AGRICULTURAL Research

U.S. DEPARTMENT OF AGRICULTURE

DECEMBER 1968

AGRICULTURAL
Research

December 1968/Vol. 17, No. 6

Man and Ecosystems

All living things—from bacteria to man—fit into a web of life governed by dependence upon one another and their environment. The threads of this web are so incredibly interwoven that it is often difficult to determine what is cause and what is effect.

It is increasingly clear that the environment is both limited and vulnerable to alteration through technology. Indeed, some manmade changes may be irreversible. We must learn how to cope with this tangled web as we extract resources for our welfare—without impairing the system that sustains us.

A major step toward gaining this understanding is the International Biological Program, a worldwide research effort involving 54 countries and scientists of many disciplines. At the heart of the IBP effort are studies on how plants and animals live and interact with the nonliving part of their environment. These living systems, called ecosystems, are units in the landscape of immediate importance to man.

Research is now underway on grasslands and this study serves as a model for the still-developing research on five other biomes—such as deciduous forests and deserts—to be analyzed in the IBP ecosystems program.

Most of the grasslands studies are centered at the Pawnee site of ARS' 15,000-acre Central Plains Experimental Range near Nunn, Colo. Grasslands research of university and government scientists throughout the country will be incorporated into the Pawnee model. This will keep the whole ecosystem in view, and not slant the research model to any one region. Four ARS scientists are engaged in this project.

The overall plan for research on the Pawnee site involves four components: abiotic factors such as soil, climate, and water; "producers," plants which manufacture food; "consumers," animals which eat plants or other animals; and "decomposers," bacteria and fungi which break down waste products and tissues and regenerate the soil.

In time, these studies will contribute toward a sensitive and scientific comprehension of man and his environment. For it is the highest purpose of science to give us an understanding of consequences.

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AGRICULTURAL RESEARCH is published monthly by the Agricultural Research Service (ARS), United States Department of Agriculture, Washington, D.C. 20250. Printing has been approved by the Bureau of the Budget, June 1967. Yearly subscription rate is $1.50 in the United States and countries of the Postal Union, $2.00 in other countries. Single copies are 15 cents each. Subscription orders should be sent to Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Information in this periodical is public property and may be reprinted without permission. Mention of the source will be appreciated but is not required.

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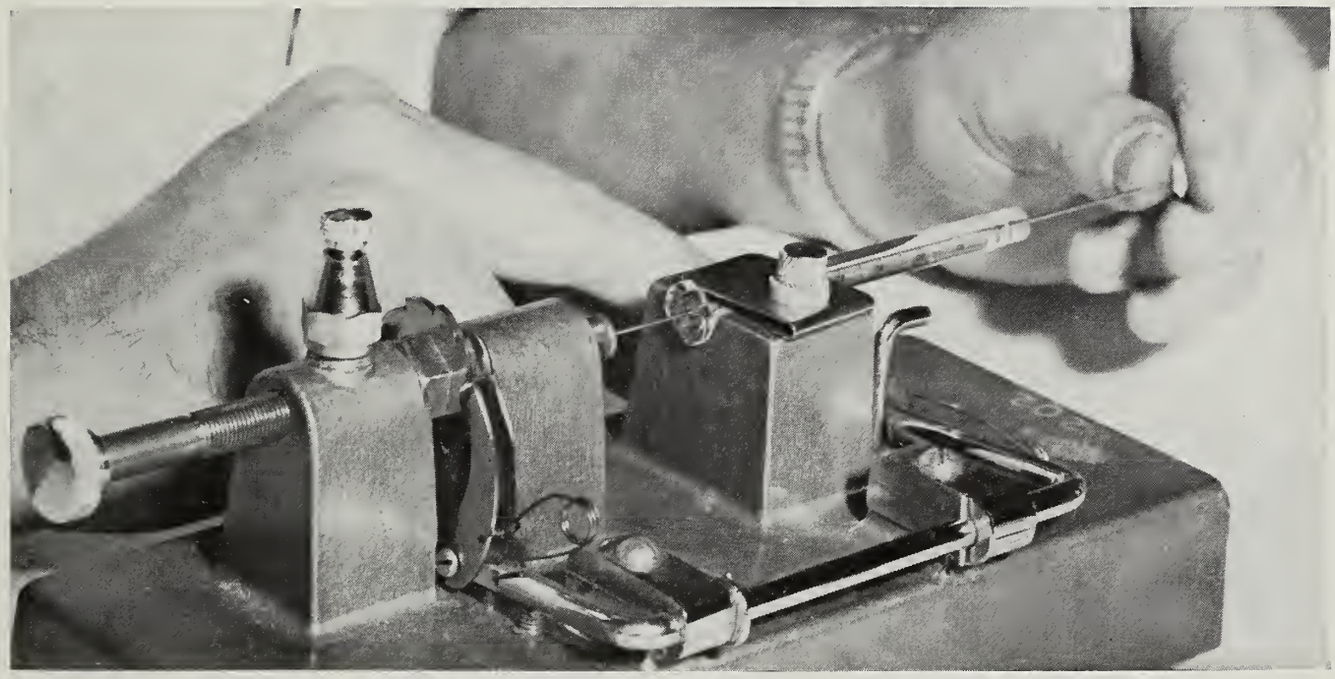
SYNERGISTS can stand alone for Insect Control



