetables would increase their use.

The extent of the use of iodized salt was of interest since it has been known for many years that the soil in many areas in Utah is deficient in iodine. The use of iodized salt will correct this deficiency. The percentage of boys and girls indicating that they were not using iodized salt was 20 and 13 percent, respectively.

The consumption of candy or sweets and soft drinks was fairly high to high for approximately half of either the boys or girls with more of the boys in the high consumption group (table 5). There was also a slightly greater percentage of boys who seldom used candy and soft drinks. The use of relatively large amounts of sweets and soft drinks has been found by other workers to be detrimental to the teeth. Dental caries will increase because the pH of the saliva changes to the acid side following the consumption of sweets and soft drinks.

The need for better nutrition, which should start with the prenatal diet, is indicated by this study.

In this survey the numbers for certain groups were somewhat limited. Additional studies are in progress to increase the validity of the data.

UTAH AGRICULTURE
(Continued from page 1)

Dry-land wheat. This area has expanded during the past decade in response to favorable weather conditions, and also because of particularly favorable prices resulting from the need for bread grains for a warring nation and its allies.

Range Livestock

Production of range livestock utilizes the major part of the land area, but accounts for only 20 percent of the total number of farms. Cattle and sheep are grazed on both public and private lands, but are also dependent to a large extent upon the forage and grain produced on irrigated farms to provide winter feed and grain needed for fattening.

Trends in the numbers of range livestock have been variable. Sheep numbers have declined for more than a decade, and at present are less than one-half the total in the state in 1932. The total numbers of cattle in the state are now near a peak, but the numbers kept primarily for the production of meat are 50,000 less than they were in 1919. There has been a gradual shift in the
kind of livestock produced on farms and ranges in Utah. The number of dairy cows has increased almost in proportion to the increase in population, while the number of beef cattle has tended to decrease in competition with dairy cattle. Trends in beef and sheep numbers in the state are the same as those of the nation as a whole. Although much of the forage of the state is well adapted to the production of sheep, economical factors resulted in a shift during the past 10 years from range sheep to range cattle. The high cost of labor has adversely affected production of sheep, since it requires almost as much labor to care for a head of sheep as it does for a head of cattle, but the value per head of the cattle exceeds by many times the value of the sheep. The relative price of beef and mutton during the past decade has also been favorable for production of cattle rather than sheep.

Number of Farms

There has been no significant change since 1900 in the number of farms in Utah except for a small increase in part-time and subsistence farms. The number of farms in Utah in 1945 was essentially the same as in 1920. The period from 1920-40 in general was one of agricultural and industrial stagnation. There were no major irrigation projects developed, no new mines discovered, and no large new manufacturing concerns established in the state. Yet during this 20 year period the total population increased by one hundred thousand. The same number of jobs and the same basic resources in 1940 were being used to support 550,000 people as compared with 450,000 people 20 years earlier.

Utah has always had a problem of too many small farms. The average cropped area per farm in the state is now less than 40 acres. Twenty-one percent of the farms have less than 10 acres, with only 2 percent of the total cropped area. In the principal irrigated valleys of the state this problem is aggravated by the fact that many of the small farm units are made up of several non-contiguous parcels of land, with attending higher costs of operation.

Agricultural Income

At the present time, the income from agriculture is at an abnormally high level. (Farmers will no doubt look to the present era as "the golden era of agriculture.") The total gross income per farm in Utah is approximately $6,000, which, incidentally, is lower than that of neighboring states. This is compared with an average of less than $1,000 per farm during the mid-thirty depression years. The amount of income received from various sources in 1948 is shown in table 1.

