Oregon's Agricultural Winter 1984

PROGRESS

Veggies vs. Cancer

Agricultural Experiment Station
Oregon State University

comment

John R. Davis,
Director, Oregon Agricultural Experiment Station

A new plan, comrades

Those who plan ahead are likely to get ahead. That's the reason the College of Agricultural Sciences has embarked upon a detailed, ambitious ten-year plan—to better serve Oregon's agriculture as we move from the '80s into the '90s, with all the inevitable economic uncertainties and the possible development of new technologies.

To some, a ten-year plan may sound like the Soviet Union trying again to whip the collectives into shape by setting new goals for wheat production. This plan will be different. It can trigger the imagination as to where Oregon's agriculture is going and what research, teaching and Extension can do to foster a successful move into the 1990s. It can light some lamps and some fires—hopefully without too much smoke or heat—and provoke thoughtful people.

Oregon's farmers and ranchers have had their share of problems in the last few years. Cattle prices reached new lows, good contracts for producing beans and peas were tough to get, and competitors with Oregon products became more efficient and aggressive at the marketplace. Many of the most difficult environmental conflicts are still to be solved. And, although the family farm continues as a social and economic entity, we know survial will be more difficult for the next generation.

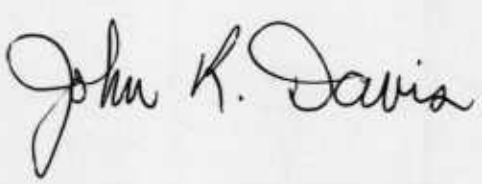
This is not the time for gloom and doom, however. Now is the time to evaluate our strengths and our weaknesses and to exploit our potential to the fullest extent possible.

Because about 85 percent of Oregon's farm products are exported, we obviously need to continue to build and strengthen markets. The Oregon Department of Agriculture, in collaboration with several commodity commissions, has worked diligently to expand our international markets, but perhaps a major research thrust on agricultural trade would be helpful, especially in dealing with freight rates, packaging, tariffs, etc. We need to provide the newest technologies for the food processing industry in Oregon so we can capitalize on Oregon's reputation for high quality processed food products and capitalize on the trend toward eating more prepared meals and food products.

New crop ventures are possible, and the Experiment Station already has a good jump in this area with a research program on such crops as meadowfoam, cuphea, rapeseed and soybeans. The support and processing systems that only industry or co-ops can provide are critical to the success of developing new crops. On the other hand, we cannot direct too much attention from our old standbys such as wheat, potatoes, cattle, dairy products, and nursery crops, for these products have been and probably always will be the economic mainstay of Oregon's agriculture. We can do better with these old standbys, though, with the application of new technologies in genetics, integrated pest management, integrated reproduction management for animals and integrated production management for crops. Efforts to adapt such new technologies are a must for Oregon. To relax our interest in adapting for the future will certainly jeopardize that future.

These are just a few of the ideas and trends that will be a part of our planning. The planning process involves many residents of Oregon— public meetings this month are providing an opportunity for constructive criticism and new ideas. The goal is for the process to involve people who have many diverse interests and approaches. So be a part of this plan—talk it up and give us your ideas.

To paraphrase one of the best-used industrial mottos, "Progress is important, if we are to have a product." □



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Cover: OSU food scientists are studying substances that may help in the battle against cancer. Left to right are researchers Jerry Hendricks, Norm Pawlowski, George Bailey, and Joe Nixon. Story on page 8. (Photo: Dave King)

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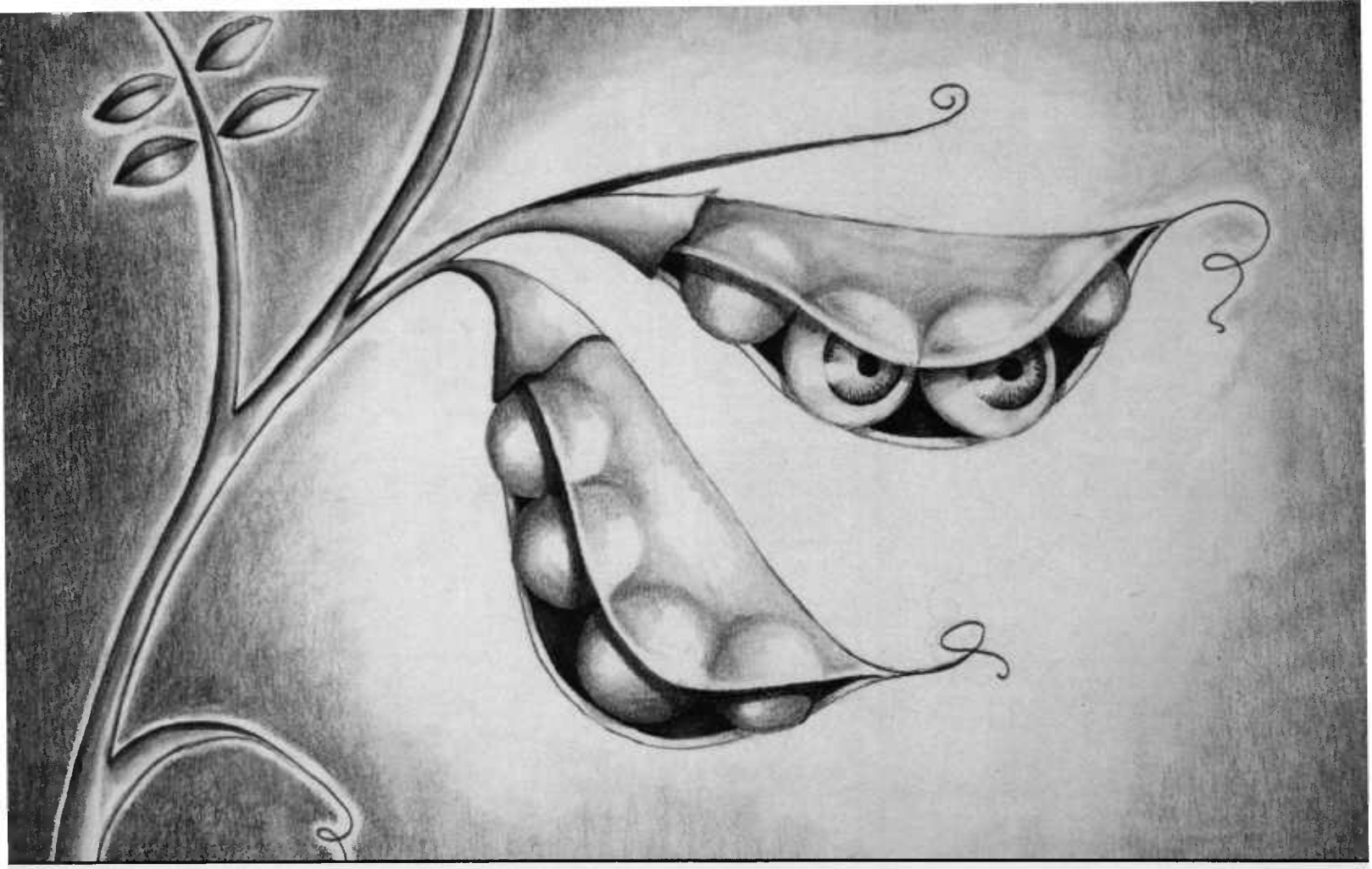


Amy Charron

The Lurking Virus

A menace to Oregon pea crops may have gone undetected for years

By Richard Floyd

A viral disease of peas, never reported in the United States until a devastating epidemic in Idaho, may have been hiding for years in other forms in Oregon and the rest of the Northwest.