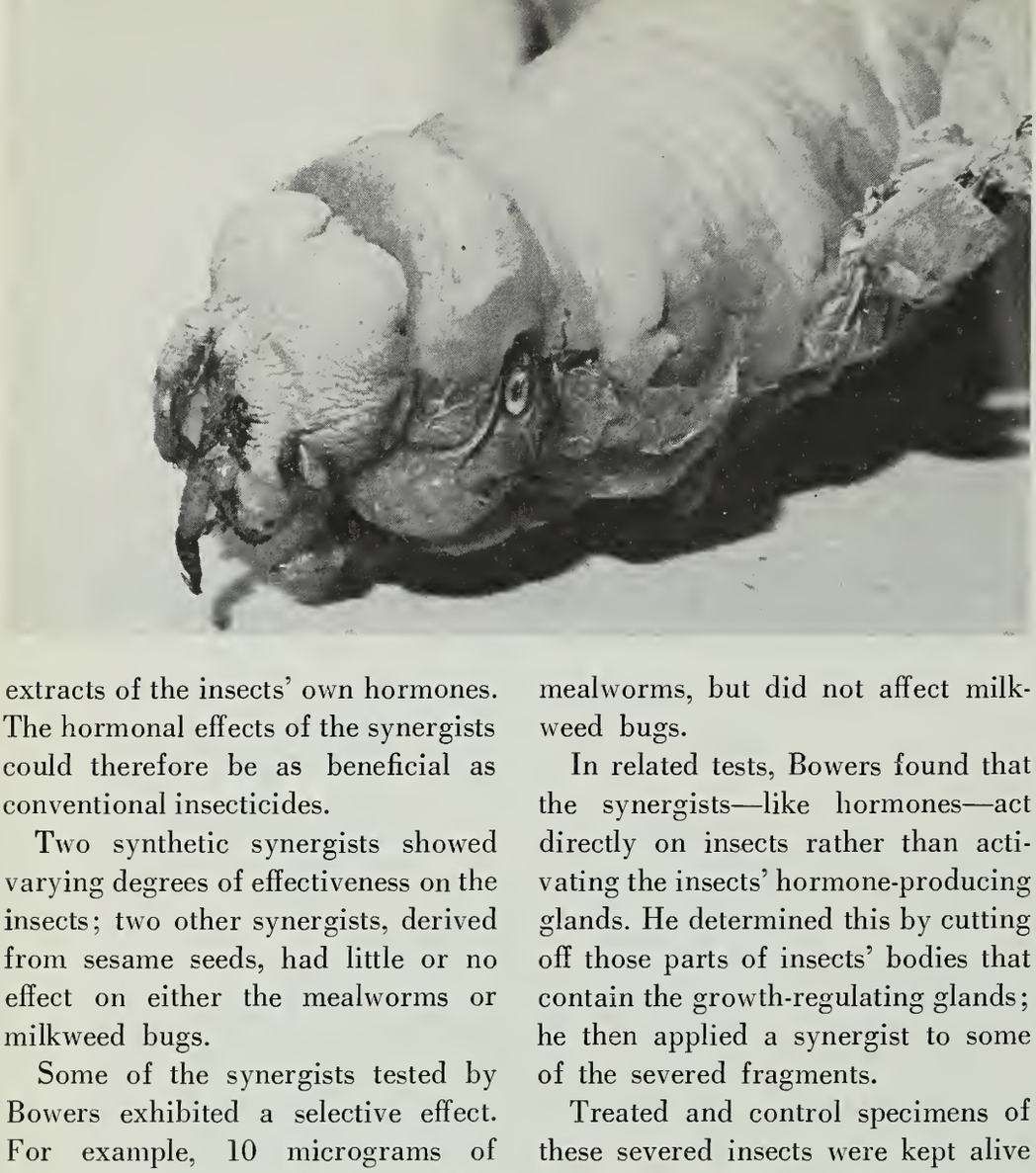
Synergist is applied to a mealworm with a device that delivers extremely small amounts of material through a hypodermic needle (PN–1709).