Normally the income from livestock is approximately twice that from sale of crops. However, the livestock industry is based largely upon the crops produced on the farms. Consequently, the irrigable lands and not the range lands are the greatest source of income. During the past few years, the sale of poultry and poultry products has brought in more income than any other single source. This has been closely followed by dairy products and dairy animals, which are included in the table with cattle and calves, and from the sale of beef cattle. As late as 1943 the income from sale of sheep, wool, and mohair was the most important source of agricultural income in Utah, but during the

Table 1. Source and amount of agricultural income, Utah, 1948

<table>
<thead>
<tr>
<th>Source</th>
<th>Million dollars</th>
<th>Percent of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle and calves (includes dairy animals)</td>
<td>30</td>
<td>19</td>
</tr>
<tr>
<td>Poultry and poultry products</td>
<td>28</td>
<td>18</td>
</tr>
<tr>
<td>Dairy products</td>
<td>22</td>
<td>14</td>
</tr>
<tr>
<td>Sheep and wool</td>
<td>18</td>
<td>11</td>
</tr>
<tr>
<td>Other livestock</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Government payments</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>All crops</td>
<td>32</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>159</td>
<td>100</td>
</tr>
</tbody>
</table>

Fig. 2. Major agricultural use of land, 1948

for June, 1949
past five years this has declined until it now falls far behind the income from poultry, cattle, and dairy products.

Because of the large number of un-economic sized farms in Utah, many families have inadequate income to maintain an acceptable standard of living.

In the year 1944, 21 percent of the farms of the state had a gross income per farm of less than $699, and their proportion of the total agricultural income of the state was only 4 percent. In fact, 74 percent of the farmers received only 27 percent of the total income from all agricultural sources. Within the state there are some large farms and ranches. Forty-five percent of the total income was received by the 7½ percent of the farmers who had more than $10,000 gross income per farm. These figures reveal that a large proportion of the operating units that have been classified as farms by the census are altogether too small to provide an adequate income for the farm family even in the most prosperous times, and that the volume of business on the majority of farms in normal times is inadequate to maintain a high standard of living. It is essential that a great number of farmers have opportunity to employ themselves in non-farm activities for at least a part of the time.

The farm population has always produced a surplus of labor. The census of 1944 again showed that approximately half of the farm operators were working off the farm. The average amount of non-farm work for this group was 186 days per year. For many of them the farm was not the major source of family income. With the high birth rate in our rural areas, it is improbable that Utah will lack for a future supply of new farmers to replace those who would like to retire.

Since the outbreak of the war and the introduction of industrial and military establishments within the state, the population in rural areas has decreased. It was the lack of opportunity of employment that led to the backing up of surplus population in rural areas during the 30's in Utah, as well as the nation. The only economic hope for a large part of the population of our rural areas lies in developing opportunities for them in industry, trade, and services rather than employment on the farms.

During the past few years the economic position of farmers in Utah has been better than at any other time in our history. However, all types of farm-ers have not benefited equally during this abnormal time. Wheat farmers, beef, and turkey producers have been particularly favored during this period. Farm income, both gross and net, in 1948 was at record high levels. This was primarily the result of favorable price relationship for agricultural products as compared with the things for which farmers expend their money, and to a lesser extent from increased productivity of land and livestock. Prices today, although lower than they were a year ago, are still favorable for all-out production for most agriculture products; but the warning signals are present for such crops as potatoes, wheat, fruits, vegetables, and eggs.

Farm Debt
Farm debt has been decreasing since 1930 and in 1948 was markedly reduced from that during the depression period. During the latter part of the 30's the total amount of farm mortgage debt was reduced through foreclosures because of farmers' inability to meet their obligations. Since 1940, the debt has been reduced even further through the application of increased earnings to the payment of principle. During the past two years, there has been a change in the trend, and farm mortgage debt has begun to increase in the state. This is serious for individuals who are just beginning to farm, and are buying land and working capital with borrowed money at greatly inflated prices. It is natural in times like this for optimism to run high, but it is quite probable that a changed economic position will cause great distress to individuals who have obligated themselves during these times with long-term debts that must be repaid with products selling at much lower prices. Many individual farmers are confused as to the reason for their much improved economic condition. They think that it is largely a result of their own ability as managers, but the primary cause has been a change in the price level. A return to normal relationships of prices will create distress for those who have taken on extravagant habits and have not adopted efficient production practices.

