# oregon's agricultural PROGRESS

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# PROGRESS

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**COVER: Carnations and other flowers are being studied for production of commercial seed in the Rogue River Valley. For a report, see Page 8. At right, soils scientist Larry Boersma checks controls of heat measuring device for soil plots. Story on Page 3.**

An underground movement:

# Warm water boosts crop yields

By Larry Boersma, *Associate Professor of Soils*

WARM WATER, NO FRIEND TO MOST Oregon fish, gets a different welcome from some crops of the state.

In first-year experiments at OSU's Hyslop Farm to show what would happen to soil and crops when warm water is run through underground pipes, the yield of bush beans, corn, soybeans, tomatoes, and lima beans increased up to 64 per cent.

Results of the experiments also could mean not only that Oregon's growing season could be lengthened—allowing crops new to the state to be introduced and possibly more two-crop harvests—but also that warm water, now a waste product, could be utilized and no longer be a problem.

### Supply no problem

A supply of warm water seems assured since demand for electricity in the United States increases about 7 per cent yearly, making it necessary to double generating capacity every decade. Most of this energy will be produced by steam-driven turbines, with boilers heated by fossil fuels—coal, gas, or oil—or nuclear fuel.

Since efficiency of the steam-generating process is only 33 to 40 per cent, an equivalent of two units of energy must be removed as a waste product for each unit of electricity produced. This is done by passing cold water through condensers to convert the steam to water again, and the temperature of large quantities of water emerging from

*For a look ahead to the farm of the future, turn to Page 4*

the cooling system is raised 10 to 30 degrees or more.

This heat in water is now wasted. Because it does not make sense to waste two units of energy for every unit produced, heat in the cooling water should be considered a resource to be managed for effective use.

One way to use it: Increase crop production by warming the soil.

Using surface irrigation to warm the soil with heated water is not feasible because the amount of water required to maintain an appreciable temperature change would flood the land most of the time. Warm water applied through a sprinkler system cools too rapidly.

But the heat can be applied under the surface by circulating warm water through a network of buried pipe. Heat moves from the pipes through the soil to the atmosphere, raising the temperature of the soil in the process.

Because many agronomically important crops grow best at soil temperatures of 70°-75° F., plant growth is limited by Willamette Valley soil temperatures. In Valley soil 1½ inches down, the temperature ranges from 40° in winter to 70° in summer. At 42 inches down, the range is 45 to 60°. Roots of most crops extend between 1½ and 42 inches.

To find out how much soil temperature could be raised, heating cables—to simulate an underground pipe network—were buried in trenches six feet apart and three feet deep. Thermistors (temperature dependent resistors) measured temperatures and thermostats on each cable network controlled temperature. A digital data acquisition system housed in a temperature-controlled trailer at the experimental site recorded measurements.

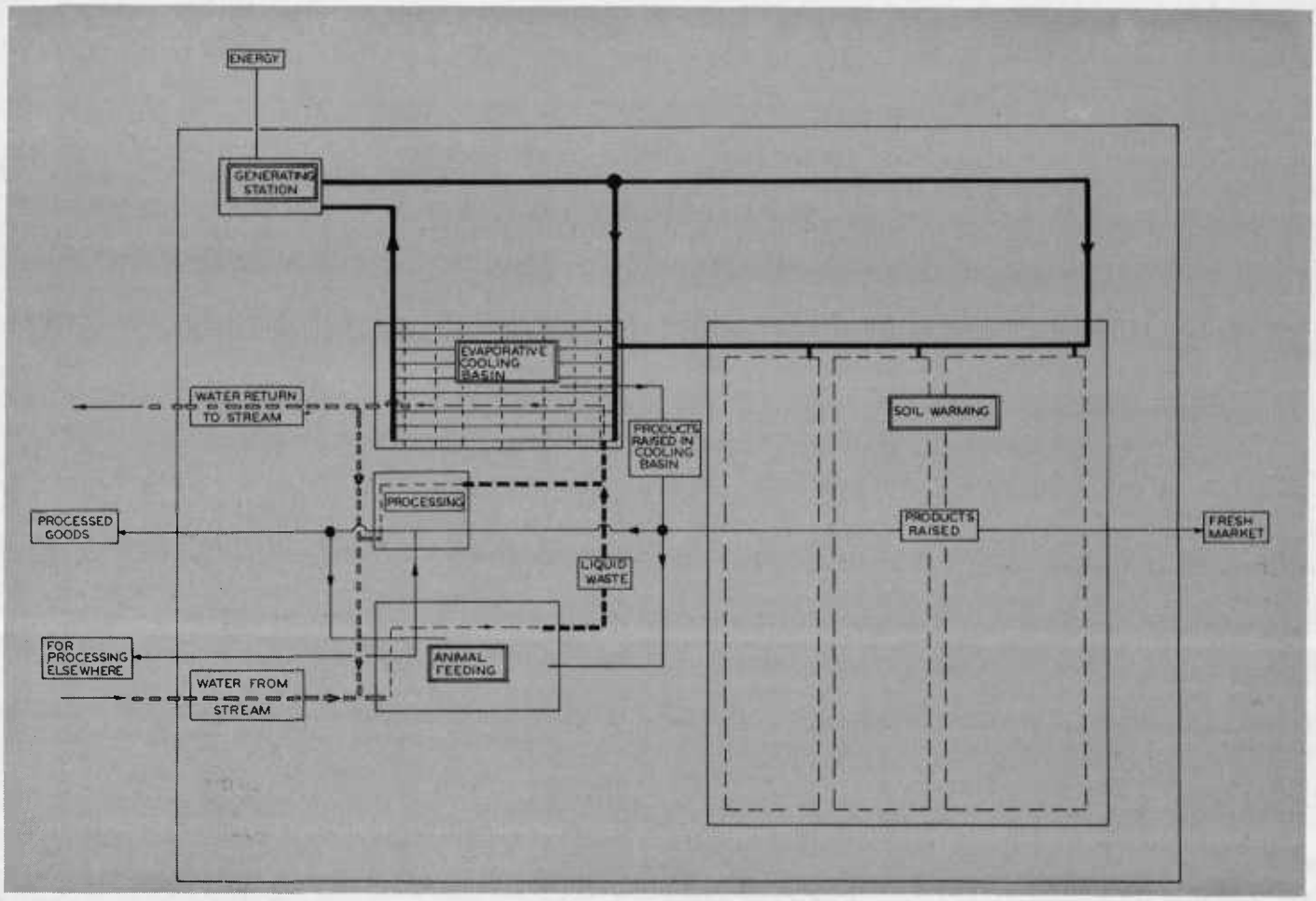
| 1969 Crop | Soilwarming Yield Increase Percentage |
|---|---|
| Corn (silage) | 45 |
| Corn (grain) | 33 |
| Bush beans planted May 12 | 22 |
| Bush beans planted May 28 | 15 |
| Bush beans planted June 17 | 38 |
| Bush beans planted July 25 | 35 |
| Soybeans (silage) | 64 |
| Tomatoes | 50 |
| Lima beans | 14 |

