oregon's agricultural PROGRESS

OREGON STATE UNIVERSITY / CORVALLIS / SUMMER 1969

oregon's
agricultural
PROGRESS

Vol. 16 No. 2

Published by the Agricultural Experiment Station, Oregon State University, Corvallis. G. B. Wood, Director; C. H. Sanderson, Editor.

OREGON'S AGRICULTURAL PROGRESS will be sent free to Oregon residents upon request. Address requests to Editor, Waldo Hall 206, Oregon State University, Corvallis, Oregon 97331, or see your County Extension Agent.

COVER: A colorful cinnabar moth caterpillar feeds on foliage of tansy ragwort, an increasing hazard to Oregon livestock. For more about this moth and its promise as a means of biological control of tansy, see the article on page 8.

New approach to food safety is opened

A NEW APPROACH to food safety has been opened up by OSU microbiologists. It consists of adding to foods a harmless, highly competitive bacterium that prevents the development of poisonous bacteria. The microbiologists, W. E. Sandine and P. R. Elliker, call the new approach "controlled population dominance."

Over the centuries, numerous methods of food preservation have been discovered—fermentation, pickling, spicing, smoking, pasteurization, canning, freezing, dehydration, irradiation. All are designed, in one way or another, to stop the entry and growth of undesirable organisms—not only those that cause disease, but those that cause spoilage and off-flavors.

In general, these methods have been quite effective and have solved many important, more obvious hazards. But the profound changes taking place in today's fast-moving food industry have created new food safety problems, not all of which were anticipated. More than 20,000 food-borne disease outbreaks were reported in the United States in 1967, and this undoubtedly is only a small fraction of the actual number of outbreaks.

Search launched

In response to the need for additional safeguards, Sandine and Elliker several years ago launched a search for organisms that might be added to perishable foods to prevent the growth of such increasingly significant disease-causing bacteria as *Clostridium perfringens, Staphylococcus aureus,* and the dreaded *Salmonella*—even if slight contamination should occur.

This search led the OSU scientists to *Streptococcus diacetilactis,* a harmless bacterium found in many dairy products. This organism produces low amounts of acid even at high populations. Thus it does not cause food it grows in to become sour, yet it halts the development of other bacteria, apparently by out-competing them for essential vitamins and other nutrients.

Spoilage stopped

Two examples of its effectiveness: In a recent test with cottage cheese, some cheese was intentionally contaminated with a common spoilage bacterium, then divided into two sets of samples. Half the samples were creamed as usual, while the other samples were prepared with cream to which a large number of *S. diacetilactis* had been added. All samples were then stored for three weeks at 45 degrees F. As shown in the accompanying photograph, spoilage was virtually stopped in the treated cheese. Indeed, it was still quite edible.

Vanilla cream filling, which can cause food poisoning outbreaks when improperly refrigerated, was used in another test. When samples of the filling were intentionally contaminated with 100,000 poisonous bacteria, then challenged with the *S. diacetilactis,* 99.9% of the poisonous bacteria died out within only 24 hours. Under commercial conditions, the OSU microbiologists note, contamination from natural sources would be much, much less.

Sandine and Elliker are now working to adapt the new approach to a wide variety of foods that can become unfit for human consumption between the food plant and the supermarket. Preliminary results, they report, are most encouraging.

Effectiveness of controlled population dominance is illustrated by the striking contrast between untreated, treated samples of contaminated cottage cheese.

Black crappie "proves up" for farm ponds

THE BLACK CRAPPIE makes fine fishing and delicious dining, as the fisherman of eastern Oregon reservoirs or warmwater lakes such as Siltcoos Lake has long known. Now, reports OSU fish biologist C. E. Bond, this attractive panfish also has proved suitable for use in farm ponds.

Tests at the Soap Creek experimental ponds north of Corvallis show that black crappies reproduce quite satisfactorily but do not tend to overpopulate and stunt when stocked with largemouth bass alone or with largemouths and bluegill sunfish.

Which combination gives the best results? Observations in ponds established by the Oregon State Game Commission and private individuals would suggest that the three-species combination—black crappies, bluegills, and largemouth bass—is best in ponds of two acres or larger. In the Soap Creek ponds, which are half an acre in size, more pounds of fish were produced in ponds stocked with all three species. However, fishing for "keepers" was considerably better in ponds stocked only with bass and black crappies.

Fishing tests

Catch per hour during regulated fishing tests of the three-species ponds averaged .4 black crappie, 1.8 bass, and 2.3 bluegills, while two-species ponds yielded 2.1 black crappies and 1.68 bass per hour. Bond notes that so many of the bluegills were small that anglers cooperating in the tests much preferred to fish the two-species ponds.