As a result, Oregon farmers should watch aphid populations in their pea crops and alfalfa crops (where the aphids overwinter) more closely, says a researcher at OSU.

The virus became known in 1980 when a major pea disease struck southern Idaho, where 80 percent of the U.S. pea seed crop is produced annually.

"In 1981 and 1982, the effects of the disease were much less destructive," said Richard O. Hampton, U.S. Department of Agriculture plant pathologist based at OSU. "But the symptoms were the same—yellowing from the top of the plant downward and lack of infection gradients across affected fields—and unlike symptoms frequently produced in that area by the better-known pea streak and alfalfa mosaic viruses."

The symptoms closely matched those of pea leaf roll, a disease first described in scientific literature by researchers in The Netherlands.

Hampton, who has worked almost exclusively on viruses that infect edible legumes (peas, beans, lentils) since coming to OSU in 1965, isolated the Idaho virus in an Experiment Station project by feeding aphids on naturally infected pea or alfalfa plants and then transferring the aphids to pea plants sensitive to pea leaf roll.

Many pea plants in the Idaho epidemic contained pea leaf roll virus and pea streak virus, both probably transmitted by the same aphid. Separation of the two viruses, plus testing pea varieties susceptible to the viruses, indicated that pea leaf roll virus was the principal cause of the disease.

Hampton used a special enzyme test called ELISA (enzyme-linked immunosorbent assay) to verify that viruses causing the disease were pure forms of pea leaf roll virus free of

other viruses (such as pea streak, alfalfa mosaic and red clover vein mosaic).

Major U.S. pea seed companies then came to the rescue with advanced breeding lines that were either resistant to pea leaf roll virus or tolerant to the disease it causes.

The symptoms closely matched those of pea leaf roll.

Recent evidence suggests that the virus virus causing the pea disease epidemic in southern Idaho is not a newcomer to the Northwest.

"I believe the virus may have existed in the U.S. agro-ecosystem, principally in alfalfa, for many years," said Hampton.

Records in his laboratory indicate that plants with symptoms similar to those of pea leaf roll existed in the Pacific Northwest several years before 1980.

"And an extremely high incidence of the virus in alfalfa plantings, assayed in 1980, suggests an enduring relationship between alfalfa and pea leaf roll virus," said Hampton.

In the Idaho epidemic, alfalfa plants in nearby fields showed symptoms analagous to those caused by pea leaf roll virus symptoms in peas, including leaf yellowing.

"Comparable symptoms have been observed in alfalfa for many years, particularly when fields were irrigated after the first cutting for hay," said Hampton. "Since this usually occurs in June, the condition has been termed 'June yellows.' The symptoms usually are enhanced when the first post-cutting irrigating coincides with cool soil temperatures."

However, Hampton found that alfalfa plants affected with June yellows contained no higher incidence of pea leaf roll virus than normal plants. He concluded that June yellows was not caused by the pea leaf roll virus but that alfalfa plants tolerate infection with few or no obvious symptoms.

Several factors interact to produce pea leaf roll epidemics. Some are not yet understood, but alfalfa, the perennial reservoir for pea leaf roll virus inoculum, plays the central role in the cycle of the southern Idaho disease, said Hampton.

The pea aphid, responsible for transmitting pea leaf roll virus to peas, overwinters on alfalfa. Winter severity determines the form (adult or egg) in which the pea aphid survives. It also influences the time of population increase. The pea aphid's reproductive rate goes up as spring temperatures increase.

"The numbers of winged aphids preceding the time of first alfalfa cutting for hay may be the most critical factor determining spread of pea leaf roll virus to peas," said Hampton.

In 1983, pea leaf roll virus was detected in lentils, peas, crimson clover, chickpeas and broadbeans in northwestern Idaho and in the Palouse area of eastern Washington.

Several factors interact to produce pea leaf roll epidemics.

"Infected lentil and broadbean plants were sometimes symptomless but typically were stunted with yellowed leaves. Infected chickpea plants were stunted and severely yellowed or killed. Infected crimson clover plants typically were stunted with brilliant red foliage," said Hampton.

In Oregon, peas grown in the Milton-Freewater area are the only edible legume crop known to have been affected by pea leaf roll virus. The three northwestern states have about 150,000 acres in peas. The total value of dry edible peas, processing peas, and seed peas for the three states is approximately $230 million.

What's the outlook for pea leaf roll virus in the Northwest?

"The epidemiological mechanisms involved in establishing the virus in alfalfa stands, particularly in southern Idaho, are unknown," said Hampton. "Having been established, however, pea leaf roll virus can be expected to persist and expand into new and surrounding alfalfa production areas."

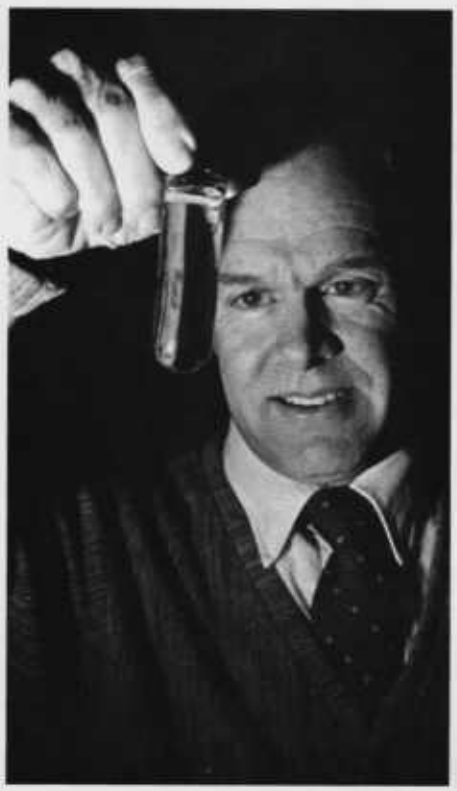
It can be assumed, he said, that factors favoring large populations of aphids in alfalfa promote the likelihood of pea leaf roll epidemics.

