2,4-D for Weed Control in Utah

For Broad-Leafed Plants in Lawns and for Small Inaccessible Areas, 2,4-D Very Effective, for Control of Creeping Perennials Such as Morning-Glory, Whitetop, and Canada Thistle Cropping and Clean Cultivation Superior

By D. C. Tingey and R. J. Evans

D. C. Tingey, associate professor of agronomy, has done research on weed control for some years. During the war Professor Tingey worked on problems connected with the production of guayule for the U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering. Dr. R. J. Evans has been head of the Department of Agronomy since 1930. He retires as head July 1, but will continue his research work.

In June 1944, two government workers investigating solvents for growth promoting chemicals discovered that a high concentration of one of these now known as 2,4-D was effective in killing tomato plants. Soon after this, one of the men sprayed 2,4-D on morning-glory and reported that it killed the tops and also penetrated into the roots.

In 1940 in England, two research men investigating the effects of spraying growth-promoting substances on cereals, noticed that one substance normally used to induce rooting on plant cuttings killed some of the annual weeds but did not kill the cereals growing in the pots. A search was initiated to find more active compounds. By the end of 1942, two new materials, 2-methyl 4-chloro-phenoxy-acetic acid and 2,4-di-chloro-phenoxy-acetic acid had been selected as most promising. The latter is the one now commonly used in weed control in this country.

Results of these early tests were so promising, considering the small amount of material used and its relatively low cost, that they stimulated intensive search for more active materials. The Special Projects Division, Chemical Warfare Service at Camp Detrich, Maryland, prepared and tested in comparison with 2,4-D over a thousand compounds.

Immediately following these early experiments on 2,4-D, all sorts of magazines carried articles on this new "wonder weed killer," as it was frequently called. In 1945 a considerable number of commercial 2,4-D materials appeared on the market. The advertising for some of these products has been overly exaggerated. A recent report stated that 2,4-D chemicals, even in these comparatively few years, have developed into a $45,000,000 industry in the United States, a million of which was spent in Utah.

Use of 2,4-D for the control of dandelion and other broad-leafed plants in lawns has given good results and on many other weeds 2,4-D has worked wonders. However, on creeping perennials like morning-glory, white-top, Canada thistle, the results have not been so favorable. Even on some of the more sensitive creeping per-
SCHOOL OF FOREST, RANGE, AND WILDLIFE MANAGEMENT

The School of Forest, Range, and Wildlife Management deals with the management of Utah's vast acreage of upland or "wild" lands. It is composed of three instructional departments, forest management, range management, and wildlife management. Each department offers a four year program for undergraduate students in addition to graduate study. Each has a research program, the forest and range work being a part of the Agricultural Experiment Station and the wildlife work a part of the Wildlife Research Unit, financed from the State Fish and Game Commission and federal wildlife agencies.

The Forest Management Department deals with such problems as timber harvesting and milling, utilization of wood products, and watershed protection. Current research deals with methods of using and preserving aspen and lodgepole pine for fenceposts, a part of a large western-states cooperative project. The department also operates a large tree nursery at Logan in cooperation with the federal government to supply farmers with low-cost trees for windbreaks and woodlots. There is also available through the Extension Service, forestry advisory service for Utah's farmers.

The Wildlife Management Department through its cooperative research unit is currently studying such interesting and important problems as maintaining pheasant populations, methods of bringing back the antelope to Utah's deserts, life history and management of mule deer, improving wild fur animal yields, especially the muskrat, and studies on how to improve waterfowl hunting in the state. In addition, many fish studies have been conducted in Utah to improve trout yields from lakes and streams.

The Range Management Department has conducted research on the range problems of Utah for many years. In addition, members of the staff have published a book, Range management, which is used throughout the country as a classroom textbook. Current research work deals with the following important problem: A large nutrition project cooperative with the Animal Husbandry Department and Swift and Company is under way for the study of range sheep grazing problems. All important forage plants are being analyzed chemically, the sheep diet is being determined, and effect of various supplements on sheep production is to be studied. Another project deals with methods, species, and costs of seeding range lands and submarginal farm lands to grass. The effect of grazing these plants at different seasons and intensities upon forage yield is the subject of another intensive study. The Department also cooperates with the Animal Husbandry Department in studying grazing and breeding of beef cattle on mountain ranges in northern Utah. A large project of great importance to Utah ranchers has been started the past year in cooperation with the State Fish and Game Commission and certain federal agencies. This project is a statewide study of big game-livestock-range problems. Its aim is to measure competition between game and domestic livestock to discover methods of avoiding range damage so as to maintain high production of both livestock and game animals.

Research Staff—School of Forest, Range, and Wildlife Management, from top to bottom:

Dr. Lewis M. Turner, is dean of the School of Forest, Range, and Wildlife Management. Formerly employed in watershed management research by the U. S. Forest Service, he is well acquainted with wild land research.

Dr. Laurence A. Stoddart is head of the Range Management Department. He is author of many research bulletins over the past 12 years and with Professor Smith is author of the textbook, "Range management."

Arthur D. Smith has been associated with the Range Management Department for many years as a teacher and is now employed by the College and State Fish and Game Department as head of the state phases of a large cooperative study with the federal government on range-livestock and big-game problems.

C. Wayne Cook, formerly in charge of Range Management at the Branch Agricultural College, is now teaching and doing research with the Agricultural Experiment Station at Logan. He has charge of experiments in range sheep nutrition and range seeding.

Jessop B. Low is leader of the Cooperative Wildlife Research Unit located on the campus. Low is the author of many papers on wildlife studies and is devoting full time to research in this field.

Dr. Dwight W. Bensend is professor of wood utilization and forest management and is currently conducting research on preservation treatment of Utah-grown woods for use as fenceposts.
PRODUCITIVE SOILS need organic matter to furnish nutrients for growing plants and to help maintain a granular structure which aids in aeration, water absorption, and resistance to erosion. Organic matter may be maintained or replenished in soil by returning residues of crops to the soil, by the addition of farm manure, or by growing green manure crops and working them into the soil. The maintenance of highly productive soils requires that crop residues and farm manure be utilized to the maximum. In many instances these two sources of organic matter may not be adequate and then green manure crops should be grown.

Green manure crops may accomplish two important functions. They furnish a supply of organic matter, and if legumes, they may add available nitrogen to the soil for the use of later crops. In addition, green manure crops may serve as a protective soil covering to prevent erosion. Even a moderate stand of weeds or other plants has been found to hold the soil in place on steep slopes during heavy rain storms while severe washing of soil has occurred in adjacent clean cultivated lands.

A crop grown for soil improvement requires seed, seedbed preparation, usually needs irrigation, must be worked into the soil, and occupies the land during part of the growing season. This added labor, cost of seeding, and the possible loss of part of the cropping year must be considered in determining whether it is profitable to produce such crops. At the present time benefit payments administered through the Production and Marketing Administration can be obtained to cover part of the seed costs. In order to be practical, however, green manure crops must be produced with a minimum of labor and without reducing the annual cash income from the land. Furthermore, if a soil management program supplies ample organic matter to maintain soil productivity green manure crops are not needed.

Green manure crops are not generally recommended if:
1. Alfalfa, clover, or pasture is grown on the land one-third or more of the cropping years.
2. The farm is a general or livestock type in which five or more tons of manure is available each year for each acre of land in intertilled crops.
3. The supply of irrigation water is insufficient to support a green manure crop in addition to the regular crop.
4. The farm is a dry land wheat type and the green manure crops would deplete moisture supplies. Dry land soils are becoming low in organic matter and nitrogen, however, and whenever possible practices must be developed to encourage the production of soil building legumes.

Green manure crops are recommended for general use for:
1. Farms devoted principally to fruit production.
2. Farms devoted principally to the production of cash crops such as vegetables.
3. Farms with limited livestock and relatively long rotations where the supply of farm manure is limited and intertilled crops are grown three or more years between soil building crops.
4. Land recently developed and with considerable subsoil exposed.

Among the desirable characteristics of green manure crops the following should receive special consideration:
1. The seed should be low in cost because the crop brings no direct cash income.
2. The crop should be easy to establish on even relatively poor soils and without special practices in culture.
3. The crop should make a rapid growth and produce a good supply of organic matter.
4. The crop should be a legume if other characteristics are suitable because legumes are able to use nitrogen from the air and thus supplement the available supply in the soil.
5. The crop should fit well into a rotation system without removing land from the production of crops providing direct income.

Suggested Crops for Green Manure

Alfalfa: Alfalfa is an excellent soil builder under general farm conditions. It is commonly grown for hay in a rotation, but as such is not classed as a green manure crop. During hay harvesting, however, about one-fifth of the total crop is left on the land as stubble, leaves.