Overall fishing was best in the spring. The take of both crappies and bluegills then declined steadily from July until November, when the fishing tests were terminated. The bass catch held up fairly well throughout the summer. Crappies and bluegills appeared to favor natural baits—particularly worms, but bass were taken best on artificial lures.

Oregon farm ponds, under normal conditions, can produce black crappies like this fine specimen in three years. Stocking with largemouth bass is suggested.

The black crappie, like the bluegill and bass, is native to areas east of the Rocky Mountains and was introduced to the West during the late nineteenth century. It is heavier bodied than the white crappie and thus provides more meat per inch.

Stocking rate

In Oregon farm ponds, black crappies can be expected to grow to a length of 7 to 9 inches and a weight of $\frac{1}{4}$ to $\frac{1}{3}$ pound in three years. Bond suggests trying a stocking rate of 100 yearling bass and 200 yearling black crappies for the average one-acre pond. He notes, however, that presently there may be some difficulty in finding a source of black crappies.

Way found to confirm insecticide residues

DETECTING a low-level chlorinated insecticide residue in foods, animal tissues, and other biological materials used to be next to impossible. Development several years ago of a device known as the gas chromatograph answered the chief need—a more sensitive means of chemical analysis. Indeed, this remarkable instrument, when equipped with a special detector, has made it possible to spot as little as one-billionth gram of, for example, DDT.

Yet a notable complication remained. For in the process of analyzing materials with the gas chromatograph, noninsecticidal compounds often are detected that are very difficult to distinguish from authentic chlorinated insecticides. Now, a new technique worked out by OSU food scientists K. A. Banks and D. D. Bills has solved the problem.

Consistent reaction

When molecules are exposed to ultraviolet light (UVL), they frequently react by rearranging themselves internally or by breaking down into smaller molecules. And while there are some exceptions, the amount of a given compound that will break down or rearrange normally stays consistent if the amount of exposure to UVL is not changed. Moreover, the number and type of broken-down or rearranged products that result also remains constant. With this in mind, here's a brief view of how the OSU scientists' technique works:

The first step is to follow the usual

Bills examines the pattern of specially equipped gas chromatograph's reactions to test material previously treated with precise amount of ultraviolet light.

Using these temperature-controlled plastic limb cages, OSU researchers have successfully induced premature ripening condition in growing Bartlett pears.

procedure for isolating chlorinated insecticides from the material slated for analysis. This operation is called "cleanup." After cleanup, a portion of the isolated material is injected into the gas chromatograph. The instrument responds by tracing a graphic pattern—similar to that produced by a recording thermometer—of its reactions to the material's chemical makeup.

Patterns compared

If an analysis of this pattern indicates an insecticide residue, the remainder of the isolated material is exposed, under carefully controlled conditions, to high-intensity UVL. A portion of this treated material is then injected into the gas chromatograph and the pattern it produces is compared to the pattern produced by the authentic insecticide after exposure to the same amount of UVL. Thanks to the consistency with which molecules react to ultraviolet light, if the patterns are the same, the presence of a residue is confirmed.

Other chemicals

To date, the new technique has successfully pinpointed seven chlorinated insecticides in various materials. Banks and Bills expect that it also can be used to confirm the presence of other insecticides, as well as many herbicides and fungicides.

Progress in predicting premature pear ripening

WHEN WILL premature ripening once again strike the Bartlett pear crop? And how many days should the harvest be moved up in order to minimize the loss?

Earlier and more accurate prediction of the answers is the goal of research now being conducted at the Mid-Columbia Experiment Station near Hood River by OSU horticulturists W. M. Mellenthin and E. Hansen.

The maturity and quality of Bartlett pears is easily affected by prevailing temperatures during the four to six weeks immediately preceding harvest. For example, if temperatures fall below 50 degrees F. for only short periods,

the fruit tends to mature more rapidly than usual. When the weather turns abnormally cool or remains cool for several weeks, the fruit's storage life can be greatly reduced. It may even ripen on the trees before harvest, which makes it unfit for both fresh and processing markets.

This condition, called premature ripening, generally occurs chiefly in Bartletts grown at higher altitudes, where mean temperatures are cooler than at lower elevations. Still, when cool temperatures prevail regionally, the condition can become quite widespread.

A heavy loss

Bartlett growers in Oregon's Mid-Columbia region sustained a heavy loss from premature ripening in 1954. Temperatures favorable for the condition also prevailed in 1955, 1957, 1960, and 1964, but losses were held down by advancing the start of harvest. Last year, premature ripening generated a severe preharvest drop in the Mid-Columbia region and also struck Bartlett pear growing regions in Washington and California. The result: an estimated loss to growers of $2 million.

