1976-A Fruitful Year Thanks to Agricultural Research
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Agricultural Research: Your Dollars Working for You

The research results that we chronicle in Utah Science represent returns on dollars invested by you. And according to conservative estimates, the rate of the return is an astounding 50 to 1.

The Utah Agricultural Experiment Station’s balance sheet shows that about 39.4 percent of its financing comes from state sources, 22.3 percent from the USDA, and 38.3 percent from various federal and industrial grants. The other western stations average 62.9 percent from state sources, 12.5 percent from the USDA, and 24.6 percent from grants. In reality, all the dollars invested in agricultural research come ultimately from consumers — you and I. And it is reassuring to know that our investment is regularly producing tangible benefits.

The hazard is that the productivity of past agricultural research, which we are reaping in today’s marketplace, will lull us into complacency. The only way to insure that the quality and quantity of tomorrow’s harvests continue to be adequate is to sustain a vigorous, imaginative research program. The Utah Agricultural Experiment Station is committed to just such an effort.

But that commitment can be fulfilled only if it is supported by understanding. An understanding that must flourish among those who have a stake in, and benefit from, research. So this and every issue of Utah Science is dedicated to nourishing the understanding of that group — the consumers — whether they are farmers, merchants, homemakers, doctors, construction workers, or something else. We welcome your comments as to whether we are on target.

December 1976
Snowmold is a disease of winter wheat that has plagued farmers of Northern Utah, Southern Idaho and the Northwest for more than fifty years. Crop losses have involved millions of dollars in reduced yields and reseeding costs. The damage is caused by molds of the *Typhula* and *Fusarium* genera. These organisms are widespread, but they can effectively attack the wheat only when winter snow cover is continuous and persists late in the spring. They are especially dangerous when the soil is not frozen.

The damage resulting from snowmold can range from an occasional plant to an entire field, with losses in excess of 50 percent usually requiring that the field be reseeded. In the winter of 1968-1969, the winter wheat crop in Northern Box Elder County was severely damaged by the mold.

In March of 1969, USU launched a research program to help solve the problem. Workers in the state of Washington had shown that snowmold losses could be reduced by using a blackening agent to hasten spring snow melt. Preliminary trials by USU's Wade G. Dewey on an irrigated site in Cache Valley supported the Washington findings. Based on this information, a series of trials was initiated.

**Testing Furnace Ash**

The first studies involved furnace ash obtained from the coal-fired heating plant at USU. The material was applied by a cropdusting plane at the rate of 200 pounds per acre. The ash *did* accelerate snow melt, and the incidence of snowmold was markedly reduced on treated areas. Untreated sites suffered considerable losses. The aerial treatments were effective whenever the ash could be applied before damage occurred.

When an airplane is used, the ash must be applied when winds are negligible since drift can be significant. Also, to be economically feasible, the aircraft should be able to land near the field to be treated. We generally could use a hard-surface county road. On a number of occasions, however, snow and ice or high snow banks resulting from the road being plowed made landing impossible. The resultant delay in ash
applications often allowed snowmold damage to develop before the field could be treated.

During the past three seasons, we've applied ash from a powered fertilizer spreader mounted on a sleigh and pulled by a snowmobile. By using such equipment we've been able to make detailed studies of the effects of variations in time, frequency and rate of ash application.

As part of this work, we measured temperatures under the snow and at various soil depths. In addition, we noted soil conditions under the snow. Eventually we were able to draw the following conclusions.

The Hows and Whys

Snowmold rarely develops when a soil remains frozen throughout the winter. But whether or not a soil freezes and how long it stays frozen depends on a number of factors. For example, soil freezes only when water is present. Therefore, dry soils rarely freeze. Loose soils are less likely to freeze than firm soils. Farmers have observed for many years that fields planted with a disk drill suffer less snowmold than those planted with a deep furrowing unit. We now know that this situation is related to the associated looseness or density of soil and its subsequent susceptibility to freezing. Continuously cropped soils suffer more snowmold than those under a crop/fallow program, again with part of the cause related to soil density.

In Northern Utah, moist soils
without early snow cover usually freeze to a depth of 4 to 6 inches when subjected to low (30°F or under) temperatures. We've rarely seen soils frozen to greater depths.

Once the soil is covered by 6 or more inches of snow, air temperatures have little effect. As the snow depth approaches 18 to 24 inches, the summer heat stored in the soil begins to thaw the soil frost at its deepest level of penetration. This thawing then works its way upward. If deep snow comes in November or early December, it is not unusual for 4 inches of soil frost to be lost to this thawing effect by mid February. We've seen a complete loss of soil frost as early as January 15th. When the soil does not freeze in the fall, either from lack of moisture or an early deep snow cover, it usually remains unfrozen throughout the winter.

Temperatures at the snow/soil interface usually remain about 31 degrees Farenheit over frozen soil. With nonfrozen soil under deep snow, we've measured temperatures of 32-33 degrees Farenheit. This small difference in temperature is sufficient to either inhibit or promote the growth of the snowmold organisms. Once the soil frost is lost, and the snow/soil interface temperature reaches 33°F, the snow begins to melt. With temperatures below the snow above freezing and the moist environment resulting from the melting snow, snowmold can spread rapidly. Where wheat is seeded with a deep furrow drill, tunnels begin to develop above the drill row as a result of the interface heat exchange. Under these conditions, the mold thrives.

Minimizing Snowmold Damage

Snowmold development can be stopped either by freezing temperatures at the snow/soil interface or by removal of the snow. By applying furnace ash, we've controlled snowmold in both ways. The ash sometimes removes the snow and other times reduces snow depths to levels that allow the soil to freeze. The melting induced by the ash changes snow density and thus significantly reduces its insulating capability. In cases of snow removal, subsequent snows have not promoted snowmold growth.

The stage of growth of the wheat plant as it goes into the winter seems to influence its susceptibility to snowmold. Our date-of-planting studies at the Blue Creek Farm in Northern Utah have shown that large, well-tillered plants and very small plants survive and recover from the disease better than do medium-sized plants (see Figure 1). Utah farmers, however, have observed the opposite effect, with medium-sized plants surviving while early and late plantings died. Workers at Washington State University suggest that early plantings result in well-tillered plants capable of surviving the disease. Under Utah conditions, not even well-tillered plants have survived severe infestations. These contradictory data may be attributed to the number of factors that can affect the course of the disease.

At the present time, no com-
mercial wheat varieties are resistant to snowmold, although progress is being made in developing strains that are less susceptible and have greater regrowth capability. Meanwhile, the application of furnace ash at the proper time seems the best solution.

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Raymond L. Cartee is Research Associate, Department of Soil Science and Biometeorology, USU.

Cereal Disease Research

James A. Hoffmann

Figure 1. Dwarf smut spores as seen under the microscope (magnified approximately 1,500 times).

In the fall of 1972, a portion of the USDA cereal disease program at Pullman, Washington, was transferred to Logan, Utah. The transfer was effected to provide the cereal breeding programs of the Intermountain area with on-the-scene support in pathology. It was also undertaken to give the USDA pathologists a more favorable environment in which to study the dwarf smut disease of winter wheat. Dwarf smut is the major wheat disease problem in the Intermountain area, and in 1973 and 1974 disrupted the area’s plans to export wheat to the People’s Republic of China. Since the Chinese believe that the dwarf smut fungus is not present in their country, they are understandably opposed to taking a chance on introducing it.
Figure 2. A healthy wheat plant on the left and a dwarf smutted plant on the right. Note considerable proliferation of the stalk and a 50 percent reduction in the size of the diseased plant.