The article on the use of commercial fertilizers in Utah in the March issue brought requests for a similar article on green manure crops. The authors have complied with this article. Dr. Thorne becomes head of the Agronomy Department July 1. Dr. Peterson becomes associate professor on the same date.

for June 1947
AMERICAN FARM BUREAU FEDERATION SUPPORTS INCREASED FEDERAL FUNDS FOR RESEARCH

Appearing before the House Appropriations Subcommittee on Agricultural Appropriations, Edward A. O'Neal, president of the American Farm Bureau Federation, expressed the views of the federation on the value of research and the other services of the land grant colleges to continued agricultural prosperity. Land-grant-colleges, experiment stations, and state extension services, he said, have proved, both during peace and during war, to be most efficient and effective agencies to assist farmers in solving agricultural problems.

Members of the Farm Bureau realize that the size of our national debt and the resulting tax burden demands the cooperation of all groups in eliminating duplication, overlapping, and unnecessary expenses in government operations. They also realize that reductions must be made in the appropriations of the Department of Agriculture as well as in other divisions of the government, said O'Neal. Carrying out the mandate of the delegates at the February meeting of the Federation the Board of Directors adopted a resolution asking for a total reduction of 20 percent in administrative expenditures of the government including the Department of Agriculture, except for agricultural research and for federal grants-in-aid to states for the extension service, the experiment stations, and the land grant colleges.

Speaking further on the value of agricultural research, O'Neal stressed that in the past research has added greatly to the national wealth. With high costs and the threat of burdensome surpluses looming ahead, farmers need more research to enable them to meet successfully increased competition at home and abroad, and to maintain an equitable balance with labor and industry. Better methods of production and soil use, new crops, improved varieties, improved breeds of livestock, and new and expanded uses for agricultural products must be developed. There has never been a time when the practical problems of demand, supply, prices, consumption, standardization, transportation, packaging, and wholesale distribution of individual commodities were so pressing and when facts on distribution are so badly needed. Since the cost of distribution of certain commodities now equals or exceeds the cost of production, there is obviously need for improved distribution practices, argued O'Neal.

O'Neal pleaded for the appropriation of funds under the Flannagan-Hope bill, enacted by the last Congress, and which called for an appropriation of 19 million dollars to conduct research. "It would be false economy to disallow these funds for research at this critical time... The bill was approved by overwhelming votes of both Houses of Congress. It would be a cruel mockery to deny help in the first year of this program, when Congress has just promised this help. Farmers are expecting Congress to provide the funds to carry out this program."

GREEN MANURE CROPS
(Continued from page 3)

etc. and this, together with root residues, builds up the organic and nitrogen supply of the soil. When alfalfa is left in less than three years, turning under the last crop will aid greatly in building up the soil. It is usually not advantageous to grow alfalfa for soil improvement only. The seed is expensive and the early growth is slow. Sweet clover is usually preferable to alfalfa as a green manure crop.

Alfalfa is used to some extent as a green manure crop in orchards, but its high water requirement and long growing season limit its usefulness under such conditions. It usually competes with trees for water and nutrients during the entire growing season. Competition for nutrients can be compensated for by leaving all top growth on the land as mulch and gradually working it into the soil. Because of the high water requirements, however, it has been found unadvisable to plant alfalfa in orchards growing on gravelly soils or other soils of low moisture-storing capacity.

(Continued on page 17)
FACTORS IN DEVELOPMENT OF GOOD TEETH

1. Studies in albino rats have indicated that susceptibility and resistance to tooth decay are inherited. Similar studies should be made on man.

2. Several environmental factors influence the development of good teeth, among which are an adequate intake of calcium, phosphorus, vitamins A, D, and C, protein, fat, and carbohydrate—in short, a well balanced diet. Recent evidence indicates that the controlled intake of fluoride compounds may play an important role in good tooth development. These constituents should be consumed in adequate amounts by mothers during pregnancy and lactation, and especially by children during the period of calcification of the teeth.

3. The intake of excessive amounts of readily fermentable carbohydrates (“sweets”) between meals tends to increase the incidence of tooth decay.

4. Good mouth hygiene and frequent visits to a competent dentist will help keep teeth sound.

Bacteria and enzymes in the mouth convert fermentable carbohydrates (“sweets”) in the mouth or tooth surface into acid in a very short time (1-10 minutes) The equipment shown here is used to measure the acid or alkali on the tooth surface or cavity (Picture courtesy Dr. Blayney and Stephan, Zoller Memorial Dental clinic, University of Chicago)

DENTAL CARIES (decayed teeth) represent one of the most common defects of mankind. It has been estimated that caries affect about 90 percent of the population of the civilized world.

The purpose of this article is to review briefly some of the factors which appear to influence the development of good teeth.

Teeth are composed of four tissues, namely: enamel, dentin and cementum, which are highly calcified, and dental pulp which is uncalcified and surrounded by dentin. The enamel covers the dentin in the crown of the tooth. It is the hardest substance in the body. The cementum contains about 30 percent organic matter or carbon compounds. It covers the dentin in the root of the tooth which is contained in the supporting structures called periodontal tissues.

Several explanations have been advanced to account for dental caries but no one is accepted universally.

Studies conducted at Michigan State College by Hunt, Hoppert, and Erwin have led these investigators to conclude that there is an inheritance factor in the development of dental caries in albino rats. They have produced a caries-susceptible and a caries-resistant strain of rats by selection, progeny testing, and close inbreeding for several generations. Both strains of rats were raised in the same environment and fed the same basal ration. These results on rats do not prove anything regarding the influence of heredity in human caries. Such studies should, however, stimulate investigators to determine the possible role of heredity in human caries. Steggerda and Hill determined the incidence of caries in persons of Dutch descent living at Holland, Michigan; Maya Indians, Navajo Indians and Negroes from Jamaica. Their studies indicated that there might be hereditary racial differences in susceptibility to caries.

Many environmental factors are involved in the formation of good teeth, some of which are an adequate intake of calcium, phosphorus, vitamins A, C, and D, protein, fat, and carbohydrate—in short, a well-balanced diet. Other possible factors, favorable and unfavorable, are the intake of flourine compounds, regular cleansing of the mouth and teeth, and excessive consumption of readily fermentable carbohydrates (“sweets”) between meals.

In order to insure the proper development of teeth in an offspring, the diet of the mother and the child should contain adequate amounts of carbon, oxygen, nitrogen, magnesium, and possibly other elements such as fluorine during pregnancy, lactation, childhood, and adult life. According to Schour and associates, the formation and calcification of the deciduous teeth of a baby begin during the fifth month of pregnancy and significant development occurs before birth.

Of the elements found in teeth, calcium and phosphorus are present in the highest concentrations. These elements occur in the form of calcium phosphate. Carbon, hydrogen, and oxygen occur as carbohydrates, fats, and certain vitamins. Proteins, which contain nitrogen in addition to carbon, hydrogen and oxygen, are required for proper tooth development.

The degree of calcification of the teeth depends on the relative, as well as the absolute, amounts of calcium and phosphorous in the diet, and on the concentration of vitamin D or exposure to ultraviolet radiations. In man the calcification of teeth occurs essentially during the first eight years.

The presence of A-vitamins or beta-carotene (found in carrots and in other yellow and green leafy vegetables and which the body converts to A-vitamins) is also essential in the diet for proper tooth development. Dietary deficiency of this vitamin during the calcification process results in defective enamel and dentin. Whole milk is one good natural
THERE IS more land in the West suitable for irrigation than there is water with which to irrigate it. The best information available shows the disposition of water diverted from streams and reservoirs for irrigation to be about as follows:
(1) One-third utilized by plants in the production of crops.
(2) One-third lost through deep percolation and runoff.
(3) One-third lost through seepage in conveyance from river to farms.

Seepage losses from canals may be largely eliminated through lining the canals. Recognizing the seriousness of seepage losses, and a need for information on methods and materials for lining canals, the Soil Conservation Service and the Utah Agricultural Experiment Station recently intensified their investigation of water conveyance problems.