### An early spring

The 1969 growing season had an early spring, a cool, dry summer, and a cool, wet fall. Temperatures from mid-May through the first three weeks of June were higher than normal with

(*continued on page 16*)

# The farm...




# ...of the future?

Tomorrow's farm?

It could be built around an integrated warm water system. While the temperature of cooling water from power-making plants is not high, it is suitable and in many cases ideal for sustaining life cycle processes.

The above system consists of (1) a power-generating station, (2) a cooling cycle with a soil-warming loop and basins where heat is lost by evaporation, (3) a processing plant, and (4) an animal-rearing facility.

The cooling water remains in a closed system, first traversing the fields where some heat is lost while warming the soil. It passes a series of basins, giving off heat to the basin water which transmits it to the atmosphere.

The basins then become bodies of water at a constant temperature with the first the warmest and the last one the coldest. The bodies of water can be used to produce fish or single-celled protein —algae, yeast, or even fungi—with great potential. The protein can be feed or diet supplement for animals and the fish can be processed for human or animal consumption.

If this is the farm of the future, what will tomorrow's farmer be like?

# POTATOES: Herbicides control weeds

IMPROPERLY USED HERBICIDES CAN be a problem.

At the Klamath Experiment Station, Agronomist George E. Carter found that Tordon and 2-4 D—applied accidentally or otherwise—caused serious losses in potato fields.

Tests to determine the degree of damage to potato plants by the two chemicals—which are not recommended for potato crops—showed that as little as one-tenth gram of active Tordon per acre can cause foliage changes on potato plants. One gram of active Tordon per acre applied to potato plants reduced yield of U.S. No. 1 potatoes more than 60 per cent.

Careless applications of herbicides such as inconsistent speed of operation, spilling, or double application can injure the potato crop and leave harmful residues for following crops.

### Deep tillage helps

Residues from some potato herbicides have reduced by 25 per cent yields of wheat, oats, and barley planted the following spring. Some experimental materials have reduced spring grain yields 100 per cent.

Plowing or other deep tillage appears to be quite effective in reducing the damage to spring-seeded grain crops from herbicide residues.

Tordon, no longer used on agricultural lands, has been used to control weeds like Canadian thistle on ditch banks. Extremely low rates of 2-4 D can stimulate growth in potato plants, but the chemical is not recommended for that use. Potatoes produced by plants severely damaged by the Tordon were both pitted and distorted in shape.

The station has conducted weed control studies since 1961 when the majority of Klamath Basin potato fields were furrow or row irrigated and there was not much interest in chemical weed control. Then, potato rows had to be far enough apart for water to flow between them and it was necessary to cultivate to provide a furrow in which the water could flow. Timely cultivation provided good weed control.

However, considerable plant damage and root pruning did occur, especially with deep cultivation after potato plants were large.

In 1964, Experiment Station weed-free plots that were not cultivated yielded 36 hundredweight per acre more U.S. No. 1 potatoes than cultivated lots. A greater interest in chemical weed control developed with increased use of sprinkler irrigation, particularly solid set sprinkler systems, and narrow row spacings. Effective chemical weed control can eliminate the need to move solid set sprinkler irrigation pipes.

*Canvas protects control plants during herbicide spray testing.*

EPTC, Treflan, Patoran, Maloran, and Lorox have provided the most effective weed control on Experiment Station potatoes.

EPTC has been used for several years to control grasses and even broadleafed weeds on mineral soils. However, like many herbicides, it is not satisfactory on organic soils. Materials like EPTC and Treflan require immediate incorporation into soil, and mechanical incorporation may be undesirable when potatoes are planted in three-row beds.

### New chemicals look good

Patoran, Maloran, Lorox, and Dacthal do not require mechanical incorporation on sprinkler irrigated fields and have provided good weed control. When used as recommended, these materials do not appear to reduce potato yields.

Carter said some new experimental herbicides look extremely good. Chemagro's Bayer 94337 can be applied over growing potato plants with no apparent injury and appears to have both soil and foliar activity. Chipman RP17623 applied pre-emergence without incorporation has provided good weed control. Registration on these materials is not yet complete.

Soil fumigation for disease, which helps control weeds under some conditions, is probably the most effective way to control quackgrass on mineral soils.

# Irrigation control can triple production of wet meadow hay

CONTROLLED IRRIGATION CAN MORE than triple hay production of wet meadow valleys of Eastern Oregon.

Yearly, the wet meadows—wild flooding from spring run-off is the principal irrigation method—produce one crop of hay yielding less than a ton per acre under natural conditions.

Earlier, the OSU Squaw Butte Experiment Station found the yield can be doubled with fertilizer.

Now, data indicate hay production can be increased to more than 5 to 6 tons of hay (650 to 750 pounds of beef) per acre by water control of native meadows.