CONVENTIONAL INSECTICIDES often contain compounds called synergists which give the insecticides a greater wallop while having little or no toxicity in themselves—or so everyone thought.

Recent tests show otherwise. ARS entomologist W. S. Bowers derailed the normal growth and development of yellow mealworms and milkweed bugs with five synergists in tests at Beltsville, Md.

These two insect species were selected for testing because they are readily available for laboratory studies. Moreover, both species are representative of important orders of insect pests—the Hemiptera (bugs) and Coleoptera (beetles). In addition, mealworms are widespread pests of stored grain and animal feed.

Bowers obtained best results with sesamex by applying as little as 0.25 microgram to the insects' abdomens. Permanently blocked from reaching adulthood, the insects died without contributing to another generation. These effects are identical with those previously achieved with



extracts of the insects' own hormones. The hormonal effects of the synergists could therefore be as beneficial as conventional insecticides.

Two synthetic synergists showed varying degrees of effectiveness on the insects; two other synergists, derived from sesame seeds, had little or no effect on either the mealworms or milkweed bugs.

Some of the synergists tested by Bowers exhibited a selective effect. For example, 10 micrograms of propyl 2-propynyl phenyl phosphonate disrupted maturation of the mealworms, but did not affect milkweed bugs.

In related tests, Bowers found that the synergists—like hormones—act directly on insects rather than activating the insects' hormone-producing glands. He determined this by cutting off those parts of insects' bodies that contain the growth-regulating glands; he then applied a synergist to some of the severed fragments.

Treated and control specimens of these severed insects were kept alive for about one week—long enough for them to develop adult characteristics. The treated insect fragments failed to transform into adults, but the untreated fragments matured normally.

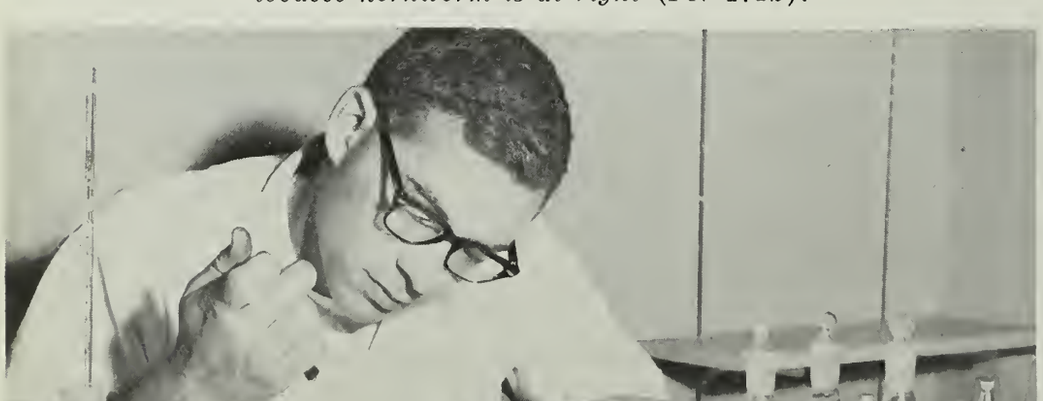
Bowers found that most of the effective synergists had certain similarities in their chemical structures. He then synthesized and tested additional compounds similar to the commercial synergists, but containing some of the chemical features of the insects' own juvenile hormones.

Both the milkweed bug and the mealworm gave the same response to these molecular hybrids that they displayed when treated with synergists. Happily, these derivatives can be manufactured at low cost from easily obtained raw materials.

Other studies have also produced successful hormonal insecticides (AGR. RES., Jan. 1967, p. 5; Mar. 1966, p. 8), but manufacturers reported that less costly materials are needed if hormones are to become practical. Bowers' synthetic derivatives may meet the cost requirements.

Another promising aspect of Bowers' findings is that earlier tests have demonstrated the synergists have little or no toxicity to man, domestic animals, birds or fish. The synergists have been used extensively without creating known hazards to these animals. ■

Above: *Treated tobacco hornworm partially emerges from cocoon as a misshapen, overgrown pupa instead of a mature moth* (*PN–1710*). **Below left:** *Bowers dilutes sesamex to prepare it for mealworm treatments* (*PN–1711*). **Below right:** *Normal tobacco hornworm is at right* (*PN–1712*).