"The active participation of research personnel of the major pea seed companies in developing cultivars tolerant or resistant to pea leaf roll virus assures progress toward the ultimate control of the disease in peas," he said.

Hampton also suggested that use of systemic aphicides to discourage prolonged feeding and colonization of aphids migrating from alfalfa to peas could be helpful. University of Idaho scientists Robert Stoltz and Robert Forster are evaluating systemic aphicides for this purpose.

"It is conceivable that cooperative work between plant virologists and alfalfa breeders could eventually produce finished alfalfa synthetics (varieties) resistant or immune to pea leaf roll virus and to other viruses for which alfalfa is a natural inoculum reservoir," said Hampton.

"In the meantime," he said, "pea lines resistant to pea leaf roll virus, and control of aphid populations in alfalfa, offer the greatest promise for controlling the disease." □



Researcher Richard Hampton examines a solution containing purified viruses.

Ewe Want Some Brush?

Sheep show promise for forestry work

By Richard Browning

A dew-covered lamb, looking for its mother in the foggy clearcut, bleats in distress. A ewe steps from behind a vine maple shrub to answer the call and the lamb flies to her side. Reunited, the two resume grazing with the rest of the flock (except for the lamb's occasional playful dashes through wild brush and Douglas-fir saplings).

You probably wouldn't suspect that such a wooly crew would be working for the U.S. Forest Service...but it just might.

For humans, clearing brush normally is sweaty, scratchy, tedious labor. Or, when herbicides are employed, it can be a mechanical but controversial task. For sheep, it's a more pleasant endeavor— snack time, Experiment Station researchers have found.

The U.S. Forest Service's Steve Smith, a rangeland conservationist with Oregon's Alsea Ranger District, hopes that by next summer his district will have flocks of sheep doing some of their brush control work, offering some Pacific Northwest ranchers the prospect of relatively inexpensive spring-through-fall grazing land. Smith says brush control in his district can cost $100 to $450 per acre, and herbicides are banned in much of the area. Sheep grazing, he believes, could save the Forest Service and ranchers money.

A sheep from an experimental OSU flock grazes next to a Douglas-fir sapling.

Smith bases his hopes on two years of research directed by OSU rangeland resources professor Steve Sharrow. In the study, sheep grazed on Douglas-fir plantations, mostly reforested clearcuts, in the Oregon Coast Range. Sharrow and his graduate students, Bruce Rhodes and Wayne Leininger, studied a flock that was rotated from plantation to plantation from mid-May through late August to take advantage of changing vegetation. The study group recorded how the trees and sheep fared.

> The sheep did almost no damage to the Douglas-firs.

The young Douglas-firs did well; diameter growth was 7 to 14 percent greater on grazed plantations than on ungrazed plantations, and the sheep caused no significant damage. No difference in tree height was measured.

The sheep—600 ewes nursing lambs in 1980 and 1981, 900 dry ewes in 1982— showed what Sharrow calls "acceptable" weight gains. In the summer of 1981, lambs in the study gained 31.3 pounds per head while the lactating ewes (ewes producing milk) lost 7.5 pounds per head. During the 1982 season, the dry ewes gained 21.6 pounds per head.

Sharrow used Columbia sheep because of the breed's strong herding instincts. In many parts of the Pacific Northwest there is not enough summer range to maintain a flock's weight. The Coast Range plantations

may provide alternative grazing land for sheep ranchers, he pointed out.

Sharrow is not sure why young trees on the grazed units showed more diameter growth than trees on ungrazed units.

Brush control in his district can cost $100 to $450 an acre.

He has some "opinions," though. There were only small differences in soil moisture, he said, between grazed and ungrazed units. He doubts that competition for light between the trees and the brush was a factor, because the trees already were taller than the brush. Needles on the trees in grazed units contained more nitrogen, a nutrient, and this might account for greater diameter growth, he said.

Why would trees in areas grazed by sheep have more nitrogen?

Sharrow said about 70 percent of the nitrogen the sheep ingest is excreted as urea in the animal's urine—essentially urea fertilizer in liquid form. Because the sheep spend more time grazing and relaxing in the shade of the trees than around brush, it is likely nitrogen concentrations are higher in the soil around the trees. Without further study, he added, "this is all speculation."

The sheep did almost no damage to the Douglas-firs when the animals were put out to pasture long enough after bud break (a few weeks) so the trees were less palatable. Also, the plantations were not overgrazed so the sheep didn't finish their preferred forage and start eating the Douglas-firs. The trees were too tall for the sheep to trample. Rarely, a ewe might chew on a Douglas-fir's bark "when she's bored," Sharrow said.

OSU fisheries and wildlife professor T.P. Kistner and the Forest Service's Smith looked at potential problems of space and food competition between sheep and deer and elk. Smith said deer and elk left the units where sheep were grazing. Deer returned three to seven days after the sheep left, if there had been a rain to wash away the odor of sheep urine. If it didn't rain, the deer took up to six weeks to return. Elk took slightly longer.

Based on deer necropsies, Smith said, the deer were better off with sheep grazing the area. Deer taken from grazed units in the spring were about 15 pounds heavier than those from ungrazed units. The deer from grazed units also bred about five days earlier and gave birth to fawns earlier in the spring, increasing the fawns' chances for survival, Smith said. The deer from grazed units had more internal parasites (transferred from the sheep) but gained more weight than those taken from ungrazed units in spite of the parasites, he said.

Sharrow said grazed areas had less edible vegetation in the fall, but it was of higher quality than that on ungrazed areas. "And quality of forage, not quantity, may be what limits wildlife populations," he said. With the sheep's constant pruning, the forage continued to grow in the fall, producing higher quality foliage.

The plants were of better quality when they died than ungrazed plants would be and made better winter browse for the deer, Sharrow said. Also, the plants might start growing sooner in the spring because of increased nitrogen, sunlight, and soil warmth, he said.

Sharrow is pleased with the way foresters and rangeland people from the Forest Service and OSU have worked together. This type of project is "deceivingly complex," he said, "in that it needs very little physical resources but a lot of expertise in many areas, so that the needs of different land uses are met without hindering each other."

Although the study didn't compare the efficiency of sheep grazing with using herbicides or hand clearing for brush control, Steve Smith is optimistic about future use of sheep as a silvicultural tool. The Forest Service's policy is to always be searching for effective alternatives to herbicides, he said.

The cost benefits of this method "look good right now," Smith said, "and not only for brush control." Using sheep on the plantations also appears to improve the winter range for big game animals, he added. He's not sure about the cost benefit to the rancher, because trucking costs may enter the picture. Smith said he hopes to mold collected information into a management plan for tree plantations on Forest Service land.