In Harney Valley and the Silvies River drainage alone, it is estimated, water control could increase forage production by 100,000 tons, beef production by 11.8 million tons, and gross income by $3.5 million.

### Nutrition drops in July

Nutritive value of native range forage declines rapidly after July 15, points out Larry R. Rittenhouse, range research scientist. Unless higher quality mountain range areas are available, growing cattle cannot make optimum gains the rest of the foraging season.

High-quality forage can be supplied by irrigated pasture when nutritive values of desert range forages decline. Irrigated pastures also can produce a high-quality hay. Native meadow hay—rushes and sedges account for about 85 per cent of total production—is adequate in nutritive value to maintain mature animals but it is not sufficient for growing animals to gain satisfactorily.

Depending on the size of the breeding herd and the quality of summer forage, some ranchers should consider running yearlings on irrigated pasture for the whole growing season. Because of better forage, animals responded economically to small amounts of supplemental energy. However, intensification of resources use means intensification of management. Even though some capital investments may be reduced or eliminated, managerial time and labor may be increased under a control irrigation program.

Animals must be inspected frequently for bloat, pink eye, scours, and other diseases. Strict irrigation schedules must be maintained. Soil fertility and a grass-legume balance must be kept.

### Feeding trials begin

To evaluate the management and production potential from water control, the Experiment Station dug a channel 5 to 6 feet deep around an area of about 60 acres. In the center of the area is an irrigation well with a capacity of 500 to 600 gallons a minute. A pump with automatic float valve controls the water table.

The area is divided into 16 pastures, each 2 acres. They were seeded with a 50-50 legume-grass mixture, eight with vernal alfalfa and tall fescue and eight with white clover and tall fescue.

Four alfalfa fescue and four clover fescue pastures are cut for hay and the regrowth grazed after July 1. The other eight pastures are grazed in rotation all season.

### 60-acre test area used

Pasture or haying?

Part of the answer to this management question will come from winter feeding trials when hay from eight pastures will be used to get an estimate of animal production from hay. These results plus the pounds of beef per acre from the remainder of the season will be compared to results of season-long grazing.

Until more studies are completed, the Squaw Butte Experiment Station is not ready to advise on the best way to proceed with water control.

But two things are recognized. Damming natural channels, providing distribution ditches, and other ways of the early settlers are not achieving maximum returns from available water.

Secondly, needed are better control of the water and the production of more water-efficient plants.

*Heifers graze on high quality Harney County irrigated pastures in mid-July.*

*Natural flooding of meadows in late spring was used by early settlers, too.*

# A new industry blooms in Oregon

Seed producers: alyssum, aster, carnation, cosmos, dahlia, dianthus, dimorphotheca, helichrysum, larkspur, nicotiana, ornamental basil, pansy, petunia, portulaca, salvia, snapdragon, stock, zinnia

SOUTHERN OREGON'S ROGUE RIVER Valley may be growing into a brand new commercial crop that can add to the state's beauty: flower seed.

Most flower seed now is produced in California where non-agricultural pressures for land are forcing some growers out of business and seed companies may need to find other production areas.

Agronomist John A. Yungen said research at OSU's Southern Oregon Experiment Station near Medford this year showed that seed of a number of flowers can be grown. Climatic and soil conditions make early spring planting possible and the fall weather, normally warm and dry, lessens harvest problems.

**Tested in field, too**

Seeds of 18 flowers were obtained from a seed company in January and an intensive screening program was started in a station greenhouse to find out tolerances of the flowers to an array of herbicides.

The flowers included alyssum, aster, carnation, cosmos, dahlia, dianthus, dimorphotheca, helichrysum, larkspur, nicotiana, ornamental basil, pansy, petunia, portulaca, salvia, snapdragon, stock, and zinnia. Some tolerated field rates of such herbicides as Treflan, Balan, Planavin, Tenoran, and TOK.

To confirm preliminary greenhouse results, a few seeds of each flower were seeded in the field early in March.

From April 3 to May 1, experimental plantings were made, depending on known frost tolerances of the flowers. All but four received pre-plant, tilled-in herbicides for weed control. The plantings, with 20-inch row spacings, were furrow irrigated.

Except for the salvia, stands and growth of most flowers were good to excellent. Seed formation was satisfactory in most cases although final yields have not been determined.

Seeds of helichrysum (strawflower), pansy, and dahlia normally are harvested by hand-picking the heads or seed bolls as they mature. These flowers might lend themselves to smaller acreage, family-type operations.

