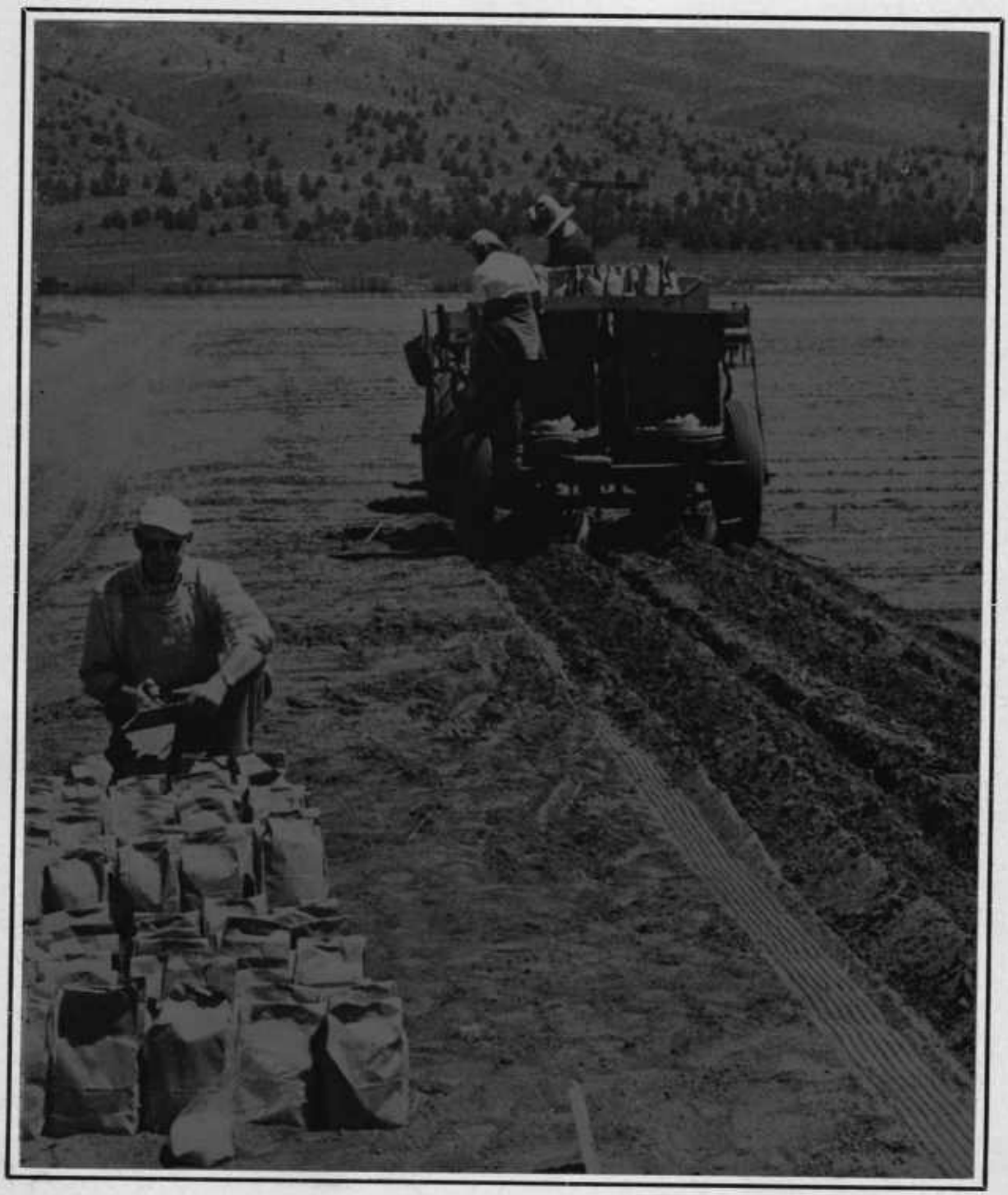
# oregon's agricultural PROGRESS



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**COVER: OSU technicians preparing potato fertilization test plots in the Klamath Falls area, one of three areas where the fertilizer needs of Oregon potatoes are being assessed. For a report on findings to date, see page 11.**

# TIMBER & FISH:
# Collision or coexistence?

by Dr. James D. Hall
Associate Professor of Fisheries

CAN OREGON'S SALMON and trout resources coexist with today's logging practices . . . or, as one observer has put it, are timber and fish currently "on a collision couse?"

Since 1957, in an effort to answer this complex but vitally important question, research and technical workers from several fields and agencies have been engaged in the Alsea Watershed Study. Completion of the study, now coordinated at the OSU fisheries and wildlife department, is not expected until 1973 or 1974. Still, as this progress report will indicate, a great deal already has been learned.

The study's immediate objective is to determine and compare how two patterns of Douglas-fir logging affect the fish populations of small, headwaters streams in the Coast Range. Ultimately, it is hoped the study results will provide a scientific foundation for improved management of all the resources found in the coastal forests of Oregon, as well as other Pacific Coast states.