Among other things, Mellenthin and Hansen have successfully induced premature ripening in growing Bartletts enclosed in temperature-controlled limb cages (see accompanying photograph). In these experiments, fruit subjected to reduced day and night temperatures for two to four weeks preceding harvest has developed the typical symptoms of advanced maturity, ripening, and core breakdown. It also has shown an abnormally high respiration rate and a reduction in certain organic acids.

Other variables

Although cool temperatures almost certainly are the prime cause of premature ripening and the best current indication that the condition will occur, the OSU researchers have gathered considerable evidence that one or possibly several other variables are involved. Determining the exact nature and relative importance of these variables, as yet unknown, is their current objective.

It is hoped that this knowledge, when combined with the information obtained thus far, will enable predictions of premature ripening that are both more accurate and earlier in the season. This capability, of course, would provide growers with valuable extra time to make arrangements for an early harvest if required.

Poultry research advances knowledge of muscular dystrophy

OSU POULTRY SCIENTISTS have added another entry to the expanding catalogue of information on muscular dystrophy.

In a continuing study of defects in poultry, J. A. Harper and J. E. Parker recently isolated, described, and found the cause of a hereditary muscular dystrophy carried by an experimental line of turkeys. The culprit: an abnormal gene.

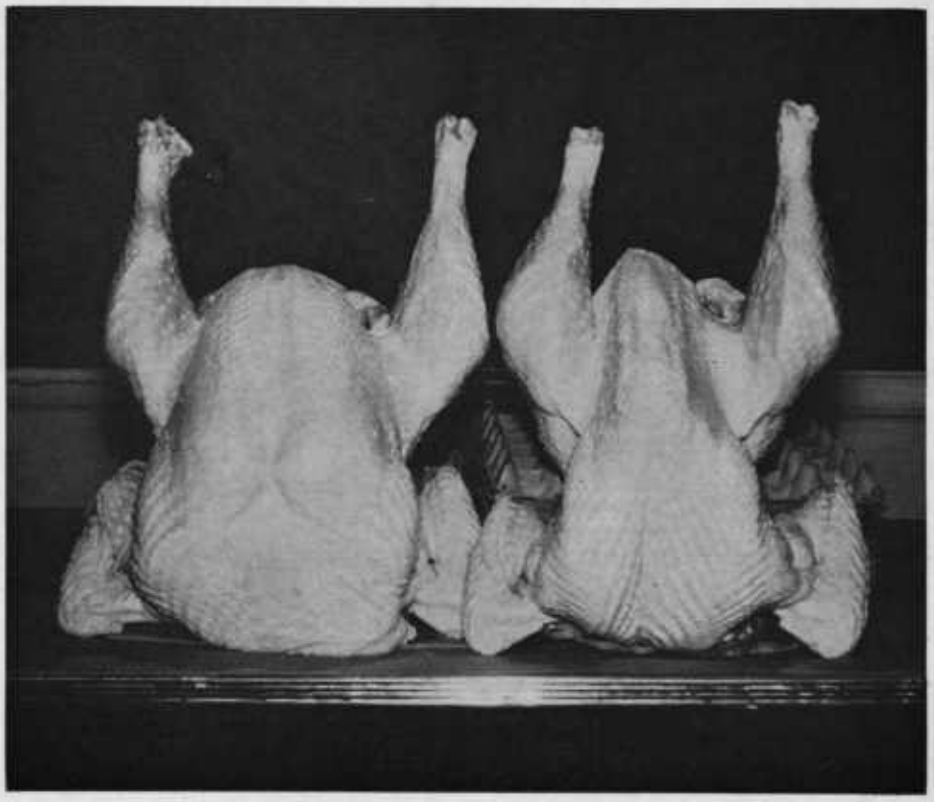
Harmful mutations

In animal as well as plant reproduction, genes—the minute bodies that transmit traits from generation to generation—normally are copied exactly. Progeny thus resemble their parents. On rare occasions, however, changes occur in genes during their formation. The result, of course, is an altered progeny, referred to as a mutation. When a mutation appears beneficial, the animal or plant breeder can use it to improve a line, strain, or breed. But when it appears harmful, he attempts to eliminate the abnormality to avoid its transmission to future generations. A good example of a harmful mutation is the muscular dystrophy reported by the OSU scientists.

Female ancestor

Harper and Parker first observed the hereditary dystrophy in two female turkeys with a common female ancestor. In subsequent matings of offspring of these birds, they determined that the

Effects of muscular dystrophy carried by the experimental line of turkeys are readily apparent in carcass at right. Muscling of carcass at left is normal.