Left: *Small, undeveloped ovaries are from house fly fed triol. Rod-shaped egg came from normal ovaries at left (PN–1713).* **Right:** *Diet of the smaller tobacco hornworm included hormone; normal hornworm's diet was untreated. Both insects are the same age (PN–1714).*

Insect Hormones

. . . Potential Pesticides

MOLTING HORMONES vital to normal insect development can also kill or sterilize insects when too much is present at the wrong time.

ARS scientists became interested in this approach to pest control when earlier studies suggested that similar hormonal compounds produced by plants help protect them from damaging insects.

In promising experiments with six hormones and similar, manmade compounds called analogs, entomologists W. E. Robbins, J. N. Kaplanis, and T. J. Shortino at Beltsville, Md., treated five kinds of insects. Chemist M. J. Thompson, biologist C. F. Cohen, and technician S. C. Joyner also participated in these experiments.

When fed to adult female house flies and confused flour beetles, some of the compounds unexpectedly caused sterility by preventing ovary development. Only a few insects could overcome the sterility effect.

Female house flies were affected for life after a 5-day exposure to artificial diets containing only 0.1 percent of an analog called triol (Δ^7-5β-cholestene-2β,3β,14α-triol-6-one). Triol's antifertility effects were intensified five to ten fold when triol was combined with synergists such as sesamex or piperonyl butoxide, which are found in some pesticides.

Diets containing less than 1 percent of four naturally occurring hormones similar to triol also sterilized house flies, and a synthetic derivative of the natural hormones was as effective as triol in tests.

Robbins and his associates obtained the same effects on adult female confused flour beetles. Best results were obtained with slightly richer concentrations of triol than the flies were exposed to; feeding tests with the beetles ran for 10 days and, together with post-feeding reaction periods, covered the major portion of the insects' adult lives.

Small amounts of the hormones or analogs had even more drastic effects on immature stages of the insects. Yellow-fever mosquitoes died when treated with as little as 0.1 parts per million (ppm) of triol. Immature houseflies died after feeding on artificial diets laced with 25 ppm of triol.

Larger amounts of triol, although still measured by parts per million, were needed to kill immature German cockroaches, confused flour beetles and tobacco hornworms.

Sterility or death resulting soon after treatment with molting hormones or analogs underscores a basic difference between the effects of these materials and those of an insect's juvenile hormones.

Unlike molting hormones, juvenile hormones act by interrupting insect development and producing monster insects that starve to death because of their physical abnormalities or die of other natural causes.

Further tests are being made on the potentials and limitations of both molting and juvenile hormones for biochemical control of insects.■

MILK CAN LAST LONGER

A typical setup for taste panel tests of milk (ST–1562–11) and a young consumer drinking milk (AAA–15001).

EVERYBODY KNOWS milk is perishable—but apparently it is not nearly so perishable as we had thought.

Under household refrigeration (usually 45° to 50° F.) milk keeps an average of 7 days. But tests conducted under an ARS research contract show that simply lowering the storage temperature to freezing or slightly above will extend the storage life to as long as 7 weeks.

Long-accepted ideas about milk perishability were in for even more of a jolt when the research showed that milk pasteurized under higher-than-normal temperatures would keep as long as 20 weeks and more.

These findings may well lead to drastic changes in the storage and distribution practices of the fresh milk industry.

The work was done by the Pet Milk Co. under an ARS research contract. Both winter and summer milks were pasteurized under normal conditions (165° to 172° F. for 16 seconds) at six Southern dairies. Then they were cooled to 32° F. and flown in ice to Pet Milk's Research and Development Center, Greenville, Ill., where they were stored at 32°, 35°, 40°, and 45° F. Weekly bacteriological tests and evaluations by a trained taste panel indicated that at the two lowest storage temperatures some of the summer milks were still safe and flavorful after 7 weeks, and the winter milks after 4 weeks.

When these tests demonstrated the value of low-temperature storage for normally pasteurized milk, the scientists next tried higher pasteurizing temperatures to see if they could extend the storage life of milk even further. With their experimental equipment, they pasteurized milk at 200° and 220° F. for the usual 16-seconds.

They also tried flash-pasteurization at these temperatures for a half-second.

The milk samples were stored at the same four temperatures as the commercial samples and subjected to the same weekly bacteriological and taste tests. Only the samples pasteurized at 220° F. for 16 seconds were still acceptable by both of these criteria after 13 to 20 weeks of storage at 32° F. In general, the storage life of most of the samples decreased with milder processing conditions and with higher storage temperatures.