Figure 3. In these individual spikes of wheat, the awns or beards are extremely ragged in the smutted sample on the left. The black smut balls have replaced the kernels of wheat. The wheat spike on the right is completely healthy.

Figure 4. This smutty cloud was a common sight in the Intermountain West during the wheat harvest for many years.
About 600,000 acres in 7 western states are known to be infested with the dwarf smut organism. These 600,000 acres normally produce about 22 million bushels of wheat. With susceptible wheat varieties and favorable weather conditions such as a persistent snow cover, disease incidence may exceed 60 percent. Conservatively estimating the average disease incidence to be about 5 percent, losses in yield may amount to 3.3 million dollars annually over the region. Penalty dockages for smutty grain would impose an additional one million dollar loss on producers.

Laboratory Functions

The main objective of the Logan-based USDA Cereal Disease Research Program is to achieve lasting control of the dwarf smut fungus. As Dr. Dewey's article details, the primary method of control has been and still is the development and use of resistant cultivars. The USDA's efforts are therefore being closely coordinated with USU's cereal breeding projects as well as those in other western states.

One of our complementary functions has been to locate sources of resistance in the World Wheat Collection to be used by breeders as parent material. We then are available to test breeders' selections for smut resistance.

We also devote substantial time and energy to identifying new pathogenic races. This is essential because new races of the fungus arise rapidly through mutation and hybridization (For more about this process, see Dr. Dewey's article in this issue). After identification, we notify the plant breeders of any changes in virulence. They then can modify their efforts and hopefully stay ahead of the pathogen. For example, five new 'dwarf smut resistant varieties (including those developed by Dr. Dewey) have been released since 1973, and already races of smut that can attack these varieties have been identified.

Fungicide Tests

Because it seems unlikely that varietal resistance will ever provide the reliably enduring control growers need, other methods are also being sought. One approach that was tested early in the campaign involved chemically treating wheat seed. Spores on seed surfaces can be easily killed with such chemicals; unfortunately, nearly all the infection results from the spores in or on the soil. These soil-inhabiting spores are long-lived (often over 10 years) and are little affected by seed treatment. Most dwarf smut infection thus takes place through plant tissues that are near the soil surface during winter rather than through the seed. Consequently, a fungicide that is active only at the seed surface is in the wrong place at the wrong time.

Application of fungicides to the soil surface after seeding have provided good control of dwarf smut, but quantities, costs, and most significantly, potential environmental hazards have precluded their use in this country. The ideal chemical treatment would be one that could be applied in small quantities to the seed, and would be gradually absorbed by the growing wheat plant to provide it with a built-in protection against smut fungus invasion. These types of fungicides, known as systemic fungicides, have been used successfully against a number of other plant diseases and are just beginning to come onto the dwarf smut scene.

Tests conducted cooperatively with Dr. Dewey and his students with a number of systemic fungicides have shown promising, though somewhat variable results. Such factors as planting date, rate and extent of fall growth, weather conditions, etc., may be significantly affecting the effectiveness of these fungicides against dwarf smut. They show great promise and will become a useful tool in conjunction with varietal resistance in keeping dwarf smut under control. One fungicide has now been registered and will be available for use in the fall of 1977.

Two-way Attack Essential

The regrettable conclusion is that, at present, neither resistant varieties nor seed treatment fungicides used alone can give us a stable control over dwarf smut. Our best hope lies in perfecting less expensive and more effective fungicides followed by an integrated use of them with resistant varieties, perhaps combined with certain cultural practices. A comparable approach achieved essentially complete control of the more docile common smut approximately 20 year ago.

Until last year, nearly all of our research resources had to be concentrated on identifying sources of resistance, screening
varieties and fungicides, and identifying pathogenic races. But then a significant increase in program budget allowed us to start badly needed fundamental research on the biology of the dwarf smut organism. These basic studies include investigations of: the cytology and genetics of the smut organisms, the effects of environment and cultural practices on smut development, and the ability of the smut fungi to develop tolerance to fungicides.

Through the coordination of this expanded USDA research program with that of cereal breeders such as USU’s Wade G. Dewey, it is reasonable to expect eventual control or even elimination of the threat posed by dwarf smut. That achievement could reopen China as a market for Western wheat as well as assuring producers of a better price on the domestic market.

James A. Hoffmann is Research Professor, Department of Plant Science, USU and Federal Collaborator, ARS, USDA.

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Dwarf Smut vs. Winter Wheat in Utah

Wade G. Dewey

Approximately 1/3 of Utah’s total cropland is nonirrigated. Precipitation over much of this dryland acreage is frequently in the marginal range for successful crop production; consequently, the choice of crops is limited. Wheat, and particularly winter wheat, has generally proven to be the best choice, and often is about the only feasible crop for these moisture-deficient areas. Winter wheat is therefore a major source of agricultural income for Utah, returning some $20 million annually to the state’s farmers. It also forms the basis for our multimillion dollar milling and baking industries and contributes significantly to Utah’s poultry and livestock feeding operations.

Dwarf Smut Hazards

Although winter wheat and its related industries are presently flourishing in Utah, it has not always been so. We were nearly put out of the wheat-growing business in the 1930s, and have had serious setbacks as recently as the early 1970s. The culprit in both instances has been a disease known as dwarf smut. This disease is caused by a fungus whose long-lived spores inhabit the soil. (See James A. Hoffmann’s article for details of the infection process.)

Grower losses result from yield reductions, which are approximately in proportion to the percent infection in the field, and from “dockage” penalties imposed at the mill for smutty wheat. Before a miller can make usable flour out of such wheat, it must be washed and dried, and even then the washed wheat can only be used in limited proportions with smut-free wheat. This extra handling and processing adds considerably to the costs of milling and baking – which costs have a way of filtering down to the consumer.

Dwarf smut first made itself felt in Utah in the late 1920s. It obstinately failed to respond to the seed treatments (blue vitriol, brine soakings, etc.) that had afforded adequate control of ordinary smut. By 1930 approxi-
mately 75 percent of the car-
loads of wheat arriving at the
Ogden and Salt Lake milling
terminals were grading smutty.
With wheat-growing in Utah on
the verge of becoming unprofit-
able, a crash program was
initiated at USU (then USAC) to
come up with a way to combat
dwarf smut. It was found in
plant breeding, i.e., in building
genetic resistance into varieties
of wheat adapted to Utah’s
drylands. The first release was
aptly named Relief. It was fol-
lowed by Cache and Wasatch in
the late 1930s and early 1940s.
As these varieties came into
general use, dwarf smut declined
in incidence (Figure 3), until by
the 1950s the problem appeared
to be licked. (We should have
known better!)