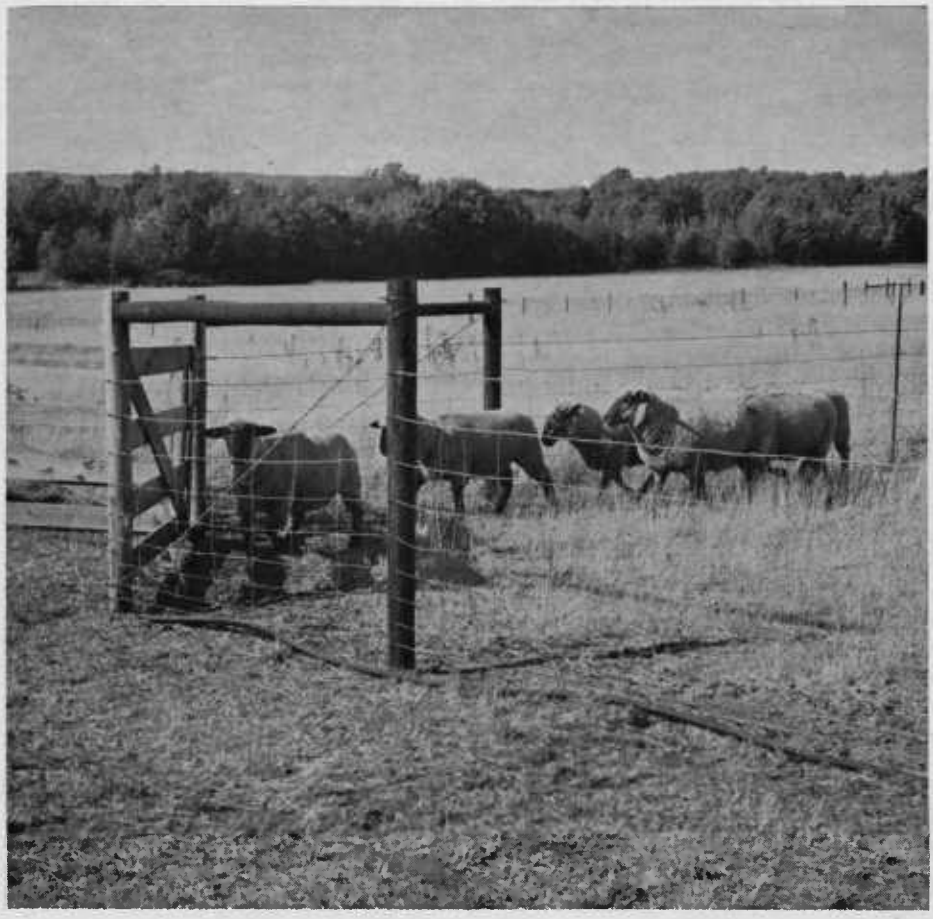
dystrophic trait is caused by what is known as a "single autosomal recessive gene."

As shown in the accompanying photograph, the dystrophy results in extensive atrophying or wasting of both breast and wing muscles. At eight weeks of age, body weights and breast widths of normal and dystrophic birds are similar. But at 23 weeks of age, the measurements of dystrophic turkeys average 40% smaller than those of normal birds.

After sexual maturity is reached at 32 weeks, the atrophying slows and may even cease. Egg production, fertility, hatchability, and livability are not greatly affected by the abnormality.

Of great value

Most present-day strains of turkeys do not appear to carry the dystrophic gene. Thus, the dystrophy has not been a problem in commercial flocks. The line is of great value, however, for studies of abnormal processes in muscle. Harper and Parker note that animals with such hereditary defects sometimes can serve as models for similar problems in other species.



Six sheep per acre is one of three stocking rates being tried in study set up by OSU research team. Objectives of the study are outlined in article below.

Study of sheep stocking rates now under way

How MANY SHEEP can be run on the subclover-grass pastures of western Oregon? Two per acre? Four? Maybe even six? Last fall, a team of OSU researchers—range scientist T. E. Bedell, animal scientist C. W. Fox, and veterinary parasitologist S. E. Knapp—launched a study designed to provide a sound, practical answer. Here's how they set it up and some of their objectives:

A 10-acre unit of predominantly perennial ryegrass with some subclover and resident annual grasses was divided into one-acre pastures. The unit, located on OSU's Adair Tract near Corvallis, had not previously been grazed by sheep. Thus, it was free of sheep foot-rot organisms and internal parasites.