This winter, he said, his district probably will take bids from ranchers, just as on any other brush control project. He expects the bids will range from zero to enough to cover trucking costs. That means next summer foresters may again hear the bleating of sheep echoing through the hills near Alsea in the Coast Range. □

Sheep may concentrate beneficial nitrogen around trees, speculate OSU range scientist Steve Sharrow, center, and graduate student researchers Wayne Leininger, left, and Bruce Rhodes.

Vegetables Versus Cancer

An OSU team is eyeing cancer inhibitors

By Andy Duncan

The magazine ad's colorful photo is eye-catching—orange, green and white garden goodies flanking a bottle of pills.

"Your grandmother was right. Eating vegetables is good for you," it begins. "According to the National Academy of Sciences, a regular diet of cruciferous (cabbage, brussels sprouts, broccoli, cauliflower) and carotene-rich (carrots and spinach) vegetables is associated with a reduction in the incidence of certain cancers.

"Of course you may not really like the vegetables. Or you may not cook them quite right," continues the pitch for Daily Greens, pills described as "concentrated servings" of beneficial vegetables picked fresh, washed and then dehydrated.

Does this sound like a real advertisement, or something a writer dreamed up?

It's real, and the display of Yankee marketing ingenuity is of special interest to George Bailey (biochemist), Joe Nixon (nutritional biochemist), Norm Pawlowski (organic chemist) and Jerry Hendricks (animal pathologist)—members of an Experiment Station research team in OSU's Department of Food Science and Technology.

The scientists are part of a national push, funded primarily by the National Cancer Institute, to learn more about so-called "cancer inhibitors," food substances that seem to have some neutralizing effect on substances that cause cancer.

Bailey, group leader of the OSU team, learned of the pills when a friend sent him a copy of the advertisement, complete with its disclaimer that "not all doctors agree" with the results of the National Academy of Sciences' study on diet, nutrition and cancer, which was published in 1982 and the ad alludes to.

To him and his associates, marketing of the pills is another loud-and-clear reminder of the public's desperate need to know—need to know now—if a person can reduce his or her chances of suffering from the most dreaded of diseases by eating the right foods.

In Bailey's opinion, it's too soon to tell.

"There probably are upwards of 20 compounds which are now known to have some inhibitory effect on cancer in lab animals," he said. "But, from the scientific point of view, it's way too early to recommend that humans alter their diets to take in these compounds. Some, like selenium (a trace mineral in water and most plants) and vitamin A (carotene, a compound in fortified milk, liver, carrots and other foods), are very toxic at high levels. Relatives of vitamin A can even enhance the cancer response in some circumstances. We're not talking about a zero risk situation. There's a risk-benefit situation that's going to exist. There are three important elements of information we need for each compound: How effective is it? Can it be harmful? What mechanism does it use to inhibit cancer?"

"It's too early to recommend that humans alter their diets."

The researcher has other reasons for being cautious.

"We don't want to raise people's hopes falsely," he said, "and we don't want to be in the situation of having to say someday, 'You people who've been eating broccoli the last 25 years can stop now—it has no beneficial effect on cancer.'"

Also, Bailey notes, most researchers do their experiments with animals.

"Few humans want to eat 25 or 30 percent broccoli or cauliflower in their diets, and besides, you can't fool around with humans in testing potentially dangerous substances," he said, pointing out that it's hard to predict how a compound will work in humans based on tests with animals, especially if the compound behaves differently in different types of animals.

"I think the National Academy of Sciences was a bit premature in making its recommendations. I think we need more research before that is done," said Bailey. "Having said that, my personal point of view is that we are going to see that a few of these compounds really meet our requirements and that they will eventually be properly tested with humans."

The direction in cancer research is fairly new.

For years, comparisons of what people in different countries ate, and the rates of various types of cancer in those countries, pointed to a link between diet and cancer. Most research was focused on identifying food ingredients responsible for increasing the risk of stomach, lung, colon, liver, breast, cervical and other types of cancer. Scientists raised questions about salt, pickled foods, charcoaled meats, alcohol, nitrite preservatives, fats, saccharin and other food additives, to name a few suspected culprits.

"There are two phases of cancer."

Accelerated study of foods that may decrease the risk of cancer goes back to the 1970s, when population studies suggested that people who eat a lot of yellow and dark green vegetables, particularly raw vegetables, have a lower risk of developing certain types of cancer.

Today, many researchers in the United States and other countries are studying cancer inhibitors from several directions, compiling information about the substances (how they work; their risks and benefits) and about human diets and cancer rates.

OSU's Bailey, Nixon, Pawlowski and Hendricks are conducting one such study—with a twist.

In one of their major projects, they're studying how five food compounds thought to be cancer inhibitors affect several carcinogens (substances known to cause cancer in animals). Unlike researchers elsewhere, who most often use chickens or mammals like rats or mice in their tests, the OSU scientists use rainbow trout.

"The trout model has a lot of advantages in cancer research and we are the only place in the world that uses it in direct tumor studies," said Bailey. Why don't other cancer laboratories use trout? "It's really as simple as this: We have a supply of pathogen-free well water that stays at the right temperature, 52 degrees Fahrenheit, year-round. Other places have tried using trout and their experiments were wiped out by disease," he said.

Using trout in inhibitor experiments, where test creatures consume a diet that contains a certain dosage of an inhibitor and a carcinogen, costs about one-fifteenth as much as similar experiments with rats, according to Bailey.

Opposite page: Biochemist George Bailey works in his OSU lab. Above: To learn more about how substances cause cancer, the OSU scientists mix them with live cells from fish livers like this one and study the reactions that take place.

Research assistant Pat Loveland mixes aflatoxin, a cancer causing agent which is being used in the inhibitor research.

"That opens up a whole new scientific area for us," he said. "We can use hundreds of animals in trout experiments and feed them smaller amounts of the carcinogen. You just couldn't do that with rats. It would be too costly."

The advantage? In a test with 30 subjects (typical in rodent experiments), a low dose of a carcinogen might not cause a single cancerous tumor. But a similar experiment with several hundred subjects would increase the chance of finding individuals sensitive to low levels of the substance.

Consider this: If one percent of the U.S. citizenry were sensitive to the carcinogen at that low level, it would mean more than 2.2 million people would be susceptible. Dietary inhibition of cancer in even a small fraction of these people would be important. Use of the trout model makes it possible to study the effects of inhibitors where the risk of cancer is low.

Russell Sinnhuber, emeritus professor at OSU, pioneered the use of rainbow trout, said Bailey, noting that Sinnhuber's studies indicated that trout have many of the sensitivities to carcinogens that rats have.

In one physiological way, the fish are better.

"Rats don't have a gall bladder. Rainbow trout and humans do, and bile excretions from the gall bladder are a major way cancer materials are excreted from the body," Bailey said.