To facilitate a phase of this work which might be classed, in part, as the model testing of canal linings, an outdoor laboratory was constructed in 1945 on the Logan River near the mouth of Logan Canyon, one mile east of the Utah State Agricultural College (fig. 1). The plan of the laboratory, showing locations of structures with respect to each other, to the irrigation canal from which water is diverted, and the river to which the stream is returned, is shown in figure 2. The principal feature of the laboratory is the four channels simulating irrigation canals. The channels have bed widths of 3 feet, side slopes of 2 horizontal to 1 vertical, top widths of 9 feet and lengths of 160 feet. Each channel is divided into eight sections, and each section is provided with independent underdrainage facilities to collect and measure seepage losses. The channel stream is continuous, making it necessary to operate each canal as a unit. In cross section the experimental channels consist of a trapezoidal concrete seepage intercepting basin, in the center of which is a 2-inch perforated pipe, as shown in figure 3. Resting on the concrete, and over the pipe, is an 8-inch mat of washed and graded gravel. This gravel mat serves as a support for the canal linings and as a highly-permeable medium for conveying the seepage water to the perforated pipe and thence to the outlets where it can be collected and measured. Typical outlet ends of the seepage water conveyance pipes in the manholes are shown in figure 4. The channels are level and the velocity of the stream was only 1/2 cubic foot per second, just sufficient to eliminate dead water. The mean velocity of the stream was only 1/2 foot per second. Figure 5 shows channels A and B. Channel A, on the right, is in opera-

---

**Table 1. Composition and permeability of experimental linings**

<table>
<thead>
<tr>
<th>Lin-ing no.</th>
<th>Material</th>
<th>Specific weight (lbs. per cu. ft.)</th>
<th>Proctor from cylinders</th>
<th>Thickness of lining (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Oasis silt loam—uncompacted*</td>
<td>101</td>
<td>.19</td>
<td>.70</td>
</tr>
<tr>
<td>2A</td>
<td>Trenton sandy loam 100 parts</td>
<td>101</td>
<td>.33</td>
<td>.08</td>
</tr>
<tr>
<td></td>
<td>Bentonite</td>
<td>101</td>
<td>.36</td>
<td>.10</td>
</tr>
<tr>
<td>3A</td>
<td>Trenton sandy loam 100 parts</td>
<td>101</td>
<td>.36</td>
<td>.07</td>
</tr>
<tr>
<td>4A</td>
<td>Mendon silt loam—salted</td>
<td>101</td>
<td>.31</td>
<td>.14</td>
</tr>
<tr>
<td>5A</td>
<td>Mendon silt loam</td>
<td>101</td>
<td>.31</td>
<td>.15</td>
</tr>
<tr>
<td>6A</td>
<td>Trenton sandy loam 100 parts</td>
<td>101</td>
<td>.30</td>
<td>.06</td>
</tr>
<tr>
<td>7A</td>
<td>Bentonite</td>
<td>101</td>
<td>.30</td>
<td>.06</td>
</tr>
<tr>
<td>8A</td>
<td>Oasis silt loam</td>
<td>101</td>
<td>.19</td>
<td>.12</td>
</tr>
</tbody>
</table>

* All linings except 1A were compacted at optimum moisture by means of a pneumatic tamper.
† Replacement lining.
‡ Insufficient flow to collect sample.

---

**IRRIGATION RESEARCH LABORATORY**
To Provide Information on Permeability and Permanence of Canal Linings
By C. W. LAURITZEN and O. W. ISRAELSEN

---

**Fig. 1. General view of irrigation research laboratory**

**Fig. 2. Plan of laboratory**

**Fig. 3. Cross section of experimental channels**
SUGGESTIONS ON CANAL LININGS

The investigation at the Irrigation Laboratory has not been in progress long enough to justify drawing general conclusions or making recommendations concerning materials or construction methods which should be employed in lining canals. The data, however, suggest that:

1. The effectiveness of clay linings may deteriorate rapidly if they are subject to intermittent drying.
2. Sandy loam bentonite mixtures seem to be preferable to clay for exposed canal linings because they are less subject to cracking upon drying.
3. Earth linings should be protected by a layer of natural earth material, gravel, loose rock, or other material to reduce freezing and drying and to prevent erosion and eventual destruction of the lining. The side slopes are most subject to erosion, particularly above the low-water level.
4. Compaction at optimum moisture does not reduce the permeability of sandy loam bentonite mixtures or the equilibrium permeability of certain soils over that of moderate packing in the air dry state.
5. Materials for lining should therefore be restricted to those materials which assume a low equilibrium permeability, irrespective of compaction, as insurance against increased permeability with use which might be expected to develop where the low permeability of a material is dependent primarily on its initial state of compaction.

Preliminary Results

Experimental canal linings have been installed in channel A and material placed for a similar set in channel B. The linings were shaped with a screed and tamper. Some difficulty was encountered with washouts of certain linings notably linings 1A, 4A, 5A, and 8A, which occurred immediately following the time the water was first turned into the channel (table 1). The focal point of these washouts appeared to be shrinkage cracks which had developed during the interval between the time of construction and the time the water was placed in the channel. The outlets were capped for 24 hours in order to avoid similar failures, and to permit testing of the linings without the necessity of making major repairs, or replacing the linings with provisions for maintaining the moisture through the construction period to eliminate cracking. This gave the lining materials an opportunity to swell, closing the cracks, or to settle. It is significant that the bentonite mixture did not develop shrinkage cracks during this initial period. Some small shrinkage cracks, however, did develop upon partial drying following a period of use. Lining 3A has failed periodically since its installation, and was removed September 13, 1946, and replaced with a lining of the same composition. Two parts of bentonite in 100 parts of Trenton sandy loam appear to be too little to stabilize the sandy loam. Also, the permeability for this lining, as presented in table 1, is rather high. All linings, except 6A, have eroded to some extent at the water line from wave action. This erosion is in the form of undercutting, characteristic of all earth canals and responsible for the shape which earth canals take, regardless of the original cross section.

The specific weight of the linings in channel A is somewhat less than the specific weight of these materials when compacted at optimum moisture.

The permeability of the various linings varied widely, as might be expected. It is notable, however, that the permeability of linings initially high tends to remain high or increase, and those linings initially low remain low or decrease. The uncompacted Oasis silt loam and oil treatments are the exception. The Oasis soil, like some bentonites, appears to be one of those materials in which the permeability gradually decreases for the uncompacted material until the equilibrium value is of the same order as that for material initially compacted. The permeability, as seen from table 1, is very different. The Trenton soil is very sandy and highly permeable. The addition of

(Continued on page 12)
VEGETABLE CROPS, grown for market and for seed are subject to many parasitic diseases caused by viruses, bacteria, fungi, and certain seed plants. Because of the uncertainty of their development, and the suddenness of their unheralded appearance, diseases often cause heavy loss before they are discovered or before measures can be taken to check their progress. The presence or absence of disease frequently determines the difference between loss and profit in the production of a crop.

Planning a cultural program to prevent disease requires forethought, care, and thoroughness at every step, as well as a comprehensive knowledge of the diseases to be controlled. Such items as the selection and treatment of the seed, the selection and preparation of the soil for the seedbed and for the field, the treatment of any nearby unkempt waste areas, and the methods to be employed in growing, harvesting, and marketing the crop, must be considered. The relative importance of any one of these items will naturally depend upon the crop and the nature of the disease to be controlled. The wisdom of taking measures for the prevention of diseases rather than waiting until they appear and then trying to control them cannot be over-emphasized.

There are many disease-producing organisms that are disseminated by wind, by irrigation water, on the clothes and implements of workers, by insects, and by animals. Others are indigenous in the soil or can establish themselves very readily when introduced. All these organisms are dangerous and can be controlled only by the use of special measures such as sanitation, crop rotation, sprays, dusts, or soil treatments. Important as these procedures are, however, the use of clean, non-infested seed is imperative in the production of a profitable crop.

Clean seed may be obtained by producing it in fields free of disease and sometimes by treating it for the elimination of contaminating pathogens. Seed-borne pathogens are of two types, namely, those on the surface, and those within the seed. Surface-borne pathogens are usually eliminated by surface disinfection. Surface disinfectants, however, are not effective against pathogens borne within the seed. These require the use of special treatments, such as hot water or certain organic penetrants as alcohol or acetic acid.

Seed that has been produced in areas free from seed-borne disease will usually produce a cleaner and better crop than treated seed from infected sources, because the treatments cannot be relied upon to destroy all the organisms within the seed. This fact has been recognized for some time, and has been the reason for locating seed-producing industries in rather small areas. The seed industry has been and still is on the alert to find areas in which vegetable seed crops can be grown free of seed-borne diseases. Considerable attention has been given in recent years to the Intermountain Region as a seed-producing area.

The Intermountain Climate as a Factor Limiting Disease

Within the confines of the Intermountain Region are some of the driest areas of the North American continent. Precipitation ranges from 3 to 60 inches per year with the valley floors receiving the least and the mountain tops most.

The Intermountain Region is divided into two rather distinct climatological zones. The southern zone includes most of New Mexico, Arizona, and southeastern California, and the northern zone extends from the boundary between Arizona and Utah to the Canadian border. The Great Salt Lake basin and the Columbia River plateau are within the confines of the northern zone.

The northern zone lies in the region of prevailing westerly winds, and its climatic characteristics are influenced greatly by the cyclonic storms which sweep in from the west. Temperatures are extremely variable and the growing season, being shorter than in the southern zone, ranges from about 60 to 190
days. The maximum precipitation comes during the winter and early spring months. The mean precipitation ranges from 4 inches in the desert valleys west of the Great Salt Lake to over 60 inches in some of the northern mountains.

Because of the extremely rough and variable topography, a great variety of climatic conditions exists in the Intermountain Region. The tillable areas are broken up by mountain ranges and salt-laden valleys. Many combinations of temperature and humidity occur. Excellent isolation for seed production is afforded in many of the higher valleys.