*Among those cooperating in the Alsea Watershed Study have been foresters, biologists, soils scientists, engineers, chemists, and other workers from OSU, the Oregon State Game Commission, U.S. Forest Service, Federal Water Pollution Control Administration, and the U.S. Geological Survey. Two private corporations and a private landowner also have made substantial contributions to the study, which was established by the State Committee on Natural Resources.*

### Watersheds selected

Because of its broad nature, more than a year was required to organize the study. Then, in 1958, three adjacent watersheds within the Alsea River Basin were selected for particularly intensive research. The next seven years were devoted to a pre-logging inventory of the fish populations and water quality features in these watersheds to assure the development of a solid basis for post-logging comparisons.

In 1966, timber was harvested from two of the watersheds. One watershed was completely clear-cut down to the stream edge. The other was partially clear-cut in staggered settings, with approximately 30% of the total area harvested and a strip of vegetation left along the stream. The third watershed remains uncut to serve as a check on results obtained in the harvested watersheds.

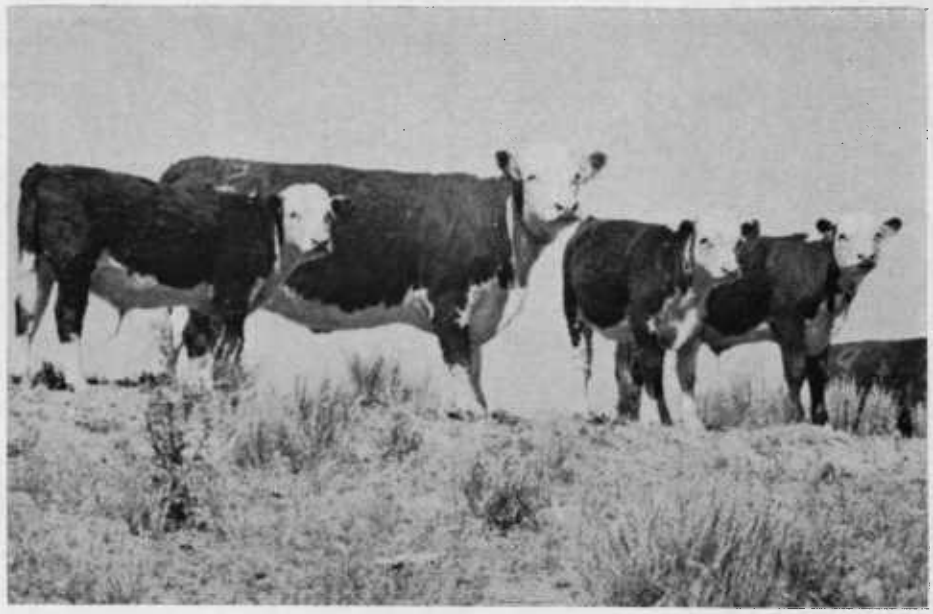
Features of water quality being monitored include temperature, levels of suspended sediment and dissolved chemical nutrients, and rate of stream flow. Biological measurements are focusing on the abundance of fish food and the populations of coho salmon and cutthroat trout, most valuable fish species in the streams.

Traps were built at the outlet of each stream to obtain a count of spawning fish moving upstream and young fish moving to the ocean. Conditions in spawning gravels are being assessed in two ways: by driving standpipes into the stream bottom to sample the water's oxygen content, and by enclosing the nests of female salmon to determine the rate of egg survival and fish emergence.

Among other things, the pre-logging inventory confirmed that clean, sediment-free gravels are essential for good spawning success. The chief reason is that sediment blocks the pores in these gravels, thus impeding the flow of oxygen-rich water over the eggs, which often are buried a foot deep. Sediment also can act as a physical barrier, slowing down and sometimes preventing the emergence of young fish from the spawning beds.

### Small streams important

The pre-logging inventory also demonstrated that even very small streams are of considerable importance to Oregon fish resources. During the summer, many streams in the Coast Range do not appear capable of supporting any kind of life, let *(cont. on page 12)*



*Squaw Butte fall calves—three typical examples shown—have weaned at an average of 173 pounds heavier than calves born in the spring. Photo taken in mid-July.*

# Fall calving yields a

Cattle ranchers can boost conception rates, weaning percentages, and weaning weights by calving in the fall

MANY EASTERN OREGON cattle ranchers can harvest a bumper crop of benefits by switching from spring to fall calving.

That's the report from OSU animal scientists R. J. Raleigh and H. A. Turner, following four years of research at the Squaw Butte Experiment Station in Harney County. The benefits include higher conception rates, higher weaning percentages, and higher weaning weights, as well as an opportunity for more intensive management virtually throughout the cow-calf operation.

Most ranchers in eastern Oregon follow a spring-calving program. That is, calves are born in March or April, then put on range in mid-April or early May. Range forage at this time is high in quality and cows are producing relatively large supplies of milk. However, by the time spring calves are mature enough to make much use of the range, its forage plants have declined substantially in both protein and energy content. This decline in forage quality also generates a reduction in cows' milk output.