In their studies on the effects of inhibitors, the OSU researchers are examining tumor development in several organs, including the liver, thyroid gland and kidney. Groups of trout are fed a diet containing a carcinogen, or a carcinogen plus a suspected inhibitor, for eight to 10 weeks, and are then fed a normal hatchery diet for 12 months. At this age, fish are sacrificed and the researchers gather in the laboratory of Hendricks, the pathologist, to examine tumor development in key organs. If the test group that was fed a carcinogen plus an "inhibitor" has no tumors, or fewer tumors than the group fed a carcinogen alone, the compound is considered to have inhibited cancer development.

> "You just couldn't do that with rats."

A recent direction of the work is to study exactly how particular inhibitors work.

"What we have to do is find compounds that inhibit cancer with the same mechanism in a broad range of animals. If they work by the same mechanism in chickens, rats, trout and mice, you can believe they will work the same way in most animals, including humans," said Bailey.

Some compounds seem to work against carcinogens by directly blocking the carcinogens' reactions with other substances in the body ("trapping free radicals," in the words of organic chemist Pawlowski). Other compounds are thought to activate natural defense mechanisms in the trout by stimulating the release of enzymes that block carcinogenic chemical reactions. Pawlowski notes that some substances are not carcinogenic until they are altered inside the trout.

"We first try to find out how the carcinogens operate. That can help you guess where an inhibitor might intercept the carcinogen in reactions that damage DNA (cell genetic material)," Pawlowski said.

Interpreting the findings is tricky, and sensitive because of the public health implications, so the team gathers almost daily to discuss its work.

"There are two phases of cancer," said Bailey. "The initiation phase is when cell DNA is damaged. The second phase, the promotional phase, is when damaged cells begin to grow without control and form a tumor."

Some carcinogens, he said, seem to initiate cell damage and others seem to promote uncontrolled cell growth (perhaps decades after the initial DNA damage).

Some inhibitors seem to work against carcinogens to prevent or reduce the initial cell damage. The researchers call those compounds anti-initiators. Other compounds seem to suppress uncontrolled cell growth (tumor development). The researcher call those compounds anti-promoters.

Indole-3-carbinol, a compound in green vegetables such as broccoli and cabbage, is an inhibitor thought to block the initiation phase of cancer. The OSU researchers have found that it inhibits the cancer-initiating effects of aflatoxin, a carcinogen produced by mold that can grow on foods like peanuts and grains.

Examples of anti-promoter compounds that seem to delay the promotional phase of tumor development include vitamin A, which is in liver, fortified milk, carrots and other foods; vitamin E, which is in many vegetables, cod liver oil, nuts and other foods, and BHA (butylated hydroxyanisole), a preservative in foods like salad oil and potato chips.

All four researchers are convinced that not enough is known about the

inhibitor compounds to recommend that people rush out and stockpile foods or pills containing them.

"Massive doses certainly are a waste and are potentially harmful," said Pawlowski. "If one is eating a balanced diet, or taking multivitamins, the body will form a pool of vitamins A and E, and there is no evidence that more than a sufficient level can be utilized."

"What happens when the beans are roasted?"

The researcher points out that the relationship of individual human sensitivities to cancer, which in part may be programmed in a person's genes at birth, and the effectiveness of inhibitors is not fully understood. Even with that information, there would be more questions. And the OSU team has an additional line of investigation in mind: studying how food preparation affects cancer inhibitors.

"There are compounds in green coffee beans that are very strong cancer inhibitors in animals," Bailey said. "What happens when the beans are roasted or the coffee is brewed? What about the indole-3-carbinol in cabbage and brussels sprouts? Should you eat the vegetables raw or cooked?

"The National Cancer Institute is very excited about linking the molecular approach to inhibitor research with a study of the food science of it—how processing and cooking affect these compounds. Not many places can put together a molecular and food science package the way OSU can," he said.

Another project the team has started, on a "bootstrap" basis with no outside funding, is an attempt to engineer a strain of genetically identical rainbow trout. That would allow more accurate study of the effects of carcinogens and inhibitors.

Despite the daily challenges in various projects and individual experiments, it is not likely the OSU researchers, nor their counterparts in laboratories elsewhere, will forget the big question in the public's mind:

How right was Grandma? □

Top: Genetic changes triggered by cancer-causing substances can show up in the color of albino rainbow trout like these at OSU's Food Toxicology and Nutrition Laboratory. Above, left: Biochemist George Bailey injects a trout with a cancer-causing substance. Above, right: Graduate student Doug Goeger examines fish liver cells.

Protecting Darwin's World

To do it, two OSU students studied pigs on a remote island in the South Pacific

Mike Hanson

Poisoning is the best way to control marauding pigs introduced by man to the South Pacific island where Charles Darwin did much of the field work for his theory of evolution.

That is the conclusion of two OSU researchers who spent 10 months on uninhabited Santiago Island, which is about 600 miles west of Ecuador in the Galapagos chain, at the request of the Smithsonian Institution.

"We evaluated several control options—including hunting, using kill snares, trapping (and shooting) and baiting—and have concluded that using poisoned bait only pigs are likely to eat would be the least expensive and most effective," said Bill Baber, a doctoral student in OSU's fisheries and wildlife department.

Mike Hanson

Removing live pigs "would be a nightmare" because of the pigs' inland location on the rugged 350-square-mile island, which ranges from desert to rain forest as it climbs from sea level

to about 3,000 feet in its central highlands, said the researcher.

Baber, the veteran of an earlier study of wild pigs on Santa Catalina Island off the coast of Southern California, went to Santiago Island in August 1982 with OSU research assistant Mike Hansen. The two returned to Oregon in May.

Snaring and trapping . . . were ineffective.

The research was supervised by an expert on domestic animals gone wild, OSU wildlife ecology professor and Experiment Station researcher Bruce Coblentz. It was done at the request of the Smithsonian's Office of Biological Conservation.

What the researchers found when a boat dropped them off on Santiago Island wasn't as bad as what they expected.

There had been reports that the pigs, whose ancestors may have been put on the island along with goats in the 1800s by fishermen or explorers who wanted fresh meat, were uprooting trees, eating fruit and seeds preventing new vegetation from growing, and eating the eggs and young of the island's famed Galapagos tortoises.

Baber and Hansen found that pigs had not damaged the island, which 19th century naturalist Darwin once described as "a little world within itself" because of its abundant and unique native forms of life, as extensively as feared by conservationists and the government of Ecuador, which owns the island.

"There is some damage to the vegetation, but it doesn't appear to be severe. The big problem is with the giant land tortoises. Pigs that live around the traditional tortoise nesting zone are destroying most nests and eating hatchlings, reducing reproduction success to near zero," Baber said.

Most pigs live in high terrain, but a small subpopulation of pigs living near a major nesting beach for endangered green sea turtles is causing similar problems, the researcher added.