The extreme temperatures and the generally arid climate of the Intermountain Region are detrimental to the survival of many important disease-producing pathogens. Pathogenic organisms that depend upon heavy rains and winds for dissemination and upon high humidity of sufficient duration for infection to occur, are seldom seen. Many serious soil-borne organisms, likewise, do not occur because of the extremes in winter and summer soil temperatures or because of the high calcium content or other characteristics of mountain valley soils. Soil-borne diseases are, however, generally more numerous than aerially disseminated fungus and bacterial diseases.

Virus diseases, on the other hand, are not so sensitive to climate and are among the most destructive diseases in the West.

Seed Production in the Intermountain West

Seed of certain vegetable crops has been grown in the West for many years, either because the region is free of some of the serious seed-borne diseases, or because it is otherwise well adapted to seed production.

The bean seed industry of the northern intermountain zone, developed principally because of the absence of anthracnose and the rare occurrence of common bacterial blight. Hale blight occurs more often than the common blight but not frequently enough to cause much trouble. Unless July is unusually wet and cold the disease will not develop. While all types of beans do not grow equally well in the mountain valleys, seed houses have tried to grow practically every commercial type at one time or another. Practically all of the standard varieties of beans are grown for seed in the southeastern part of the state because of the absence of anthrocnose and the rare occurrence of bacterial blight.
IN CONSEQUENCE of losing an expansionist war, Japan has been stripped of her hard-won overseas empire and is confronted with the gigantic task of reconstructing her economy, her social and political structure, and her educational system. Foremost among her post-war problems is to find the means of supporting a population of more than 80,000,000 people living in a total land area of less than 150,000 square miles, 75 to 80 percent of which is not suited for farming and which is relatively poor in many important natural resources.

At the present time perhaps not over 16 percent of the total land area of Japan is under cultivation. The population density in Japan exceeds 500 per square mile of total land area, or more than 3,000 per square mile of cultivated land area. From the standpoint of population per unit area of cultivated land, Japan has the highest population pressure in the world.

Despite the fact that Japan has a population more than one-half that of the United States and less than one-twentieth as much cultivated land, she has been able to produce, from native sources, 80 to 85 percent of her total domestic food requirements, as well as significant quantities of non-food crops for export. Such an achievement is more astounding in view of the generally low fertility of her soils.

Characteristics of Japanese Agriculture

Agriculture is the most important single industry in Japan. Approximately 50 percent of her national capital is invested in agriculture, and more than 40 percent of her population is directly engaged in farming as a livelihood. The 15,000,000 acres of land under cultivation is divided into approximately 5,600,000 individual farms. The average sized farm is about two and one-half acres, but more than two-thirds of the farms are smaller. Moreover, Japanese farms usually do not exist as compact units of land, but consist of several tiny isolated fields, one-fourth acre or smaller in size, scattered about the community.

Agriculture in Japan is gardening rather than farming as we know it. Production per unit area of land is surprisingly high, but production per man is very low. Yields of rice, wheat, and barley average 73, 28, and 46 bushels per acre, respectively. It usually requires one hundred man days per acre to produce a rice crop and 85 to produce a crop of wheat or barley. Most of the work is done by hand with primitive tools, since most of the fields are too small for effective use of horse-drawn implements. Many fields are made to produce two or more crops per year, a practice which enlarges the effective area under cultivation by as much as one-third. Intercropping of such diverse crops as mulberries, cereals, and soybeans is widely practiced in non-paddy fields to increase the total productivity of the land. Japanese farmers are skilled in getting the most from their land.

Rice, wheat, barley, naked barley, sweet potatoes, and Irish potatoes account for 85 to 90 percent of the home-grown food supply of the Japanese people. Rice dominates the agricultural economy, occupying about 53 percent of the total cultivated area. About 96 percent is grown in paddy, or irrigated fields. Wheat and barley are usually grown as winter crops, alternating with rice in paddy fields. These two crops occupy about 25 percent of the total cultivated area. Sweet potatoes are widely grown as far north as Sendaï, whereas Irish potatoes are grown most extensively in the northern prefectures. Because of serious spoilage problems the sweet potato crop is usually consumed immediately after harvest. The Irish potato has only recently come into general use as a staple food crop. The efficiency of potato production is very low.

The most important source of cash income for the Japanese farmer is silk. Most of the work in rearing silkworms is done by the women. During the summer months the entire house is largely given over to the rearing of silkworms, and all members of the household concentrate on their care. Many farm girls find employment in the modern silk mills in the cities.

Tea production is important in the upland areas of certain localities south of Tokyo. In the southern prefectures an extensive citrus industry flourished prior to the war, but much of the citrus acreage has since been converted to the production of staple food crops. In northern Japan a thriving apple industry has been developed largely from American varieties. Production of various fruits which do well has been curtailed during the war to provide more land for staple food crops.

The livestock industry is of minor importance in Japan, because the production of livestock products requires from four to six acres to produce as many calories as can be produced from one acre of cereals. Consequently, the Japanese depend on fish and plant sources for most of their proteins. The Japanese government is encouraging the increased production of rabbits and chickens to supplement the protein supply.

Tenancy and the Japanese Farmer

Farm tenancy and land reform constitute the most knotty agrarian problem confronting the Japanese people today. The underlying factors involved in the agrarian situation are so deeply rooted in Japanese history and tradition that it is extremely difficult for Americans to grasp fully and evaluate the problem. Everyone is agreed that agrarian reform is essential to Japan's reconstruction. Few can agree as to the exact measures to be taken.

(1) A typical agricultural village in Fukushima prefecture. Note compost heap to the left, communist electroneering unit in Tokyo, their energetic political activity, common no appeal to agrarian Japan. (2) Japanese farmers are hard-working, thrifty, stable, intelligent, they rest the democratic future of Japan. (3) Japanese farmers are hard-working, thrifty, stable, intelligent, they rest the democratic future of Japan. (4) Japanese farmers are hard-working, thrifty, stable, intelligent, they rest the democratic future of Japan. (5) American scientific consultants, I. Salmon and Dr. V. R. Boswell, U.S.D.A. extension station. Japanese are eager to learn in prefectural extension methods. (6) Japanese geisha farmers frequently sold their daughter indentured servant to pay their debts. (7) A potato farmer and in Hokkaido. (8) An apple orchard in prefecture. Note the method of training. (9) A cart loaded with liquid human fertilizer and the importance of most Japanese soils is so low that the quantities of fertilizers are essential to production. (10) Preparing paddy land for planting rice. (11) Paddy fields with the strip separating the paddy fields. (12) Planting rice is a backbreaking family affair.
Tenancy is prevalent in Japan. More than 70 percent of the farmers are tenants, or part tenants, less than one-third own the land which they till. Fifty-four percent of all paddy land and 37 percent of the non-irrigated upland are cultivated by non-owners.

The most conspicuous feature of the Japanese tenancy system is the extraordinarily high rentals and the continued feudal practice of payment in kind. Rents are paid chiefly in rice, regardless of the nature of the farming enterprise. Rents on double-crop paddy land are frequently as high as 50 to 60 percent of the total produced crop. A system of surcharges over and above the regular rent adds to
the financial burden of the farmers by as much as 10 to 25 percent in some districts. Special additional rents are levied even on the narrow strips of land dividing the paddy fields. The tenant must bear all costs of production, including costs of fertilizers. Fortunate is the tenant farmer who can keep for himself as much as one-third of the year's harvest. Debt-ridden, tax-burdened, hounded by ruthless government controls, undernourished, miserably housed, the wretchedness of the Japanese tenant farmer is difficult to imagine.

The Japanese agrarian problem involves not only the landless peasantry, but the land-owning class as well. Much of the difficulty arises from the fact that throughout the process of Japan's emergence as a modern industrial power, her agricultural economy has remained essentially feudalistic in character. The present system had its origin in the eighth and ninth centuries A.D., when a manorial system of land ownership appeared. It was not until the seventeenth century, however, that tenancy became so widespread as to constitute a problem. The feudalistic government of the Tokugawa Shoguns threw the financial burden of their government on the landholding feudal lords by extortionary taxation, which in turn reduced the entire peasant class to serfdom. The land reform of the Meiji government, while drastic in its revolutionary provisions, actually did not correct the basic situation. Rents continued high, 68 percent of the tenant's produce being considered a normal rate. The land tax of the period required 34 percent of the cash value of the produce. The result has been that only the large land owners have benefited. The position of small land owners and the tenant farmer has deteriorated steadily until the end of World War II.