Increased Farm Productivity
Productivity per acre, per animal, and per man has consistently increased over the years. For the nation, a 35 percent larger physical volume of production was obtained from our farms than the prewar volume. Statistics are not available to indicate to what extent the production in Utah was greater than prewar, but it likely was not greatly different from the national average. This increased production from our lands and livestock is a result of the application of better knowledge and methods of farming. There are hardly any varieties of crops or breeds of animals that have not been materially improved through past research. New weedicides, insecticides, and the use of fertilizers have contributed to the expanded volume of production for the same area of land.

Mechanizing Agriculture
Since the first world war there has been a marked improvement in the amount and quality of equipment used on the farms of the nation. The application of labor-saving devices to the farms has made it possible for 25 percent fewer farm workers to produce sufficient food and fiber to maintain an increased population of 35 percent; or in other words, a larger proportion of the working population of the nation has become free to engage in the production of goods and services that make for a higher standard of living for all our population. The physical volume of production per man employed on the
farm has approximately doubled in the last 30 years.

This increased mechanization of agriculture will increase the handicaps of many farmers in Utah. Many small operating units consisting of non-contiguous parcels of land do not lend themselves well to the uses of modern, efficient machine methods of production. Yet farmers of Utah must sell their products in competition with the mechanized areas of the midwest, and other commercial producing areas where it has been economical to use modern machines. This is one of Utah’s serious agricultural problems. Our small farms will be put to greater and greater disadvantage as mechanization of agriculture runs its course. This will be particularly important to the producers of field crops where it is easier to adapt production practices to machine methods and will, to a much lesser extent, affect the producers of livestock.

Mechanization is particularly important to agriculture, for it is closely correlated to the productivity per capita. The economic well-being and the high standard of living of the people of this nation is based fundamentally on their efficiency of production and this has been increased largely by the substitution of mechanical energy for human and animal muscles. It would now require 290,000,000 workers to produce the present volume of goods and services if they had to be produced by methods used in 1860. At that time, 14 percent of all energy used in production was supplied by humans, 79 percent by animals, and 7 percent by mechanical energy. At the present time only 3 percent of the total energy comes from human muscles, 3 percent from animals, and 94 percent from mechanical energy. This mechanization of production has increased productivity and has led to shorter hours for workers and higher standards of living for all of the people in the United States.

Dr. Howard B. Peterson, associate professor of agronomy at Utah State Agricultural College, has been granted leave of absence until July 1, 1950, to work with the Division of Soil Management and Irrigation of the B.P.S.A.E. on a special survey of the needs for phosphate fertilizers in the Western States. Rex Hurst has been appointed instructor in agronomy during the absence of Dr. Peterson. Mr. Hurst will conduct research on the effect of fertilizers on the yield and quality of celery.

CONTROLLING OR ERADICATING WEEDS

Controlling weeds is not just one problem, but an extensive and complicated series of problems. All weeds cannot be solved by any one simple method any more than all human diseases can be controlled by one simple prescription. It is the persistent and timely application of appropriate methods that results in effective and economical weed control.

Methods of control must be modified for different situations. Control of weeds in small areas may justify a more expensive method than in larger areas. Weed control on tillable land may utilize methods that could not be used on non-tillable.

Serious weed problems are often a result of faulty farming practices. Until such practices are corrected, the maximum benefit from any methods of control cannot be realized. Many annual, biennial, and some perennial weeds can be eradicated easily by making more effective use of rotation methods, giving more consideration to weed control in preparing the seedbed, and utilizing the simple, yet important, principle that weeds are most effectively and economically controlled while they are in the seedling stage. Tillage is still the most universal and effective method of weed control. The difficulty is that this method has not been used to the greatest advantage.

Rotation is valuable in weed control. Wild oats, black mustard, and similar weeds are generally a result of continuous grain crops. Rotating crops is one of the most effective and the least expensive aids in the control of annual and biennial weeds.

Weedy fields of alfalfa are usually the result of either poor stands at the start or wilt or other factors that have thinned the stands allowing weeds to enter. Such fields should be plowed and planted to another crop as part of a systematic rotation.