To find out how to control the pigs, the researchers studied how they live.

"We used radio collars to study their movements. We studied their reproduction, diet, habitat preference, and the survival of piglets to identify different control possibilities," said Baber.

"Snaring and trapping the pigs were ineffective," he said. "Hunting was effective in reducing their numbers, but it required extensive man-hours."

Using bait containing a special poison pigs are sensitive to would involve "only a remote risk to other animals" and to plants and would be less costly and require less labor, concluded the researchers.

They plan to submit a report containing a suggested plan of action to the Charles Darwin Research Station "around the end of the year," Baber said, adding that station personnel are anxious to implement their plan.

Even when the paper work is done, Baber and Hansen won't soon forget the expedition. Part of the reason is El Nino, the ocean current pattern that has caused unusual weather around the world.

"We pretty much stayed wet the entire time. We'd go to bed wet and get up and put on wet clothes. In the desert area just in from the beach, which usually gets about five inches of rain a year, we recorded five inches in one day," Baber said, adding that the average 80-degree-plus daytime temperature made humidity more uncomfortable.

Removing live pigs "would be a nightmare."

The two lived in tents and set up one camp near the beach where supplies arrived every month (by boat) and two camps in the island's forested highlands. Heavy vegetation made walking on the island, covered by lava rock, difficult.

"It rained so much the vegetation was shoulder high in the desert where there's usually very little," Baber said. "In the beginning, it only took us about four hours to hike the 12 miles from the beach to our highest camp. Before we left, it was taking seven hours."

The researchers "ate a lot of canned tuna and freeze-dried vegetables" but the staples of their diet were goat and pig meat, Baber said.

"I wouldn't trade the experience," he said. "But I'm not sure I'd want to do it again." □

—Andy Duncan

Bill Baber

Opposite page, top: Researcher Bill Baber stands in a dry, inland forest on varied Santiago Island. Opposite page, bottom: One of the island's famed giant land tortoises takes a drink. Marauding pigs are rooting up tortoise nests, eating the reptiles' eggs and young. Above: Researcher Mike Hanson holds a tranquilized pig.

Bug Patrol

The search for fruit pests has become a full-time job

Bug scouts don't get merit badges, but they are receiving applause and money from growers in two of Oregon's juiciest industries.

Insect scouting services, using techniques pioneered in Oregon by Experiment Station researchers and Extension Service specialists and agents, have sprung up in Medford and Hood River to serve the state's pear and apple growers, who produced more than $50 million worth of fruit last year.

Through the services, growers hire a consultant who monitors pests in their orchards, regularly assesses the potential for fruit damage, and outlines possible strategies for dealing with the bugs, including simply letting them alone if there aren't too many.

Growers subscribing to the two services, both basically one-person operations, are looking for a way to curb the skyrocketing cost of pest control.

By keeping closer tabs on bugs like codling moths, spider mites and pear psylla, growers hope to spray their trees only when absolutely necessary or when the pests are especially vulnerable. Also, they hope to avoid spraying trees when the chemicals would wipe out populations of beneficial insects that help keep pests in check.

In some cases, the approach seems to be working.

"I still have problem spots in my orchards, but spray costs are going up terribly and I know I've saved money. There's no question about it," said Ed Earnest, a Medford pear grower and packer who is unabashedly enthusiastic about the scouting service he used the last two growing seasons.

Insect scout Wayne Rolles, opposite page and above, searches for pests in a Medford pear orchard.

"It's the only way to go," said Al Brown, a Hood River grower who uses a scouting service. "I used to have three chemical salesmen come by and each recommend a different spray. You don't know what to do. You might put on all three sprays. Now Gary (a scout) says, 'Don't spray till I tell you to,' and I don't."

Both of Oregon's fledgling scouting services (for pears and apples—there are similar services for other crops) are three years old. The one in Medford is operated by Wayne Rolle, a 32-year-old former entomology research assistant at OSU's Southern Oregon Agricultural Experiment Station at Medford. The Hood River scouting service is operated by 41-year-old Gary Fields, formerly a technician at OSU's Mid-Columbia Agricultural Experiment Station at Hood River.

That both Rolle and Fields used to work for OSU is no coincidence.

For more than 10 years, scientists at the Medford and Hood River branch stations have studied the benefits of insect scouting as part of integrated pest management, or IPM, a program which stresses coordinated use of chemical and biological pest control strategies.

Hood River insect scout Gary Fields stands in front of his mobile lab, a truck outfitted with microscopes and other tools.

To take a more precise approach to pest control, growers need more data about the insects in their orchard, say the researchers spearheading IPM research with pears and apples, Pete Westigard at Medford and Bob Zwick at Hood River.

"For a long time we've been telling the growers scouting is coming. It looks like it's finally arrived," said Westigard who, along with Mike Willett, a former OSU Extension Service agent in Jackson County, helped Rolle start his Medford scouting service by introducing him to growers interested in the concept.

Not everyone is convinced scouting can pay its way.

"We didn't push," said Westigard. "The growers knew we had been studying scouting and came to us. Just a few years ago they were paying maybe $50 an acre for pesticides. Now some of them are paying $300 or $400 an acre. You can justify hiring a consultant when you're paying that much."

In a study with 1983 crops, Westigard and others found that Medford pear grower Ed Earnest saved about $40 an acre on spray costs, after paying scouting costs, compared to a grower with a similar orchard who did not use the insect scouting service.

Willett points out added benefits of scouting.

"When you apply chemicals less frequently, it takes insects longer to develop resistance," he said, noting that insect resistance to pesticides is an increasing problem for fruit growers.

Not everyone is convinced scouting can pay its way, though.

"I have to look at the bottom line—did it save me money? I can't see that it did," said Monty Penwell, a Medford pear grower and packer who used a scout last year but not this year.

"To tell you the truth, I don't work with pears much anymore. I work with people. I'm a people manager," said Penwell, who has a large packing house and more than 1,000 acres of pear trees. "I spent $5,000 on scouting last year, and I don't feel I wasted my money—I think the work is worthwhile. But I didn't have time for it."

Penwell said he thinks small-acreage orchardists who "don't have as many headaches" and can be more flexible in managing their fruit trees benefit more from pest scouting, although he said the rising cost of chemicals may force him to hire a full-time employee who can make all his pest control decisions.

However, Westigard says "the cost-per-unit price of scouting makes it more feasible for the big operator than the small one, although the small operator certainly has more flexibility."

The four pear growers who used Rolle's Medford scouting service last season—two large-acreage growers and two small-acreage growers—farm a total of about 2,000 acres, about 15 percent of southern Oregon's total pear acreage.

In Hood River, where farms are smaller, Fields estimated his 37 clients farm about 10 percent of the Hood River Valley's 15,000 or so acres of pears and apples.