A Recurring Threat

In the early 1960s reports
began coming into the Agricul-
tural Experiment Station at USU
that previously resistant varieties
were “breaking down.” Cache,
which had become the pre-
dominant dryland wheat variety
in Utah, was said to be “running
out” or losing its resistance. A
quick check with the USDA
Regional Cereal Disease Labora-
tory at Pullman, Washington,
confirmed our suspicions that
Cache had not changed, but that
a newly arisen race (or combina-
tion of races) of dwarf smut was
overcoming the resistance genes
in Cache. To our dismay this new
race (or races) could also attack
our two newest releases, Delmar
and Bridger, which had been
bred specifically for bread-
making quality and were being
groomed to replace Cache.

By 1970, smutty wheat was
once more pouring into the mill-
ing terminals, with yield reduc-
tions and smut dockage penalties
again cutting significantly into
grower receipts. Black clouds of
smut were belching out behind
the combines (Figure 1), and the
machines and their operators
were coated with a black layer of
smut after cutting fields of
Cache, Delmar and Bridger. Some
fields were running over 50
percent smutted, and several of
the larger growers in the hardest-
hit areas of Box Elder County
(Utah’s largest wheat producing
county) reported annual losses as
high as $35,000-$40,000.

VARIETAL DEVELOPMENT PROCESSES

Fortunately this time we
didn’t have to start from the
bottom, as in the 1930s. Breed-
ing lines, at fairly advanced test-
ing stages were already in the
system, and some showed high
levels of resistance to these new
races of smut. Two lines, which
derived their smut resistance
from an otherwise worthless
wheat from Turkey and their
breadmaking quality from Delmar and Bridger, were selected for increase and release. The varieties were named Hansel and Cardon: Hansel after Hansel Valley, one of the chronic dwarf smut areas of Box Elder County; and Cardon after P.V. Cardon, a former Director of the Utah Agricultural Experiment Station.

Since new strains usually begin from a single plant, then progress to a few pounds of Breeder's Seed and then to a few acres producing Foundation Seed, the development of a new variety is always gradual. It takes several years after the release-decision has been made for a promising variety to reach commercial production. Hansel and Cardon were released to growers on a limited basis in 1974. To spread the seed as far as possible, each farmer was limited to 30 bushels. This would plant about 30 acres, which in turn would provide seed for approximately 1,000 acres the following year. 1976 was the first year these varieties could be grown on extensive acreages in Utah, and it appears that they have significantly helped to bring the dwarf smut problem back into check.

Growers in some of the worst dwarf smut areas of Cache and Box Elder counties cut clean wheat in 1976, for the first time in several years. The bulk of the dryland wheat acreage in dwarf smut-infested areas of Utah and southern Idaho was planted this fall to these varieties and to several other resistant varieties developed in Idaho. Hopefully, our dryland wheat producers, as well as the miller, the baker, and ultimately the consumer, can now enjoy the benefits of a

![Figure 2. Kernels from a healthy wheat plant at the bottom as compared to the darkened and shriveled kernels from a smelly wheat plant at the top.](Photo by Wade G. Dewey)
healthy winter wheat industry for several years to come.

What Next?

Unfortunately, unless past patterns are disrupted, the reprieve will be temporary. The dwarf smut fungus may be down, but it most certainly can not be assumed out. Because it has genes and chromosomes just as wheat does, it is capable of hybridizing, mutating and developing new races in much the same way that we develop new varieties of wheat. In all probability, therefore, within a few years we can expect reports to start filtering in from growers that Hansel and Cardon are “running out”, that they are “losing their resistance”, and the cycle will begin again.

Suspecting this course of events, and knowing all too well that varietal development often takes 10 to 15 years from the initial cross to the time the variety reaches the farmers’ fields, we continually have breeding materials on the drawing board. It is too late to begin the process the day a problem or need is discovered. For example, several years before Hansel and Cardon were released, crosses were being made using different sources of smut resistance. This was our hedge against the resistance of those two varieties being overcome by new races of smut. Some of those lines are approaching the advanced testing stages and will be waiting in the wings if (when) the presently satisfactory varieties begin to falter.

There is always the sobering possibility, however, that we may run out of resistance genes in wheat before the dwarf smut fungus runs out of new races. The potential use of systemic fungicides (See Dr. Hoffmann’s article in this issue for details.) is therefore encouraging since it may help us conserve our supply of resistance genes and tip the balance in favor of the wheat. As ingenious as the fungus has been thus far in matching the best efforts of wheat breeders, we will likely need both genes and fungicides to keep it in check in the future.

Wade G. Dewey is Professor, Department of Plant Science, USU.
USU and Utah’s Rangeland Development

Frank E. (Fee) Busby, Don D. Dwyer, Doyle J. Matthews, and J. Clark Ballard

Utah’s 48 million acres of rangeland produce forage for wild and domestic animals, are crucial watersheds for urban areas, and provide scenic beauty and recreational opportunities to residents and nonresidents alike. Until recently, the importance of these lands has not been understood by the general public. No agency or group existed at local, state or national levels to provide coordination and leadership in the proper use and management of these lands.

Then in January 1973, Utah’s Rangeland Development Committee was established by the Utah State Department of Agriculture. Committee membership* includes representatives of the private, state and federal organizations most concerned with the proper development and management of our state’s range resources. The primary purpose of this Committee is to provide a forum where problems of Utah’s rangelands can be identified and discussed before they become critical. USU Extension, with financial assistance from the Four Corners Regional Commission, provides an executive secretary to assist this committee in its coordination and promotion efforts.

Once the problems are recognized, action programs are initiated. For example, by working with comparable groups in other western states and with congress, the Range Development Committee has been able to promote better funding of the Bureau of Land Management and the Forest Service for range management and development activities. Legislation presently being considered by congress would provide an even more realistic level.

The Committee is also working to translate information in agency files about the extent, ownership, ecological condition, and development potential of our rangelands into a useful data base for decision makers. With assistance from the Four Corners Regional Commission, the Committee is initially concentrating on the management and development needs of rangelands in central Utah.

To give the average citizen a better understanding of range resources, the Committee initiated a public information program utilizing TV, newspapers, radio, and other media. Most of these public relations programs have been coordinated by USU Extension.

Utah’s Rangeland Development Fund

Economists at USU have long preached that many private land owners are kept from adapting range improvement practices by financial barriers. One prime obstacle has been the need to rest rangeland while desirable forage species become established, particularly following brush management and reseeding projects. During such “rest”, the rancher has to either sell the animals that would normally graze on that land or lease additional lands. Either approach generally equates with economic hardship. When the rancher couples this with the high interest rates he’d have to pay on money borrowed to finance the original improvement program, he tends to decide against the whole idea.
In response to such economic realities, Utah’s Rangeland Development Committee worked with the Utah Legislature to create Utah’s Rangeland Development Fund. Personnel at USU produced educational materials designed to inform Utah Legislators of the importance and development needs of Utah’s rangelands. The initial appropriation of $250,000 is available to individuals or groups who need help to apply costs of range improvements on private lands.

The Fund is managed by local Soil Conservation Districts and the Utah Soil Conservation Commission in such a way that the land owner is guaranteed access to the funds needed to conduct a long-term development program. The borrower must fully repay the Development Fund, but payments do not have to start until the improved land is ready for use. Also, no interest is charged. Thus, the first loans from Utah’s Rangeland Development Fund (awarded in October to five recipients) are benefiting Utah land by actively helping ranchers overcome previously insurmountable financial barriers.