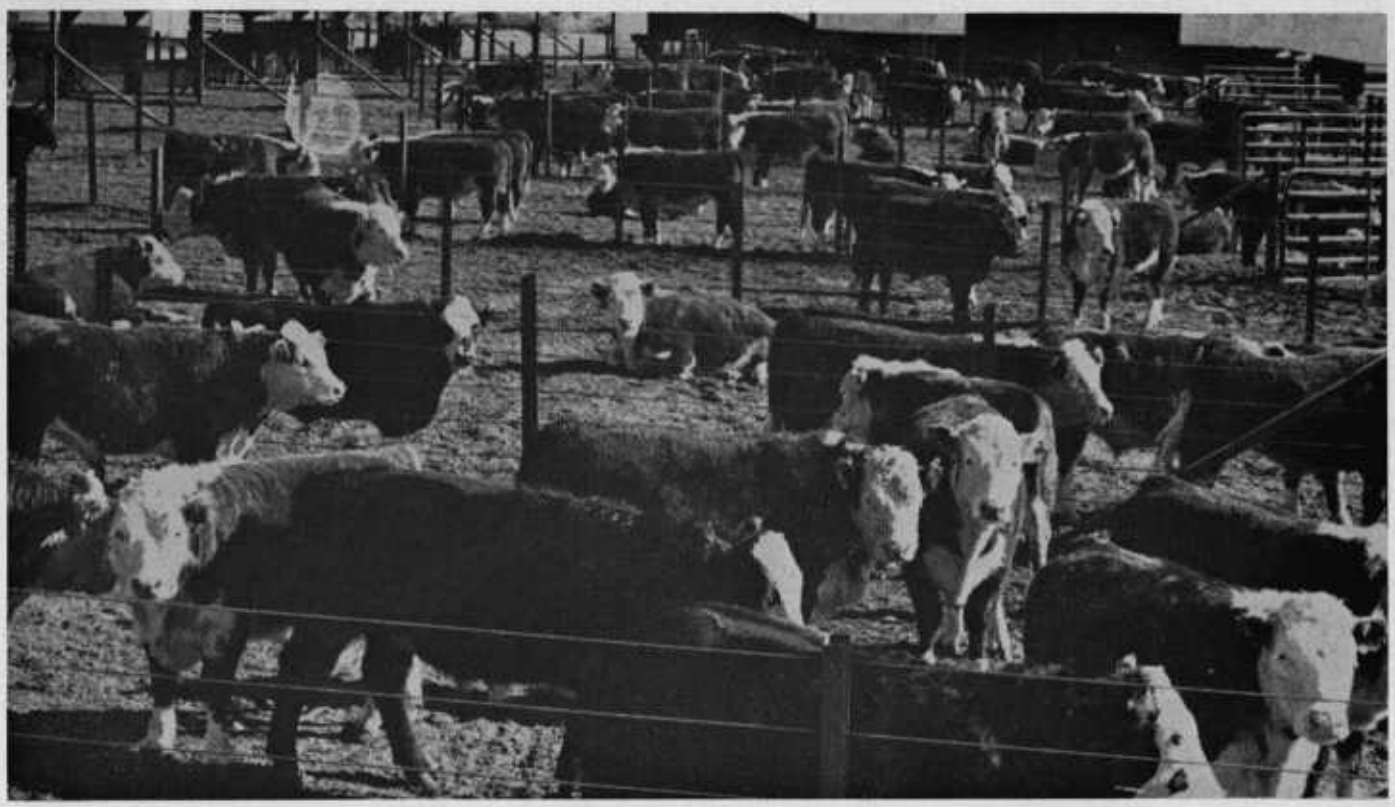
The other flowers are usually harvested by combine, either standing, from the swath, or after being cut and put on canvas, paper strips or plastic sheets to dry. Seed shattering is a serious problem with several of the flowers.

Under contract with a seed company, four Rogue Valley growers planted a total of 16 acres of zinnias, 4 acres of snapdragons and 2 acres of dahlias in 1970. The flowers were grown on land formerly in grass seed crops in what could develop into useful new cropping programs. A number of growers hope to obtain contracts for expanded acreage of flowers for seed in 1971.

Needed, said Yungen, is more research on problems such as soil fertility requirements, irrigation frequencies, control of insects, diseases, and weeds and harvest techniques.

The answers could add up to an industry that adds to the environment.

*Herbicide tolerances of cosmos and other flowers are checked in greenhouse before field planting.*



# Progeny program puts premium on production

BETTER BEEF.

To get it on your table, progeny testing is helping improve the quality of Oregon beef cattle by identifying superior genetic material.

Tests at the OSU Umatilla Experiment Station at Hermiston give owners an idea of growth potential, feed efficiency, and carcass quality of offspring of their sires. Important information as to biological efficiency and economic efficiency both became necessary if the purebred breeder wishes to survive.

Generally the sire is the only animal evaluated or considered in a test program. But real progress hinges on a careful scrutiny of individual cow records, say A. T. Ralston, animal nutritionist, and T. P. Davidson, superintendent of the experiment station.

### Most animals from Oregon

Then the breeder can select cows or cow families from which sire selection should come. The use of calves from first-calf heifers in a progeny test would then not only identify sires to be used, but also cows that would be mated to produce prospective sires.

Ralston and Davidson completed the first feedlot test of progeny in June, 1969, with 10 pens of cattle. During second-year tests completed in June this year, 24 pens of cattle from 16 breeders—progeny from 27 sires—were fed.

The 197 animals included three herds from Montana and six from Washington, states which do not have a progeny testing program. The bulk of the animals came from Oregon breeders who have pen preference each year until Aug. 15.