Rolle, who gives his clients data but not pest control recommendations, charges about $10 an acre for his service during a growing season. Fields, who recommends spray schedules, charges $18 an acre.

How do the scouts themselves see the prospects for their business?

"Spray costs are going up terribly."

"I'd guess that, slowly, this sort of thing will gain wide acceptance," said Rolle, adding that he is working with just about all the acreage he wants to. "I can walk through an orchard with most any grower and he'll know as much as I do about the pests. But growers don't have time to keep track the way you must for IPM."

Fields is more outspoken.

"I've had a few dropouts, partially because of the recent cash flow situation, but I've had just outstanding success helping convert apple orchards from chemical control to IPM by letting predator populations build up. The first year I saved a fellow over $4,500 on 52 acres—over and above my fee. It's just a matter of time until some others get in," he said.

Will there be enough trained personnel to do the job if scouting gains wide acceptance?

"The main limitation we have now in southern Oregon is that there's only one person, and his part-time assistant, to do the work," said Westigard. "But I know there are graduates coming out of college (OSU) who could do the job if people would hire them." □

—Andy Duncan

Agronomist John Yungen holds shallots grown at the Medford experiment station.

Small-acreage crops for Southern Oregon

Blueberries and shallots are among several crops OSU researchers are studying to find alternatives for a rising number of small-acreage farmers in southern Oregon.

"You'd be surprised. We have an increasing number of people who come in here and want to know what to grow on two or three acres," said David Sugar, plant pathologist and farm manager at OSU's Southern Oregon Agricultural Experiment Station at Medford.

Fruit (pears, primarily) and livestock production head the agricultural production of the area's three counties— Jackson, Josephine and Douglas. But most of that comes from operations on medium-sized or large acreages.

"That's where blueberries fit in," said Sugar. "They are a high-value crop that a careful farmer can grow and profit from on small acreage, and they seem to grow well here."

Most fresh blueberries sold in Oregon are produced in the Willamette Valley, he explained.

"But the Willamette Valley doesn't produce enough to supply all the fresh market needs of southern Oregon. At $1.19 or more per pound in stores and fruit stands, you should be able to pay the high cost of establishing blueberries and still come out ahead after several years," he said.

Blueberry bushes, usually planted in the field when they are two years old, produce about two years later and usually reach maximum yield (about 20 pounds per bush per season) when they are 10 years old, said Sugar.

"The only pest we've found here so far is birds. You have to control the birds. The most effective means are chemical deterrents and plastic netting. One grower here has three acres under plastic netting," he said.

The plants, which require acid soil and must be irrigated once or twice a week in the spring and summer, produce berries from late June (about one to two weeks earlier than in the Willamette Valley) until the middle of August, he said.

"Most people think because blueberries are native to boggy areas they need an extremely wet growing situation. That's not true. In the northeastern United States where they grow in bogs, they're on floating mats that are well drained and extremely high in organic content. We recommend using a mulch such as sawdust or straw plus ammonium sulfate during the growing season to add acidity to the soil around the plants. Adding elemental sulfur, which is inexpensive, will supply additional acidity," Sugar said.

Shallots seem to do well in southern Oregon, too, according to John Yungen, superintendent of the research station.

"In our experiments, I planted them in October and harvested in July. They grow very well," Yungen said. "Now we've got to find a market. We shipped some down to Southern California as a test."

In America, shallots, which look like a cross between onions and garlic, are sold mostly in large cities where there are concentrations of people of European descent.

Yungen is experimenting with another crop on the rise.

"Our normal sweet corn acreage is about 250 acres," he said. "Last year, we had an additional 200 acres or so grown on contract. This year, I believe it's going to be an additional 225 acres or so." □

Wheat's black sheep

Goatgrass, a distant relative of wheat, is causing a problem for Columbia Basin grain growers.

"Cheatgrass, wild oats and annual ryegrass cause a lot more damage. But we have chemical controls for them. Goatgrass is now our number one unsolved weed problem, and it is a growing concern," said Don Rydrych, an agronomist at OSU's Columbia Basin Agricultural Research Center at Pendleton.

"A postemergence herbicide works on cheatgrass. But goatgrass is so similar to wheat the chemicals that kill it kill wheat, too," said the researcher, explaining why the goatgrass problem is hard to solve. Goatgrass is so genetically similar to wheat that on rare occasions it crosses with the grain in Oregon fields and produces a sterile, hybrid plant, he noted.

Contamination and competition are the ways goatgrass inflicts economic damage.

"If there's too much goatgrass seed in wheat, the grower can be docked up to 20 cents a bushel by buyers at the grain terminal," said Rydrych.

Also, it is "almost impossible" to separate goatgrass kernels from wheat kernels so wheat seed can be certified as pure, he said.

In the field, goatgrass competes with wheat for moisture and nutrients, the researcher said.

Economic damage is unknown; no figures are available.

"But our estimate now is that we have, in spot infestations, probably 100,000 acres in this area," Rydrych said, explaining that if goatgrass is in a field or along its edge, the entire field is considered infested.

Goatgrass is spread by combines moving from field to field, residue blowing from grain trucks, farmers planting contaminated wheat seed and, possibly, trucks transporting wheat straw to be used as livestock bedding, the researcher said.

Without selective chemical controls, farmers must combat the weed by isolating it in fields or along their edges, killing wheat and goatgrass in the isolated area, and leaving the area fallow for three years—an expensive procedure.

Rydrych is testing how various chemicals affect the weed in wheat plots he plants each season at the Pendleton research station. He purposely contaminates the plots with goatgrass.

OSU graduate students are studying genetic characteristics of goatgrass, with the hope of finding a key to selective chemical control within wheat stands.

"It's been around a long time. I've been looking for a chemical control for 20 years," said Rydrych. "But there are getting to be more seed sources. It's on the rise and can be found in all eastern Oregon counties that raise wheat. Farmers are beginning to realize it could become as bad as cheatgrass.

"One thing we really need is an education effort," he said. "If goatgrass is along the edge of a field, you should keep that field out of production and chemically kill the weed to keep it from spreading." □

Here, the longer seeds of goatgrass, a weed, are mixed with wheat.

Salmon diet

Researchers at the OSU Seafoods Laboratory at Astoria are searching for a new diet for salmon that would increase their chances of survival in the Columbia River.

Bonneville Power Administration officials signed a contract with Dave Crawford, director of the laboratory, and Oregon Department of Fish and Wildlife officials to formulate and test the new diet. BPA, concerned about declining salmon runs in the Columbia River, will contribute more than a million dollars to the project.

"We plan to produce a low-temperature, vacuum-dried fish meal of high protein, one made from fish products," said Crawford. "Primary source of the products will be salmon carcasses, hake, some rockfish and fish waste from packers."

