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The success of a cooperative effort, by W. Thorne ........................................ 90

Utah's population, by T. R. Black ................................................................. 92

The demand for Christmas trees, by F. W. Kearns ...................................... 94

Uinta alfalfa, by M. W. Pedersen and D. R. McAllister ................................. 97

Techniques in breeding improved wheatgrass,
   by D. R. Dewey ................................................................................. 98

Stem pitting affects apple trees in Utah, by B. N. Wadley ......................... 100

Phosphorus intake depends on taste, by G. E. Stoddard
   and C. H. Mickelsen ......................................................................... 103

Milk bases and their value, by R. A. Christensen ........................................ 104

Research reports ....................................................................................... 113

Vol. 22, No. 4  December 1961

UTAH STATE UNIVERSITY • LOGAN • AGRICULTURAL EXPERIMENT STATION
During the coming year we shall celebrate the hundredth anniversary of two significant events in the history of the United States. On May 15, 1862, President Lincoln signed an act creating the U.S. Department of Agriculture. On July 2 of the same year he signed the Morrill Act, which provided for the establishment of the Land Grant Colleges and Universities. These acts have been especially meaningful in the revolution of agriculture in the United States and in the breakaway of American higher education from the tradition of limited opportunity to that of the open door to all who have the ability to learn.

Although 65 percent of the population of the United States was employed in farming in 1862, the nation’s subsistence-type of agriculture could not meet adequately the food and fiber needs of a population which was increasing by one fourth to one third every ten years. A large part of the population was actually underfed. The diet of most Americans was meager and monotonous.

Only one out of every 1900 persons entered college in 1862, and even this small proportion was decreasing. Few of these students were women. College education was designed primarily to train young men for the ministry, medicine, or law and was limited to the privileged few. While the slowly evolving sciences clamored for attention, agriculture, engineering, and industrial arts were strongly resisted by tradition-bound minds as unsuited to college education. As late as 1872 only six colleges in this country taught either physics or chemistry by the laboratory method. Research, although associated with education from the earliest times, was almost nonexistent in American colleges.

**The floodgates are opened**

Lincoln’s signature opened the floodgates to long-needed ventures. The Morrill Act provided that every state could select 30,000 acres of land for each of its congressmen and that the income therefrom was to be used to endow, support, and maintain “at least one college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts in such manner as the legislatures of the states may prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life.” The last phrase, “to promote the liberal and practical education of the industrial classes,” chartered the new era in education.

**History of the movement**

By 1870, 37 states had taken steps to establish this new type of college. These land grant institutions fostered new concepts in higher education. Colleges were no longer for the limited aristocracy; higher education became available to all. The proportion of citizens gaining college education increased steadily from 1 in 1900 to 1 in 5 at present. Educational opportunities expanded from the three early professions to include almost the entire range of industrial, professional, and intellectual activity to meet the people’s needs.

Two subsequent federal acts had major impact on the responsibilities and the expanding influence of the land grant institutions. In 1887 Congress passed the Hatch Act, which provided for an experiment station to be associated with the land grant college in each state. The Smith-Lever Act of 1914 created the extension services to carry the education process directly to the farms and homes.

**Cooperative efforts of the state and federal government**

The experiment stations and extension services have effected a close tie between the land grant universities and the U.S. Department of Agriculture. Federal funds, which provide part of the support...
for research and extension services, are distributed through the Department of Agriculture. Many members of the Department's research staff are stationed on land grant university campuses. Numerous important research accomplishments have been cooperatively planned and carried out by Department and experiment station scientists. The research findings of both organizations are channeled through the state extension services to farmers and others who can use the information.

The role of the land grant institutions

The land grant universities, now located in fifty states and Puerto Rico, have pioneered in the movement to bring science into the educational curricula. Large bodies of scientific facts have been discovered and cataloged. Basic principles and experimental methods have been developed and tested. Complicated laboratory equipment has been invented. Out of these have come the great scientific discoveries and inventions. These have made our factories truly productive and have given Americans, as consumers, an amazing variety of comforts and mechanical conveniences.

Among other things, to every American this cooperative effort has meant that American agriculture can produce abundantly and efficiently the food we need to support a strong nation, both in time of peace and in time of war. It means that we have all become accustomed to a wide variety of wholesome and nutritious foods the year around.

Most people of the world spend half their disposable income for food. Because our agriculture is efficient, we in the United States spend about one fifth of our income to pay for our food bill. In 1952 the average employee worked 51 hours each month to pay for the food needs of his family. In 1959 only 39 hours were so required. In the short period of seven years this average employee had a reduction of 1 ½ days each month in his work time needed to purchase food. In the same period the quality of food has been improved and considerable built-in maid service has been added to the food bill so that his wife spends proportionately less of her time in food preparation chores.

The role which the land grant institutions have played in increasing America's capacity to produce can hardly be over-estimated. The work of these institutions has contributed greatly to the level of America's educational and scientific achievement. The job which they have accomplished has made them one of our most important social institutions. Today the land grant institutions enroll more than 20 percent of the college students, grant 40 percent of the country's doctoral degrees in all subjects, including approximately half of those in the sciences, engineering, and health professions, and 25 percent in the arts, languages, business, and educational training. The land grant system has become the largest single source of trained and educated manpower.

But the contributions of the land grant universities do not end at our national boundaries. They extend to most countries of the world. The foreign students educated in our land grant institutions, the various technical assistance programs in the underprivileged countries, together with the cooperative programs between American land grant universities and universities of foreign lands, have made the contributions of the land grant colleges worldwide in scope. This is perhaps America's greatest contribution to world-wide education.

We are proud of the contributions of the land-grant system and of the U.S. Department of Agriculture over the past 100 years. But the future is before us. There are greater challenges facing these institutions in the years ahead than existed 100 years ago. These challenges must be met and conquered. To this end the workers of the land grant universities and the Department of Agriculture are dedicated.

The new animal husbandry farm

Arrangements have recently been completed for the purchase of a new animal husbandry farm. This farm will replace the land north of the campus presently used as a livestock farm, but which is needed for University housing. Construction of the first of the married students housing units in this area is now underway.

The new farm consists of 230 acres and is located some 5 ½ miles southwest of Logan City and borders highway 89-91. The acquisition involved tying together into one block land that was owned by six individuals. The land is all irrigable. Water rights were acquired with the land, and the soil is of a clay loam type that is well suited for pastures and hay production.

The farm will serve both as a research and a teaching facility. Most of the research now being conducted on the land and in the sheds near the campus concerned with the breeding, feeding, and management of beef cattle, sheep, and swine will eventually be transferred to the new farm. The livestock used in the teaching program will also be moved to the farm and the farm will serve as a teaching laboratory as well as a demonstration unit. It is expected that the new land will permit more detailed investigations concerning pasture use than are underway at present.

New sheds, corrals, and related facilities will have to be constructed before the livestock can be moved to the new land. It is expected that it will be some three years before these can be provided.

The metabolism building will be maintained at its present location just north of the main campus. The detailed type of work conducted at this building requires services such as heat, water, power, and sewage disposal that can be supplied efficiently at the present location.

—James A. Bennett
Numbers 1, 2, and 3 refer to census-defined "urbanized areas" in four counties (expanded on 2nd map to fuller accuracy).

<table>
<thead>
<tr>
<th>Size of Centers</th>
<th>Number of Persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,500</td>
<td></td>
</tr>
<tr>
<td>1,700</td>
<td></td>
</tr>
<tr>
<td>9,000</td>
<td></td>
</tr>
<tr>
<td>1,000</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td></td>
</tr>
<tr>
<td>Under 200</td>
<td></td>
</tr>
</tbody>
</table>

Outside these centers • = 100 residents

Total State Population: 1,006,467
Less than 100,000 to go and Utah will have one million people! She had 890,627 in April 1960. Assuming the same yearly rate of growth as the average between 1950 and 1960, her population today is something over 910,000.

Where these people reside

Where these people reside within the state is one of the most important demographic facts to be considered in social planning, in administration, and in research.

To provide a bird's eye picture of the massing and dispersion of population, two maps were constructed. Different sizes of population groupings are shown by the relative sizes of 18 globes and dots. The legend on the first map is a guide to the use of both maps. It shows the size of community center represented by eight sizes of globes in order to facilitate the reader's interpretation of all gradations in globe size. The large black dots represent small communities—population in incorporated centers of less than 200 population. Each of the smaller dots represents 100 people in the open country areas of the state.

The map shows ribbon-like distributions

The spatial distribution of Utah's population is ribbon-like in its arrangement over the state. To persons well acquainted with the state's geography, it is evident that the population is located along valley floors and on plateaus. The ribbon-like effect is enhanced in some cases by a river and its tributaries as they meander through the valley floors. An example is the population along the Sevier River in the counties of Sanpete, Sevier, Piute, Garfield, and northeastern Millard.

(Continued on page 106)

DR. THEREL R. BLACK is associate professor of sociology. Julia Frandsen helped plan and prepare the maps. Dennis Poplin, a student in sociology, and Professor John N. Burrus of Mississippi Southern College also assisted in planning the maps.
The Demand for Christmas Trees

Frank W. Kearns

As Utah's population has expanded, the demand for Christmas trees has increased correspondingly. Since this is a product where sales are extremely seasonal, it is highly important for supply sources of Christmas trees to have an accurate knowledge of consumer purchasing habits and practices in order to balance supply with demand and avoid costly wastage.

This article summarizes the findings of one phase of a study made during the 1960 Christmas season in the cities of Salt Lake and Ogden vicinity, comprising the metropolitan area of Utah. This phase of the study is based mainly on a telephone survey of some 373 families selected systematically from the Salt Lake City and Ogden telephone directories, and from a mail survey of a sample of the business establishments in these same cities.