**Coordinated Range Resource Planning**

Most livestock operations in Utah have to utilize lands owned or administered by several landlords, which can include: private interests, Utah’s Division of State Lands, Utah’s Division of Wildlife Resources, Bureau of Land Management, and Forest Service. Unfortunately for the livestockman, each agency landlord probably has its own set of management objectives. As a result, the rancher repeatedly has to adjust his operation as agency objectives change, and promising management opportunities are missed because diverse ownership boundaries prohibit a unified approach to the land.

To try to solve this costly dilemma, Utah State University, with funding from the Four Corners Regional Commission, has been working with private, state, and federal landlords to develop several demonstration units in which the resources of all concerned groups are addressed in one management and development plan. Ranchers and agency personnel who have participated in the program report that it is the best management advance that they have ever seen.

A typical result near Vernal, Utah, has been the combining of private, Bureau of Land Management, and Forest Service lands (each ownership separated by several miles) into one grazing system. Under this combined system, two ownership units are grazed while the third is rested. The system has saved the agencies about $12,000 in anticipated fencing costs, as well as providing an efficient use of the grazing resource. Other benefits have included: trade-offs of land use that help wildlife species, more efficient use of limited water resources, reduced cost of improvement projects as several landlords cooperate to contract for large acreages, and

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*Figure 1. Range resource planning—particularly coordinated planning—requires that those involved in the development of the plan meet in the field and discuss management alternatives.*

Photo by Michael Ralphs

December 1976
land use exchanges that increase the number and kinds of recreation opportunities.

As livestock, range, wildlife, soil conservation, agronomy, and recreation specialists from the management agencies and Utah State University have coordinated their efforts and worked with the ranchers and other concerned groups, they've accomplished goals that probably would never have been achieved through the traditional procedures.

USU and BLM Grazing Plans

The Bureau of Land Management (BLM) is currently required to write environmental impact statements for their livestock grazing programs. These impact statements are to be based on management plans developed for BLM allotments. The planning process involves inventorying the resources in each grazing allotment, establishing management objectives, designing an appropriate grazing system for the land and livestock operations in question, and identifying needed improvement and management practices. The resultant management plans will direct livestock use on BLM lands for many years. Thus it is to their advantage for local livestock operators to work with the BLM in developing the allotment management plans.

To facilitate rancher involvement, Utah State University’s Colleges of Agriculture and of Natural Resources, the Utah State Department of Agriculture, and the BLM are cooperating in devising an explanatory program.

Since the first environmental impact statement relative to Utah involves a 563,000-acre, hot-desert area in Washington County, initial efforts are being concentrated there. Ranchers in the area are being encouraged to contribute their valuable knowledge about land and livestock interactions to those trying to develop practical allotment and impact statement plans.

USU Extension has also made range and livestock management specialists available to ranchers throughout the state and to the BLM as sources of up-to-date information relevant to the planning process. USU research data is often serving as a “third-party” opinion to help ranchers and the BLM solve problems.

Demonstration and Extension Programs

Researchers, ranchers and agency personnel have recently rediscovered fire as a rangeland management tool. Converting brush lands to a grass-dominated system can be accomplished by chemical or mechanical means, but increased costs are making many of these methods inefficient.

Photo by Michael Ralphs

Figure 2. Prescribed burning involves the careful use of fire to achieve range management objectives. Cooperation from all concerned groups is required.
economically unfeasible. The old, natural method of burning seems to offer a useful alternative.

USU Extension personnel, with assistance from the Four Corners Regional Commission, have worked with local land owners and agency personnel to plan and initiate several burning projects to demonstrate fire as a management tool. One effective project was conducted at Park Valley, Utah, as a result of cooperative planning among USU range specialists, local ranchers, and concerned agencies.

Approximately 800 acres of a 1300-acre pasture, dominated by sagebrush and producing only 25 pounds of usable forage per acre were burned and seeded in the fall of 1974. Usable forage production had increased to 400 pounds per acre by 1975 and 700 pounds per acre by 1976. Fire and reseeding increased forage production on the 800 acres to more than 10 times the production on the entire ranch prior to treatment.

Neighboring ranchers took note of the results, and over 9,000 acres of land were burned in the Park Valley area in 1976. This type of demonstration project is significantly affecting the economic base of this and other areas in the state.

Summary

The program is accomplishing sound objectives: informing the citizens of Utah about rangeland and its uses, compiling resource data, seeking funds for desirable programs, providing technical assistance to ranchers and management agencies, encouraging needed research, and demonstrating proven practices. And above all, the program has encouraged highly productive cooperation among individual ranchers and agency personnel who are concerned with the management of our range resources. Unprecedented progress is being made through these cooperative efforts.

*Utah Cattlemen's Association, Utah Woolgrowers, Multi-County Planning Districts, Utah Agricultural Land Owners Association, Utah Association of Soil Conservation Districts, Utah Wildlife and Outdoor Recreation Federation, Ute Indian Rangeland Development Committee, Utah Division of State Lands, Utah Division of Wildlife Resources, Utah State Department of Agriculture, Agricultural Stabilization and Conservation Service, Bureau of Land Management, Farmers Home Administration, Forest Service, Intermountain Forest and Range Experiment Station, Soil Conservation Service and Utah State University.

Frank E. (Fee) Busby is Assistant Professor, Department of Range Science and Range Specialist, College of Natural Resources and Extension, USU.

Don D. Dwyer is Head and Professor, Department of Range Science, USU.

Doyle J. Matthews is Dean, College of Agriculture; Director, Agricultural Experiment Station; and Professor, Department of Animal, Dairy and Veterinary Sciences, USU.

J. Clark Ballard is Vice President, University Extension and Continuing Education and Professor, Department of Plant Science, USU.
As world population inexorably moves toward the 6 billion predicted for the turn of the century, 120 million hungry babies are born each year. Many of them are destined to spend their entire lives malnourished and without hope. Since the present 2 percent annual rate of population growth seems likely to persist through the foreseeable future, an urgent question for all of us in agriculture is: Has the stork passed the plow too emphatically for us to reverse today’s patterns?

A substantial part of USU’s efforts to insure an optimistic answer, centers around improving livestock utilization of range feed and other forages, as well as other rangeland research and demonstration programs. The overall aim has consistently been to achieve a more efficient, imaginative use of Utah’s rangeland resources.

Today’s economic and population realities, however, have broadened our viewpoint and caused some shifts in emphasis. For example, America can be highly competitive on world markets with her production of cereal grains. Foreign trade in cereal grains greatly helps in boosting the sagging American dollar. Unfortunately, some 7 gallons of increasingly hard-to-come-by fuel are consumed for each ton of cereal grain produced.

The growing need for US grain as a world trade item and our sudden realization that fossil fuel does not exist in unlimited supply have promoted a reevaluation of grain use in livestock production, particularly of beef animals. Over the past 25 years, American cattle production systems have come to utilize high concentrate (grain) rations as a finishing step. Presently, US beef cattle derive 25 percent of their total feed from concentrates. The resultant high quality beef has become, at 120 pounds per capita annual consumption, the number one American food. The challenge now is to maintain quality, while upping use of hay and rangeland forage and cutting grain consumption.