The ultra-high pasteurization temperatures did not destroy milk flavor. Using fresh market milk as a control, the taste panel evaluated samples each week. They did detect a cooked flavor immediately after pasteurizing, but within the first week of storage this off-flavor disappeared.

Although these results could profoundly affect the dairy industry, the original purpose of the work did not

concern normal dairy operations at all. The research was part of a continuing ARS program to protect the Nation's milk supply in the event of nuclear attack or accident.

Of immediate concern was the relatively short-lived radioactive nuclide iodine-131. Because iodine-131 has a half-life of 8 days, and virtually disappears within 40 days, the objective of the research was to determine whether milk could be stored long enough to permit the natural decay of this radioactive substance to a harmless level.

In line with this objective, one phase of the experiment consisted of pasteurizing the milk at the ultra-high temperatures and storing it in bulk at 32° F. for 3 to 4 weeks to permit decay of any iodine-131 with which it may have been contaminated. Then it was repasteurized at both high and ultra-high temperatures (175° to 220° F.), packaged, and stored at 32°, 35°, 40°, and 45° F. Most of the samples kept for more than 10 weeks (including the initial bulk storage) and many were still good after 23 weeks when the test supply was exhausted.

The work proved that, under emergency conditions, milk could be stored long enough to permit decay of iodine-131. From a practical point of view, however, using this method for decontaminating milk would require storage facilities that are not generally available today.

In any event, ARS has developed an ion-exchange method of removing strontium-90 from milk which could also be used to remove iodine-131 (AGR. RES., Sept. 1961, p. 14). Strontium-90, another radioactive nuclide, is of more concern than iodine-131 because it has a half-life of 27 years. This work was conducted in cooperation with the Atomic Energy Commission and the Public Health Service.■

Researcher examines dielectric oven (PN–1715).

Faster Thaw for

IMPORTED MEATS

ELECTRONIC OVENS—the type that can bake a potato in 4 to 5 minutes or boil water in a paper cup that remains cool—may one day help protect the American consumer of imported meat.

Approximately 1.35 billion pounds of meat—about 2 percent of our supply—is imported each year. Practically all this meat arrives frozen, and samples of it must be thawed by the port authority before the meat can be inspected according to Federal regulations.

ARS-sponsored research by the Battelle Memorial Institute in Columbus, Ohio, suggests that substituting dielectric ovens—a type of electronic oven—for the heated water tanks currently used to thaw the samples would speed inspection and marketing of this meat.

The use of electronic equipment would also reduce the amount of labor and space required for inspection. These facilities are supplied by the port authority. Operating costs with such equipment would be about the same as with the present equipment. However, initial cost for setting up the electronic oven system would be considerably greater than the cost of hot water thawing equipment.

The frozen meat comes in lots of from 5,000 to 500,000 pounds, packed in cardboard cartons containing about 60 pounds of meat each. The inspectors randomly select 15 boxes from every lot and from each of the 15 slabs of meat they cut a 12-pound section for testing.

With the Battelle system, samples from the lot are fitted into the dielectric oven for a 15-minute exposure to the electronic heat. In contrast, water tank heat takes 30 to 45 minutes to thaw these samples.

After inspection, the thawed meat samples are returned to the original lot. Electronic heat is well suited to thawing meat inspection samples because a carefully timed exposure in the dielectric oven will not cook, burn, or desiccate the meat or render the fat.

This thawing equipment is not yet commercially available. The scientists feel, however, that electronic thawing units could be useful to others besides port officials. For instance, dielectric ovens could be employed to thaw meat at packing plants to facilitate processing.■

MOLDY FEED: Source of

Above: *Cattle can pick up spores that cause fungal abortion by eating moldy feed or by just inhaling dust from it* (*N–37212*). **Center:** *Cysewski extracts aflatoxin from moldy feed sample* (*PN–1721*). **Right:** *A sample of blood is drawn from a pig for laboratory tests* (*PN–1722*).

●●● deaths in Swine

A CLEARER UNDERSTANDING of livestock damage caused by moldy feed is leading to better diagnosis and control of fungus-caused problems.

Research indicates that mold can reduce production efficiency and cause death. ARS specialists suggest that farmers seek laboratory tests and post-mortem examinations to establish the cause of unexplained abortions in cattle or poor growth and death losses in swine.