To see if such drawbacks could be circumvented, OSU scientists decided to convert half the Station's experimental herd to a fall-calving program. The basic idea, of course, was that calves born in October and November would be sufficiently mature by the following spring to make good use of early, high-quality range forage. Last summer, the conversion was completed and the fourth consecutive crop of fall calves was weaned. The comparative findings to date:

Conception rates in both fall- and spring-calving cows have averaged in excess of 90%. Why, then, would a switch to fall calving be beneficial?

On the Squaw Butte Station, spring-calving cows are bred on relatively small range pastures. This, combined with good water conditions brought about by water hauling, means animals are concentrated in small areas. Most eastern Oregon summer ranges, however, are considerably larger, poor in water distribution, and include somewhat more rugged terrain. Cattle, therefore, often scatter over the entire range area. As a result, breeding seasons may last five months or longer and conception rates can be as low as 50% or 60%.

### On winter headquarters

Under a fall-calving program, cows normally would be bred while on small, winter headquarters pastures. Given this degree of confinement and good

**Fall calves vs. spring calves**

| Item | Spring calves* | Fall calves* |
|---|---|---|
| Number of calves | 507 | 377 |
| Date of birth | Mar. 30 | Oct. 26 |
| Weight when put on range (*lb.*) | ..... | 302 |
| Average daily gain from birth to when put on range (*lb.*) | ..... | 1.34 |
| Average daily gain from when put on range to weaning (*lb.*) | ..... | 1.95 |
| Average daily gain from birth to weaning (*lb.*) | 1.56 | 1.58 |
| Weaning age (*days*) | 166 | 273 |
| Weaning weight (*lb.*) | 329 | 502 |

* All figures listed are averages of four years' data with the exception of the first item, "number of calves."

# bumper crop of benefits

winter nutrition, Raleigh and Turner figure most ranchers could readily achieve conception rates of 90% or better with a 60-day breeding season. Breeding on these small pastures also would require fewer bulls, provide a more uniform calf crop, and facilitate crossbreeding or artificial insemination.

### Higher weaning percentages

Spring weather in eastern Oregon usually is cold, windy, and wet. These conditions can cause scours, pneumonia, chilling, and other serious calving hazards. Fall weather, on the other hand, often is mild and dry. Largely because of better weather during calving, weaning percentages at the Station have averaged nearly 5% higher with fall-born calves than with spring calves. The OSU scientists note that five additional calves per 100 cows at times may be the difference between a profit and a loss.

Converting half the Station herd to fall calving has enabled a significant reduction in the amount of calving difficulties experienced by first-calf heifers. Ever since the conversion was launched, replacement heifers for fall-calving cows have been selected from spring-born animals and, as fall-born animals have become available, *vice versa*. Thus, heifers now are 2.5 years old before calving for the first time.

Fall calves, as shown in the accompanying table, have weaned at an average of 173 pounds heavier than calves born in the spring. How much expense have these extra pounds involved?

Feed costs for wintering lactating cows have ranged from $10 to $18 per animal more than for wintering spring-calving cows. And the fall calves have been creep-fed during the winter at a cost of $3.75 to $5.50 per calf. This adds up to wintering feed costs of $13.75 to $23.50 more for a fall-calving cow-calf pair than for a spring-calving cow. For the past two years, fall calves also have been creep-fed during the summer at a cost of $5 to $7 per calf. (Reason for the spreads in feed costs is that several different rations have been tried.)

### How costs would compare

By way of comparison, the spring calves would have to be fed to gain 1.25 pounds per day for 140 days after weaning in order to attain the average weaning weight of the fall calves (see table). Feed costs for these gains would range from $25 to $30 per animal and, of course, the feeding period would extend well into the winter, at which time the animals would be nearly one year old.

Currently, Raleigh and Turner are working to determine the minimum level of winter feed that can be provided fall-calving cows without lowering conception rates and weaning weights. Other important questions under investigation include: Is creep-feeding profitable in summer, as well as winter? Does creep-feeding reduce calves' milk consumption? Do supplements lower the hay intake of lactating cows? Is the increase in daily gain after fall calves go on range (see table) due to an increase in milk production, use of the high-quality range forage, or both? How much more—if any—range feed does a fall cow-calf pair consume than a spring cow-calf pair?

The OSU animal scientists point out that fall calving will not fit all cattle operations. In particular, a rancher whose range is at high elevation already may be weaning heavy spring-born calves. Or spring calving may be better suited to his feed supply. As more questions are answered, there may prove to be other situations in which fall calving would not pay.

But for many eastern Oregon ranchers, that bumper crop of benefits clearly is ready and waiting to be harvested.

# OSU field burning research: a progress report

"FIELD BURNING," a Linn County grass seed grower remarked recently, "is by far our industry's most essential cultural practice. Without it, grass seed production in the Willamette Valley simply wouldn't be feasible."

There is much evidence in support of this view. For field burning effectively controls blind-seed, ergot, grass seed nematode, and numerous other crippling diseases. It also checks weeds, rodents, and certain insects, contributes greatly to yield maintenance, and economically disposes of post-harvest straw and stubble.