The basic animals to be used in the study—20 Suffolk X Hampshire and 20 Lincoln-Romney X Suffolk ewe lambs—were quarantined for one month in nearby clean facilities. They also were "wormed" and given a foot trimming.

When the animals were turned into the pastures, worm egg counts in their feces were minimal. One goal of the study, Knapp reveals, will be to monitor worm egg counts at monthly intervals and, thereby, learn if stocking rate has any influence on build-up of internal parasites. Foot-rot and associated foot health problems also are being watched for closely, accompanied by an intense effort to maintain the cleanest possible foot environment.

Three rates used

Three stocking rates are being used —two, four, and six sheep per acre. Each pasture contains an equal number of animals of the two breed crosses, and the animals will be kept on the same pasture year-round, except during lambing.

Growth rate of the ewes prior to lambing will be assessed in relation to forage availability. And if possible, all ewes will be bred to one ram to minimize genetic variability among the offspring. Another major study objective, Fox reports, will be to assess the effects of stocking rate on lambing performance and pounds of lamb weaned per ewe and per acre.

Forage mixture

Since there presently is only a small amount of subclover in most of the pastures, Bedell is extremely interested to see how the different stocking rates will affect forage mixture. Results of tests in New Zealand and Australia would indicate that the clover population will be considerably higher under the higher rates of stocking. Western Oregon growing conditions are similar in some ways to growing conditions in those countries. However, western Oregon has somewhat lower winter temperatures and much less summer moisture than New Zealand and some parts of Australia. Thus, Bedell points out,

what will happen in the way of subclover development really is not yet known.

The pastures will not receive any commercial nitrogen fertilizer. Only phosphorous, potassium, and sulphur have been applied. Measurements of soil phosphate levels and pH will be made annually.

The study will be continued for a minimum of five lamb crops. If the stocking rates now being tried prove unrealistic after two or three years, the OSU researchers plan to modify them in order to obtain the maximum amount of practical information.

Moth releases boost prospects for control of tansy

RELEASING an imported insect looks like Oregon's best bet yet to control an increasingly hazardous imported weed. The weed: tansy ragwort. The insect: the colorful cinnabar moth, whose yellow-and-black-banded larvae feed exclusively on tansy leaves and flower heads.

And because the control is biological, soil residues, substantial costs, and other items associated with the use of chemical weed killers are reduced.

Tansy ragwort, reports OSU entomologist W. P. Nagel, is of European origin and was introduced to the North American continent nearly a century ago, in eastern Canada. It first became established in Oregon about 1936, in Tillamook County. An extremely aggressive biennial with conspicuous yellow flowers, tansy now infests more than 500,000 acres in western Oregon. And it is continuing to spread on both agricultural and nonagricultural sites.

Toxic to livestock

Tansy is a hazard chiefly because of its toxicity to livestock. Cattle are particularly susceptible, although horses, swine, and to some degree, sheep also can be poisoned. Cattle feeding on large quantities of either green or dry tansy can be killed within 10 weeks. Of course, tansy also reduces the grazing potential of areas it invades. Nagel points out that if an effective, yet economical means of control is not found soon, tansy could become a big problem —not only in Oregon, but throughout the United States.

Excellent control

Biological control of weeds by insects has worked out quite well in several instances. For example, introduced insects have established excellent control of the prickly pear in Australia and greatly reduced St. Johnswort, also known as Klamath weed, in northern California and many areas of Oregon. When successful, the technique not only avoids the drawbacks of using chemicals, but provides virtually permanent control, since insect populations are self-maintaining.

Back in 1959, OSU entomologist P. W. Oman, then with the U. S. Department of Agriculture, directed the introduction of the red and black cinnabar moth, a native of Europe, to the United States. The insect was first released near Fort Bragg on the northern California coast. The following year, two releases of 1,000 moths each, collected in France, were made in Oregon. One release was made east of Scio in Linn County, the other near Valley Junction in Polk County. In 1964, another release was made in Coos County.

The insect has since become established in both Linn and Coos counties, and has greatly reduced the number of tansy-infested acres near Scio. Indeed, a number of local residents have collected cinnabar moth larvae and released them on their own lands.

Rate of spread

Although the prospects for widespread biological control of tansy are encouraging, little research has been done to date on the moth's rate of spread or under what conditions its use is most likely to succeed. In cooperation with OSU extension entomology specialist Robert Every, Nagel is now working to determine at what stage and when the insect is best released in new areas, how many should be released, and how various natural conditions influence the insect's chances for survival.

Equipped with this greater knowledge of the relationship between the cinnabar moth and tansy ragwort, the researchers hope to be able to achieve control of tansy in many more areas of western Oregon and elsewhere.

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