Number of trees used

The family unit is the greatest consumer of Christmas trees in the area, representing approximately 80 percent of total consumption. Non-family users consisting of business establishments, schools, and churches, make up the remaining 20 percent.

Of the 373 families sampled, 335 displayed a Christmas tree of some type, averaging one tree for every 4.6 persons. Assuming this ratio statewide, then Utah's population of 890,000 people used about 190,000 Christmas trees in 1960.

Only about 3 percent of the families with trees displayed more than one tree. This points up the present inflexibility of the Christmas tree market—since demand is geared to population. Small price changes can have little effect on this volume of use.
Retail Christmas tree lots were the principal place of purchase, with almost 70 percent of the families reporting that they bought their trees from these lots. However, purchasers seem to have no favorite lots where they purchase trees regularly year after year, since 65 percent of the families reported they bought from a different lot the previous year. Whether the lot is located on their regular market route is not significant in influencing their choice, either, since more than half of the respondents bought trees from retail lots in more distant locations. Advertising by retail lots did not appear to be effective in attracting buyers, for only 10 percent of the families who bought trees from lots indicated that they were aware that the lots had advertised their trees. Some 42 percent bought trees from lots which to their knowledge had not done any advertising. Of those who were attracted to purchase by advertisements, the advertisements appearing in newspapers seemed to be the most effective.

Consumers of Christmas trees in Utah seem willing to shop around to find the tree which definitely suits them. This is evidenced by the fact that 50 percent of the purchasers shopped at from 2 to 4 lots before finally buying their tree, and 10 percent of the buyers shopped...
at 5 or more lots before making a final choice.

Time of purchase

Christmas tree purchases for home use were confined to the month of December (fig. 1). Three consumers in the sample purchased trees on the first day of the month, and no further purchases occurred until December 6. The last purchases took place on December 24, the day before Christmas.

Only 6 percent of the trees were purchased during the first week ending December 7. Twenty percent of the trees were purchased in the second week; 66 percent in the third week, and 8 percent in the 3 day period preceding Christmas Day.

Based on cumulative totals for each week day, the busiest sales periods were weekends, with Sunday by far the most active single sales day (fig. 2). Sales fell off during the week days, with Monday the least active sales day and surprisingly Friday as the next least active day.

Type of trees

Ninety-five percent of all trees purchased in the metropolitan area of Utah are natural, untreated trees. Sprayed and flocked natural trees comprise only about 2 percent of the total. Artificial trees make the remaining 3 percent of the total consumption.

Artificial trees have been increasing in use, but still offer only limited competition to natural trees. Their disadvantage of appearance, high price, and storage problems, have restricted their acceptance almost entirely to a small segment of the 1 and 2 member family units.

Business establishments are the greatest users of the painted and flocked trees, but even in this consumer group the modified trees make up only about 10 percent of the market.

Species of trees

Apparently there are strong consumer preferences for Christmas tree species in Utah. Over 70 percent of the families buying trees reported that they knew what species they had purchased. The preferred species were reported as follows:

<table>
<thead>
<tr>
<th>Species purchased</th>
<th>Percent of all trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pinyon pine</td>
<td>56</td>
</tr>
<tr>
<td>Douglas fir</td>
<td>20</td>
</tr>
<tr>
<td>Blue spruce</td>
<td>12</td>
</tr>
<tr>
<td>White and balsam firs</td>
<td>7</td>
</tr>
<tr>
<td>Ponderosa pine</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

Pinyon pine was by far the most preferred species of Christmas tree in 1960 in metropolitan Utah. This fact indicates that most consumers are willing to shift their allegiance to certain tree species with great rapidity. Douglas fir and the true firs comprised 70 percent of the trees on the market in Salt Lake City and Ogden valleys in 1952, but by 1960 the percentage had dropped to 27. Pinyon pine, which made up only 20 percent of the trees sold in 1952, was up to 56 percent in 1960.

Since the majority of the pinyon pine Christmas trees that are marketed come from Nevada and Utah, the increasing preference for pinyon pine Christmas trees in this state emphasizes the growing economic importance of a species once considered worthless and a nuisance.

Tree sizes

The Christmas tree sizes most preferred are perhaps best revealed by the data gathered in a survey of the tree stocks from a sample of the retail yards in the metropolitan area.

(Continued on page 108)
Uinta alfalfa, named and released by the Utah Agricultural Experiment Station and the United States Department of Agriculture on November 1, will make valuable germplasm available to producers and breeders alike. A limited amount of foundation seed was produced in 1961; some of this will be used for testing to determine accurately the area of adaptation. Uinta is the second alfalfa variety that has been named in Utah. The first was Nemastan, the progenitor of Lahontan.

Uinta alfalfa has predominantly purple flowers, but also produces a limited proportion of plants with varying degrees of light colored flowers. Other descriptive forage characteristics are not distinctive.

1. Origin and breeding

Uinta is a synthetic variety derived from five clones and was developed by the polycross system. The five clones survived evaluations that were conducted over a period of years. Originally 1,500 plants were spaced planted. From these, 72 plants were selected on the basis of seed yield, general appearance, and crown wart resistance. The 72 selected plants were in-

(Continued on page 109)
Figs. 1, 2, 3. Cells of crested wheatgrass plants with 14, 28, and 42 chromosomes. In each cell the chromosomes are collecting in two groups previous to the formation of a reproductive cell, the pollen grain, which will contain a nucleus with half the chromosome number of the pollen-mother cell from which it was derived. Figs. 4, 5. Cells of crested wheatgrass with 33 and 34 chromosomes. The extra or supernumerary chromosomes in these cells are indistinguishable from the normal chromosomes. Fig. 6. Chromosome pairing in diploid Fairway crested wheatgrass. The 14 chromosomes of this variety pair two-by-two to form 7 bivalents. Six of the seven chromosome pairs are connected at both ends to form ring-shaped bivalents, while the remaining pair is connected only at one end and forms a rod-shaped bivalent. Fig. 7. Chromosome pairing in tetraploid crested wheatgrass. The 28 chromosomes have paired to form 6 bivalents and 4 quadrivalents. The four quadrivalent formations in this cell appear in figure-eight configurations. Quadrivalent formation is indicative of autopolyplody. Fig. 8. Triplet seedlings of crested wheatgrass. Occasionally 2, and rarely, 3 seedlings develop from a single seed. Multiple seedlings provide an excellent source of cytological aberrants, which often prove useful in cytogenetic investigations. Fig. 9. Chromosome pairing in a polyhaploid crested wheatgrass plant derived from a twin seedling. Chromosome pairing in the polyhaploid was equivalent to that in the diploid (fig. 6) and provides positive proof of the autopolyplody nature of tetraploid crested wheatgrass.

DOUGLAS R. DEWEY
FARM AND HOME SCIENCE
Techniques in breeding improved wheatgrass

Crested wheatgrass, a native of the steppes of Russia and Siberia, was first introduced into the United States in 1898 but failed to achieve any widespread recognition until the drought years of the mid-1930's. Since that time, in excess of 10 million acres has been seeded to crested wheatgrass in the United States, and this grass continues to be the most valuable grass for reseeding the vast arid ranges of the West.

Some of the qualities that make this species so valuable as a range grass are exceptional drought tolerance, longevity and persistence under intense grazing pressure, high productivity of nutritious and palatable forage, ease of establishment, excellent seed production, and relative freedom from disease. Although crested wheatgrass is characterized by many desirable features, great potential for further improvement exists through the application of plant breeding techniques. Many different forms and types of crested wheatgrass occur, and this wide genetic diversity provides an excellent opportunity for the selection of improved varieties.

Inasmuch as plant-breeding methods are merely practical applications of genetic principles, these principles must of necessity be clearly defined and understood if the full breeding potential of a species is to be realized. The basic facts of heredity have been known since the early 1800's, yet not until the mid-1930's did the full breeding potential of the species become realized. The basic principles must of necessity be clearly defined and understood if the term "cytogenetic" is still necessary to determine the genetic characteristics of crested wheatgrass and to provide a sound basis for the selection of improved varieties.

Chromosome numbers in crested wheatgrass

Chromosome numbers in and of themselves have an important bearing on expectations of genetic ratios and the results to be achieved in a breeding program. The basic chromosome number in gametes (sex cells) of most members of the Gramineae (grass) family is \( n=7 \). Vegetative cells contain twice the number, \( 2n=14 \), seven of which were contributed by the pollen parent and seven by the female parent. Although seven is the common basic chromosome number in grasses, many grasses produce gametes which contain chromosomes in multiples of seven, i.e. \( n=14 \), 21, 28, 35, etc. Plants of this nature are referred to as "polyploids" in contrast to "diploids," plants that contain \( 2n=14 \) chromosomes. Polyploids are further classified on the basis of chromosome number as tetraploids (\( 2n=28 \)), hexaploids (\( 2n=42 \)), octoploids (\( 2n=56 \)), etc.

Crested wheatgrasses occur in natural populations at the diploid, tetraploid, and hexaploid chromosome levels. Chromosome numbers can be readily determined with the aid of a microscope, and figures 1, 2, and 3 are microphotographs of cells containing 14, 28, and 42 chromosomes. The Fairway variety of crested wheatgrass contains \( 2n=14 \) chromosomes, whereas the "standard" strain contains \( 2n=28 \). Hexaploid strains are relatively rare and usually resemble the "standard" strains. Tetraploid and hexaploid plants in general are larger, coarser, less fertile, and have great potential for further improvement.