Unfortunately, these are not the only effects of the practice. Under certain conditions, smoke from burning fields causes considerable visibility loss and occasionally serious traffic tie-ups. Field burning also injects into the atmosphere gaseous pollutants and contaminant particles that often soil and otherwise damage personal property. And it may affect human health. As a result, use of the practice has become one of Oregon's more significant public issues. Consider, for example, the following comments, typical of those made by one Lane County resident:

"I don't think any one business has the right to cause air pollution when other people live in the area. Sure, I realize the farmers have a problem. But I'm not convinced that stopping the burning would put them out of business. . . . I think the air pollution is worse here than in Los Angeles. We were down there last summer and when we came home, the pollution was worse here."

### First used in 1940's

Back in the mid-1940's, when field burning was first used on Willamette Valley perennial grass seed fields, less tha 50,000 acres were involved. The practice proved sufficiently beneficial, however, that by 1968, it was being used on an estimated 315,000 acres: 140,000 acres of perennial grass seed crops, 90,000 acres of annual ryegrass, and 85,000 acres of small grains. And the volume of straw and stubble residues being burned was estimated to exceed 700,000 tons.

The field burning season generally lasts about two months, beginning around August 1 and continuing through September 30. Normally, this is a period of fine weather in the Willamette Valley. But it also is a period during which the airmass above the valley becomes increasingly stagnant and poorly ventilated. As summer progresses, therefore, the capacity of this airmass to accept, dilute, and disperse all of the emissions produced by burning is increasingly likely to be overpowered. When it is overpowered, of course, the result is greatly intensified levels of local air pollution.

In recognition of this increasingly serious problem, OSU scientists are conducting intensive research in many areas related to field burning. This effort, reports R. M. Alexander, assistant director of the Agricultural Experiment Station, is aimed both at finding ways to alleviate the harmful effects of field burning and at finding alternatives leading to reduced use or elimination of the practice. Among the significant general findings to date:

¶ The excellent field sanitation which burning provides is of prime importance for most perennial grass seed crops. As yet, no satisfactory alternative way has been found to control the major diseases of perennials.

¶ Burning of some perennial grass seed crops on an every-other-year basis may be possible without drastic yield reductions. In addition, two relatively smoke-free residue disposal devices now being developed—a propane flamer and a mobile incinerator—may prove capable of replacing at least a portion of the open burning in perennials. Both devices involve higher production costs, however, and one—the propane flamer—most likely involves increased incidence of diseases.

### Helps reduce costs

¶ Burning of annual crops—annual ryegrass and cereal grains—is an advantageous practice primarily because it helps reduce production costs. Disease control is not as necessary a consideration as it is with perennials. These annual crops account for an estimated 55% of the acreage and two-thirds of the residue tonnage now being burned. A few varieties of annual ryegrass are vulnerable to diseases presently controlled through field burning. Too, a satisfactory alternative way has not yet been found to control weeds in annual ryegrass.

¶ Straw removal by some means is vital for both perennial and annual crops. With perennials, removal appears essential for successful production of all species. With annuals, the most feasible alternatives to removal by burning are soil incorporation and mechanical removal. Large residue tonnages and the heavy, wet-type soils commonly used to produce annual ryegrass make satisfactory incorporation very difficult to achieve with this crop. Mechanical removal, of course, requires that uses be found for straw residues, since they otherwise would become a solid-waste pollutant.

¶ Straw residues can be used to make various industrial products, such as plastics and pulp for paper, although there are technical and economic hurdles involved. A recently developed microbial process could facilitate many utilization possibilities. The most promising and immediately available use for straw residues, however, appears to be as livestock feed.

¶ It may be possible to grow crops that do not require burning on at least a portion of the lands now devoted to grass seed production, though a very considerable investment, as well as developments of markets, would be required.

Here, now, is a more detailed look at some of the projects in which OSU scientists are at work:

Engineer R. W. Boubel, crop physiologist D. O. Chilcote, and E. M. Bates,

U. S. Weather Bureau agricultural meteorologist stationed at OSU, are evaluating the many meteorological and agronomic variables involved in field burning. It is hoped these variables can be combined into a series of mathematical models which, when computerized, will enable more rapid and precise prediction than now possible of when, where, and how much growers should burn on a given day. Also engaged in this effort are atmospheric scientists E. W. Hewson, L. E. Olsson, and W. P. Lowry. It should be noted, however, that neither the advisory program nor the regulatory program, in which growers are advised when they can burn with minimum adverse effects on air quality, have proved fully effective to date.

### Mobile incinerator

A mobile incinerator, now being developed by agricultural engineers R. W. Bonlie and G. E. Page, appears a promising alternative to open burning and also may possess some advantages over propane flaming. For with this unit, which Chilcote and the engineers will test this coming summer, the flame can be kept under control. Better combustion and, thus, reduced smoke and particulate output should be achieved. Good field sanitation also should be accomplished, since residues are burned right on the ground. Projected capacity of the incinerator is from two to five acres per hour. Such a unit, though, probably would be quite costly—perhaps from $15,000 to $25,000.