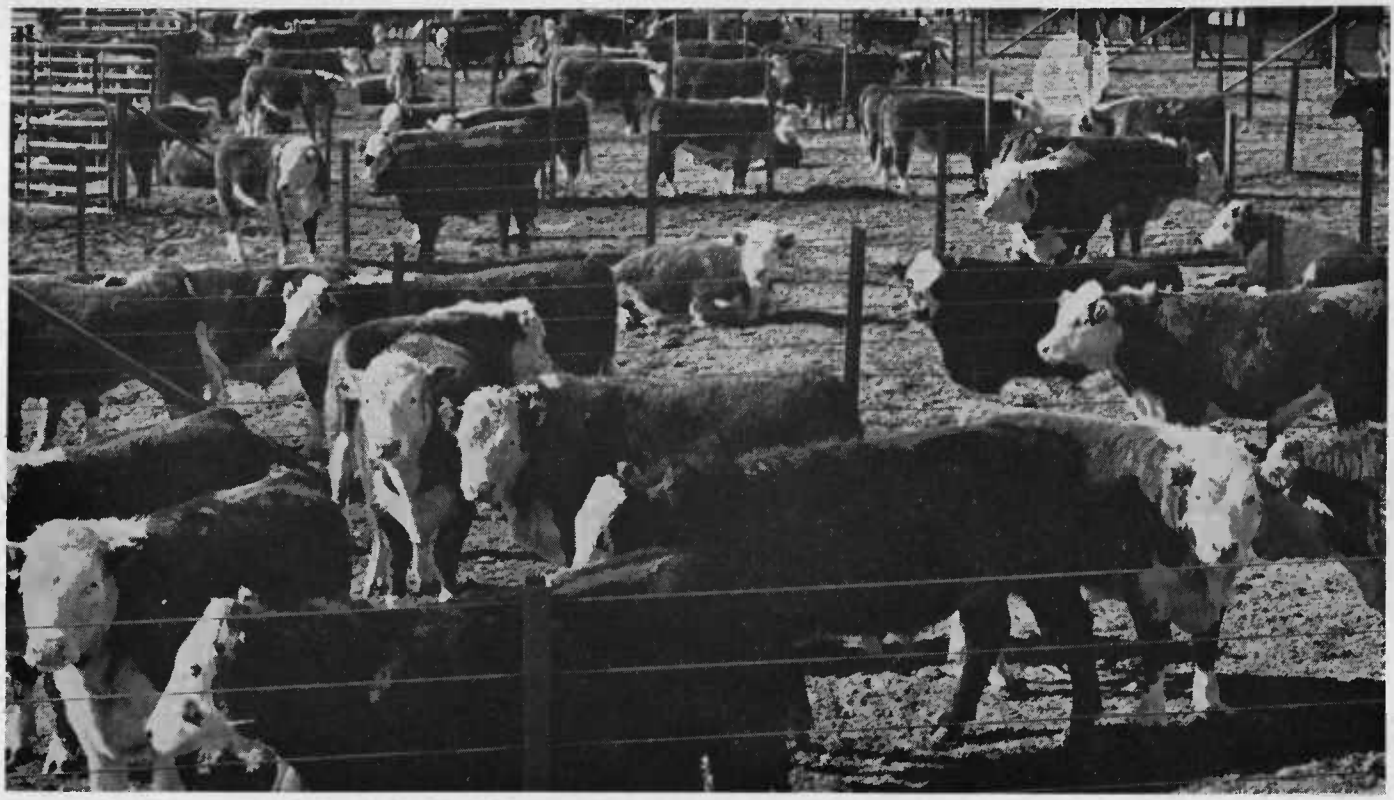
### Owners pay for carcass data

Owners pay for conditioning shots, yardage fee, and feed and marketing costs. They also pay a Pendleton packing firm for carcass data.

Most of the animals go into the pens shortly after weaning, usually Nov. 1 when they are six to eight months old. In this year's tests, ration started with 72 per cent total digestible nutrients (TDN) and 12.6 per cent protein. As feeding trials progressed, the ration changed to 75 per cent TDN and 12 per cent protein.

The ration included 5 per cent molasses, 20 per cent pelleted alfalfa, 28 per cent steam rolled wheat, 20 per cent steam rolled barley, 10 per cent cull peas, 10 per cent millrun and 7 per cent beet pulp.

At a body weight of 650 pounds, alfalfa was dropped to 15 per cent with a



compensating increase to 10 per cent beet pulp and 22 per cent barley. At 850 pounds, alfalfa was dropped to 10 per cent. Wheat was raised to 30 per cent and barley to 25 per cent.

Steer calves were implanted with 12 milligrams of stilbestrol. Heifer calves got Synovex H. Both preparations are growth stimulants.

Initial weight of the cattle did not vary much from 1969 tests. The lightest pen averaged 403 pounds; the heavy pen, 634 pounds. In the pens, variation was even greater with as much as 300 pounds difference between heavy and light animals. When this occurs, heavy cattle generally are handicapped because of lack of energy concentration in the ration.

**Daily gains varied**

Average daily gains also varied (some sire groups as much as 1.25 pounds a day) but the differences were not statistically significant. Steers gained 2.39 pounds a day; heifers, 2.35 pounds.

A more meaningful figure is the live weight per day of age at time of slaughter or carcass weight per day of age. Although some breeders thought 1.25 pounds of carcass a day of age was not realistic 10 years ago, only three groups of steers in tests this year failed to reach that production level. Two of them were close with 1.23 and 1.24 pounds of carcass a day of age produced.

**Conformation rates high**

Carcass conformation of most of the cattle was average choice or above with many grading low prime. Marbling was adequate to allow most cattle to grade low choice or above. However, there were 10 head with adequate marbling that graded good because of dark cutting lean.

In yield of trimmed cuts, 54 per cent of the steer carcasses and 85 per cent of the heifer carcasses were in Grade 2. Pounds of feed per pound of gain and feed cost per pound of gain were excellent. The range was 6.51 to 7.64 pounds and 15.89 cents to 18.59 cents.

About two-thirds of the cattle in the latest tests were Herefords. The rest were other breeds and some crossbreds.

To meet response from cattlemen, the station will expand facilities for the next tests from 24 to 30 pens.

The results will not only increase efficiency of the program but also will speed up the serving of that better beef.

Cattle ranchers can eliminate problems by using superior genetic material which has been identified

**A chemical that speeds ripening of berries and also helps separate them from the plant is expected to make harvesting more uniform, easier—and cheaper**

# Spray brightens berry outlook

A CHEMICAL SPRAY THAT ACCELERates ripening of berries and helps separate them from plants without damaging the environment is brightening the outlook for Oregon's multimillion dollar caneberry crop.

Ripening and ease of separation of fruit is of prime importance in both hand and machine harvest of the state's 12,000 acres of caneberries.

### Hydrocarbon released

Fruit separation is often uneven because of heat, drought, soil moisture, humidity and even time of day. Difficult separation slows hand harvest, makes machines perform poorly and results in a greater mechanical effort which damages canes and fruit.

Two-year tests conducted by an OSU team headed by Horticulturist Ralph Garren Jr. show that much of this difficulty can be overcome by timely application of a chemical, 2-chloroethylphosphonic acid which is available as Ethrel. The chemical releases ethylene, an unsaturated hydrocarbon long known for its role in ripening and abscission of fruit.