Rotation grazing, the avoidance of grazing, more liberal use of fertilizer, light frequent irrigations, scattering manure dropings, and an improvement of the more effective use of crop rotations; giving materially in weed control in pastures. Weedy pastures are definite evidence of improper management. Wherever possible, the pasture lease should work with the section in the natural pasture system, since the weeds that are prevalent in pastures seldom cause serious difficulty in row crops.

Seedbed preparation can be made an effective means of retarding creeping perennials and eliminating many annual and biennial weeds. On land infested with creeping perennial weeds, such as morning-glory, whitetop, Canada thistle, it is important to make plowing a part of the seedbed operations. Following plowing, the soil should be worked into a firm seedbed and planted immediately. The soil should be kept moist, so that the crop will germinate quickly and make rapid growth.

For annual weeds on fall-plowed land, and especially where small-seeded crops are to be grown, the soil should be worked in the spring as shallow as possible. This will leave a firm moist seedbed which is essential for rapid germination and emergence. For those crops that require early planting, seeding should follow immediately without delay. If, for some reason, the seeding is delayed a few days, the land should be harrowed with a spike tooth harrow, with the teeth flat, just before planting.

AARON FRANCIS BRACKEN

(Continued from page 4)

ning consultant for the National Resources Board, doing agricultural planning for Utah. Because of the excellence of his work he was advanced in rank and responsibilities, becoming successively assistant professor of agronomy, associate professor, extension agronomist, and professor of agronomy.

Professor Bracken attained a worldwide reputation as an authority on crop production in arid regions. In 1946, the government of Syria requested that he assist them in improving agriculture in that country and in developing an agricultural research program. After a year and a half in Syria, he returned to Logan in the fall of 1948 with an illness from which he did not recover.

Among the professional and honorary societies to which he belonged are the American Society of Agronomy, American Association for the Advance- ment of Science, Utah Academy of Sciences, Arts and Letters, Utah Educational Association, American Association of University Professors, the honor research society of the Sigma Xi, and the honor scholastic society of Phi Kappa Phi. He was president of the western division of the American Society of Agronomy in 1931-32 and one of the most enthusiastic supporters of this branch of the society.

Aaron Bracken married LaVerne Miller, October 28, 1917. He is survived by his wife and three daughters, Mrs. Thora Ward of Ithaca, New York; Mrs. Donnell Balls of Salt Lake City, and Mrs. Alice Peterson of Logan.

R. J. EVANS

Rex Nielson has been appointed research assistant in agronomy at Utah State Agricultural College. He will assist with seed certification work and field tests with fertilizers and crop varieties.

POISONOUS PLANTS


This report, illustrated in color, lists the 17 plants that cause most of the livestock losses in Utah. It is especially valuable to livestock men as an aid to identifying these plants on the range. The publication also contains a table listing the plants, their characteristics, their poisonous properties, and their effects on livestock.

Because of the high cost of color printing, a charge of 50 cents will be made for this report.

f or June, 1949

19
Arsenic Persistence on Plants Worked by Bees

By G. F. Knowlton and T. C. Yao

During the severe yellow-striped armyworm outbreak that occurred in agricultural areas in Utah during 1946, roadside sweetclover and alfalfa were dusted while in blossom with liberal to excessive amounts of calcium arsenate. Alfalfa and other crops were also treated. This caused heavy death of both field worker and hive bees in a number of nearby bee yards, particularly in Cache County. Much of the death of hive bees, in particular, resulted from bees gathering the calcium arsenate with pollen and taking it to the hives. Chemical analyses showed a high arsenic contamination in both hive pollen and the dead bees.

To determine the length of time that plant blossoms remained dangerous to bees, experimental dustings with calcium arsenate were made on white sweetclover and other plants during 1947 and again in 1948.

A light dusting with calcium arsenate, applied on July 24, 1947, deposited an average of 744 parts per million of arsenic trioxide equivalent (dry weight basis) on white sweetclover blossoms. By July 31 the arsenic present on blossoms had dropped to 72 parts; to 12 parts by August 5, and to but 1.3 parts on August 22. Arsenic residue on leaves of these same plants decreased more slowly. Doubtless contamination of new blossoms had occurred from the wind blowing such new growth blossoms against arsenic-contaminated leaves and stems of adjacent plants.