At USU we are using three primary approaches: modifying forage-eating livestock, devising new feedlot systems for “finishing” meat animals, and revitalizing rangelands and their vegetative cover.

The Animals

For nearly three-quarters of a century Utah’s range cattle have been predominately of Hereford or Angus breeding. During recent years exotic breeds have been introduced in hope of capitalizing on their large body size and rapid gains. Exotics are being crossed with the basic range Hereford and Angus and the genetic composition of Utah range herds is changing markedly. These changes are occurring despite a lack of reliable data on the ability of the new types to flourish under Utah range conditions and to produce quality beef with a maximum-forage diet.

To gain the needed information, Station personnel have started studies in which they’ll compare different genetic strains of cattle. Production systems that maximize use of forage (including combinations of reseeded range, native range and irrigated pastures) will be tested. In addition, feedlot rations involving different concentrate levels will
be fed to the various strains of cattle after they've been raised on a specified roughage utilization system.

Basic data will be collected at each stage of each production system. These values can then be incorporated into simulation models and by use of the computer the most promising combinations can be determined and recommended to Utah’s cattlemen.

The Feedlot

Pasture fattening instead of feedlot (grain) finishing is another possibility under investigation. Irrigated pastures of alfalfa and grass combinations gave good gains in our studies. In our most recent tests, animals grazing straight alfalfa supplemented with a small amount of grain, as a carrier for a bloat preventative, made average daily gains of 1.56 pounds. Each acre of such pasture produced 1,686 pounds of good quality beef.

Another possible way to decrease concentrate requirements in beef production is to use fewer concentrates and more roughages in the feedlot. Such rations have been tested in a preliminary way in a commercial feedlot during a cooperative study by the New Mexico, Arizona and Utah Experiment Stations. Our first year’s results indicate that satisfactory feedlot gains may be obtained with reduced concentrate levels.

The Land

In the past three decades, notable increases in range forage production have been achieved by improved management practices and through reseeding. Our studies with reseeded crested wheatgrass pastures have demonstrated that reseeded areas are ready for grazing earlier in the spring and have 4 to 10 times the carrying capacity of adjoining unreseeded areas. Cows grazing the reseeded areas averaged 2.49-pound daily gains, while their suckling calves averaged 1.77 pounds and yearlings averaged 2.47 pounds during the spring grazing season.

Effective coordination of high quality summer ranges with an early spring use of reseeded areas can give a potential 200-day period for good gains by steers. Such steers would require a minimum amount of concentrate feeding before going to market.

In other range work, researchers in the Departments of Biology (entomology) and Range Science are studying the impact of insects on rangeland production. The scientists suspect that the black-grass bugs and other insects may be harvesting more forage than are cattle, sheep and game animals. The researchers are therefore trying to develop ecological and cultural methods that will control these insect populations at low levels, thus making more forage available to livestock and wildlife, and for watershed protection. Financial assistance for such research is being provided by the Utah Agricultural Experiment Station and the Four Corners Regional Commission.

The genetic composition of Utah range herds is changing markedly due to exotics being crossed with Hereford and Angus cattle.

Cooperative research efforts among USU, USDA Agricultural Research Service, and Intermountain Forest and Range Experiment Station personnel are determining the best potential uses of native shrubs and new grass varieties developed through cross breeding. The goal is to create vegetation that will increase overall rangeland production, nutritionally enhance the diets of range livestock and wildlife, and improve our ability to protect watersheds.

All of USU’s range-related research is expected to not only enhance the productive use of Utah’s extensive rangelands, but to have a favorable effect on national and world food prospects.

James A. Bennett is Professor, Department of Animal, Dairy and Veterinary Sciences, USU.
Who'll be doing the work in Utah in 1980 and 1985? Is your age and sex group going to be more—or less—of a factor in the work force as the years go by? How will Utah's situation compare to that in the United States as a whole?

Answers to such questions can do more than just satisfy curiosity. They can be of value to government and industry officials who want to optimize their use of labor force potentials. Virtually all manpower and planning programs depend on population and labor force projections. The study that is briefly summarized here was undertaken to provide the requisite data to those who are trying to plan for the future.

The labor force projections for Utah assume that the relative differences in the labor force participation rates between the state and the nation will continue to exist throughout the projection period with only relatively small deviations.

Unemployment rates for both the United States and Utah are expected to continue to follow historical trends, which have been roughly 5 to 6 percent unemployment since 1948, excluding the Korean and Vietnam war years. On this basis, our projections for Utah in this study include an assumed unemployment rate of roughly 5.5 percent in 1980 and 1985.

The most dramatic trend will be the continuing movement of married women into paid employment.

The projections are also limited by: possible errors in the data used such as under- or over-enumeration in the census, the accuracy of the United States labor force projections, and the accuracy of the Utah population projections.

Projections of Population

According to our population projections for Utah, as calculated from Table 2, the total working-age population (16 years old and over) will increase from 682,543 in 1970 to 942,202 in 1980. By groups, the increases will be 4,258 for the 16- to 17-year-olds, 7,611 for the 18- to 19-year-olds, 38,405 for the 20- to 24-year-olds, and 105,959 for the 25-
notable is within the 25- to 34-year-old group (Table 3). The projected increase of 73,756 between 1970 and 1980 reflects a major shift in the age distribution of the labor force as the large number of persons born after 1945 move into this age category. The participation rates for males 25 to 34 years old are projected to remain stable, while the participation rates for females are expected to increase by 4.8 percent.

Another noteworthy shift within the age groups involves Utah's oldest workers (65 years old and over). This group will increase only from 14,526 to 17,298 between 1970 and 1980. The national trend toward earlier retirements seems to explain the declining participation rates for both males and females of this age group. Despite substantial increases in total population for this group, the reduced labor force participation rates mean only a slight increase in workers aged 65 years or older.

Projections of the Labor Force in 1985

The Utah labor force is projected to increase from 566,085 in 1980 to 636,476 in 1985, an increase of 12 percent (see Table 4).

The outstanding feature of the projected 1980 to 1985 period in Utah is the slower pace of labor force growth—an 8 percent decline in a five-year period. Also significant is the shift of the bulk of the labor force from the 25-