Tests showed that neither flavor nor plants were damaged by the chemical. And since Ethrel breaks down to prod-

**MACHINE HARVESTED BLACKBERRIES**

| | Percentage of Fruit | | | |
|---|---|---|---|---|
| | *black w/o stems* | *black w/ stems* | *red w/o stems* | *red w/ stems* |
| Control | 73.8 | 03.9 | 06.3 | 16.0 |
| Ethrel treated | 84.3 | 02.5 | 05.4 | 07.8 |

Table shows fewer undesirable types as result of treatment, i.e. fruits with stems attached or not mature.

**THORNLESS EVERGREEN BLACKBERRIES**

| *Treatment* | *Harvest* | *FRF** |
|---|---|---|
| Control | 5 days after | 163.0 |
| Ethrel | Treatment date | 113.3 |
| Control | 11 days after | 158.9 |
| Ethrel | Treatment date | 98.7 |

* Fruit removal force. Low value indicates easy separation.

*Ready for harvest, these trailing blackberries are typical of quality crop grown in Willamette Valley*

ucts present in the fruit, danger to human health has not been a problem.

The OSU team found that Ethrel begins to generate ethylene almost immediately after application. Using special instruments, the team determined that fruit removal force (FRF) was reduced by 20 to 50 per cent, depending on concentration, time, and frequency of application.

**More fruit harvested**

Numerous trials with several varieties of blackberry and with red and black raspberries showed that FRF is modified considerably as early as three days after treatment and that the effect is sustained up to two weeks by a single application.

Tests with commercial mechanical harvesting machines in several widely separated growing areas proved the effectiveness of the treatment.

Up to 40 per cent more fruit was harvested per unit area for picking than from comparable non-treated areas. The increase did not reflect greater yield but the fact that more of the crop matured early and could be readily removed with fewer pickings.

Tests also were favorable in areas where growers were having unusual difficulty in getting fruit off the plants because of drought conditions.

In addition, the team found that the soluble solids content—a measure of sugars in the fruit—was consistently higher for treated fruit. Size was somewhat less than fruit from non-treated areas but was not considered important because of other benefits of the chemical spray.

Use of the chemical promises greater control over harvest and reduced harvest costs because fewer pickings will be needed to remove the crop. Fewer pickings also would cut picker damage to immature berries and canes of the plant.

**No strawberry response**

Since the two-year tests showed no detrimental effects and Ethrel has been cleared for use on other food crops, Oregon's berry industry is hopeful that clearance for its use on caneberries will not be difficult.

Work is continuing on strawberries which have not responded to Ethrel or other chemicals tested as separation aids.

# Two harvesters tested on strawberries

CLIP OR STRIP?

OSU agricultural engineers have found that the best way to harvest strawberries apparently is to clip.

Tests of two machines showed that the one that cut off the plant has several potential advantages.

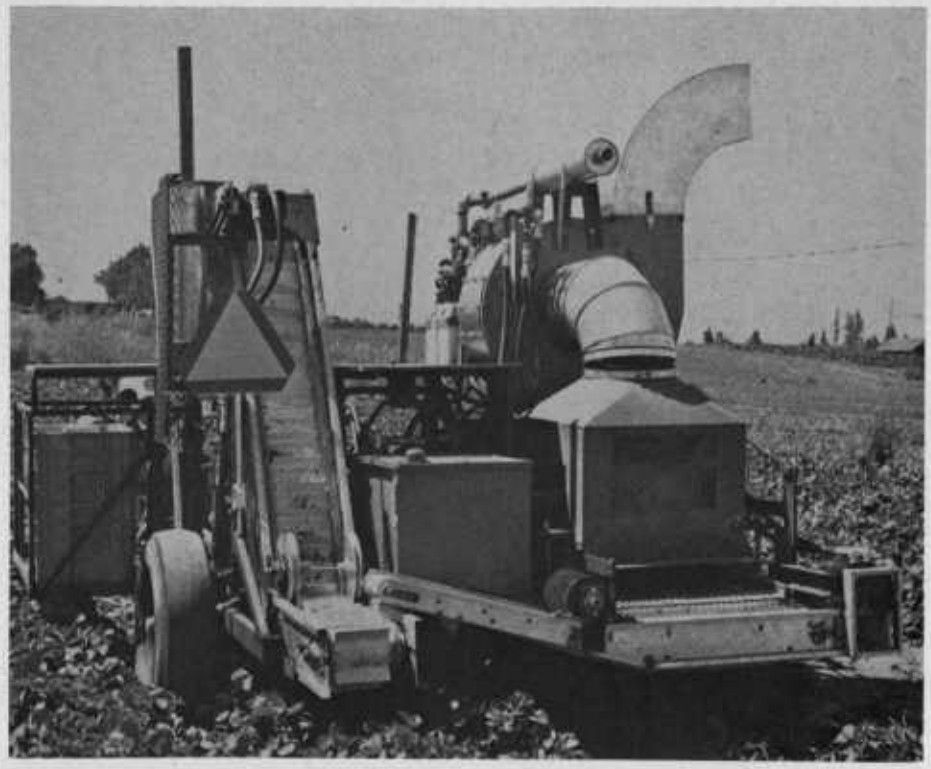
Both machines are "once-over" harvesters. One, called the Clipper, is a pull-type machine which cuts off the plant. The other, the Stripper, is a one-row self-propelled harvester. Its picking mechanism is a series of steel fingers mounted on picker bars attached to strands of roller chain.

Additional field testing will be necessary to verify the 1970 harvest results of the Clipper mowing unit, said OSU agricultural engineer Dean E. Booster.