ODFW will work closely with Crawford in evaluating the new diet and will do laboratory feeding studies at its Clackamas laboratory near Estacada and survival studies at salmon hatcheries at Bonneville and Sandy.

John Westgate, who directs the Clackamas laboratory, is principal project leader. Harold W. Lorz, fish biologist stationed at OSU who heads ODFW's nutrition group, will coordinate work on the feeding and survival studies.

"What we really want is a way to improve survival of salmon," said Lorz. "In the past, high quality meal was available because herring, one of the major ingredients, was plentiful. Now there is more demand for herring, so the supply available for fish meal is less. Too, the meal is prepared with a high-temperature, flame process which tends to denature some of the protein and lower quality."

"We won't really know fully about the new diet until about 1990 because we plan to use three broods of salmon and some take five years to mature," said Lorz. "We plan to start with 20-week feedings trials and juvenile fish, taking measurements every two weeks." □

Food scientist Leticia Pilando tastes wine made from overripe strawberries.

Strawberry wine

Oregon winemakers could improve the quality of their strawberry wine by making it with overripe fruit, OSU food scientists have discovered. But, so far, the payoff doesn't appear to be worth the risk.

In tests with two popular strawberry varieties, Totem and Benton, overripe fruit produced a better, more stable wine color than did ripe fruit, which normally is used.

But the testing also showed that mold in overripe strawberries can slow down wine fermentation, speed up color degradation and cause an undesirable syrupy consistency.

"Since overripe strawberries tend to be contaminated by mold, you'd want to be very cautious about using them. From time to time, we hear about wineries having trouble getting their fruit wine to ferment. Mold may be the reason," said Ron Wrolstad, who conducted the research with graduate student Leticia Pilando and fellow OSU food scientist David Heatherbell.

For the study, the researchers carefully separated strawberries they used to make wine into ripe, overripe and mold-contaminated batches.

"I think we proved overripe fruit does give better color. But in a commercial situation, it would be hard to separate all the moldy overripe fruit from the unmoldy overripe fruit," said Wrolstad.

The researchers are continuing their work, trying to find out if strawberries with some percentage of mold can be used for winemaking without a risk of fermentation problems or other problems.

"We got into this," Wrolstad explained, "after people who make strawberry wine told us they always try to buy early-season strawberries so the fruit won't be overripe. This intrigued us because we knew that maintaining good color in processed strawberry products is difficult. While we had not specifically addressed the issue of maturity, we would have expected overripe fruit, with its higher pigment content, to give better color."

All the strawberry wine produced with ripe fruit, overripe fruit and overripe, moldy fruit had acceptable taste in the OSU test, according to the researchers. Totem strawberries produced wine with better color than did Benton strawberries.

Less than .5 percent of Oregon strawberries are thought to go into wine production. Strawberry wine makes up about 2 percent of Oregon's total wine production.

Wrolstad said results of the color research may be helpful in the production of other strawberry products such as preserves, jams, juice concentrates, syrups and confections. Better color in processed strawberry products would increase the demand for—and value of—Oregon strawberries, he noted. □

Just how thirsty are the potatoes?

Some Columbia Basin potato growers may be able to increase profits by irrigating less, researchers at Hermiston have found.

Dan Hane, manager of the Hermiston branch of OSU's Columbia Basin Agricultural Research Center, and OSU agronomist Vance Pumphrey started searching three years ago for the optimum amount of moisture for the Russet Burbank potato, the type grown most in the irrigated fields of northcentral Oregon.

"The potato has varying needs during its growing season. We felt, generally, there was overirrigation early in the year and late in the year," Hane said.

In their study, the researchers put varying amounts of water on potato plots and monitored factors such as rainfall, evaporation rates and the rate at which the plants used up water in the soil, which is called evapotranspiration.

"Between 26 and 28 inches of moisture a year—irrigation water, rainfall, and soil water—seems to be the right amount," said Hane. "Optimum yielding potatoes used 0.1 to 0.17 inches of water per day from emergence to early tuber initiation. Water use increased to more than 0.25 inches per day during maximum leaf area and early tuber bulking and then gradually declined as plant leaves senesced (aged) and plants matured."

What that means is that Russet Burbank potatoes, usually planted in the Columbia Basin in early April, need a maximum amount of water from mid-June to mid-July when tubers develop and grow rapidly. Some growers may be watering too much early in the season and late in the season.

"You don't want to get caught short, however. It's better to use a little too much water than to stress the potato plant," said Hane.

Potato growers trying to be precise in irrigating will have to pay close attention to growth stage and weather conditions, said the researcher. □

profile

Tending the flock keeps him flying

George Arscott

George Arscott is a busy man.

He not only runs one of the busiest departments in the College of Agricultural Sciences, but also maintains a close knit working relationship with his staff and students, teaches, does poultry nutrition research, and is president of two national organizations, the 1,894-member Poultry Science Association and the Intersociety Council of Presidents. He also has visited North Yemen four times in the last two years to help that nation's poultry industry.

How does he get so many things done?

"We work as a team in the poultry science department," he said.

His treatment of staff and students as colleagues is not new in the department, he stresses. It began with other heads of his department (Arscott is the fifth head of the department which was esablished in 1907).

"I believe in sharing—information, responsibilities, resources—and we help each other," said Arscott. "Not only that, and perhaps because we are a small department, we have a lot of fun doing our work."

Arscott, a native of Hawaii, completed his Ph.D degree at Maryland in 1953 and joined the OSU poultry science department. He was named acting department head in 1969 and, a year later, was named department head.

Today, Arscott's department includes six faculty members on the resident staff and four on the international staff. There are 12 undergraduate students and 14 graduate students. "We also teach about 150 to 200 students per year from other units on campus," he said.

Now joining OSU students are Yemeni students seeking degrees who come to OSU to learn more about poultry, part of the department's international program. The other major part of the program sends instructors to North Yemen to train Extension personnel to help villagers with poultry problems.

A strong believer in close ties to the poultry industry, Arscott said, "Our activities probably are more extensive than the activities of many comparable poultry departments. We maintain our contacts through five organizations that make up the Poultry Council, with very close working relationships with all member groups and others."

Arscott encourages a strong visitation program for the staff so members can learn about commercial poultry operations. A second visitation program for students, kept separate, is equally strong.

"We know what is going on in our region," said Arscott. "We don't restrict ourselves to Oregon. There are many contacts in Washington and Idaho."

These contacts are increasingly important because the OSU department is the only academic poultry department in the Northwest. The only other Land Grant West Coast university poultry department, at the University of California, Davis, is more research oriented.

George Arscott is a busy man. □

—Richard Floyd

Agricultural Experiment Station
OREGON STATE UNIVERSITY
Corvallis, Oregon 97331
John R. Davis, Director
Publication

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