J. R. Hardison, U. S. Department of Agriculture plant pathologist stationed at OSU, is testing a wide variety of chemicals in hopes of finding some materials that will check the major diseases so effectively controlled by burning. He has found that soil applications of an experimental systemic fungicide will provide direct chemical control of ergot and blind-seed. The material would be expensive, however, and large dosages would be required. Hardison also will conduct evaluations of the mobile incinerator from the standpoint of disease control.

In search of satisfactory herbicides and other methods of weed control—particularly in annual ryegrass—are W. O. Lee, U. S. Department of Agriculture agronomist stationed at OSU, Chilcote, and agronomist A. P. Appleby. The most promising herbicide found to date for controlling weeds in annual ryegrass at the time of establishment is a compound known as paraquat. However, this material is quite costly and also can be toxic to humans.

### Other suitable crops

Work by soil physicist L. Boersma and many other plant and soil scientists indicates that satisfactory yields of a number of crops which do not require burning can be obtained on the heavy, wet-type soils traditionally devoted to grass seed. The list includes alfalfa, lotus, white clover, corn for silage and grain, bush and dry beans, winter wheat, sweet corn, potatoes, and green peas. Production of such crops on these lands, though, would require development of extensive irrigation and drainage systems, as well as substantial annual applications of lime and basic fertilizers.

Would development of these irrigation and drainage systems be too costly to permit production of, for example, sweet corn? Would the probable high cost of the mobile incinerator rule out its use? If field burning were to be banned, what short- and long-run effects would it have on the economics of grass seed production and, ultimately, on the Oregon economy? Developing an economic model which will make it possible to answer these and many other crucial questions are agricultural economist F. S. Conklin and his associates. The model also will enable an assessment of the economic feasibility of mechanically removing straw residues and utilizing them in various ways. For instance:

### Pulp can be produced

W. J. Bublitz, pulp and paper chemist, has learned that a pulp satisfactory for manufacture into certain grades of paper can be produced from annual ryegrass straw. Yield on a dry basis is about one-half ton of pulp per ton of straw—the same yield as obtained from wood. The paper is superior to that made from Douglas-fir pulp in folding, tensile, and bursting strength. Moreover, straw residues are best adapted to the soda pulping process which is virtually odorless. The paper is quite low in tear strength, however. And the bulkiness of straw presents some severe difficulties in handling and preparation.

Agricultural chemist V. H. Freed and other workers at the OSU Environmental Health Sciences Center have found that various industrial raw materials can be extracted from straw residues. Among them are lignin, pentosans, waxes, and in particular, cellulose, which can be used to make a wide range of acetate plastics. Straw also can be used to make such products as a high density construction board and an organic soil amendment. Whether these materials and products can be manufactured at competitive prices is not yet known, however.

A new process developed by microbiologist D. A. Klein and his associates could solve many of the problems involved in both utilization and disposal of straw residues. For it makes possible rapid and controlled microbial breakdown of straw, as well as other lignin-containing materials. The process, called photofermentation, essentially consists of exposing the straw first to intense light energy, then to selected types of fungi or bacteria.

### Feed for livestock

Perhaps the most promising potential use of straw residues found to date is as a feed for livestock. In feeding tests conducted by animal scientist A. T. Ralston with replacement heifer calves, ryegrass pellets supplemented with molasses, urea, and barley have produced average daily gains of 1.74 pounds at a cost of 13.3 cents per pound. And pellets containing equal amounts of wheat chaff and alfalfa also have produced average daily gains of 1.74 pounds on steer calves. Ralston cautions that further research on a number of particulars will be necessary before feeding of straw residues can be recommended. In addition, he notes that the presence of pesticides could pose difficulties.

"In summary," R. M. Alexander comments, "it now appears very hopeful that pollution-avoiding ways can be found to capture many of the tremendous benefits provided grass seed growers by open field burning. If so, there is good reason to believe that residents of the Willamette Valley and Oregon's $30-million grass seed industry can learn to live together."

# New mite-fighting method proves up

A NEW METHOD of fighting spider mites is demonstrating its potential in Rogue Valley pear orchards.

Worked out by OSU researchers at the Southern Oregon Experiment Station near Medford, the method is known as integrated mite control. And growers who practiced it last year, with the aid of a new mite evaluation service, kept mites in check, reduced the hazard of chemical residues, and cut spraying costs in two-thirds of the blocks of pears where it was used.

Spider mites, which feed on foliage and, when present in sufficient numbers, seriously decrease tree vigor and fruit yields, were not a persistent pear pest before the release of DDT in 1946. They soon became one, however, when growers started applying this pesticide regularly to control codling moth. Apparent reason for the buildup, OSU entomologist P. H. Westigard points out, was that repeated DDT sprays severely reduced populations of the natural enemies of mites.