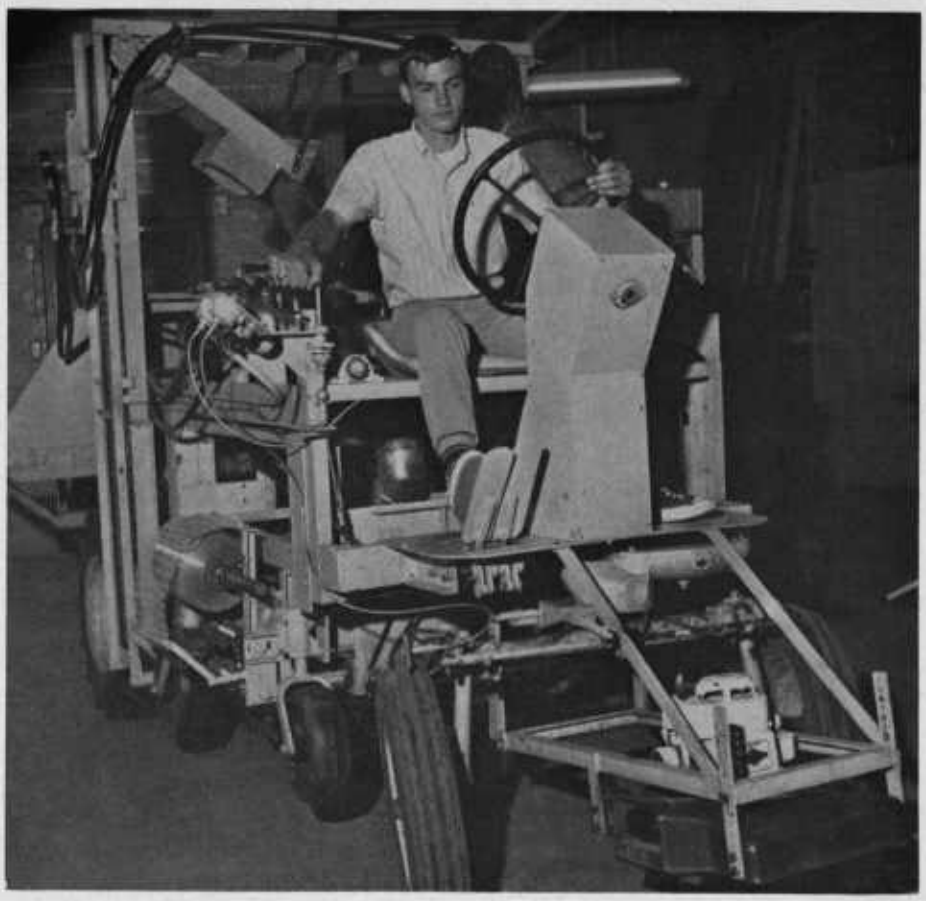
### Lifters raise fruit

Mechanical lifters on the Clipper raise the fruit up off the ground. A double reciprocating knife mowing unit cuts off the vegetative growth just above the crown of the plant which does not harm root and crown systems. A reel-like device helps move severed material across the cutter bar and onto a conveyor belt. A pneumatic cleaning system removes leaves from the harvested fruit which is almost entirely in cluster form. Rubber-covered conveyor belts transfer the fruit from the cleaner into plastic lug boxes.

The Stripper, designed for the single plant row system normally used in Oregon, has been tested under a variety of field conditions. Best results were obtained on rows free of runners, runner plants, weeds, and clods. Fruit recovery was slightly better on ridged



*The Clipper*



*The Stripper*

rows shaped and sized to accommodate the picking mechanism.

Picking fingers approach the plants from the side of the row. Berries are picked as the fingers comb through the plant foliage. Detached fruit is conveyed to a pneumatic cleaning system where leaves and similar material are removed.

The cleaned fruit then moves to a crating station where it is placed into the same kind of container used for hand-picked strawberries. Fruit harvested by the Stripper has only a few clusters. Nearly all berries have caps attached and about half also have stems.

### 70 per cent picked

During the 1970 field tests, the Stripper picked and recovered 70 per cent of fruit on plants at time of harvest. Losses on the ground accounted for another 20 per cent; 10 per cent was left attached to plants. An average 77 per cent of ripe berries harvested were usable for processing. Approximately half the ripe berries recovered showed some signs of mechanical damage.

The Clipper recovered an average 50 per cent of fruit on plants at time of harvest. On average, 90 per cent of ripe berries were of acceptable quality for processing. Approximately 35 per cent of ripe berries had some mechanical damage.

Although more effective lifting and gathering devices will have to be developed to increase fruit recovery rate, the Clipper showed the following potential advantages:

- ¶ It is not limited to use on the single plant row system.
- ¶ Runners and runner plants do not plug the cutting mechanism as much as they do mechanical picking fingers.
- ¶ Greater field capacities can be achieved because the Clipper can operate at faster speeds.

Other OSU agricultural engineers are doing research on mechanical capping and stemming.

Their goal: Mechanizing the entire strawberry harvesting operation.

*research briefs*

## Citric acid improves fruit color

The right kind of color in frozen strawberries is vital for acceptability.

Studies of stored berries by OSU food scientists R. E. Wrolstad, Teryl P. Putnam, and G. W. Varseveld showed that pH (a measure of acidity and alkalinity) was the only objective measurement having a high correlation with color quality.

To have acceptable color, the scientists found, berries should have pH of 3.51 or lower. Two varieties, Shasta and Tioga, are fairly light berries and tend to have poor color after freezing. They also tend to have pH above 3.5.

Citric acid, a natural fruit acid, was successfully used to adjust the pH without affecting flavor. Color improvement was noticeable.

The citric acid is added with sugar when sliced berries are packaged.

## DMSO in soil can change beans, potatoes

DIMETHYL SULFOXIDE (DMSO), known for its unique ability to transport compounds through membranes, including human, has been studied by agricultural scientists at OSU since 1963.

Work then showed that DMSO may aid in absorbing and translocating herbicides after soil injection or foliar application. Other OSU scientists have reported rapid uptake and distribution of DMSO—a colorless, mobile liquid commercially produced by using methyl groups of liquor from the kraft paper manufacturing process—when applied to leaves and stems of fruit trees.

DMSO also stimulated phosphorus uptake from nutrient solutions by strawberry plants. Other OSU studies showed that DMSO might influence nutrient uptake by decreasing soil pH (measure of acidity and alkalinity).