### Table 1. United States labor force participation rates by age and sex, actual 1970, and projected 1980 and 1985

<table>
<thead>
<tr>
<th>Age</th>
<th>Actual Participation Rate 1970</th>
<th>Projected Participation Rate 1980</th>
<th>Projected Participation Rate 1985</th>
</tr>
</thead>
<tbody>
<tr>
<td>MALE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16-17</td>
<td>46.7</td>
<td>45.9</td>
<td>45.6</td>
</tr>
<tr>
<td>18-19</td>
<td>68.8</td>
<td>65.8</td>
<td>65.1</td>
</tr>
<tr>
<td>20-24</td>
<td>85.1</td>
<td>83.0</td>
<td>82.5</td>
</tr>
<tr>
<td>25-34</td>
<td>95.0</td>
<td>94.6</td>
<td>94.4</td>
</tr>
<tr>
<td>35-44</td>
<td>95.7</td>
<td>95.1</td>
<td>94.9</td>
</tr>
<tr>
<td>45-64</td>
<td>87.9</td>
<td>85.8</td>
<td>85.1</td>
</tr>
<tr>
<td>65+</td>
<td>25.8</td>
<td>21.2</td>
<td>20.0</td>
</tr>
<tr>
<td>16 years &amp; over</td>
<td>79.2</td>
<td>78.0</td>
<td>78.3</td>
</tr>
<tr>
<td>FEMALE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16-17</td>
<td>34.6</td>
<td>36.0</td>
<td>36.7</td>
</tr>
<tr>
<td>18-19</td>
<td>53.4</td>
<td>54.8</td>
<td>55.7</td>
</tr>
<tr>
<td>20-24</td>
<td>57.5</td>
<td>63.4</td>
<td>64.9</td>
</tr>
<tr>
<td>25-34</td>
<td>44.8</td>
<td>50.2</td>
<td>50.9</td>
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<tr>
<td>35-44</td>
<td>50.9</td>
<td>53.2</td>
<td>54.4</td>
</tr>
<tr>
<td>45-64</td>
<td>48.8</td>
<td>50.5</td>
<td>51.3</td>
</tr>
<tr>
<td>65+</td>
<td>9.2</td>
<td>8.6</td>
<td>8.5</td>
</tr>
<tr>
<td>16 years &amp; over</td>
<td>42.8</td>
<td>45.0</td>
<td>45.6</td>
</tr>
</tbody>
</table>

The number of young workers (from 16 to 24 years old) is projected to decline by 3,375 due to the effect of the assumed continued growth of school enrollment.

Throughout the projection period, expected trends in labor force participation rates have included a declining participation of males in the younger ages due to increased schooling, while continued high participation rates were expected for men in the central ages. The participation rates for older men show a declining trend due to earlier retirement benefits. The participation rates for younger women are expected to be somewhat affected by schooling activities, although not to the extent for males. The most dramatic trend will be the continuing movement of married women into paid employment. Older women will also have a declining labor force participation trend because of earlier retirement programs.

Summary

Utah's labor force is expected to increase from 404,790 to 566,085, or by 40 percent between 1970 and 1980, and from


<table>
<thead>
<tr>
<th>Sex and Age Group</th>
<th>Total Population, July 1 (16 yrs. and over)</th>
<th>Total Labor Force, Annual Averages</th>
<th>Labor Force Participation Rates, Annual Averages (percent of population in labor force)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual</td>
<td>Projected</td>
<td>Actual</td>
</tr>
<tr>
<td>MEN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 to 17 years</td>
<td>24,621</td>
<td>25,995</td>
<td>25,764</td>
</tr>
<tr>
<td>18 to 19 years</td>
<td>21,217</td>
<td>26,834</td>
<td>25,607</td>
</tr>
<tr>
<td>20 to 24 years</td>
<td>46,185</td>
<td>69,381</td>
<td>67,232</td>
</tr>
<tr>
<td>25 to 34 years</td>
<td>64,618</td>
<td>114,486</td>
<td>137,044</td>
</tr>
<tr>
<td>35 to 44 years</td>
<td>53,257</td>
<td>69,643</td>
<td>90,916</td>
</tr>
<tr>
<td>45 to 64 years</td>
<td>87,101</td>
<td>104,624</td>
<td>110,490</td>
</tr>
<tr>
<td>65 years and over</td>
<td>33,997</td>
<td>46,997</td>
<td>54,202</td>
</tr>
<tr>
<td>16 years and over</td>
<td>330,996</td>
<td>457,960</td>
<td>511,255</td>
</tr>
</tbody>
</table>

WOMEN

<table>
<thead>
<tr>
<th>Sex and Age Group</th>
<th>Total Population, July 1 (16 yrs. and over)</th>
<th>Total Labor Force, Annual Averages</th>
<th>Labor Force Participation Rates, Annual Averages (percent of population in labor force)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual</td>
<td>Projected</td>
<td>Actual</td>
</tr>
<tr>
<td>16 to 17 years</td>
<td>22,499</td>
<td>25,383</td>
<td>24,513</td>
</tr>
<tr>
<td>18 to 19 years</td>
<td>24,089</td>
<td>26,083</td>
<td>24,582</td>
</tr>
<tr>
<td>20 to 24 years</td>
<td>51,674</td>
<td>66,883</td>
<td>65,728</td>
</tr>
<tr>
<td>25 to 34 years</td>
<td>65,343</td>
<td>121,434</td>
<td>135,566</td>
</tr>
<tr>
<td>35 to 44 years</td>
<td>54,291</td>
<td>71,025</td>
<td>98,382</td>
</tr>
<tr>
<td>45 to 64 years</td>
<td>90,087</td>
<td>111,944</td>
<td>119,202</td>
</tr>
<tr>
<td>65 years and over</td>
<td>43,564</td>
<td>61,490</td>
<td>72,256</td>
</tr>
<tr>
<td>16 years and over</td>
<td>351,547</td>
<td>484,242</td>
<td>540,229</td>
</tr>
<tr>
<td>TOTAL</td>
<td>682,543</td>
<td>942,202</td>
<td>1,051,484</td>
</tr>
</tbody>
</table>
566,085 to 636,476 or 12 percent between 1980 and 1985.

Projections of the labor force for the 1970s show a substantial increase in the number of young workers 25 to 34 years old due to population changes. Also, the projections for 1980 indicate an increase in the proportion of women in the labor force. The participation rates of men in all age groups during this period are estimated to decline.

During the early 1980s, the Utah labor force growth will probably slow down significantly. A major shift of the labor force from the 25- to 34-year-old group of the 1970s to the 35- to 44-year-old group in the early 1980s is expected. Women are projected as continuing to increase their proportion of the labor force at a very slow pace in the early 1980s while the participation rates of men in all age groups will continue to decline.


Craig R. Lundahl is Assistant Professor of Sociology in the Department of History and Social Science and Director of the Office of Economic, Social, and Population Research at Western New Mexico University.

Yun Kim is Professor and Head of the Department of Sociology, Social Work, and Anthropology, USU.


<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MEN</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 to 17 years</td>
<td>407</td>
<td>-175</td>
<td>.4</td>
<td>-.4</td>
</tr>
<tr>
<td>18 to 19 years</td>
<td>2,589</td>
<td>-839</td>
<td>2.7</td>
<td>-1.9</td>
</tr>
<tr>
<td>20 to 24 years</td>
<td>16,471</td>
<td>-1,945</td>
<td>17.2</td>
<td>-4.5</td>
</tr>
<tr>
<td>25 to 34 years</td>
<td>45,771</td>
<td>20,547</td>
<td>47.9</td>
<td>47.7</td>
</tr>
<tr>
<td>35 to 44 years</td>
<td>15,313</td>
<td>20,113</td>
<td>16.0</td>
<td>46.7</td>
</tr>
<tr>
<td>45 to 64 years</td>
<td>13,557</td>
<td>4,406</td>
<td>14.2</td>
<td>10.2</td>
</tr>
<tr>
<td>65 years and over</td>
<td>1,401</td>
<td>981</td>
<td>1.5</td>
<td>2.3</td>
</tr>
<tr>
<td>16 years and over</td>
<td>95,509</td>
<td>43,088</td>
<td>99.9</td>
<td>100.1</td>
</tr>
</tbody>
</table>