GLOSSARY OF TERMS

- allopolyploid—having more than two sets of chromosomes in the somatic cells, the additional set or sets having been derived from a different species
- autopolyploid—a polyploid that has multiple and identical or nearly identical sets of chromosomes
- bivalent—two homologous chromosomes united at the first division of meiosis
- chromosome—one of several microscopic dark staining bodies arising from the cell nucleus in nuclear division. The physical structure upon which genes are carried
- cytogenetics—the combination of cytology and genetics in the study of the cell and its contents
- cytology—the branch of biology dealing with the structure, function, and life history of the cell
- diploid—having twice the gametic or haploid number of chromosomes, as usually occurs in somatic cells
- gametes—sex cells
- gene—a hereditary element comprising a specific location on a chromosome
- genetics—the science of heredity, variation, sex determination, and of plant and animal breeding
- haploid—having the half number of chromosomes, as usually occurs in reproductive cells
- hexaploid—having six times the usual haploid number of chromosomes, or having six complete sets of chromosomes in the somatic cells
- homologous—like
- hybridization—crossing of two individuals of unlike genetic constitutions
- meiosis—the process by which gametes are formed
- morphology—deals with the form and structure of animals and plants
- polyploids—plants having three, four, or more times the normal number of chromosomes in their nuclei
- quadrivalent—group of four chromosomes
- somatic cells—pertaining to the vegetative cells
- supernumerary—said of a chromosome that is extra to the normal number for an individual
- tetraploid—a cell having four times the normal number of chromosomes
- triploid—a cell having three times the normal number of chromosomes

(Continued on page 110)

**DR. DOUGLAS R. DEWEY works as a research agronomist for the Crops Research Division of the U.S. Agricultural Research Administration with offices in the New Crops Research Laboratory.**

**FOR DECEMBER 1961**
Stem pitting, a virus disease of apples widespread throughout the United States and Canada, has recently been found in Utah. This has become a major disease where Virginia Crab has been extensively used as a body stock for the production of winter-hardy apple trees.

History of stem pitting

During the 1940's many plantings of apple trees were made throughout Northern United States and adjacent areas of Canada composed of seedling roots with Virginia Crab as a body-forming stock on which the desired horticultural varieties were top-worked. This crab apple was used because it had shown outstanding resistance to low temperatures and produced vigorous trees with sturdy framework and strong crotches. However, when apple scions from certain source trees were top-worked on Virginia Crab, incompatibilities developed which were considered to be of a horticultural nature. Later, pits were observed in the wood under the bark of affected Virginia Crab. In 1956 stem pitting was shown to be a virus-induced disease, which could be transmitted with buds or bark patches from diseased to healthy trees.

Symptoms of stem pitting

Frequently affected trees are stunted, lack vigor, and show general decline. Other causes may induce these symptoms, but the presence of stem-pitting disease can be detected by removal of the bark from the Virginia Crab portion of the trunk. Affected Virginia Crab develops pits and grooves in the sapwood (fig. 1) with matching projections from the inner surface of the bark. Pits may be shallow and isolated or they may be deep and extensive depending upon the length of time a tree has been infected, and perhaps on the severity of the infestation.
of the virus strain. Stem pits will be produced in the sapwood of Virginia Crab one year after infection. Pitting will be mild at first, but becomes progressively worse each year. Pitting is more prominent near the base of the trunk than in the scaffold branches. In affected trees, branches may be sparse with low spreading and open center types of growth; trunks are smaller than those of healthy trees of the same age, and abundant suckers may be produced from the original seedling rootstock.

Host range of stem-pitting virus

Stem pitting was associated first with Virginia Crab, but other crab varieties, such as Florence, Hyslop, Beauty, and Columbia, are also affected. The stem-pitting virus has been shown to be latent in or produce only mild symptoms in many commercial varieties, such as Red Delicious, Golden Delicious, Rome Beauty, Jonathan, and McIntosh.

Observations in Utah experimental plots

Frequently apple trees in Utah orchards are damaged by low winter temperatures. Therefore, in 1948 and 1949 researchers at Utah State University established an experimental plot on the campus at Logan to study winter-hardy body stocks and apple varieties for Utah. Various apple varieties, some on seedling rootstocks and others top-worked onto various body stocks, were planted. Most of the body stocks were Hibernal and Virginia Crab with a few Hawkeye Greening and Ames.

Other plots were established at the Howell Field Station near North Ogden as part of the same study, but using mainly 3 apple varieties and 3 hardy body stocks.

Many of the trees in the Logan plot made only fair to poor growth. Shallow soil underlain by coarse gravel was assumed to be the reason. No investigation for disease was made until the fall of 1960 when some of the trees were to be removed to make room for a student-housing project. The appearance of the trees at this time suggested the possible presence of stem-pitting disease, but since the trees were dormant and the bark tight, the trunks could not be examined until April 1961. Some of the varieties on seedling rootstocks had been removed, but the remaining trees, all of those on hardy body stocks and some on seedling roots, were checked for stem pitting. The bark was readily removed for examination in April by lifting V-shaped flaps from near the base of the trunk or by stripping bark from the trunks of trees being removed.

Some of the trees with Virginia Crab trunks showed good growth (fig. 2), but most of these trees were small and lacked vigor (fig. 3). Severe stem pitting symptoms were found on the Virginia Crab part of the trunk of trees making poor to fair growth, whereas no pitting was evident on most of the trees making good growth (table 1). However mild symptoms of stem pitting were found on a few Virginia Crab trunks on which the apple varieties were making good growth. All trees

Fig. 3. Stunted and stem pitted Rome Beauty on Virginia Crab (foreground and background left). Winesap on standard seedling rootstock not pitted (background right)

Fig. 4. Transmission of a lethal factor from apple affected with stem pitting. Left, Spy 227 control. Right, Spy 227 inoculated September 1960 with budwood Early McIntosh top-worked on Virginia Crab. Growing points of Spy 227 have been killed. Early McIntosh inoculation shoots appear to be unaffected.
on non-pitted Virginia Crab were vigorous. None of the trees on Hibernal, Hawkeye Greening, or Ames were pitted, though some of the trees on these stocks were making only fair or poor growth. A few trees with seedling rootstocks showed mild pitting on the variety trunks.

Virginia Crab was pitted with the following top-worked varieties in the Logan plot: Jonared, Starking, Rome Beauty, Black McIntosh, Patricia, Orleans, Winesap, Idared, Staymared, Jonathan, Grimes, Sharon, Early McIntosh, Winter Banana, and Fameuse. Virginia Crab was not pitted when top-worked to Golden Delicious, Cortland, Macoun, Secor, and Joan. One tree of Virginia Crab without a variety top was free of stem pitting.

The trees planted in the North Ogden plot did not grow much better than those in the Logan plot, although the soil conditions were more favorable; so these trees were studied. The results were similar to those found in the Logan plot. About 70 percent of the trees on the Virginia Crab were pitted, and trees on pitted stocks were smaller and less vigorous than those on non-pitted stocks. None of the Hibernal or Hawkeye Greening trunks were pitted, but the average growth of trees on these stocks was no better than that of trees on pitted Virginia Crab stocks. All Virginia Crabs on which Rome Beauty was top-worked were pitted and were smaller and less vigorous than other varieties.

**Virus-transmission studies**

Budwood taken in 1960 from orchard trees in the Logan plot showing poor growth was grafted to Spy 227 in the greenhouse. Spy 227 is a seedling of Northern Spy, selected by the USDA because of its vigor, wooly aphid resistance, and ease of propagation. Subsequently it was discovered that many apple varieties were infected with a latent virus which kills this stock; therefore it was never used commercially. Spy 227 is now used as a virus-indicator plant. In the present study the Spy 227 tree, on which buds from the non-vigorous orchard tree were placed, appeared to be normal for the first 3 or 4 weeks of growth, but then began to decline. Decline continued until the growing point of the Spy 227 was killed and only a few leaves remained alive (fig. 4). The buds from the non-vigorous orchard tree produced shoots that appeared to be unaffected. This would indicate a possible relation of stem pitting to the lethal Spy 227 virus or that the trees showing stem pitting were also carrying the Spy 227 virus.

**What the findings imply**

Since symptoms of stem pitting usually get progressively worse, mild symptoms on the Virginia Crab part of trees that were still showing good growth might indicate recent virus infection or infection with a mild virus strain.

The fact that some of the same varieties which showed poor growth on pitted Virginia Crab also showed poor growth on some non-pitted stocks seems to indicate that the stem pitting virus causes poor growth regardless of whether the variety is on Virginia Crab. One tree of Early McIntosh on Hibernal showed mild pitting on the McIntosh top, but no pitting was evident on the Hibernal trunk.

The stem-pitting virus appears to be widely distributed in commercial apple varieties. The fact that although many of the apple varieties were on pitted Virginia Crab, some of the trees on Virginia Crab showed no pitting, tends to indicate that the virus was probably latent in the variety tops and was not originally in the Virginia Crab stocks. Although many apple trees in commercial orchards may be infected with the stem-pitting virus, little or no injury is apparent. However, injury which is difficult to recognize may occur.

**Recommendations to growers**

Virginia Crab or other crab varieties are not now recommended for use as body stocks in developing winter-hardy apple trees. Apple growers should be aware of stem pitting and the losses it can cause.

**The rose stem girdler on raspberries**

The rose stem girdler is a highly injurious pest of raspberries in Utah from Kaysville on the north to Pleasant Grove on the south. The insect can be controlled by combining cultural practices with a single insecticide spray. Prune and burn infested canes before the middle of April, and spray with a half pound of actual dieldrin, endrin, or Thiodan, or with one pound of actual Sevin in 100 gallons of water during the first week of May. The spray should be applied so that the plants are thoroughly wet.