### Hydroponic results differ

In recent greenhouse investigations at OSU, G. O. Estes, former graduate science student, Harry J. Mack, horticulturist, and D. L. Willis, biologist, found DMSO harmed both beans and potatoes when grown at levels of soil-incorporated DMSO in excess of 0.1 per cent. But no visible toxicity or significant yield reductions occurred when DMSO was applied to soil at concentrations less than 0.01 per cent.

Adding DMSO to soils caused a significant depression in soil pH which appears to be strongly linked to uptake of manganese and phosphorus by bean plants.

In hydroponic studies with nutrient cultures there was no significant pH change after DMSO was added. Neither was there an increase in zinc or manganese uptake.

The scientists, whose object was to find out more about plant toxicity of DMSO and the mechanism of its effect after soil application, tentatively concluded that DMSO appears to affect zinc, manganese, and phosphorus uptake through a pH change in the soil rather than through influencing plant root membranes.

(*continued from page 3*)

less than average rainfall. Heavy June rains were followed by 79 days when only .05 inch of rain was recorded.

The heating cables maintained the soil at about 75° instead of the natural temperature of 50 to 60°.

### Corn emerged early

Tomatoes, corn, bush beans, lima beans, and soybeans grown on heated plots were compared with identical plantings grown on unheated ground. All plots were fertilized and irrigated by overhead sprinklers.

Soil heating had a significant effect on yield and maturity of field corn. Seedlings emerged one day earlier on heated plots and vegetative growth and stages of maturity were distinctly different through the growing season. In late July, heated corn plants were more than three feet taller than unheated plants and stalks were noticeably thicker. Tasseling and silking were four to five days earlier on heated plots.

Difference in silage yields of 5.5 versus 8.0 tons of dry matter per acre represents a 45 per cent yield increase from soil heating. The yield of shelled grain increased 34 per cent.

There was no evidence that soil heating hastened ripening of tomatoes, but yields increased 50 per cent and size and number of tomatoes per plant increased. Yields were 32.1 tons per acre on an unheated plot and 48.3 tons on a heated plot.

### Growth, yield increased

Soil heating increased soybean silage yields 66 per cent. Heated plants have heavier stems, taller plants, and better nodulation. Vegetative growth on heated plots was more vigorous early in the season and continued through the vegetative growth stages. However, soil heating did not seem to affect maturity of seed.

Lima beans in heated plots showed a 14 per cent yield increase, but bush beans in four plantings on heated plots increased yield from 15 to 35 per cent. Soil heating reduced the number of crop days by at least 10 for the fourth planting of July 25. Results suggest that under heating conditions, a second crop could mature in about 70 days for harvest about the middle of September, making double cropping of bush beans feasible.

Data from the 1970 growing season have not been processed but, in general, show higher yields from heated plots though not as great as 1969 yields.

Preliminary observations indicate the need for more detailed study of pesticide, herbicide, and fertilizer requirements and other aspects of the system.

Water for plant growth was depleted rapidly from heated soil and replenishment by irrigation was difficult. Moving from the heat source to the surface of the soil, heat drives out the water. Getting irrigation water to penetrate the soil against the heat flow is like trying to make water flow uphill. A dry core developed around the heat source.

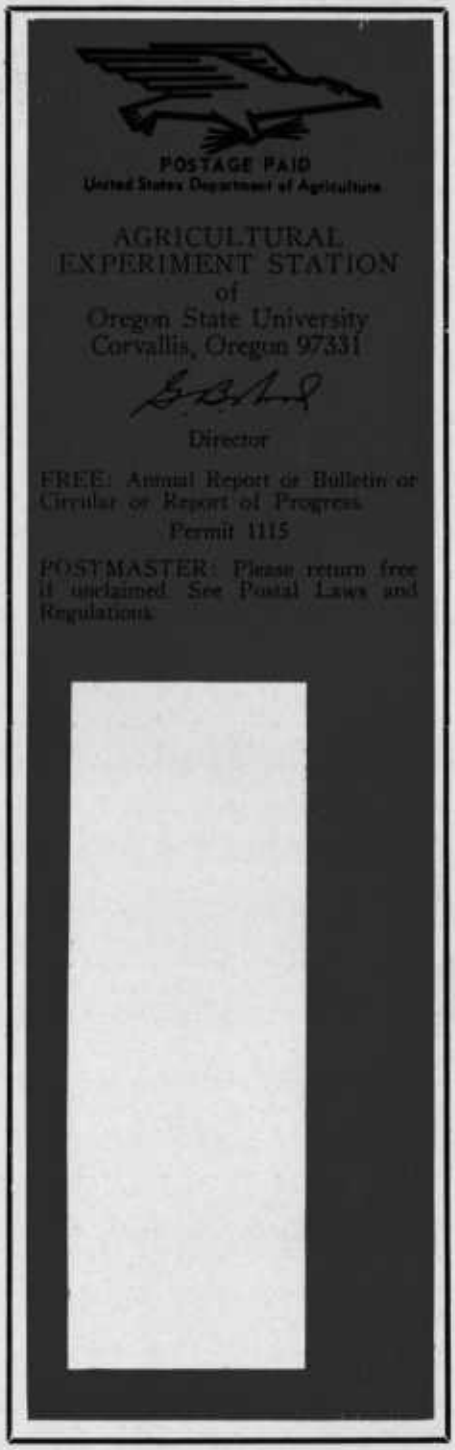
### Irrigation system tested

To overcome these problems, a subsurface irrigation system in conjunction with subsurface heat application is being tested. Water is applied near the heat source so a simultaneous flow of heat and water maintains a soil water content and soil temperature ideal for plant growth.

Added heat affects the availability of soil nutrients. Whether heat applied over a long time will harm the soil can only be evaluated over a period of years.

But already established is the fact that plants on warmed plots grow much faster. Perhaps even more important is the possibility of being able to plant earlier and sustain growth later into the fall in the Willamette Valley.

"...whether heat applied over a long time will harm the soil can only be evaluated over a period..."

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