Sweetclover was dusted more liberally with calcium arsenate on July 7, 1948. These plants showed 1,728 parts per million of arsenic on blossoms following the dust application. This amount had dropped to 550 parts on July 10, to 74 parts on July 17, and total arsenic had returned to about the normal level found on nearby untreated blossoms, at 3.09 parts, by August 7. White sweetclover leaves from the same dust application, upon chemical analysis, showed 4,442 parts per million of arsenic trioxide equivalent on July 7.

Arsenic washed from the surface of 3 inch by 3 inch oiled heavy paper cards, which had been tied to white sweetclover plants before the calcium arsenate dust was applied on July 7, 1948, showed 1,076 to 3,500 micrograms of arsenic per card.

Plant blossoms and leaves dusted with calcium arsenate may have an adhering coat of arsenic totaling from several hundred to a few thousand parts per million of plant blossom and leaf. This arsenic dust residue is dangerous to honey bees working the plants, and to hive bees in colonies where arsenic-contaminated pollen is stored. Such surface arsenic may drop to about 10 percent of the original (maximum) amount within one week, but the blossoms may still possess enough arsenic to be a definite risk to bees for at least two to four weeks. Alfalfa, sweetclover, or other heavily dusted crop plants need a substantial period of weathering before they can be safely worked by bees, and before they would afford safe feed for livestock. Application of poisonous dusts to plants being worked by bees results in adult bee death losses. Such losses should be carefully avoided.

Fig. 1. Arsenic levels before and following calcium arsenate dust applications to white sweetclover

August 7 the arsenic had decreased to 36.25 parts. By August 14 it was down to 12.5 parts.

Similarly dusted spearmint blossoms, including entire axillary spikes, which showed 449 parts of arsenic on July 7, had dropped to 54 parts on July 24. Dusted spearmint leaves, which at first had 1,300 to 2,100 parts, showed no important decrease in arsenic until July 31, at which time 38 parts were still present. By August 7, samples showed 4.5 to 12 parts per million of arsenic, with 4 parts on August 14.

Arsenic (Nepeta cataria) blossoms, including entire axillary cymes, dusted on July 24, 1947, contained 2,923.5 parts per million of arsenic trioxide equivalent. This contamination had dropped to 291 parts by July 31, and practically to normal, 3.23 parts by August 5. Dusted catnip leaves, which showed 1,591 parts per million contamination July 24, were down to 92 parts on July 31, and approximately to normal of 6 parts per million on August 14.

Arsenic washed from the surface of 3 inch by 3 inch oiled heavy paper cards, which had been tied to white sweetclover plants before the calcium arsenate dust was applied on July 7, 1948, showed 1,076 to 3,500 micrograms of arsenic per card.

*DR G. F. KNOWLTON is professor of entomology. MR. YAO was a graduate fellow in entomology while working toward his master of science degree. He is now a research assistant in chemistry. Research on adult bee losses has been conducted in cooperation with the U. S. Bureau of Entomology and Plant Quarantine.*

---

**IN THIS ISSUE**

Trends in Utah agriculture, by D. A. Broadbent... 1
New seed cleaning laboratory.............................. 2
Should range heifers be bred as yearlings, by J. A. Bennett, L. A. Stoddart, and L. E. Harris ......... 3
Regional cooperative research............................. 4
Aaron Francis Bracken....................................... 4
Ripe peaches preferred by consumers, by E. W. Lamborn.... 5
Lining of canals and reservoirs saves land as well as water, by C. W. Lauritzen and O. W. Israelson... 6
2,4-D reduces yields of sweet corn and potatoes, by D. C. Tingey.................. 8
Carp as a protein supplement, by W. F. Sigler.............. 10
Cracking of cherry fruit, by F. B. Wann................... 12
Utah born students have more decayed, filled, and missing teeth than out-of-state students, by E. B. Wilcox, F. D. Walker, and D. A. Greenwood .................... 15
Arsenic persistence on plants worked by bees, by G. F. Knowlton and T. C. Yao 20