—D. W. Davis

**Range fertilization**

The application of nitrogen fertilizer at a rate of 40 pounds per acre on seeded foothill range increased production the first year as much as 500 pounds and an additional carry-over of 200 pounds the following year.
Cows have indicated their preferences among several phosphorus supplements in a free-choice feeding trial. Steamed bone meal, heretofore recommended and accepted as the phosphorus supplement for dairy cows, appears to be one of the least palatable.

Diets of dairy cows generally contain inadequate amounts of phosphorus unless it is supplied as a supplement to the ration. Such a supplement may be mixed with the grain ration or may be fed free-choice, alone, or in combination with salt. On many farms it is fed both in the grain mix and free-choice. When fed free-choice, palatability influences its consumption.

In a previous article in Farm and Home Science (Dew et al. 15:36, 1954) the palatability of steamed bone meal was shown to be improved by mixing it with salt. The highest phosphorus intake was obtained from feeding a mixture of approximately equal parts of steamed bone meal and salt. It was also observed that steamed bone meal allowed to remain in a mineral box for more than about two weeks became unpalatable even when mixed with salt.

Other sources of phosphorus

Several phosphorus supplements are commercially available and have been fed to farm animals. However, only limited information is available on their use for dairy cows. Dicalcium phosphate, defluorinated phosphate, and monosodium phosphate are examples of those now on the market. The phosphorus content varies with the type of product, the processing method, and the source of raw materials.

The availability of phosphorus to the cow is an important factor but was not included in the present study. In a study with calves made elsewhere, the researchers rated dicalcium phosphate as most available, followed closely by defluorinated phosphate, and Curacao Island phosphate. Soft phosphate

(Continued on page 111)
Seasonal pricing plans have been adopted in many markets to encourage more even shipments of milk throughout the year and to achieve greater equity in payments to producers. One of the more commonly used plans is the base-excess. It has been used by dairy cooperatives in the Great Basin Area for many years. Recently a base-excess plan was incorporated in the pricing provisions of the Great Basin Federal Milk Marketing Order. This study, however, applies only to milk bases of cooperatives.

Under the base-excess plan producers acquire a base with a handler for a specified number of pounds of milk per day. One price base by grade A producers does not increase production and marketing costs, except by the cost of base itself.

Considerable amounts of base are being bought and sold. This study was made to analyze base transactions and values.

**Purchase and sale of base**

During 1958 and 1959, 234 producers in the Great Basin Area bought base, some on more than one occasion. About 98,000 pounds were bought at a total cost of near two quarters of a million dollars. The average cost per pound of base was $6.65 in 1958 and $8.39 in 1959 (table 1). Part of this cost consisted

<table>
<thead>
<tr>
<th>Year</th>
<th>Base value capitalized per pound of base transferred</th>
<th>Price paid in cow prices</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958</td>
<td>$6.13</td>
<td>$.52</td>
<td>$6.65</td>
</tr>
<tr>
<td>1959</td>
<td>6.69</td>
<td>1.70</td>
<td>8.39</td>
</tr>
</tbody>
</table>

of base values capitalized in cow prices.

**Factors affecting the value of base**

The value of base depends largely on (1) the differential between base and excess prices, (2) base rules, (3) time of purchase, (4) risk, and (5) time lapse before additional receipts are received.

1. **Differential between base and excess prices**

Other things remaining the same, the larger the differential between base and excess prices the more value base has. An increase in price of milk used for fluid purposes, a decrease in price for excess milk, or an increase in the percent of base milk used for fluid consumption would all increase the differential.

The differential in the Great Basin Area varied between $1.83 and $2.15 per 100 pounds of milk between 1955 and 1959. Due to the influence of the pricing provisions of the Great Basin Federal Milk Marketing Order the differential dropped to about $1.70 in 1960.

The purchase of one pound of base at the beginning of a base paying year would increase producer receipts by one pound of milk per day, or a total of 365 pounds during the year, times the price differential.

2. **Base rules**

Many variations exist in base rules. Some substantially affect the value of base.

**Transfer of base**

For base to be bought and sold it must be transferable. If base rules were changed and base became non-transferable, it would lose all its potential value to buyers. When only a portion of base is transferable, buyers should consider only that portion when deciding how much to pay for it. Likewise, when determining the value of base, buyers should consider only the value it has from the time it is transferred. In some cases base is not transferred until some time after it is bought.

**Transfer of production records**

The purchase of base results in additional receipts only during the year when bought if production records of cows bought with base are not transferable. Normally, at the end of the base-paying year bases are recalculated and allotted to producers in relation to their production during the previous base building period, or periods.

However, if production records are transferable, the purchase of base can increase receipts during

DR. RONDO A. CHRISTENSEN is assistant professor of agricultural economics. This article presents the highlights of a study published in more detail in bulletin 432, Milk bases in the Great Basin area and factors affecting their value.
one or more future years, depending on the number of base building periods included in calculation of base. By transferring production records producers can usually increase base permanently by the amount bought. The more years included in base calculations the more value transferring production records has.

**Base building restrictions**

Sometimes base building is restricted by allocating base in relation to average daily shipments during the previous two, three, four, or more base building periods, instead of only the previous one. When this is done base cannot be built as rapidly from year to year as shipments are increased. The more years included in calculation of base the longer the lag. The greater the lag that is overcome by buying base the more value it has.

When base is built it takes as many years for it to increase as much as production is increased initially as there are years included in the calculation of base. If production were increased an average of 100 pounds per day during the base building period and two years were included in the calculation of base, base would increase 300 pounds per day during the next base paying year and 50 pounds during the following one.

If base building were closed, the only way to increase base would be to buy it. Under such a situation the purchase of one pound of base would increase receipts 365 pounds times the differential for as many years as base remained closed.

**Base building period**

Changes in base building periods do not affect the general level of the amount by which milk receipts can be increased by buying instead of building base; they do however, affect seasonal variation of the amount.

Potential receipts during the current and future years decrease from the first of the base paying period to the beginning of the base building period. At that time, if production records are transferable, potential receipts increase as the opportunity to build base during that year decreases. The earlier in the year the base building period the earlier base values cease to decline and begin to increase.

**Base paying period**

Shortening the length of the base paying period decreases the number of additional pounds of milk for which the base instead of the excess price can be received by buying instead of building base. Receipts are decreased in the same proportion that the base paying period is decreased.

3. **Time of year when purchased**

The sooner base is bought during a given base paying period the more days, and therefore the more pounds of milk, for which the base instead of the excess price can be received during that year. Once the base building period has begun, however, the later base is bought the more receipts can be increased during future years, providing production records are transferable. Thus, additional receipts during the current year will be highest if base is bought early in the year, and total additional receipts during the current and future years will be highest if base is bought early or late in the year and lowest if bought during the middle of the year.

4. **Discounting for risk**

Base values are derived from what future prices and base rules will be rather than from what they have been or what they are at present. The greater the risk concerning future prices and base rules the more estimated increased receipts from buying base should be reduced in arriving at its value.

Although price relations change from year to year they ordinarily change slowly. The greater risk has to do with future base rules. In discounting estimated additional future receipts in arriving at the value of base, all receipts should be eliminated except those which will be received during the current base paying year and in the future years for which base rules have been announced.

5. **Discounting for future receipts**

In addition to discounting for risk, estimated additional receipts from buying base should be discounted to their present value in arriving at the value of base. This can be done roughly by discounting estimated receipts by the going rate of interest on long-term obligations, compounded annually.

**Base values**

Base values were estimated for the Great Basin Area. In doing so the following assumptions were made:

1. Producers could either build or buy base.

2. Base allotted to producers equaled average daily shipments of milk during the preceding four base building periods.

3. Base building was permitted annually from August 1 to December 31.

4. The base paying period included the following 12-month period beginning February 1.

5. Bases were transferable.

6. Production records of herds bought with base were transferable.

7. The differential between base and excess prices was $1.70 per hundredweight.

8. Because of risk, only estimated additional receipts to be received during the current and following year were included.

9. Estimated additional receipts were discounted to their present value at the rate of .5 percent per month.

The rules assumed approximate
those that existed during 1959 in the Great Basin area.

Within the framework of these assumptions producers could have increased net receipts from sales of milk from about $6 to $10 for every pound of base bought in 1959, depending on the time of year they purchased it (table 2). These values apply only to the pounds of base transferred and from the time of actual transfer. Base values will change over time as milk prices and base rules change.

During the period studied prices paid for base were reasonably in line with values.

How to estimate base value

No simple formula can be given for calculating the value of base because of the many variations in price and base provisions that exist or may occur. The following general method can be used, however:

1. Learn what the base provisions are now and what they are expected to be during the foreseeable future.

2. Calculate the extra pounds of milk during each year for which you could receive the base instead of the excess price if you bought a pound of base now instead of waiting to build it.

3. Determine what the differential between the base and excess price of milk is now and estimate what it will be in the future during each year that receipts from sale of milk will be increased if base is bought.

4. Multiply the additional pounds of milk during each year in the future for which the base instead of the excess price could be received times the estimated differential in price between a pound of base and a pound of excess milk for each respective year. The sum of these products is the total estimated increase in future receipts from the sale of milk which would result from buying instead of building base.

5. Discount the estimated additional receipts for risk and uncertainty. To do this eliminate from estimated additional receipts those for which you are not reasonably sure. This should include all estimated increases during future years for which base provisions have not been announced and are not known.

6. Discount estimated additional receipts to their present value. This is done roughly by discounting additional receipts left after step 5 by 6 percent per year compounded annually.