Source: Table 2

### Table 4. Distribution of Utah’s labor force, by age and sex, actual 1970, and projected 1980 and 1985

<table>
<thead>
<tr>
<th>Sex</th>
<th>Number</th>
<th>Percent Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual</td>
<td>Projected 1980</td>
</tr>
<tr>
<td>MEN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 to 17 years</td>
<td>10,537</td>
<td>10,944</td>
</tr>
<tr>
<td>18 to 19 years</td>
<td>12,411</td>
<td>15,000</td>
</tr>
<tr>
<td>20 to 24 years</td>
<td>35,495</td>
<td>51,966</td>
</tr>
<tr>
<td>25 to 34 years</td>
<td>59,900</td>
<td>105,671</td>
</tr>
<tr>
<td>35 to 44 years</td>
<td>61,126</td>
<td>66,439</td>
</tr>
<tr>
<td>45 to 64 years</td>
<td>78,826</td>
<td>92,383</td>
</tr>
<tr>
<td>65 years and over</td>
<td>10,301</td>
<td>11,702</td>
</tr>
<tr>
<td>16 years and over</td>
<td>258,596</td>
<td>354,105</td>
</tr>
</tbody>
</table>

Source: Table 2
To build or not to build can be a tough decision whether you are planning for one home or a whole new community. The decision becomes even tougher when the land in question includes steep hillsides (Figure 1). Construction on such lands inevitably disturbs drainage channels and reduces infiltration rates, which in turn can enhance flood potentials. That means that if the decision is to build, preconstruction planning should include attention to minimizing those potentials.

Various east bench locations around Salt Lake City provide prime examples of the kinds of building sites that can mean serious flooding trouble for valley as well as hillside dwellers. Fortunately for residents of the Olympus Cove Development (Figure 2), Salt Lake County officials recognized that the area could pose runoff problems before such hazards became reality. The County Planning Commission therefore activated an interagency team of specialists to investigate the situation and recommend ways to avoid foreseeable difficulties.

That team included personnel of the Utah Water Research Laboratory (UWRL) at Utah State University (J. Paul Riley, Vernon J. Rogers and George B. Shih). Their assignment was to coordinate existing information about Olympus Cove with data being generated by the newly appointed research team. Based on that coordination, they were to develop a computerized, mathematical model of the area’s hydrology. Besides clarifying current runoff and inflow patterns, the UWRL researchers expected that their model would allow planners to predict and evaluate probable changes in those patterns as urbanization progressed up and down the hills. As it happened, the model that was developed not only fulfilled their expectations for Olympus Cove, but proved readily adaptable to similar urbanizing areas.

First Steps

Before the UWRL investigators could create their mathematical model of Olympus Cove as an urbanizing watershed, they had to become familiar with all the relevant variables. The general location of Olympus Cove (Figure 3), as well as its natural drainage channels, topography, geology, vegetation and climate, had to be defined. These factors and their relationships to one another and to general hydrologic processes (Figure 5) were the realities from which the model would be abstracted.

Because of the complexity of the Cove area and the number of factors involved in flood prediction, the investigators began by identifying subunit sources of inflow. These included Neff’s Canyon and seven separate drainage areas on the steeply rising slopes of Mt. Olympus (Figure 4). They then collected, correlated, and graphed precipitation, drainage, runoff, slope, vegetation, etc. data from each

Urbanization should be prohibited on steep (60 percent or over) slopes.
Figure 1. Steep hill sides are often selected as homesites due to their esthetics yet such a choice can be risky.

Figure 2. Olympus Cove in Salt Lake County benefited from advance planning to avert runoff problems.

Gradually, certain facts were established, conclusions drawn, a model devised and tested, and recommendations made.

**Guarding Against Floods**

Although the following recommendations were designed specifically for Olympus Cove, many (if not all) could be applied to the urbanization of steep hill sides anywhere in Utah. Even more important, the model will correctly answer questions about such areas if their data are simply inserted in place of the Olympus Cove information.

Within Olympus Cove, the southerly, undeveloped land is the target of much of the flow from the surrounding mountain drainages. Maintaining, or preferably enhancing, the infiltration potentials of that area could therefore equate with substantial flood protection for the rest of the Cove. The infiltration could be most effectively enhanced by digging wells that would shunt flood waters into subsurface soils. Structures could also be built along natural drainages that would contain and gradually disperse potentially heavy runoffs before they endangered the urbanized acreages.

Additionally, the researchers say that urbanization should be prohibited on steep (60 percent or over) slopes. Natural vegeta-
Figure 3. Map showing relation of Mill Creek, Neff's Canyon, and Olympus Cove.

Figure 4. The 8 Mt. Olympus slopes' runoff areas.

In order to minimize the potential for flood hazards, the natural vegetation should be preserved on steep slopes and natural drainage courses. Effective vegetative cover (lawns tend to have lower infiltration rates than do many other kinds of vegetation) should be established wherever possible within urbanized areas.

Storm sewers and streets should be designed with erosion control, flood potentials, and natural drainage channels in mind.

Contour trenching, bench construction, or comparable land modifications within Neff's Canyon might also help protect the Cove from future flood hazards.

Caution In Order

The general message seems clear. Steep hillsides should never be capriciously disturbed. A more than average investment in prethinking and evaluation of alternatives has to precede development of steeply sloping land if flood hazards are to be avoided. With the UWRL mathematical model, however, the necessary preliminaries can be accomplished with relative ease and efficiency.

Lois M. Cox is Science Writer, Agricultural Experiment Station Publications, USU.
Figure 5. Flow chart showing the various hydrologic processes represented within the daily time increment.
CORRALING THE VARIABLES

Because farmers have nature as a recalcitrant partner, their management plans are regularly disrupted by unforeseen events or factors. But help is coming. Work directed by R. John Hanks (a soil scientist) promises to put a unifying handle on previously incoherent variables.

By combining computer know-how with data accumulated over many years and the results of new experiments, the researchers are learning how to accurately predict crop production under specified conditions. Their sophisticated computer models are contrived to incorporate all the crucial variables: past cropping patterns, soil characteristics including salinity, prevailing climate, crop variety, irrigation or precipitation potentials, and proposed fertilization practices.

They are currently concentrating on defining wheat, corn, and alfalfa reactions under all likely combinations of the variables. Eventually they expect to be able to generate management plans for specific farms that will assure the farmer optimum yields of the recommended crops.

PREGNANT COWS AND PINE NEEDLES

What Indian folklore and reports from cattlemen have long implied, is being confirmed by scientifically sound experiments. The needles of ponderosa (western yellow) pine trees do indeed have abortive effects under certain conditions. Cattle, sheep, and probably deer are susceptible.

In response to serious losses in several western states and western Canada, A. H. Stevenson (an Oregon veterinarian), Lynn F. James (a USDA animal nutritionist), and Jay W. Call (a USU research veterinarian) are defining the hows and whys of pine needle abortion in range cows.