The mold *Aspergillus fumigatus*, for example, causes several diseases in poultry and livestock, including fungal abortion in cattle. Livestock need not eat contaminated feed to get into trouble; mold spores enter as easily when animals merely breathe spore-laden dust from moldy hay.

Aspergillus flavus causes damage indirectly by producing a poison called aflatoxin, which may kill swine by disorganizing and destroying liver cells. Small amounts of aflatoxin administered experimentally over a period of time cause pigs to use feed inefficiently and grow slower; a single, larger dose produces death in 1 to 7 days.

ARS veterinarian S. J. Cysewski and scientists at the National Animal Disease Laboratory, Ames, Iowa, followed the exact progression of aflatoxin damage.

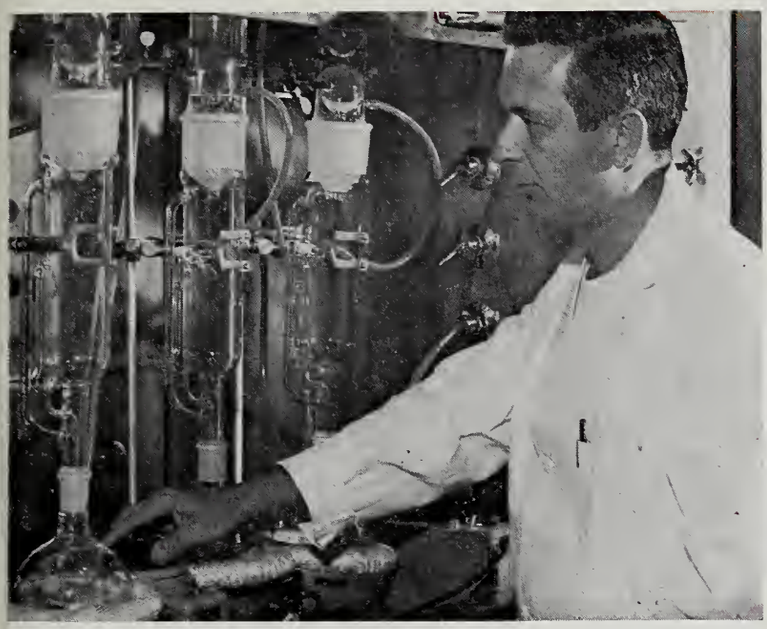
Young pigs weighing about 33 pounds became listless and began shivering 6 hours after receiving orally about 29 mg. of crude aflatoxin—a dose known to be lethal. They stopped eating but continued drinking. Droppings were stained with blood after 24 hours, and pigs started dying from then on.

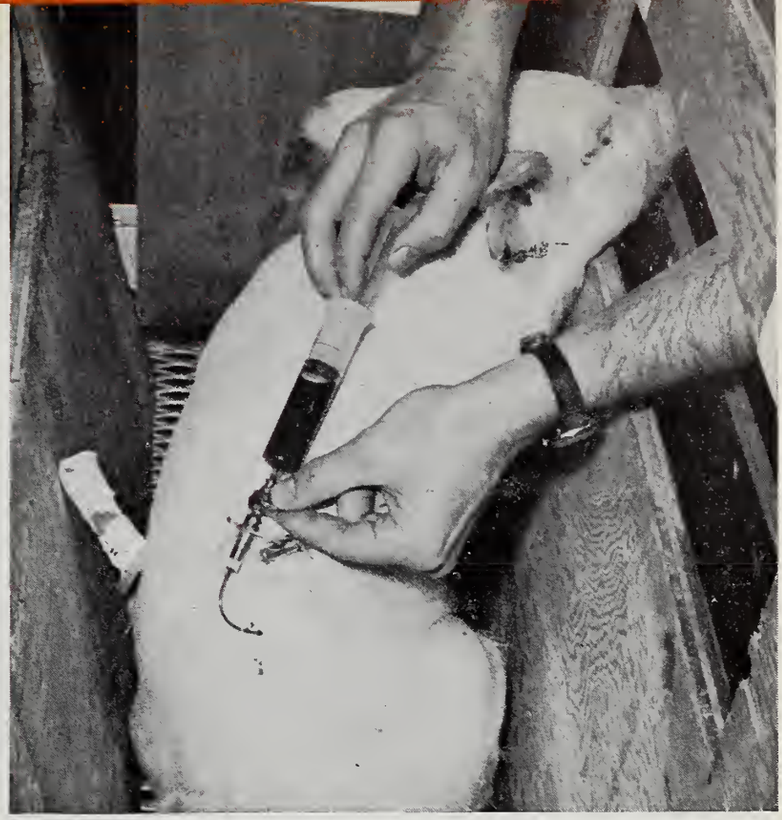
Post-mortem examination of pigs at various stages of the study confirmed that liver damage started 3 hours after aflatoxin was administered. Extent and severity of damage increased, and most liver cells were destroyed within 72 hours. Remaining cells showed various signs of internal disorganization.