Despite the miserable lot of the Japanese farmer and the hapless condition of the small land owners, these agrarian elements constitute our greatest hope for the establishment of a democratic, peaceful and friendly Japan. Throughout the centuries these classes have been forced by a semifeudal, harsh, and oppressive government to bear the entire financial burden of Japan's rapid industrialization and military expansion. These people have had enough. They are antagonistic towards their present government because of the heavy representation of elements associated with the pre-surrender government. They reject communism, because it is inimical with their aspirations. The Japanese farmer, though ignorant and often superstitious, is essentially a hard-working, thrifty, and stable individualist. His native common sense and integrity are adequate to fit him to be a good citizen in a democratic society.

For Japan to become a stable, friendly, and peaceful democracy, the agrarian population must be entrusted with governmental responsibility. The farmers must become politically wise and learn to look to themselves for leadership. The political and intellectual leaders of Japan must learn to have confidence in the political integrity of the agrarian classes, even as we had to do in our own country not more than a hundred years ago. Moreover, Americans must have faith in the destiny of a Japan founded on a newly libered agrarian population.

Progress has been made. The power of the military and semi-feudalistic vested interests has been destroyed under the efficient direction of General MacArthur and his staff. A democratic political structure has been established. The April elections enabled the Japanese people to elect their local governmental officials for the first time in history. A far-reaching land and tax reform program is being developed. The educational system has been completely revamped.

One additional measure should be undertaken, however, namely, an agricultural extension service on the American plan. No means exist for the effective instruction of the rural population in better living, better nutrition, better farming methods, or effective participation in democratic processes. Is it possible that we are missing the opportunity of a lifetime to plant democracy in the grass roots of a country whose future is our sole responsibility?

**IRRIGATION LABORATORY**

(Continued from page 7)

bentonite at the rate of 5 to 10 parts per 100, reduced the permeability sufficiently to place these mixtures in the class of materials well suited to the lining of canals. The mixture containing 10 parts of bentonite (7A), in fact, had the lowest permeability of any of the linings tested.

The Oasis soil was used for lining a 4000-foot section of the Delta Melville C-Canal in March 1941. The average permeability of the compacted soil at 5 stations immediately after lining was 0.12 feet per year. Subsequent measurements in 1944 resulted in an identical value for the permeability with that determined immediately following lining, indicating no measurable change in the permeability in 3½ years.

It is known that the presence of salts, and differences in the exchange ion on the clay complex, greatly influence the permeability of earth materials. The salt content of the percolate is being measured as an index to the changing permeability of the linings and disintegration which may occur accompanying use. There has been a tendency for the salt content of the percolate to decrease but no marked change has occurred to date.

During freezing weather there was a tendency for the linings to break up at the water line. Inspection on December 19, 1946, revealed a marked increase in the flow of percolate from 2A and it was found that the water was coming from a small hole which had developed in the lining near the water line. The ice on the channel at this time was strong enough to hold a man's weight. In view of these conditions, the water was turned out for the winter. The tests in channel A and B are being continued.
SYMPTOMS OF NUTRITIONAL DEFICIENCY DISEASES IN BEEF CATTLE

By LOUIS L. MADSEN

I N SOME CASES the symptoms of nutritional deficiency diseases in beef cattle are specific. It is, however, the more insidious mild deficiencies resulting in suboptimal performance that are most difficult to diagnose and are commonly the source of greatest economic loss. Such conditions as reduced appetite or growth, rough hair coat, and general unthriftiness are common to most states of malnutrition. Since nutritional deficiencies may range from very mild to severe, they may exist without gross functional or anatomical alterations. Acute symptoms, though frequently modified from laboratory cases by complication of unknown variables encountered in the field, are often dramatic and focus special attention on the problems.

Energy Intake: Lack of sufficient total feed is probably the most common deficiency in beef cattle. In limited feeding on farms or overstocked ranges, low energy intake may be the sole deficiency, the results being slowing or cessation of growth, loss of weight, failure in reproduction, and increased death loss. On ranges, low feed intake also commonly results in increased mortality from toxic plants and from lowered resistance to parasites and diseases. Underfeeding is often complicated by shortages of protein, phosphorus, vitamin A, and possibly other nutrients as well as a lack of sufficient energy.

Protein: Shortage of protein is the second most common deficiency in beef cattle. It results in poor growth, depressed appetite, lowered milk production, failure to breed regularly, and rapid loss of weight.

Salt (NaCl): Salt deficiency is manifested by intense craving for salt, lack of appetite, and unthriftiness appearance.

Phosphorus: Areas of phosphorus deficiency in cattle feeds are widespread throughout the world, particularly in semiarid regions, and are commonly associated with soils deficient in the element. Phosphorus content of plants generally decreases markedly with maturity; and this decrease, along with protein deficiency, commonly occurs when cattle must subsist for long periods on mature, dried grasses and herbs.

The earliest symptoms of phosphorus deficiency are decrease in blood phosphorus, in appetite, and in rate of gain. Milk production falls off and consequently weaning weights of calves are low. These effects are followed by an abnormal appetite, with specific craving for bones. Depraved appetite may lead to excessive salt ingestion, and, in the absence of bones, to the chewing of stones and wood, and the eating of dirt. Carcasses of dead animals, if found, may be consumed. The results may be a secondary disease, characterized by paralytic symptoms which is called loin disease in Texas. The trouble is caused by toxins produced by microorganisms of the botulins type ingested with the putrid flesh. Long continued phosphorus privation results in low percentage calf crop, poor condition, lameness, and stiffness of joints.

Calcium: In contrast with phosphorus, calcium deficiency in beef cattle is comparatively rare and mild; the symptoms are inconspicuous. When fattening calves are fed heavily on concentrates, with limited quantities of non-legume roughage, their calcium intake may be insufficient for optimum gain and bone development. Severe privation may so deplete the bones of calcium and phosphorus that fractures may occur. The addition of calcium to a deficient ration for fattening calves increased the rate of gain, improved feed utilization, resulted in heavier bones with higher ash content and greater breaking strength, and enhanced the market grade.

Iodine: Deficiency usually is manifested by the production of dead or weak calves. Occasional borderline cases may survive; in these, the moderate thyroid enlargement disappears in a few weeks.

Magnesium: Deficiency of magnesium may result from prolonged feeding on milk without grain or hay. The magnesium content of the blood plasma is lowered, and the animals usually die in convulsions. So-called grass tetany with decreased blood-serum magnesium has often been noted, but apparently is not primarily associated with magnesium deficiency in the forage. Naturally occurring deficiency of this kind has not been reported.

Iron: Uncomplicated iron deficiency has not been satisfactorily demonstrated under natural conditions; the usual complication is a shortage of cobalt or copper or both. A shortage of one or more of these minerals results in anemia.

Vitamin A: The first easily detected clinical symptom of vitamin-A deficiency is night blindness, readily observed when animals are driven about in twilight, or other dim illumination. Night blindness may be present even though the animals appear thrifty and are gaining at practically normal rates. When gross night blindness is evident, vitamin A in the blood is very low, and liver reserves approach exhaustion. As the deficiency progresses the hair coat becomes rough, dry and dusty, the appetite is poor, growth is slow or the animal loses weight. The next conspicuous symptoms usually developed are muscular incoordination, staggering gait, and convulsive seizures caused by elevation of the cerebrospinal fluid pressure. Excessive lacrimation (secretion of tears) is usually seen in cattle. Severe diarrhea in young calves and intermittent diarrhea at advanced stages of deficiency in adults are characteristic. In fattening cattle, generalized edema (swelling of the legs, brisket, and elsewhere) may occur. Degenerative changes in the kidney and degeneration of testicular germinal epithelium have also been demonstrated.

Estrum may continue when the deficiency has advanced to the point where convulsions are common. Deficiency in the pregnant animal results in abortion or birth at term of dead or weak calves.

Vitamin D: In calves, prolonged deficiency causes rickets similar to that which occurs in other young animals. Clinical symptoms are usually preceded by a decrease in either or both blood calcium and inorganic phosphorus. This is usually followed by poor appetite, decrease in growth rate or loss in weight, digestive disturbances, stiffness of gait, and occasional convulsions. Later, enlargement of the joints, slight arching of the back, bowing of the legs, and pain on walking are evident. Symptoms develop more slowly in older animals. Work with dairy cattle has shown that vitamin-D deficiency in the pregnant female may result in dead, weak, or deformed calves at birth.
The Last Chance to Save This Year's Peach and Apricot Crops from Ravages of Peach Twig Borer

By C. J. Sorensen

A good sprayer should be used with any of these materials.

Best control of the peach twig borer is obtained with a spray of lime-sulfur in the pink-bud stage. This destroys the partly grown borers in their winter chambers. If this spray is omitted, the next best treatment is a spray of standard lead arsenate immediately after all of the blossoms have fallen from the peach trees. When neither of these sprays has been applied, then the last chance spray should be applied as suggested above. Even though one of the first two sprays has been used, it is worthwhile insurance against wormy peaches and apricots to spray within a week after the first moths of the season make their appearance. Moth emergence can be accurately timed by collecting a few pupae from the trunks of peach trees, placing them in a wire screen cage, placing it in one of the trees in the orchard, and then observing the time of the appearance of the small brownish moths.