*Microscope is used to determine number, species of mites present on sample leaves.*

Growers then turned to the use of acaracides, compounds specifically designed to control mites. But a given acaracide seldom remains effective for long, since mites can and usually do develop resistance to these chemicals quite rapidly. New and effective acaracides thus became more and more difficult to obtain and, in turn, more and more expensive. By the early 1960's, the three most destructive species of spider mite—two-spotted, carpini, and European red—were responsible for at least half of the Rogue Valley pear grower's average total spray bill.

### From another angle

Westigard and OSU horticulturist P. B. Lombard, recognizing that continued reliance on chemicals alone was not a satisfactory answer, decided to tackle the mite problem from another angle. Among their findings after five years of research:

¶ If no pesticides are applied to an orchard, mite populations generally are held at low levels by natural enemies, the most effective of which is a preda-

ceous mite called *Typhlodromus occidentalis.*

¶ Healthy pear trees of most varieties can tolerate moderate densities of mites with no reduction in productivity or fruit quality.

¶ The resistance of mites to a given acaracide, as well as the species of mites which predominate, varies from orchard to orchard.

**Predaceous mite tolerant**

¶ The *T. occidentalis* is tolerant of certain acaracides and other pesticides if they are applied at low rates.

On the basis of these findings, the OSU researchers concluded that spider mites often could be controlled adequately and at significantly lower cost by making use of a combination of natural enemies and chemicals. In other words, an "integrated" method of control. (For a detailed discussion of integrated pest control in pears, see the article beginning on page 10 of the Winter 1967-68 *Oregon's Agricultural Progress.*)

**Trends can be predicted**

They also learned that trends in an orchard's mite population can be predicted with considerable precision simply by collecting sample leaves on a regular basis, then determining the numbers and species of mites present. Equipped with this information, Westigard, Lombard, and Jackson County extension agents Clifford Cordy and Donald Berry last season initiated a demonstration mite evaluation service for growers. Chief aims of the service:

¶ To recommend whether an acaracide spray was needed and, if so, to recommend the most suitable compounds;

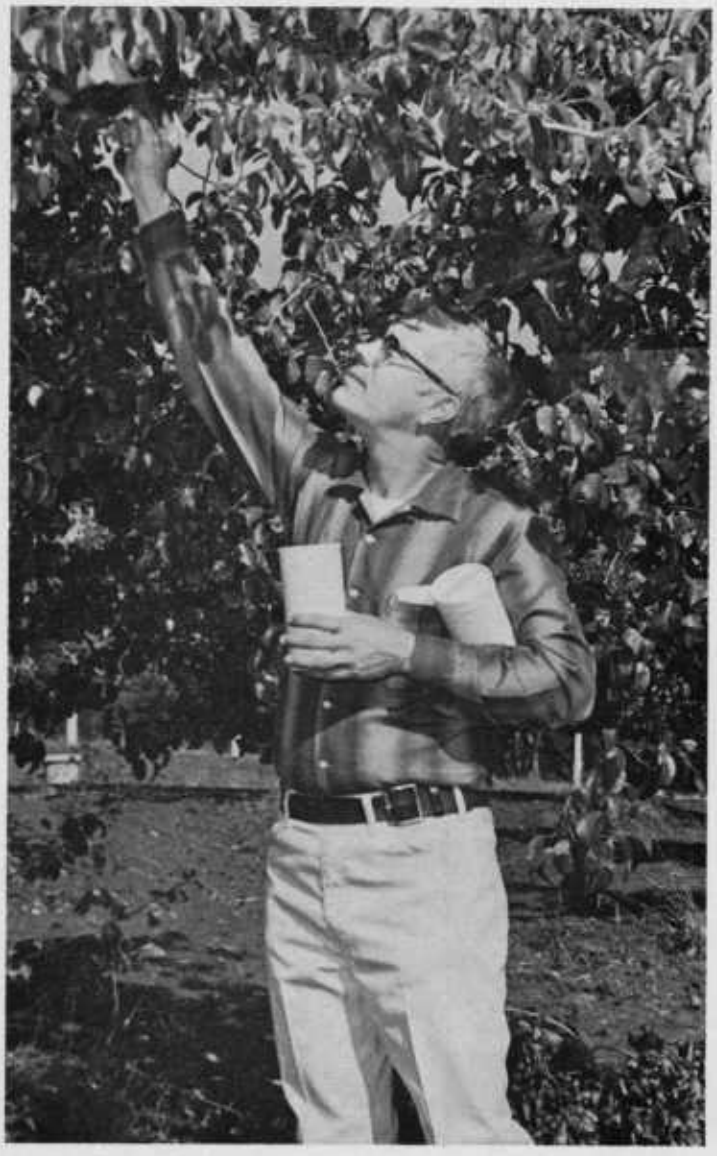
¶ To assess the prospects for control by mite predators, and where they were favorable, to recommend sprays and rates of application that would enable predators to aid in the control of destructive mites.

Operation of the mite evaluation service was supervised by Cordy and Berry. The cost of processing the sample leaves, which were collected either weekly or biweekly, was paid by participating growers. Since time so often is of the essence in mite control, evaluations were made and forwarded to growers the same day their samples were gathered.