Plant poisons or tars that pigs may chew out of old roofing and clay pigeons cause liver changes similar to those caused by aflatoxin. The best specific diagnosis, Cysewski found, is to check either the feed or urine of stricken pigs first for traces of aflatoxin in natural or metabolically altered form. This is readily done by thin-layer chromatography, a chemical method for separating and identifying related substances in complex mixtures. Aflatoxin poisoning is then confirmed by finding the toxin and typical liver damage in autopsied pigs.

Pigs in these tests received aflatoxin derived from known strains of mold grown on rice in the laboratory. But Cysewski says that the symptoms and evidence of liver damage were indistinguishable from those observed by other scientists in field cases.■

Livestock Loss





●●● abortions in Sheep, Cattle

CERTAIN FUNGAL INFECTIONS from moldy feeds may cause abortion in farm animals by destroying the placenta and shutting off the supply of nourishment to the fetus.

ARS veterinarians S. J. Cysewski and A. C. Pier studied fungal abortion in detail by experimentally infecting sheep with *Aspergillus fumigatus*, a widely distributed mold that is the main cause of fungal abortion in field cases. Both researchers are stationed at the National Animal Disease Laboratory, Ames, Iowa.

The researchers found that before aborting, ewes showed no measurable symptoms of trouble except for a brief rise in body temperature. Internal damage was also minor. Tissues from ewes slaughtered on successive days after experimental infection showed only a few small and scattered areas of mold growth. Built-in resistance of ewes apparently kept spores from germinating or restricted them to the earliest stage of germination.

Placental tissue lacked this resistance, and mold readily developed there, eventually destroying the placenta. The resulting cutoff of nourishment to the fetus caused its death, and it was aborted.

The mold grew across the placenta and into the amniotic fluid surrounding the fetus, but it rarely got into the fetus itself via the umbilical blood supply. In a few cases, the mold got into the skin, lungs, and stomach of the fetus, probably via the amniotic fluid.

Cysewski and Pier studied fungal abortion in ewes because they are easier to work with than cows and the two species have a similar type of placenta. However, the researchers feel that the basic conclusions from their trial will apply to cows. In fact, the strain of mold used in their study was isolated from the stomach contents of an aborted calf fetus.

Cattle producers can benefit directly from fungal abortion research because the findings help make accurate diagnosis possible. The disease has been hard to recognize because it doesn't produce distinctive symptoms. The fetus is infected in fewer than 50 percent of the cases, so its availability for diagnosis is of little help.

Neither does circumstantial evidence aid the diagnosis. Fungal abortion strikes sporadically without a logical pattern and without warning. Most animals which abort become pregnant after rebreeding and complete the next pregnancy without trouble, thus many cases go entirely unnoticed.

ARS research shows that the placenta, unlike the fetus, makes a good subject for specific diagnosis because it is infected in all cases of fungal abortion. They stress strongly, therefore, that farmers submit for diagnosis not only the dead fetus but also the placenta, no matter what its condition. This way, livestock producers can take steps to reduce harm that may come from moldy hay or straw, and disease control specialists can get a better idea of the true incidence of fungal abortion.■

HIGH PROTEIN *A Label for Future*

WHEAT KERNELS packed with more and better protein—that's the target, and current efforts by ARS and State researchers are showing encouraging results.

Wheat is the main food of an estimated 1 billion people in the world. With this head start, a high-protein wheat could be a major source of nutrients for the millions who suffer from deficient diets.

Environment is one factor affecting protein levels in wheat. Depending on growing conditions, protein content of a hard wheat variety can vary from 8 to 18 percent. Nitrogen fertilizer can also increase protein levels, but a combination of fertilizers and varieties that can synthesize extra protein in their grains will probably be needed to increase protein levels in different parts of the world.

The development by ARS and North Carolina Agricultural Experiment Station scientists of the soft winter wheat, Atlas 66, as a high-protein variety demonstrated the significant increases in protein level possible through breeding. Atlas 66 and a sister variety, Atlas 50, have since been used extensively in breeding programs. ARS and Nebraska scientists, for example, transferred the high protein of Atlas 66 to other wheats, including hard winter wheats.