Life History Described

The peach twig borer lives through the winter as a partly grown larva or worm, hidden in a small chamber which it constructs for itself. This chamber is generally in the bark of twig crotches of one and two year-old wood. In early spring, these small, dark, reddish-brown larvae emerge from their overwintering chambers and begin feeding on the buds and twig terminals of peach, apricot, plum, and prune trees. Several buds may be destroyed by a single larva before it enters the terminal of a young twig where it completes its feeding. Feeding in the tips of twigs kills both the wood and leaves of the areas attacked. The dead greenish or brownish leaves become conspicuous on the twigs until they dry up and blow or fall off. Occasionally young leaves are also fed upon by these first larvae of the season. In this event, the leaves are webbed together by the worms thus concealing them while they feed within.

The feeding period of this overwintered brood of twig borers is generally completed by about May 15. They then seek seclusion in some crevice, pruning scar, or curled bit of bark on the trunk of the tree, and occasionally within a dead curled leaf. After a week or ten days, they transform into small grayish-brown moths which are seldom noticed unless specially searched for.

First moths of the season appear from about May 10 to 25, the time varying according to weather conditions. Within two or three days after their emergence, female moths lay eggs on the leaves, fruits, and occasionally on the twigs. Eggs hatch after about 10 days. Larvae hatching from these eggs first feed in the tips of young twigs. Later, they burrow into, and feed upon, the fruit until their larval growth is completed. They then leave the fruit and pupate in the same manner as already described for the overwintering brood of twig borers.

During their pupation, these worms transform into a second brood of moths which begins appearing about June 25 and continues to about July 15. Eggs are again laid and these hatch into larvae that do not feed in the twigs but immediately enter the fruit. After their feeding and pupation has been completed, a third brood of moths emerges during the period from about August 1 to 20.

These moths give rise to a third brood of larvae, some of which attack the fruit, but most of them immediately begin constructing their overwintering chambers, feeding meanwhile, on the inner bark of the twig crotch in which they construct their winter shelters.

Charles J. Sorensen is professor of entomology and specializes in insect pests of tree fruits, alfalfa, and cereal crops. He is best known for his work on lygus control in seed alfalfa.

Pupae, adult moth, and worm of the peach twig borer or peach worm (enlarged about five times)
Summary of Life History
The annual life cycle and activity periods of the peach twig borer may be briefly summarized as follows:

1. September 1 to April 10: Partly grown overwintering generation of larvae (worms) in hibernation chambers which they have constructed in twig crotches.
2. April 10 to May 15: Overwintered generation of larvae feed on buds, leaves, and in twig terminals.
3. May 1 to 25: In pupal stage, transformation from larval (worm) stage to adult moth.
5. May 15 to July 1: Feeding period of first-brood larvae. These worms are designated first-brood because they are the first to hatch from eggs which were laid during the current season and are thus differentiated from the overwintered brood of larvae which hatched from the last eggs laid during late summer of the preceding year.
6. June 20 to July 5: Period of pupation.
8. July 1 to August 1: Feeding period of second-brood larvae.
10. August 1 to 20: Emergence of third-brood moths and eggs.
11. August 10 to September 1: Feeding and preparation of winter quarters by third-brood larvae.

There is considerable overlapping in the time occupied by various life stages of this insect; therefore, the dates specified above are approximations of the average time rather than exact designations of it.

**Utah Federal-State Cooperative Brucellosis Program**

**Head of Veterinary Science Department Outlines New Program to Control Bang's Disease in State**

By WAYNE BINNS

UTAH adopted a new Federal-State Cooperative Brucellosis (Bang's disease) Program, April 15, 1947. This program consists of three phases, all voluntary. The livestockman may choose which ever phase he wishes and may change from one phase to another, depending upon the amount of infection present in his herd.

The first phase is an agreement for the control of Brucellosis by having all adult cattle tested and all infected animals branded with a hot iron, with the letter "B" on the left jaw and all calves vaccinated between 4 and 8 months of age. The infected animals may be retained in the herd as long as the owner desires, but when sold must be sold for slaughter.

The second phase is the test and slaughter method, with indemnity paid on all infected animals. This method was practiced several years ago. The livestockman must have all adult animals tested and all infected individuals removed from his herd at his own expense. Then he may sign phase 2, test and slaughter with indemnity, and receive $20.00 from each of the state and federal governments for grade cows, and $40.00 for registered animals if sold for slaughter within 15 days after branding. Indemnity will not be paid on steers and grade bulls, but only on grade cows, registered cows, and registered bulls.

The third phase of the program consists of testing all adult animals in the herd, branding all reactors with a hot iron with the letter "B" on the left jaw, and then vaccinating all negative adult animals and all calves with strain 19, Brucellosis vaccine. All animals vaccinated after 8 months of age must be branded with a hot iron with the letter "V" on the right jaw to indicate adult vaccination. The reactor animals may be retained in the herd as long as the owner desires, but when removed they must be sold for slaughter. This phase of the program is only recommended when there is heavy infection in the herd. Before this phase can be adopted, the dairymen must have the approval of the attending veterinarian, state veterinarian, and inspector in charge of the Bureau of Animal Industry. The necessary agreement forms may be obtained from any of these men or the Veterinary Science Department, U. S. A. C., Logan, Utah.

This program was drawn up by the Utah Veterinary Medical Association, the Utah Dairy Association, and the Utah State Department of Agriculture in an effort to formulate a Brucellosis disease program adaptable to every livestockman in the state and set up an organized fight against this costly disease of cattle.

When a livestockman enters this program, regardless of what phase he chooses to follow, the testing of the animals and vaccinating of the calves will be done without cost to the owner.

It has been estimated that the economic loss from Brucellosis in the United States in farm animals amounts to more than $60,000,000 annually and the disease is recognized as a major public health problem. The livestock industry and the veterinary profession should be conscious of the fact that the medical profession, the general public, and the health officials of the country are taking an increased interest in the subject of Brucellosis control from a human health standpoint, and if the disease is not controlled by livestockmen these agencies will set up rigid regulations for the protection of the general public.

The first step in control of Brucellosis in animals is the eradication of infected individuals.
Brucellosis vaccine, strain 19, recommended for calves between the ages of 4 and 8 months, is an important factor in Brucellosis eradication, but it has limitations. Information available indicates that systematic vaccination of adults will, in some herds, hold down the abortion rate, but its value where the disease has recently been introduced is less clear. It will not change the status of the cow already infected, or those exposed to the infection, but in those destined to contact the organisms months after vaccination, there is reason to believe that valuable, though by no means complete, protection is provided. Adult animals that overcome the vaccination reaction are more likely to be protected than calves showing a like recovery, but in adults the recovery is much less likely to occur. Vaccination of adult animals is practiced far more extensively than its proved advantages justify. It is used extensively as a substitute for effective sanitary measures, and more extensively than it would be if its known advantages and disadvantages were carefully explained in advance to the breeders contemplating its use.

The following is a statement from the Committee on Brucellosis of the U. S. Livestock Sanitary Association presented to cattle breeders contemplating the use of adult vaccination in their herds:

1. Animals vaccinated as adults, if they overcome the vaccination-reaction, acquire valuable protection. A high percentage, however, continue as persistent reactors. Some protection against actual abortion is provided even among those that continue to react.

2. There is no way of distinguishing between a vaccination-reaction and a reaction caused by exposure; hence, following vaccination of the adult herd, sanitary measures based on the agglutination test must be postponed indefinitely.

3. Raw milk from all reactors, vaccinated or not, represents a danger to man; hence board of health requirements and attitudes, as well as the safety of the individual farm family, are to be considered, prior to vaccination.

4. Failure to obtain beneficial results from the vaccination of adult animals frequently results from a lack of good sanitation and provision for the isolation of infected animals at the time of parturition. Intense exposure to infection can break down the acquired immunity.

5. Animals from reacting herds, vaccinated or not, sell at a disadvantage in their native states, and their interstate shipment is restricted or prevented altogether.

6. Vaccination of pregnant cows causes some abortions and the danger increases as pregnancy advances. Vaccination applied shortly before calving does not have time to produce actual abortion but uterine infection may take place.

7. Adult vaccination cannot be depended on to check the usual "abortion storm." It helps in some herds, it appears to help in others in which the storm has already spent its force, but it frequently fails completely.

8. Adult vaccination has a wider application in beef herds than in dairy herds, but the objections, except those relating to danger in milk consumption, apply to beef herds.

9. Eradication, or near eradication, of Brucellosis will be delayed or prevented altogether by the extensive and indiscriminate use of adult vaccination.

DEVELOPMENT OF GOOD TEETH

(Continued from page 5)

Vitamin C (ascorbic acid) is another constituent of the diet which is required for proper dental growth. Diets deficient in this vitamin during the period of tooth development lead to defective calcification of the dentin, accompanied by hemorrhagic and degenerative pulp tissue. In many cases the gingival tissue or gums is damaged. Fresh citrus and other fruits and many green and yellow vegetables are good sources of vitamin C.