Completion of these steps will give you the present value of the additional receipts which could be reasonably expected from buying instead of waiting to build a pound of base. At a price less than this value purchase of base would be a good investment. To pay more would result in a loss. At a price equal to the value derived a producer should be indifferent; by purchasing rather than building base he would neither make nor lose money.

Vast desert and mountain regions have no population, except at desert oases or mountain outposts. In some of these areas population groupings are associated with natural resource developments; in these cases the population tends to be concentrated near the resource or its processing while vast stretches of unoccupied and untitled lands lie between settlements. Moab illustrates this pattern. It is a uranium boom town and prospecting headquarters.

Village settlement pattern is emphasized

Another unique feature in Utah's population distribution is the relative scarcity of open country dwellers. (One hundred of these are represented by a small black dot.) The vast majority of Utah's residents, even in the more rural parts of the state, live in villages and cities. Lowry Nelson in his book, The Mormon Village, and his earlier reports on Escalante, Ephraim, and American Fork, has explained and documented the origins of this unique cultural feature of Mormon settlement in detail. The majority of the small dots that do appear on our maps are in the vicinity of Utah's larger centers where they indicate a change from the original settlement pattern.

Most noticeable fact is population concentration

Perhaps the most noticeable fact about the distribution of Utah's population is the sizable concentration in the three metropolitan areas of north central Utah. In attempting to describe and delimit such population concentrations in the United States, the Bureau of the Census has set up two concepts and procedures. One is the STAND-ARD METROPOLITAN STATISTICAL AREA; the other is the URBANIZED AREA. Ogden, Salt Lake City, and Provo-Orem are the centers that constitute the cores for the areas formed under both concepts. The concepts differ, however, in what is included on the periphery of these cities. Of the two, the urbanized area concept is the most meaningful in the Utah situation. This concept includes a geographical area in which there is a central city or twin cities of 50,000 or more population and the surrounding closely settled incor-
porated and unincorporated places that meet certain size, density, and related requirements. This concept, unlike that of the standard metropolitan statistical area (SMSA), allows us to include the densely populated part of southern Davis County in the urbanized area of Salt Lake City and the densely populated part of northern Davis County in the urbanized area of Ogden. Also, unlike the SMSA approach, the rural population of the county in which the urbanized area is located is excluded.

Within each of the urbanized areas of Utah there are several governmental boundary lines. These include more than one county line in the case of the Ogden and the Salt Lake City urbanized areas, and they include several municipal and other governmental boundary lines in all three areas. Residents of cities, towns, villages, and suburban areas are located on each others’ doorsteps in each of the urbanized areas. An “on the ground” journey makes a person aware that one town or city within an urbanized area merges into another imperceptibly. From a broad socio-economic point of view these boundaries are somewhat superficial in terms of identifying geographic patterns of working, shopping, schooling, and many other day-to-day activities of people. The boundaries of the urbanized areas tend to enclose areas in which day-to-day socio-economic patterns of living are recognized.

About 60 percent (531,383) of Utah’s people live in her three census-defined urbanized areas in the four counties of Weber, Davis, Salt Lake, and Utah. Not included in this figure, of course, is the population outside of the urbanized areas in each of these counties.

In the Ogden urbanized area are the cities and towns of Ogden, North Ogden, South Ogden, Washington Terrace, and Roy in Weber County, and Clearfield, Kaysville, Layton, and Sunset in Davis County. Also included are 118 persons in Davis County and 203 persons in Weber County in the “urban fringes” of these cities and towns.

In the Salt Lake City urbanized area are the cities and towns of Salt Lake City, West Jordan, Midvale, Sandy, Murray, and South Salt Lake in Salt Lake County, and Bountiful, Centerville, and North Salt Lake in Davis County. Also included are 94,768 persons from urban fringe areas such as Holladay and similar areas in the vicinity (mostly southeast) of Salt Lake City, and 4,925 persons in urban fringe areas of southern Davis County.

In the Provo-Orem urbanized area are included the cities of Provo, Orem, Pleasant Grove, and the town of Lindon. Also included are 432 persons in the “urban fringes” of Orem.

Sizeable numbers live outside of Utah’s three “urbanized areas”

While there is no question that there is a concentration of population in these three urbanized areas, the maps and the figures in table 1 showing where Utah people live do not allow us to lose sight of the fact that sizable numbers reside elsewhere. Forty percent (or 359,244) of the state’s population is found in places other than the Ogden, the Salt Lake City, and the Provo-Orem urbanized areas. Even in Weber, Davis, Salt Lake, and Utah Counties alone there are 135,147 people who live outside of these three areas. Of these about 45 percent live in the open country.

Table 1. The number of Utah’s people living in places and groups of places according to size, 1960

<table>
<thead>
<tr>
<th>Type of area</th>
<th>Size of place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three urbanized areas</td>
<td>531,383</td>
</tr>
<tr>
<td>Ogden urbanized area</td>
<td>121,927</td>
</tr>
<tr>
<td>Provo-Orem urbanized area</td>
<td>60,795</td>
</tr>
<tr>
<td>Salt Lake City urbanized area</td>
<td>348,661</td>
</tr>
<tr>
<td>All other population in the state</td>
<td>359,244</td>
</tr>
<tr>
<td>Other urban territory</td>
<td>135,775</td>
</tr>
<tr>
<td>Rural towns and villages (1,000 to 2,500)</td>
<td>60,726</td>
</tr>
<tr>
<td>Other rural territory</td>
<td>162,743</td>
</tr>
<tr>
<td>Total for the state</td>
<td>890,627</td>
</tr>
</tbody>
</table>

Interdependency is suggested

Considerable interdependency among open country areas, villages, towns, cities, and urbanized areas is implied in the size and location of dots and globes over the map of Utah’s face. The socio-economic patterns of this interdependency might well be the subject of a comprehensive study, but our maps themselves suggest certain important facts. Note that centers of about 3,500 to 7,500 population are seldom located in close proximity to each other, while smaller centers may be side by side. For example observe the size and dispersed locations of St. George, Cedar City, Richfield, Price, and Vernal. Apparently these serve as types of “service centers” to smaller cities and villages in their hinterlands. Some of the smaller centers in such hinterlands, however, appear side by side with almost equal populations to each other. For example, in the Richfield area, note Sigurd and Aurora; also in this area note the number of the larger black dots signifying small centers under 200 population.

It is well known that the larger centers of north central Utah, most notably Salt Lake City, service the many needs of the rest of the state, and even centers in surrounding states. But perhaps less well known is the fact that some centers such as Richfield regularly service certain customers as far south as
south through towns of different sizes, and finally to one of the smallest centers such as Boulder, Utah; and then returns by the same route. Going away from Salt Lake City, one notes how small the smaller community appears. Returning towards Salt Lake City one is struck by how large the larger community is. For example, Provo looks small on the southward trip from Salt Lake City, but on the northward trip, Provo looks huge as compared to Payson. Again, Escalante looks small compared to Panguitch on the one leg of the trip, but Escalante looks almost urban on the return trip from Boulder.

Will the maps develop a "wholistic" view of Utah

As residents of the state do we fail to understand Utah cities, towns, and villages and their interrelation because of a natural tendency to focus our attention on the part of the state in which we live? Or have we been unable to see the wholeness of Utah because our trips through the state have been, by necessity or choice, few and limited. If so, perhaps a study of the two maps can be a partial antidote since they make it possible to see the whole panorama of Utah's population distribution at a glance.

CHRISTMAS TREES

(Continued from page 96)

area (table 1). The most popular sizes are the 5 and 6 foot trees. This corresponds with the findings of the consumer survey which indicated that the average size of trees purchased was 6 feet. The maximum height for trees displayed in the home is usually 8 feet. About 5 percent of the trees purchased are larger, but consumers are frequently willing to buy larger trees and cut them off to desired sizes. Better quality trees are often obtained in this way.

Tree quality

All the consumers seemed to be affected in their purchases by tree quality. Over 60 percent of the consumers sampled stated that they attempted to buy the best tree on the lot when they made a purchase. As with tree sizes, perhaps the best indicator of the quality of trees purchased in the consumer market would be the data obtained from a sample of trees taken in the retail yards. The appraisal of tree quality presented in table 2 is based on a sample of some 3,000 trees, roughly 50 trees from each of 60 retail lots in the metropolitan area of Utah.

The grading of the trees was based on rules devised for Douglas fir Christmas trees which considered the characteristics of density, balance, taper, deformity, and foliage viewed from several angles of the tree. Twelve percent of the trees were classed as premium, 37 percent standard, 40 percent utility, and 11 percent cull. Since cull trees are those which fail to meet the minimum requirements of the utility grades, the evidence shows that the quality of trees offered for sale is generally disproportionately low for most all species. Some cull trees are sold from retail yards at low prices; some are used as greens by dealers, but more frequently cull trees go unsold.

Price paid for trees

Retail prices for Christmas trees are highly variable. Many dealers have no set pricing plan. They base their price more on an appraisal of the customer than on an appraisal of the tree. Others set prices, but use blanket prices for assortments which may cover several species, sizes, and grades of trees. There are dealers, however, who have set prices which vary directly with species, size, and quality.

Out of the varied prices reported in the consumer survey there emerged the typical pattern which
indicated that the size of the tree (and undoubtedly quality) is important in determining the price of a particular species in a given area. Each foot of height usually adds to the average price, varying from about $0.25 to as much as $1.00.

For natural, unmodified trees, the average tree purchased was 6 feet in height, and cost an average of $4.00. Painted or modified natural trees cost an average of $6.00, or a 50 percent increase in price. The average height for artificial trees purchased was 4 feet, costing $2.25 per foot, or $9.00 per tree. This was about $0.25 to as much as $1.00.