The OSU researchers point out that the new mite-fighting method was not successful in every case. Still, 11 of 43 blocks of orchard where it was practiced required only two acaracide sprays, though growers normally apply three. Another twelve blocks needed only one application of acaracide. And six of the blocks required no acaracide sprays whatsoever. Total spray material costs in one of these blocks were reduced, with no loss in yield or quality, to $55 per acre—$30 per acre less than last year's Rogue Valley average.

This coming season, the mite evaluation service will again be made available to growers on a demonstration basis. The possibility of using similar services for several other pear orchard pests also will be examined. Ultimately, it is hoped, such services can be offered by private firms.

Integrated control of spider mites and a mite evaluation service are helping pear growers reduce spray costs



*Berry collects sample leaves from Rogue Valley orchard.*

# research briefs

## Populations of pheasants tested for DDT tolerance

QUESTION: do populations of ring-necked pheasants, one of Oregon's most important game birds, become more tolerant to DDT when the areas they inhabit are treated with this insecticide?

The answer, based on tests conducted by OSU wildlife ecologists J. A. Gill and B. J. Verts: not necessarily.

Progeny of birds captured from two different pheasant populations were used in the experiments. One of the populations inhabits an area to which large amounts of DDT have been applied. The other occupies a nearby area which has never been treated with the insecticide.

The scientists tested three categories of progeny from each population for tolerance to DDT: first-generation offspring of birds held captive for 18 months; second-generation offspring of these same birds; and first-generation offspring of birds held captive for six months. In each case, average lethal concentrations of DDT were lower for progeny of the population inhabiting the area where the insecticide has been used.

### Other characteristics

This surprising outcome, Gill and Verts conclude, indicates that tolerance of test-birds to DDT probably was not directly influenced by exposure (or nonexposure) of parent birds to the insecticide. Rather, it appears to have depended primarily on other characteristics of the populations from which the test-birds originated.

The OSU scientists' conclusion does not eliminate the possibility that the pheasant population exposed to DDT

*Agronomist M. J. Johnson, one of four OSU scientists engaged in continuing potato fertilization tests, examines effects of a severe potassium deficiency.*

*Marine scientist W. P. Breese checks "setting" of oyster larvae, a crucial step in the production of oyster seed at new pilot hatchery on Yaquina Bay.*

has become more DDT-tolerant. If it has, however, its level of tolerance has not yet reached that of the nonexposed population. Indeed, tolerance of the exposed population ranged from 12% to 19% lower than the tolerance of the population not exposed to DDT. Differences of this magnitude, Gill and Verts note, clearly indicate that care should be exercised in interpreting established levels of insecticide toxicity, not only for ring-necked pheasants, but all wildlife species.

## Tests pinning down fertilizer needs of Oregon potatoes

EXPANDED POTATO fertilization tests, launched in Oregon's major potato-growing areas in 1967, are paying off. That's the report from OSU soils scientist T. L. Jackson and OSU agronomists M. J. Johnson of the Central Oregon Experiment Station near Redmond, L. A. Fitch of the Malheur Experiment Station near Ontario, and G. E. Carter of the Klamath Experiment Station near Klamath Falls.

Chief aim of the tests is to learn how growers can predict more precisely the fertilizer—particularly nitrogen fertilizer—needs of a given field of potatoes. To that end, the scientists are working to measure the effects of fertilizers on yields and quality, and to evaluate the relationships between fertilizer responses and values obtained in soil and plant analyses. Here's a report on some of the test findings to date:

### Adequate nitrogen

Adequate nitrogen fertilizer is essential for production of high-quality potatoes, although quality can be adversely affected if excessive nitrogen is applied. In the Ontario area, for example, the percentage of No. 1 tubers has been increased by the application of 80 and 160 pounds of actual nitrogen per acre. However, the percentage of No. 1 tubers has dropped sharply as the rate has been increased above 160 pounds.

In both the Klamath Falls and central Oregon areas, potato yields have been increased by banded applications of phosphorus fertilizers placed 2 to 4 inches from the seed-piece at planting—even on soils considered high in phosphorus for many other crops. Thus, the scientists recommend banding on 80 pounds of $P_2O_5$ per acre if soil tests show more than 20 ppm (parts per million) phosphorus and from 160 to 200 pounds of $P_2O_5$ if less than 20 ppm is shown. Application of phosphorus fertilizers also has increased test yields in the Ontario area, although banding does not appear important.

Compared to most other crops, potatoes require very high levels of potassium. Responses to potassium fertilizers have been observed in both the Klamath Falls and central Oregon areas. Indeed, in the Powell Butte area of central Oregon, application of as much as 400 pounds of $K_2O$ per acre is now recommended where soil test values for potassium are low. Too, a combination of soil analyses before planting and analyses of potato petiole samples during the season has proved a satisfactory basis for predicting potassium needs, as well as for diagnosing potassium deficiencies as they occur in the field.

### Diseases influenced

Fertilizers can influence the impact of diseases on potatoes and *vice versa*. In the Klamath Falls area, for example, higher than normal rates of nitrogen fertilizer have helped plants resist early dying due to verticillium wilt.