The concentration of fluorine in the diet during the period of the calcification of the teeth is another factor which appears to influence their structure. Excessive amounts of fluorine (more than 1 part per million in drinking water) causes dental fluorosis. There are several classes of dental fluorosis ranging from teeth which are chalky white to brown stained, accompanied by pitting of surface areas.

On the other hand, the consumption of a drinking water containing one part per million of fluorine during the period of the calcification of the teeth causes a marked reduction in the number of carious teeth in man. The results of the studies conducted to date have been promising enough to stimulate three different groups of investigators to induce the residents of three different American cities, (Newburg, New York; Grand Rapids, Michigan; and Evanston, Illinois) to add one part per million of fluorine as sodium fluoride to their drinking water as a means of reducing the incidence of tooth decay. The exact mechanism by which fluorides aid in reducing caries is unknown. These are well-supervised and long-term projects which will yield information regarding the value of this procedure. Fluorine compounds are very poisonous and should be handled with great care by trained persons.

Good mouth hygiene is another factor which contributes to good teeth. It is important to keep the mouth and teeth clean.

Decayed teeth sometimes harbor disease-producing microorganisms which cause headaches, eye and ear troubles, heart disease, and abscesses of the stomach, kidneys, and other organs of the body. In order to reduce such health hazards, each individual should have his teeth inspected by a competent dentist at frequent intervals.

Defective teeth have been observed in children who have had diseases which produced high fever during the critical period of the calcification of the teeth.

One of the most widely accepted theories of tooth decay is that acid is largely responsible for initiating the carious process. Acids occur in certain drinks or they are produced by microorganisms during their utilization of certain foods, notably refined sugar. The acid first attacks the enamel and finally invades other parts of the tooth.

A number of studies have indicated that an excessive consumption of fermentable carbohydrate (sweets in the form of candy, gum, soft drinks, cough drops) increases the incidence of dental caries. This is particularly true if the carbohydrates are eaten frequently between meals.

Special equipment has been developed by Stephan and associates for measuring the acid produced on tooth surfaces and in cavities in man. The accompanying photograph shows a patient with equipment used in determining the acid or alkali present on tooth surfaces.

Stephan and associates have studied the effect of 10 percent sugar rinse (comparable to many soft drinks) on the production of acid on the surface of the
Comparisons have been made of the incidence of dental caries in England and in Norway before and during World War II. A significant reduction in caries incidence was reported in both countries. The English investigators, Mellanby and Coumoulos, attributed the reduction in tooth decay to the improved nutrition program which was adopted during the war. Increased allowances of milk, cod-liver oil, and fruit juices were made available to pregnant and nursing women and to children. Refined sugar was scarce.

In Norway the total caloric intake was reduced. The consumption of sugar, candy, and soft drinks was negligible. Tøverud, the Norwegian investigator, suggested that the reduction in refined carbohydrate intake was a probable cause of the decline in dental caries. He did not discuss the general nutritional status of the people. It will be interesting to follow the dental caries incidence in these two countries and others when normal peacetime food supplies become available to the common man.

SUGGESTED CULTURAL PRACTICES FOR GREEN MANURE CROPS

<table>
<thead>
<tr>
<th>Crop</th>
<th>Rate of seeding</th>
<th>Date of planting</th>
<th>Date for working into soil</th>
<th>Rotation practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>10-12</td>
<td>Early spring</td>
<td>Fall or spring</td>
<td>Cover and green manure in orchards, or turn last hay crop under to build up poor soils</td>
</tr>
<tr>
<td>Red clover</td>
<td>10-12</td>
<td>Early spring</td>
<td>To meet needs of next crop</td>
<td>Can be used for green manure and cover crop in orchards, or a crop turned under after use for hay or seed on general farms</td>
</tr>
<tr>
<td>Biennial sweet clover</td>
<td>10-12</td>
<td>Early spring or Aug. 1-Sept. 1</td>
<td>Fall or late spring</td>
<td>Plant with peas or small grains, or seed following harvest of early crop</td>
</tr>
<tr>
<td>Hubam sweet clover</td>
<td>10-12</td>
<td>Early spring or early summer</td>
<td>Late summer or fall</td>
<td>Plant early with peas or small grains, or in July following harvest of early crop</td>
</tr>
<tr>
<td>Hairy vetch</td>
<td>30-40</td>
<td>Aug. 1-Sept. 10 or in early spring with small grains</td>
<td>May 20 - July 1</td>
<td>Plant in orchard in late summer or early fall. Plant on general farm land in August following harvest of early or midseason crops. May be planted with a small grain, 15 pounds of vetch to one bushel of grain</td>
</tr>
<tr>
<td>Small grains</td>
<td>8 pecks</td>
<td>Early spring or fall</td>
<td>While still green</td>
<td>Used in orchards or between short season crops. Plant 3 bushel of oats per acre</td>
</tr>
<tr>
<td>Sudan grass</td>
<td>20-25</td>
<td>Early spring or summer</td>
<td>While still green</td>
<td>Planting date and date of turning under can be adapted to precede or to follow crops</td>
</tr>
<tr>
<td>Field peas</td>
<td>75-90</td>
<td>Early spring</td>
<td>Early summer</td>
<td>Useful in orchards, or turn under before planting late planted crops. May be planted mixed with small grain</td>
</tr>
</tbody>
</table>
Field Peas: Field peas have been used to a limited extent for green manures in central and southern Utah. The field pea is a legume and is rated about equal to hairy vetch in soil building properties. Peas may be planted in early spring and turned under by mid-June.

Small Grains: Small grains grow readily on a wide variety of soils and under most climatic conditions. Barley, rye, and winter wheat have been used in orchards on gravelly land. While small grains are not as desirable as legumes for soil improvement, the seeds are readily accessible at reasonable costs, and in orchards small grains are preferable to clean cultivation. A mixed planting of small grains and vetch or peas gives a large yield of organic matter and has a high value for soil improvement.

Sudan Grass: Among the non-legumes sudan grass has gained in favor as a quick-growing crop for green manuring. It can be planted following the harvest of an early growing crop and turned under after a good growth is obtained.

Weeds: A good growth of weeds adds to the organic matter supply of soils. In orchards weeds serve a useful function in protecting soil as well as adding organic matter. Where non-noxious weeds can be used for green manure without introducing other farm problems, beneficial results can be anticipated.

DISEASES OF VEGETABLE SEED

(Continued from page 9)

dry beans and most of the snap beans can be successfully grown, however, somewhere in the region.

In order for peas to be grown successfully the seed must be free of three destructive diseases, namely, (1) ascochyta blight, (2) bacterial blight, and (3) anthracnose. These diseases either do not occur or, at least, are seldom seen in the Intermountain Region.

Cabbage seed production became an important industry in the Skagit Valley of northwestern Washington many years ago, because the climate was such that seed could be produced free of black rot and blackleg.

Most of the onion seed grown in the United States is produced in the arid West. The dry climate favors pollination, facilitates the harvesting and curing of the seed, and prevents the development of mildew. Utah has been important in onion seed production and has contributed one of the best strains of yellow Sweet Spanish on the market.

Celery seed production is extensive in California and the southern zone of the Intermountain Region. The fields are free of two important seed-borne diseases of celery, late blight and phoma root rot.

In recent years a sugar beet seed industry has developed in the region. The production of curly-top-resistant varieties of sugar beets, and the discovery that sugar beet seed of high quality could be produced without pulling and replanting the roots have made possible the development of this enterprise in the central zone, the southern part of the northern zone, and in the Northwest. Sugar beet seed of high quality has been produced experimentally in many of the higher valleys of the northern zone. The demand for resistant seed, however, has not been great enough to encourage the expansion of the industry in those valleys.

Until recently California produced nearly all the nation's supply of lettuce seed, but at present, large quantities also are being grown in Arizona and Idaho, more as a result of climatic adaptability than to facilitate disease control. Lettuce seed produced in those areas, however, is relatively free from Septoria leaf spot.

The bulk of the carrot seed grown in this country was produced in California until 1930, when production began in Idaho. By 1943 nearly 2000 acres were devoted to this crop in the Gem state. The development of the carrot seed industry in the West, as with lettuce, was a result of climatic adaptability rather than a need for disease control. However, two seed-borne diseases, Cercospora leaf blight and Alternaria leaf blight are not found on western produced seed.
crop plants. Seed of the table beet, for example, cannot be produced in the region because of the disease, and only resistant varieties of sugar beets can be grown.

Curly-top is a factor in the production of bean seed in the Snake River and Palouse countries. In years when the disease assumes serious proportions only resistant varieties of beans can be produced. The U. S. Department of Agriculture and several western state experiment stations are attempting to introduce curly-top resistance into acceptable strains of dry and snap beans.