**UINTA ALFALFA**

(Continued from page 97)

creased clonally, and carefully evaluated for resistance to yellow leaf blotch, downy mildew, and bacterial stem blight. Polycross progenies of the selected plants were tested for seed yield and bacterial wilt resistance. Only five of the original 1,500 met all the requirements stipulated for the new variety. First generation seed of the five clones was produced in the greenhouse; the next generation was produced under cages. Second generation seed was distributed in Idaho, Wyoming, Montana, Oregon, and Colorado for testing in 1958, and in the central region for testing in 1960.

2. Hay and seed yield

Hay yield. In tests at Logan, Utah, Uinta alfalfa has produced about the same amount of hay as check varieties. In one test Uinta produced slightly more than Ranger and in another test slightly less. As an average of both tests Uinta yielded 5.10 tons of air dry hay per acre compared to 5.02 for Ranger (table 1). Differences between Uinta and Ranger in hay quality were not significant. Hay quality was rated on the basis of the content of protein, fat, fiber, ash, moisture, sugar, and lignin.

Seed yield. One of the outstanding characteristics of Uinta is its high seed yield. In one 4-year test at Logan, Uinta produced an average of 650 pounds of seed per acre compared to 350 for Lahontan and 510 for Ranger. In another test at Logan, covering a 3-year period, Uinta alfalfa yielded 650 pounds of seed per acre while Buffalo, Lahontan, Ranger, and Vernal yielded 350, 263, 381, and 387, respectively. In both tests, the year of seeding was included in the averages.

Factors contributing to the high seed yield of Uinta include:

a. A strong floral odor which is believed to attract pollinators.

b. A tendency to bloom a few days earlier than certain other varieties. For example, on June 15, Uinta was 47 percent in bloom, compared to 36 percent for Ranger, and 25 percent for Lahontan. This characteristic is especially noted when the varieties are grown in thin stands. It was not noticeable when the varieties were grown for hay.

c. More “pods per raceme” is a seed yield component that favors Uinta. In a test at Logan, Uinta alfalfa had 8.0 pods per raceme, compared to 7.4 for Ranger and 6.7 for Lahontan.

d. “Seeds per pod” is another seed yield component favoring Uinta. In a test at Logan, Uinta had 41 seeds per pod, compared to 40 for Ranger and 36 for Lahontan. The advantage in seed numbers is dissipated slightly by seed weight, as the seed weight of Uinta was 2.27 mg., compared to 2.30 for Ranger and 2.36 for Lahontan.

3. Disease and insect resistance

Uinta alfalfa is superior to Ranger in resistance to downy mildew (Peronospora trifolii) and yellow leaf blotch (Pyrenopeziza medicaginis). The ratings assigned to these diseases are somewhat subjective, but nevertheless meaningful. A rating of 1.2 was given to Uinta for downy mildew, compared to 5.2 for Ranger. A yellow leaf blotch rating of 1.5 was assigned to Uinta, compared to 6.6 for Ranger. The relative value of these advantages will vary from season to season, depending upon the incidence of the diseases. Resistance to yellow leaf blotch will give Uinta a considerable advantage for seed production in northern Utah and southern Idaho. Resistance to both diseases will prove advantageous in producing high quality hay. If first crop hay is allowed to bloom rather fully before being cut, Uinta should retain a higher percentage of the leaves than Ranger because of its resistance to yellow leaf blotch. In some seasons a considerable loss in hay quality is caused by downy mildew, and while the resistance of Uinta is not complete in this respect, it certainly will be of value.

Tests indicate that bacterial wilt

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**Table 1. Alfalfa hay yields** of six varieties at Logan, Utah, Evans Farm

<table>
<thead>
<tr>
<th>Variety</th>
<th>Nursery number</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Buffalo</td>
<td>5.00</td>
<td>5.10</td>
</tr>
<tr>
<td>Ladak</td>
<td>4.86</td>
<td>-</td>
</tr>
<tr>
<td>Lahontan</td>
<td>3.94</td>
<td>4.35</td>
</tr>
<tr>
<td>Ranger</td>
<td>4.66</td>
<td>5.37</td>
</tr>
<tr>
<td>Uinta</td>
<td>5.14</td>
<td>5.06</td>
</tr>
<tr>
<td>Vernal</td>
<td>4.98</td>
<td>4.88</td>
</tr>
</tbody>
</table>

*Table 1. Alfalfa hay yields* of six varieties at Logan, Utah, Evans Farm

*+Tons per acre air dry weight
†Average of 1958, 1959, and 1960
‡Average of 1959 and 1960

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DR. MARION W. PEDERSEN is a research agronomist for the Crops Research Division of the Agricultural Research Service. He is working with DR. DEVERE R. MCAULISTER, professor of agronomy, USU, in alfalfa breeding and selection.
(Corynebacterium insidiosum) resistance of Uinta is about equal to that of Ranger. Resistance of 39 percent was obtained for Uinta, compared to 36 percent for Ranger and 15 percent for Grimm.

4. Winter hardness

No winter killing of Uinta alfalfa has been observed in Utah. Growth habits indicate that it is between Ranger and Buffalo in winter hardiness.

5. Seed increase

A 10-acre dryland field was planted near Logan in 1961 for the production of foundation seed. Some of this will be allocated for testing purposes, and a limited amount for production of certified seed. Uinta is a northern region alfalfa. This means that seed produced outside of this region must meet special certification procedures if it is to be certified.

6. Potential

Uinta alfalfa is presently recommended only for Utah, and even there it is still only on a trial basis. Its area of adaptation is considered to be the southern part of the northern zone, designated for alfalfa seed production. This area extends from central Utah on the south to central Idaho on the north, and includes other areas with similar environmental conditions. Potential use of the variety will depend upon the results of trials presently underway.

**WHEATGRASS BREEDING**

(Continued from page 99)

larger pollen and seeds than the diploids. Although morphology and chromosome number are related, the only positive means of determining chromosome number is by actual count under the microscope.

Crested wheatgrass plants with different chromosome numbers may look much alike; however plants which differ in chromosome number are usually cross-sterile, i.e. they cannot be crossed with each other readily. Even if a cross is successful, the resulting progeny are usually highly sterile. The crested wheatgrass breeder, therefore, must know the chromosome numbers of the plants with which he is dealing if his hybridization program is to be fully effective.

In addition to the aforementioned variations in chromosome number, which involve differences in multiples of 7, some crested wheatgrass plants contain 1 to 6 additional chromosomes. Most of these chromosomes differ from the normal ones in function, but are frequently indistinguishable from them in appearance. This type of chromosome variation occurs chiefly among the tetraploid plants. For example, plants with 29, 30, 31, 32, 33, and 34 chromosomes have been isolated. Cells with 33 and 34 chromosomes are shown in figures 4 and 5. These extra chromosomes are unique in that, as a rule, they have no influence on genetic ratios, fertility, or morphology of the plant. These additional chromosomes are called "supernumerary" or "accessory" chromosomes. Their origin and function are yet to be determined. The influence of supernumerary chromosomes on the breeding behavior of crested wheatgrass plants is also unknown; however this problem is currently under investigation by Canadian cytogeneticists.

**Origin of additional chromosomes**

From a practical plant breeding standpoint, it is not only important to know the chromosome number of a plant but also to know the source of additional chromosomes. There are two primary means by which multiple chromosome numbers may arise. (1) By duplication of the chromosome number of a given plant (plants of this nature are termed "autoploids"). (2) By hybridization of two different species followed by subsequent chromosome doubling (these plants are referred to as "allopolyploids").

Both of these types of polyploids occur in nature and have also been produced experimentally. Polyploid forms intermediate between auto and allopolyploids also exist.

Diploid crested wheatgrass plants contain seven different chromosomes which for illustrative purposes may be designated A B C D E F G. Each vegetative cell contains two of each chromosome: AABB—GG. Autopolyploids, which result from chromosome doubling in a diploid, contain exactly the same kind of chromosomes as their diploid prototypes, but each chromosome is represented four times, AAAABB BBB—GGGG, rather than twice. This increase in chromosome number has a profound effect on genetic ratios. Instead of the customary 3:1 genetic ratios found in diploids, autotetraploids yield 35:1 ratios in similar crosses and autohexaploids exhibit 399:1 ratios. Thus it becomes obvious that genetic expectations are influenced greatly by the level of autoploidy, a fact of prime importance to plant breeders.

A cross of two different diploid species, with chromosomes designated as AABB—GG x HHII—NN, would give rise to a fourteen-chromosome plant, ABC—N. Subsequent doubling would produce a 28-chromosome plant, AABB—NN, which would be designated as an allotetraploid. This plant contains each chromosome in duplicate, the same as diploids do. Although allotetraploids contain twice as many different chromosomes as diploids, genetic behavior of allotetraploids and diploids is similar because both types of plants contain chromosomes in duplicate.

Inasmuch as breeding behavior of polyploid species is conditioned largely by the source or origin of the additional chromosomes, the plant breeder must know the type of polyploid (whether auto or allopolyploid) that occurs in the species with which he is working. Chromosome counts of crested wheatgrass plants leave no doubt that this species forms a natural polyploid series including diploid, tetraploid, and hexaploid plants. The important question which must
be answered next is, "what kind of polyploids are the crested wheatgrasses?" Cytogenetic grass research at Logan, Utah, for the past several years has been directed toward the answer to this question.