So far they know that abortions can follow the eating of either green needles off the trees, or dead needles around trees, or slash from lumbering, or windfalls. They are also reasonably sure that stage of gestation and external stress are important factors. A cow in her last trimester of pregnancy that is stressed (as by severe weather) just before or while she is eating the needles is especially likely to abort.

Ranchers who have ponderosa pines on their winter ranges are well advised to invest considerable effort into avoiding pine needle abortion. They can do this by trimming the trees high enough so the cows can’t reach branches — and meticulously clearing away downed branches and needles. Or they can fence their cows out of the pine stands. Or they can provide supplemental feed when their cows are stressed by weather during the last third of their gestation period.

The alternative is to risk up to 100 percent loss of both the cows and the potential calf crop. Cows affected by pine needles commonly produce either dead or seriously weakened calves. And they themselves must have prompt treatment following the abortion, or they too will die.

As more is learned about the problem, additional management possibilities should become available.
PROBING THE PRIVATE LIFE OF FRUIT TREES

The question "To grow or not to grow?" probably does not claim much attention from individual fruit trees. It seems safe to assume that the average tree simply responds each year to a series of interactions between its internal and external environments.

But scientists such as USU's Schuyler Seeley (a horticulturist), are devoting a great deal of attention to defining the hows and why's of when fruit trees start and stop growing. If they can figure out the correct answers, they should eventually be able to program a tree's time of bloom by artificially manipulating chemicals that occur naturally in the trees. In effect they might supply the trees with a hormone-based anesthetic in early spring and withdraw it when frost dangers moderate.

Right now the Seeley-led research group is concentrating on one particular piece of the puzzle: Why do fruit trees require a certain amount of chilling before they can respond productively to warming spring temperatures?

Thanks to their own and others' prior research, they are starting with some "knowns". For example, a healthy tree, left to its own devices, has to accumulate a certain number of chill units before it can begin to grow each spring. Also, once a mature tree's chilling requirement is satisfied, it will grow best at temperatures between 40 and 80°F. In fact, temps that consistently exceed 80°F will stop growth. And, after a tree has produced its fruit, stripping it of all its leaves simultaneously strips it of its chilling requirement. (The Javanese, with their mild climate, put this phenomenon to practical use. They harvest Rome Beauty apples in April, strip the trees of their leaves in May, and harvest again in October.)

The USU researchers are experimenting with peach trees to find out whether the observed effects of leaf removal are correlated with variations in the trees' supply of growth-promoting and growth-inhibiting hormones. If so, the next step will be to separate the hormones from all the other chemicals in the leaves. Once that technically exacting task is accomplished, the hormones would be tested on seedling trees to pin down precisely how they operate.

Achieving the ultimate goal of controlling the dormancy (chilling) requirements of fruit trees would mean better fruit production in areas that are currently marginal because of either too much or not enough natural chilling potential.

*1 chill unit=1 hour of 43°F temperature
Longer time required above and below 43°F
(2 hours at either 50 or 35°F for 1 chill unit)

GOATS HELPING (?) CATTLE

Can a goat make life easier for a cow? Three Utah scientists (John Malechek, James Bowns, and Philip Urness) will have a fact-based start toward answering that question within a year. Their idea is to use the goats as vegetation-modifiers on blackbrush-dominated range.

Such lands in Southern Utah and elsewhere normally provide (at best) only fair grazing for livestock during a very few months of each year. The forage on these millions of acres is in short supply because blackbrush...
is inhospitable both to other plants and to the animals themselves. How the blackbrush intimidates other vegetation is not fully understood — but it discourages cattle from grazing by being woody and bristling with spines.

Results of previous experiments and observations by various researchers and ranchers indicate that the growth appearing on blackbrush plants each spring is palatable to and nourishing for cattle, when they can manage to harvest it. Also, the amounts of this annual new growth can be enhanced by fall or winter cut-backs of the preceding season’s twig production. For diverse reasons, chaining, beating, chemicals, and burning are less than satisfactory as removal mechanisms. In contrast, historical and recent reports point to goats as potentially ideal pruning machines.

The Utah researchers have scheduled their grazing tests to begin in early 1977. The outcome should tell them whether goats are as beneficial to blackbrush acreages as they have proved to be on oak woodlands and Acacia-dominated ranges in other parts of the country. If they are, ranchers and land management agencies with blackbrush range may find themselves turning to goats as a valuable management tool.

SUGARS AREN’T ALL EQUAL

When you’ve tasted one sugar, you most definitely have NOT tasted them all. Consider sweetness for example. Though relative values will vary with concentrations, if table sugar (sucrose) were set as equal to 100, fruit sugar (fructose) would equal 173, corn sugar (glucose) would equal 74, and milk sugar (lactose) would equal only 16.

Right now, it is the peculiarities of lactose that are being intensively investigated by a group of USU researchers led by C. Anthon Ernstrom (head of the Nutrition and Food Sciences Department). Besides being much less sweet than sucrose, lactose is also much less soluble. These characteristics are of practical concern because lactose is a major ingredient of whey, the proverbial millstone of commercial cheesemakers.

Every 1000 pounds of milk they convert into cheese leave the manufacturers with 890 pounds of problematical whey. Researchers at USU and elsewhere have long been seeking ways to put this “waste” material to work.

Out of such past investigations came today’s practice of running the whey through a separator. The resultant whey “cream” is used in butter. The leftover skimmed whey is put through an ultrafiltration process that delivers a liquid permeate and a concentrate composed of primarily noncasein protein, along with lactose and minerals such as calcium, phosphorus and sodium. This concentrate is then dried. And, as soon as the FDA gives formal approval, it will be incorporated into ice cream since its protein is of remarkably high

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quality and the lactose and minerals are useful nutrients.

Even after all these volume-cutting steps, however, the cheese manufacturers reluctantly reap 770 pounds of whey permeate from every 1000 pounds of milk. And the permeate contains mostly lactose in combination with a few minerals and insignificant amounts of protein.

The original whey-disposal problem has thus become a question of "How to put lactose to work?". The obvious answer: "Use the sugar as a natural sweetener for ice cream and syrups", is regrettably impracticable. As it stands, the lactose is neither sweet enough nor soluble enough to have commercial value. So, before it can be used, the lactose must be both separated from the rest of the permeate and split into its component sugars (glucose and galactose).

As they struggle toward those goals, the USU researchers are drawing on results of basic lactose investigations by T. A. Nickerson of the University of California (Davis), particularly in connection with using sulfuric acid to separate the glucose and galactose molecules. The other approach being checked out has yeast-produced enzymes as the bond-splitting tool. Each approach provides its own perplexing set of problems and prospects, but the overall perspective is optimistic.

AAAS Arid Lands Directory

The AAAS Committee on Arid Lands is preparing a directory of North American scientists who are active in research in some aspect of Arid Lands (Geology and Geography, Biological Sciences, Anthropology, Social and Economic Sciences, Engineering, Medical Sciences, Agriculture, Atmospheric and Hydrospheric Sciences, etc.).

The directory, on computer tape at the University of Arizona, will be updated continually and made available in whole or part at cost upon request.

Persons wishing their names to appear in the directory should submit the following information in the order indicated:

Name:
Title:
Professional Address (including zip code):
Specific interests as related to Arid Lands Research:
Arid Regions Studied:

This information should be sent (before August 1977) to:

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