The amount of nitrogen carried over from the crop immediately preceeding potatoes can have considerable bearing on the amount of nitrogen fertilizer that should be applied. In the Madras area, for example, following grass seed, application of 200 or more pounds of actual nitrogen per acre is now recommended. Following alfalfa, however, 80 to 150 pounds is the recommended rate.

Because of this wide range in response to nitrogen fertilizer, the OSU scientists note, further research is needed to establish a basis for using nitrate-nitrogen soil analysis to measure nitrogen carryover from the preceding crop. Equally essential is further study of the effects of soil moisture and air temperatures on nitrogen response. Tests in the Ontario area indicate that the adverse effects of high rates of nitrogen are accentuated by moisture stress and hot weather.

## Successful pilot oyster seed hatchery is developed

OSU FISHERIES RESEARCHERS have successfully developed a pilot oyster seed hatchery at the Marine Science Center on Yaquina Bay. Production from the new hatchery, first in the Pacific Northwest, is currently averaging six bushels of oyster seed per week. And by next summer, the weekly seed output is expected to exceed 20 bushels.

Several years ago, it became clear that a chronic shortage of oyster seed—both imported and naturally produced—was limiting expansion of Oregon's oyster fishery. So marine scientist W. P. Breese tackled the problem. One result of his efforts is the pilot hatchery, which is aimed at demonstrating the commercial feasibility of producing oyster seed in Oregon under artificial conditions.

The major hatchery operations are housed in three adjoining rooms at the Center. Adult oysters are spawned and oyster larvae "set" in the first room; larvae are reared in the second; and cultures of two algae, *Monohrysis lutheri* and *Isochysis galbana,* used to feed the larvae are grown in the third.

### Released to oystermen

Between 80% and 90% of the hatchery's seed yield is being released to oyster farmers at Coos, Tillamook, and Yaquina bays. The remainder is being used in tests of intensive oyster cultural methods under way at Netarts and Yaquina bays. Most of the seed output is of the Pacific variety, although some Kumamoto oyster seed also is being produced.

In addition to its other benefits, Breese points out, the pilot hatchery will enable OSU fisheries researchers to expand their work on oyster nutrition, disease control, and genetics. Goal of the genetic investigations is to develop faster-growing strains of oysters with improved size, shape, and disease resistance.

(*cont. from pg. 3*) alone a spawning salmon. For example, one stream in the study area becomes virtually intermittent in August and September—little visible flow between isolated pools. Yet this stream carries a large volume of water during the winter spawning season and is an important spawning and rearing area for coho salmon and cutthroat trout.

### Changes observed

Following the 1966 logging, some notable changes were observed in the fish habitat on the completely clear-cut watershed. Dissolved oxygen levels decreased significantly due to bacterial decomposition of slash and debris deposited in the stream channel. With much of the stream exposed to direct sunlight, water temperatures increased markedly. Winter sediment levels also increased. In addition, slash burning resulted in some fish mortality due to temporary heating of the stream water.

After a very thorough job of stream channel clearance, dissolved oxygen levels improved, as did the rate of stream flow. But clearance of the stream channel also brought further increases in water temperatures. In fact, water temperatures rose to a maximum of 24 degrees F. above the pre-logging maximum—considerably higher than optimum for salmonid fish growth. Too, daily fluctuations of up to 29 degrees were recorded, in contrast to pre-logging daily fluctuations of 1 to 3 degrees.

The most severe environmental changes on the completely clear-cut watershed occurred in the first year following logging. Subsequent rapid revegetation on the slopes and along the stream has brought about a moderation of summer water temperatures and reduced winter sediment loads.

Ultimately, of course, the most meaningful measure of whether today's logging practices and Oregon's salmon and trout resources can coexist is whether fish populations are affected. At this point in the study, it appears that cutthroat trout can be significantly affected in the period immediately following clear-cut logging. The cutthroat population in the completely clear-cut watershed was severely reduced for two years after logging, but now seems to be recovering. Thus far, the watershed's coho salmon population does not appear to have been much affected—particularly since clearance of the stream channel.

No significant changes, either in fish populations or fish habitat, have yet been observed on the partially clear-cut watershed, where a strip of vegetation was left along the stream edge. It is worth noting that results to date also indicate an increase in water temperature can be reversed if water that has been warmed subsequently passes through a shaded area.

Perhaps the most remarkable quality of the vegetation in Oregon's Coast Range is its very fast rate of recovery. However, some watersheds recover faster than others. On the North Umpqua drainage, for example, the vegetation recovery rate is relatively quite slow, and considerable public concern has been expressed regarding stream temperature increases that have occurred in the area following logging.

### Continued concern likely

There seems little doubt that the future will bring continued and, possibly, even greater public concern for the well-being of Oregon's salmon and trout resources, not to mention the overall quality of the state's waters. Those engaged in the Alsea Watershed Study hope their findings, to be summarized within the next four years, will assist materially in the development of management techniques that eliminate the possibility of a collision between timber and fish.

"... even very small streams are of considerable importance to Oregon salmon and trout resources."

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