Several types of cytological evidence have been brought to bear on the origin of multiple chromosome numbers in crested wheatgrass. The first line of investigation has been to study chromosome pairing in tetraploid plants. During the process by which gametes are formed (a process known as meiosis) like chromosomes pair with one another. Thus in diploid plants, the two A chromosomes pair together as do the two BC- and G chromosomes to form seven bivalents (pairs). This situation is illustrated in a cell of diploid Fairway crested wheatgrass shown in figure 6. If tetraploid crested wheatgrass plants arose by doubling of the diploid, i.e. autoploidy, each cell would contain 4 homologous (like) chromosomes, AAAA BBBB, etc. Meiosis of an autotetraploid is characterized by quadrivalent (pairs of 4 chromosomes) associations formed by the 4 like chromosomes. Allelo- tetraploid plants, on the other hand, form only bivalent associations, since in this type of polyploid the chromosomes occur only in duplicate. Our cytological observations, as well as those reported elsewhere, show that chromosomes of crested wheatgrass often form quadrivalent associations (figure 7). These data are indicative but do not furnish critical proof that tetraploid crested wheatgrass is a complete autotetraploid. The possibility yet remains that this species is a partial autotetraploid, i.e. that only some of the chromosomes are represented in quadruplicate.

Further evidence of the autotetraploid nature of crested wheatgrass comes from "polyhaploid" plants. Since doubling the chromosome number of a diploid species gives rise to an autotetraploid, the reverse process of halving the chromosome number of the autotetraploid should yield a diploid. Diploids which originate in this manner are called polyhaploids. Several polyhaploid plants have been isolated in our laboratory from twin seedlings. Occasionally two or three plants develop from a single crested wheatgrass seed (figure 8). Very rarely, one of the plants contains half the chromosome number of the parent plant and the other twin plants. From over 2000 twin plants seven polyhaploids have been located.

The nature of chromosome pairing in polyhaploids furnishes critical proof of the type of polyploidy. Halving the chromosome number of an autotetraploid, AAAA BBBB — GGGG, would give rise to a polyhaploid plant with the diploid chromosome constitution, AABBCGG. Chromosome pairing in polyhaploids of this type should be two by two, the same as in a diploid. On the other hand, halving the chromosome complement of an autotetraploid, AABBCN, would give rise to a plant with AB-NN chromosomes. No chromosome pairing should occur in this polyhaploid since none of the chromosomes have like-chromosomes with which to pair. Thus if pairing in polyhaploids is consistently two by two, one may conclude that the tetraploid plant from which it was derived is a strict autotetraploid. However if no pairing occurs in the polyhaploid, the parent plant must be an allotetraploid.

Chromosome pairing in the crested wheatgrass polyhaploids was found to be almost exclusively in associations of two (figure 9). On the basis of these data and related information including chromosome pairing relations in crosses of diploid and tetraploid plants, it is now apparent that polyplid crested wheatgrasses are autoploids.

With this information, the plant breeder can adapt his methods and techniques to meet the specific plant breeding requirements of crested wheatgrass as dictated by its cytogenetic characteristics. Studies similar to these are continuing at the Utah Agricultural Experiment Station to provide basic background information so essential to a successful plant-improvement program.

PHOSPHORUS FOR DAIRY COWS

(Continued from page 103)

1960 comparison favors dicalcium phosphate over steamed bone meal

In January 1960, dicalcium phosphate supplements containing a guaranteed 18.5 and 21.0 percent phosphorus were compared with steamed bone meal. A 50:50 mix of steamed bone meal and salt, which had previously been shown to be the most palatable combination of the two, was compared with the two dicalcium phosphate products mixed with 75, 50, 25, and 0 percent salt.

Mineral boxes containing four compartments were available to each group of cows. During four successive 2-week periods, the four mixes were rotated in each of the compartments to avoid a positional influence on consumption.

The greatest amount of phosphorus was consumed from the boxes containing dicalcium phosphate without added salt. In all but one of the comparisons, with both the 18.5 and the 21 percent dicalcium phosphate, there was a definite increase in phosphorus consumption with each decrease in amount of salt. This suggests that the intake of mix is relatively constant irrespective of the amount of added salt. Forcing cows to consume additional amounts of salt
in such mixes may limit phosphorus intake of a cow below her needs.

In two or three comparisons between 18.5 and 21 percent dicalcium phosphate, the 18.5 percent product was consumed in greater amounts.

In two comparisons between steamed bone meal and the two dicalcium phosphates, the steamed bone meal was consumed in the least amounts.

In a second phase of the tests, comparisons were made between steamed bone meal and a 50 percent dicalcium phosphate, salt mix. In one series, the supplements were allowed to accumulate in the mineral boxes for the period of the trial; in the other the supplement was rotated for each of the four 2-week periods. Phosphorus consumed was 184 and 143 grams of the 21 percent dicalcium phosphate rotated and non-rotated, respectively, and 18 and 21 grams for the steamed bone meal. In the other comparison, 626 and 327 grams of 18.5 percent dicalcium phosphate were consumed for the rotated and non-rotated, respectively, as compared with 559 and 190 for the steamed bone meal. From these results it may be assumed that steamed bone meal is less palatable than either of the dicalcium phosphates and that all were less palatable when left in the mineral box than when changed every two weeks.

1961 study compares several phosphate supplements

In the 1960 tests, only one source of each of the phosphates was tested. Since there are differences in methods of manufacture of the dicalcium phosphates and there are other phosphate supplements on the market, the 1961 tests were expanded to include two 18.5 percent dicalcium phosphates; two 21 percent dicalcium phosphates; one defluorinated rock phosphate; one monosodium phosphate; one 9 percent commercial mix containing salt and dicalcium phosphate; one 6 percent mix containing dicalcium phosphate, monosodium phosphate, and salt; and a mix containing 50 percent salt and 50 percent monosodium phosphate. Salt without added phosphate was also included in some comparisons. A definite and consistent difference in phosphorus consumption was noted between the different sources of phosphorus. A difference in method of manufacture, acid residue, or other factors may contribute to this preference.

The 18.5 percent dicalcium phosphates were consumed in consistently larger quantities than the 21 percent. Monosodium phosphate compared favorably with the 18.5 percent dicalcium phosphate in palatability. Defluorinated phosphate seemed to be the least palatable form.

Phosphorus consumed in the two commercial mixes was less than in the 18.5 percent dicalcium phosphate but more than in defluorinated phosphate. This confirms our 1960 observation that mixing certain phosphate supplements with salt reduces consumption of phosphorus.

Cost of phosphorus varies

Prices of phosphorus supplements vary and any cost comparison is limited to the prices at a given time. However, a comparison permitting adaptation to price fluctuations can be of value under a changing pricing system. Such a comparison is shown in table 1. Prices of supplements can be compared as to cost of phosphorus rather than price per pound of supplement. For example, if 18.5 percent DCP costs $5.50 per hundred pounds, others to be comparatively economical for phosphorus should be priced at or below the following prices: 21 percent DCP $6.24; DP $5.65; MSP $7.58; 9 percent mix $2.67; 6 percent mix $1.78; SBM $3.56. When a mix contains other ingredients of value, some means of evaluating cost must be used other than assessing all the value to phosphorus.

What the results suggest

Although palatability is not the only important consideration in comparing phosphorus supplements, it does have a bearing on the acceptability by cows when fed free-choice. Free-choice feeding of mineral supplements has been recommended because of apparent differences in requirements of individual cows. It is assumed with some justification that cows will balance their needs if a palatable phosphorus is available. This does not assume a control of intake beyond needs, however. If a cow consumes amounts above her needs, the only problem assumed here is the added cost of the supplement. Under usual conditions this assumption is considered valid.

The inclusion of 1 to 2 percent phosphorus in the concentrate mix is still advised with free-choice feeding in covered mineral boxes readily accessible to the cows. Cows given grain mixes without added phosphate will consume considerably more phosphate supplement available free-choice. Heifers not receiving grain with added...
phosphorus should also have free-choice access to one of the supplements.

A consideration not to be overlooked in selection of a phosphate supplement is the fluoride content. Colloidal clays, rock phosphates, and others that have not been de-fluorinated should be avoided. Fluorine residue should not be more than 0.1 percent (1,000 ppm) to avoid excessive intake.

The trials reported here were conducted solely to compare palatability of several commercially available phosphorus supplements. Several types and brands were compared, but others are also available commercially. Changes in processing methods which have been made and which will likely yet be made can affect palatability. No practical means of determining the palatability is suggested other than to make available to the cow any supplement considered. Her acceptance based on amount consumed will serve as a guide to palatability.

Based on observations in this trial, it is recommended that salt and phosphorus supplement (except steamed bone meal) be made available free-choice in separate mineral boxes or separate compartments of the same box. Small amounts should be put out and fresh supplement added as needed. Any amounts remaining in the box longer than about two weeks may not be consumed readily and should be replaced.

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research reports

New federal apiculture laboratory

In April the basic contract was completed on a $110,000 laboratory and greenhouse building located east of the Rural Arts and southwest of the Automotive Technology Buildings. The one-floor masonry block structure has 3360 square feet of floor space and the two greenhouse wings each have 2441 square feet. The building, which is not designed for office space, has two large lab rooms, two general utility rooms, a cool room, and an 18 by 32-foot room designed for bees to use under conditions of controlled light, temperature, and humidity. There is one large greenhouse section designed for nesting and foraging by wild bees. The other four sections, designed for general use, are about standard size. Corridors run the length of the greenhouses so that each section can be entered separately. Another feature is the ventilation and cooling system which pulls air through evaporative cooling pads and across the sections.

The building was constructed primarily for the U.S. Bee Culture Laboratory. Personnel include George E. Bohart (laboratory head and specialist on pollination by wild bees), Marshall D. Levin, Elbert R. Jaycox, and William P. Nye (apiculturists), and Ross A. Nielsen (sub-professional). Studies underway or projected for the near future include (1) the effect of insecticides on honey bees, (2) the behavior of honey bees under controlled conditions, (3) propagation of wild bees, (4) development of various kinds of bees under different temperatures and humidities, (5) pollination of red clover and tomatoes under greenhouse conditions.