Aster yellows, another virus disease, frequently becomes destructive in lettuce and carrot plantings. It has already become a limiting factor in the production of carrot and lettuce seed in some parts of California and Idaho. As the cultivation of these crops becomes more intensive, the destruction from this disease is expected to become more severe unless successful control measures are developed.

The mosaic viruses are important in the production of bean and lettuce seed. The common mosaic virus of each of these crops is transmitted through the seed. A breeding program is under way for the purpose of developing both dry and snap bean types resistant to the common bean mosaic virus. No breeding work is under way in the West on the lettuce mosaic. Virus diseases are common on celery, cucurbits, crucifers, tomato, and sugar beet. Whenever they are present, they lower vegetative vigor and reduce yields. They are a menace not only to the seed crop but also to the crop produced from the seed. The mosaic virus of cucurbits is controlled in the Skagit Valley of Washington by isolating the seedbeds. Control measures for virus diseases of other crops are the subject of extensive investigations.

As the seed production research program of the U. S. Department of Agriculture and the western state experiment stations progresses, valuable information on the cultural practices designed to reduce costs of production and increase yields of the major seed crops, will be obtained. It is hoped that this will make possible the establishment of a permanent source of clean seed of those vegetables in which seed-borne diseases are important. With few exceptions, under approved cultural practices, a well-filled, highly viable, non-infested seed of most of the vegetable crops can be produced in the arid Intermountain West.

2,4-D FOR WEED CONTROL

(Continued from page 1)

The first application appears better than it really is. The tops are killed but not the roots, except those at or near the surface. In pot tests in the greenhouse at the Utah Station not a single treatment has killed morning-glory roots down 4 inches, even though relatively large amounts of material have been used.

Whether repeated applications will eventually eradicate sensitive creeping perennials remains to be determined. Some workers have failed to eradicate morning-glory with 2,4-D in three years with repeated applications. The number of applications necessary will likely make the cost of 2,4-D as high as some other weed control methods now in use.

The general opinion of research workers at the Western States Weed Control Conference in Portland, Oregon, in February 1947, was that 2,4-D for the eradication of creeping perennials had been greatly over-rated. Weed control problems are too complex to expect any one chemical to be a cure-all. It is important to determine under what condition 2,4-D can be used to advantage in weed control and at the same time recognize its limitations.

Some experimental plots were treated in Utah in the fall of 1945 with different kinds of 2,4-D and at different rates. It was obvious from the results that 2,4-D was not effective in the eradication of whitetop, poverty weed, alkali mallow, and morning-glory. Repeated applications made in 1946 on these same areas were even less encouraging. Furthermore, additional experiments were started in 1946 and to date the results are no more promising than those made in 1945.

Recommendations for the Use of 2,4-D

Recommendations for the use of 2,4-D in weed control in Utah are based on reports for 1946-47 for the North Central and Western States Weed Control Conferences, published reports by research workers, and results of experiments conducted at the Utah Agricultural Experiment Station. While the recommendations are based on the latest information available, it should be understood that because of the newness of 2,4-D in weed control some of them may be revised as more experimental data become available.

Conditions Where 2,4-D Has Possibilities in Weed Control

1. 2,4-D is recommended for the control of broad-leaved weeds in lawns especially dandelion, plantain and some others, but not crabgrass and mouse ear chickweed. Caution should be exercised in using 2,4-D on bent grasses, as some strains are susceptible to 2,4-D and injury may result. Repeated applications of 2,4-D will be necessary to control dandelions in lawns unless better lawn management practices are adopted. The cutter bar on the mower should be raised as high as possible, the grass not clipped too often and the clippings left on the lawn, the lawn fertilized and irrigated thoroughly rather than given a daily light sprinkling.

2. For the control of susceptible and moderately resistant creeping perennials that occur in small patches in pastures or to control susceptible broad-leaved annuals and perennials where legumes are not an important part of the pasture mixture. Legumes are largely susceptible to 2,4-D.

3. To control susceptible annuals either alone or growing in resistant crops. Crop rotation will control annual weeds in small grains and if practiced 2,4-D will not be necessary.

4. For the control and possible eradication of broad-leaved weeds, including susceptible and creeping perennials and many woody plants, on ditch banks, fence lines, right-of-ways and other places inaccessible to cultivation.

5. For the prevention of seed production in susceptible annual and perennial plants growing in resistant crops.

6. For weed control in grass fields grown for seed production. Work in Oregon indicates spraying is safe in spring or before the grass gets out of the "boot" but should not be sprayed after the grass has headed.

On tillable land, 2,4-D is not recommended at the present time to replace the methods developed at the Utah Station, which involve a combination of crops and cultivation and are discussed in mimeographed series 328, 1946. The belief that 2,4-D can be used to control perennial weeds in resistant crops, small grains, and grasses is based on observations and not on actual crop yields.

In the spring of 1946 some experimental plantings of wheat, oats, barley, and grass were made near Logan on morning-glory infested land. The land
was plowed prior to planting the crop. Later in the season some plots were treated with 2,4-D to control morning-glory. The treatments were made after the grains had headed as the regrowth of morning-glory was too light to be treated before this time. When the grain ripened it was harvested and the yields were determined on both the plots sprayed with 2,4-D and on the untreated plots. The non-treated plots, even though morning-glory was present in the grain, yielded as high as the plots treated with 2,4-D which killed the tops of the morning-glory.

The 2,4-D treatments were made by hand and care was exercised to avoid tramping down the grain. Had mechanical methods been used other than the airplane, some damage to the grain would have resulted in applying 2,4-D.

When Should 2,4-D Be Applied?

In general, weeds are more susceptible to 2,4-D when they are young. Many annuals are very susceptible when young and become resistant as they get older. Dandelion and other broad-leaved plants in lawns are susceptible to 2,4-D throughout the growing period. There are some differences of opinion among research workers on when to apply 2,4-D on creeping perennials to get the most satisfactory control. In the spring of 1946 some experimental plots on whitetop were marked off near Logan to receive various 2,4-D treatments at various times during the season. Treatments were made at four stages of growth, early bud, bloom, early seed, and fall rosette. The last treatment was made on October 26. While the percentage kill was not high for any of the treatments the stage of growth did not appear to be an important factor. Experiments on morning-glory treated with 2,4-D in the pre-bud, the bud, and

Morning-glory weed plots before spraying the early bloom stages showed no appreciable differences in percentage of plants killed.

Spraying Weeds in Resistant Crops

Small grains, grasses, corn and sorghums are considered more resistant to 2,4-D than many weeds. However, any of these crops may be injured if an overdose of the chemical is applied. For spraying in most crops, it is recommended that not more than one pound of active ingredient per acre be used. On some susceptible weeds one-half pound per acre is enough. In applying 2,4-D to corn and sorghums, the spray should be kept low near the surface of the soil to avoid getting 2,4-D on the growing tips of the plants. In spraying small grains, reports indicate there is less injury to the crop by delaying the application until after the seedling stage, but applying before jointing or after the milk stage of growth. Some reports have indicated that 2,4-D has prevented the development of brace roots on corn and later in the season lodging resulted. This condition did not occur in experiments conducted at the Utah Station in 1946. Corn on morning-glory infested land sprayed with 2,4-D at the rate of one and two pounds per acre yielded about the same as where the weeds were kept out by hoeing. In these experiments, the spray was kept low during the application to avoid getting it on the growing tips.

Unless an individual has had some previous experience with 2,4-D in weed control in resistant crops it is not advisable to attempt a large scale spraying program. Cost of materials and application, and possible injury to the crop may more than offset the benefit received.

Kinds of 2,4-D

The 2,4-D chemical appears in various forms such as liquids, powders, pastes, and pills, and these materials may be prepared for spraying by dissolving in water. The mixture can be applied with any kind of a sprayer. In addition to the different forms in which the chemical appears, there are different kinds of 2,4-D chemicals namely, acid, ammonium, sodium, and amine salts and esters. These appear on the market under a great variety of trade names. When compared on an equivalent basis of active acid, they all appear to give about the same results. However, some materials are much cheaper than others. It is rather odd that in Utah the 2,4-D used most extensively is the one that is most expensive. In fact, it is 3 or 4 times more expensive than some others. Individuals not familiar with 2,4-D materials might not be expected to be good buyers of these chemicals, but there is no excuse for counties purchasing the most expensive 2,4-D chemicals for the county weed control program. One 2,4-D material may have only 9.6 percent active ingredients and another 40 percent, and both sell for the same price on a gallon basis. The latter costs only a fourth as much as the former.

For most conditions 1 gallon of water is sufficient to cover a square rod or 160 gallons per acre when the liquid is applied with ordinary spray equipment. In preparing the spray, mix the appropriate amount of 2,4-D with the water. In spraying merely wet the vegetation. Excess water will only run off the plants and result in waste.