The Federal Vegetable Insects Laboratory will occupy one of the greenhouse sections and share space in the east laboratory. Howard E. Dorst, who heads the work of this unit, plans to rear colonies of the major intermountain vegetable crop pests for detailed biological studies and evaluation of effectiveness of insecticides.

The Zoology Department is now occupying one of the greenhouse sections and shares some of the laboratory space. Donald W. Davis, Austin B. Haws, and several of their graduate students are using the facilities for research on alfalfa seed chalcids, rodent parasites, and codling moths. Other smaller projects have already been completed.

It is expected that this fine new facility will greatly assist both federal and state research in entomology. Interested persons are invited to inspect the building, which was formally dedicated on October 26, 1961.

A new alfalfa pollinator for Utah

*Megachile rotundata* Fabr., a small leaf-cutting bee introduced from the Old World, reached
New way to control insect pests with chemical sterilants

Discovery that several chemicals prevent reproduction in insects could lead to improved control or eventually aid in eradicating some of mankind's worst pests.

USDA entomologists report that certain chemicals induce sterility in houseflies, mosquitoes, stable flies, screwworms, boll weevils, and Mexican fruit flies. The researchers believe chemical sterilization has potential advantages over sterilizing radiation.

By treating insects in laboratory-reared test colonies with minute quantities of sterilizing chemicals (chemosterilants), the scientists succeeded in halting reproduction. Sterilized females laid no eggs, and the eggs laid by fertile females that had mated with sterile males did not hatch.

In a preliminary field test entomologists nearly wiped out a population of houseflies with a bait containing a chemosterilant. The bait was applied once a week for five weeks to a heavily infested refuse dump. At the end of the fifth week only a few flies could be found, and 99 percent of those captured were sterile.

Potential advantages of inducing sterility to control insects were first suggested by Dr. Edward F. Knipping, head of USDA entomology research. This principle of insect self-annihilation is being intensively explored at a number of laboratories.

In the successful screwworm eradication program in the Southeast, laboratory-reared screwworm flies (adult screwworms), that had been sterilized while in the pupal stage by exposure to radioactive cobalt, were released in screwworm-infested areas. Because native females, after mating with sterilized males, laid eggs that did not hatch, the screwworm population was gradually reduced and finally eradicated.

Entomologists believe that for many insects chemosterilization may be more effective and more practical than sterilization by radioactive cobalt. A safe chemosterilant could be used in the field to sterilize native insect populations. Sterilization of both males and females would speed reduction of the population. Also, the job of rearing, sterilizing, and releasing males would be avoided, as well as any temporary damage that might be created by additional insects released into the area. If the infestation is large, the entomologists point out, field application of the chemosterilant could be more economical than releasing sterilized males.

Agricultural Research Service chemists provided approximately 2,000 chemicals of which the entomologists found more than 70 that showed some effect on insect reproduction. Most promising are a half-dozen derivations of ethylenemine, a family of relatively simple organic compounds composed of carbon, hydrogen, and nitrogen.

These chemicals are being used under carefully controlled conditions, because their effects on animals, plants, and beneficial insects have not been fully determined. However, the scientists are optimistic that chemosterilants will be found that can be applied safely and effectively against insect populations.

Key to the use of chemosterilants to cause self-annihilation of insects was the discovery at Orlando, Florida, more than a year ago of a chemical that sterilizes female houseflies and prevents them from producing fertile eggs, even after mating with normal males. This discovery led to a more intensive search for chemicals that would sterilize both sexes of houseflies and other insects without affecting their mating behavior.

Chemical growth retardants can increase plant salt tolerance

Growing of plants in highly saline soils may someday be possible if current research upholds early findings. Excessive accumulations of salts in the soil interfere with normal growth of crop plants in many areas of Utah.

In the preliminary studies made by scientists of the U. S. Department of Agriculture, certain chemicals that retard plant-stem growth were also found to prevent salt damage to plants growing in highly saline soils.

Soybean plants treated with chemical retardants and grown in soil made salty by excess fertilizer grew to maturity and produced some viable seeds. Untreated plants wilted within 24 hours and died within three weeks.

Researchers tested three chemical retardants — Amo-1618, phospon, and CCC. Each chemical was applied to the soil at the rate of 38 milligrams per plant — the equivalent of 15 pounds of chemical per acre. Amo-1618 was also applied as a spray to the foliage.

Seven to 12 days after treating the plants with growth-retardants, the researchers applied fertilizer in amounts varying from four to eight grams per plant. Four grams of fertilizer per 3-inch pot is equivalent to about 7,800 pounds per acre.

Fertilizer is not generally applied at these excessive rates in crop production. High rates were used in this research only because fertilizer
is a convenient source of several different chemical salts.

Chemically retarded plants treated with four to five grams of fertilizer were not damaged. The plants grew to maturity and produced viable seed. Yields were low, however. Six or seven grams of fertilizer caused some damage but the plants recovered and produced viable seed.

Plants not treated with a chemical retardant died when five or more grams of fertilizer were applied. Unretarded plants receiving four grams of fertilizer were damaged, but recovered. Eight grams of fertilizer killed both retarded and unretarded plants.

Plant-growth retardants are generally used to produce compact plants. But in addition to retarding plant-stem growth, retardants make leaves greener than those on untreated plants. In other experiments, bean plants treated with plant-growth retardants lived as much as 60 percent longer than untreated plants.

Human nutrition and consumer use research urged

Research to develop new knowledge of human nutrition and how consumers actually use the foods they buy has been recommended by the National Agricultural Research Advisory Committee.

Too little is known about how various foods and combinations of food contribute to health and vitality, the committee said. Thus, information is needed on the functions of amino acids, fatty acids, carbohydrates, minerals, and vitamins as a guide to the production, processing, marketing, and consumption of foods.

In addition, data also are needed on food composition and food consumption, including the adequacy of diets among various segments of the population.

Emphasis on six other broad areas of agricultural research was also urged. These include the need for expanded research on (1) elimination of undesirable residues from food and feed, (2) economic adjustments to balance production and consumption, (3) soil and water conservation and management, (4) new uses for farm and forest products, (5) merchandising and improvement of market quality, and (6) protection of crops, livestock, forests, and their products from disease, pest, and other losses.

Research to prevent undesirable residues — particularly pesticidal chemicals — involves basic work on insect physiology and pathology, the metabolism of chemicals in plants and animals, genetic and biological methods for control of weeds, diseases, and pests, and development of non-toxic chemicals. This research also includes work on the problem of radioactive residues in agriculture.

The committee said that solution of economic adjustment problems will require increased research to improve methods of estimating production, to improve analysis of supply, demand, and price, to determine the impact of various government agricultural programs, to develop profitable production adjustments, and to appraise foreign market demand and competition. Problems of low-income rural areas also call for attention.

Soil and water are indispensable resources that can be conserved if wisely used, the committee said in urging studies to find ways of preventing loss of soil productivity through wind and water erosion, leaching, oxidation, crop removal, soil compaction, and salt accumulation.

Expansion of basic research on the chemical and physical composition of agricultural products is needed to find valuable new non-food uses for them.

Plan resistance to the clover seed chalcid

Researchers at Utah State have determined that clear and definite differences exist in alfalfa varieties in their resistance to the clover seed chalcid. More than 7,000 individual plants representing more than 300 different kinds of alfalfa gathered from all over the world were examined for chalcid resistance during the summer of 1961. Three of these plants were found free of chalcids. These have been moved to the greenhouse for further confirmation of resistance. These same varieties had the least chalcid infestation in 1960 also.

Evidence accumulated suggests a
correlation between resistance and certain types of alfalfa. The alfalfas with the fewest chalcids are among the non-winter-hardy groups.

Some of the newer systemic insecticides (those absorbed by the plants) show promise for control of chalcids on alfalfa. The two phosphorus-containing materials, dimethoate and phosphamidon, were highly toxic to bees when taken up in the nectar. Phorate was not toxic when applied at comparable rates. Soil applications of these materials in granular form require higher dosages to cause bee mortality and offer hope that chalcid control can be achieved with reduced danger to honey bees and other pollinators.

—B. H. Haws and G. E. Bohart

**Phorate for the control of symphilans and rootmaggots in sugar beets**

Phorate is a promising insecticide for the control of symphilans and sugar beet rootmaggots. The insecticide is applied in a granular form in a 6-inch bank in the top 4 inches of soil at a rate of 2 pounds per acre immediately before seeding the sugar beets.

Symphilans while feeding on the seed reduce the emergence or germination and later the growth rate. Sugar beet rootmaggots feed on the seedlings themselves and thereby destroy the stand.

In tests by Utah Station entomologists, phorate increased the stand of beets 7 percent. It also increased yields by 4 tons per acre compared to untreated plots.

—H. E. Dorst

**Drosophila control in tomato fields**

Application of insecticide granules by machine from harvest roadways provides the first practical means of control of drosophila in tomato fields. In a field experiment at Palisades, Colorado, Diazinon 2½ percent granules thoroughly applied to large piles of culm peaches reduced the drosophila population 96.5 percent 15 days after application. In a field plot experiment at Willard, Utah, aldrin emulsion at 0.7 pound per acre, Korlan dust at 1½ pounds, Diazinon granules at 1 pound and Dylox soluble powder spray at 2 pounds per acre, reduced the infestation of drosophila egg on tomatoes 70 to 100 percent up to six days after application.