In several years of testing at the Nebraska station, these hard wheat lines have equalled or outproduced their parents and protein increases have ranged from 15 to 20 percent. Although the trait appears fairly stable under conditions in the winter wheat-producing area of the United States, whether comparable results can be achieved in other wheat-producing areas of the world is not known.

To improve the protein quality of wheat, researchers under contract with the Agency for International Development (AID), are now screening common and durum wheats from the World Collection maintained by USDA in the hope of locating sources of high protein and high lysine.

The protein of currently grown varieties lacks the necessary balance of amino acids essential for tissue synthesis and body growth. Lysine, methionine, and threonine are the most deficient essential amino acids in wheat protein.

To date 4,100 varieties of the common wheat have been analyzed. Protein content ranged from less than 9 to over 21 percent. Lysine expressed as percent of protein ranged from 1.77 to 4.15 percent. Seven U.S. winter wheats and three spring and winter wheats from other countries have shown the highest lysine/protein content among the samples.

How useful these wheats will be for breeding purposes will depend largely on the stability of the high lysine

Cover: *Tweezers reveal seat of reproductive organs in a head of wheat (PN–1718).* **Far left:** *Agronomist examines a wheat variety at the Nebraska station (PN–1716).* **Near left:** *Wheat sample is analyzed for amino acids (PN–1717).*

e/heats

trait. If the level of these amino acids, lysine particularly, could be increased, the nutritional value of wheat would rise.

An International Winter Wheat Performance Nursery is being established by ARS and the Nebraska Station and selections will also be grown at experiment stations in 12 countries. The Nebraska nursery will permit early identification of superior winter wheat varieties broadly adapted as recipient geno-types for high-protein and high-lysine genes.

It could also serve for wide-scale and rapid testing of new breeding materials with improved nutritional quality as they are developed.

In addition to the Nebraska Experiment Station, other stations cooperating in the effort to develop high nutrient wheat include Kansas, Montana, North Dakota, and Texas. The work at the Nebraska station is financed in part by AID.■

Above: *A head of wheat is emasculated to prepare it for crossing with another variety (PN–1719).* **Left:** *The wheat reproductive parts, male at left and female, right, are compared in size to a dime (PN–1720).* **Below left:** *Technician at the World Wheat Collection, Beltsville, Md., operates seed divider which sorts equal numbers of seeds into packets for distribution (ST–4262–9).* **Below right:** *Technician checks seed samples mailed from other countries (ST–4262–2).*

SUGAR BEET LEAF STEMS

A Gage for Nitrogen Needs

PREDICTING THE NITROGEN needs of sugar beets by leaf stem analysis may soon be an important tool in the efficient production of high-quality beet roots.

Too much or too little water and fertilizer can materially affect yields and sugar content of the sugar beet crop. Nitrogen level is particularly important. Too little limits root yield; too much stimulates excessive top growth and reduces the root sugar percentage.

A prediction technique being developed by ARS soil scientist J. N. Carter and agricultural engineer M. E. Jensen should help growers avoid either extreme and still meet the varying nitrogen requirements of beets during the season.

The researchers say that until midseason beets require 1,000 to 2,000 parts per million of available nitrate-nitrogen in the soil. But, for highest sugar yield, the beets should exhaust available nitrogen 4 to 6 weeks before harvest.

The experimental procedure is based on the fact that nitrate-nitrogen in beet leaf stems varies with the plant growth stage, level of applied nitrogen, and, to a limited extent, with the moisture level. Concentration in the stems reaches a peak and declines rapidly after the first part of July in Idaho, where the ARS research was conducted.

By determining the nitrate-nitrogen levels in leaf stems on two dates after the peak value has been reached, the researchers can predict nitrogen needs for the remainder of the growing season.

A reliable soil test would still determine nutrient requirements before planting or at early side dressing. The leaf stem tests, however, would supplement soil tests to guide later applications to ensure that available supplies would be exhausted 4 to 6 weeks before beets are dug.

The Idaho Agricultural Experiment Station cooperated in the studies made at the Snake River Conservation Research Center, Kimberly.■

MUSHROOM WASH

Only Cosmetic

Claude Fordyce dissects a mushroom to determine the extent of deterioration (PN–1723).

A COMMERCIAL WASH for fresh mushrooms intended to extend their life does not prevent spoilage and deterioration.

In tests by ARS plant pathologist Claude Fordyce, Jr., at Beltsville, Md., the deterioration of mushrooms treated with the wash, which contains sodium bisulfite and sodium chloride, was more rapid than that of untreated mushrooms. Although washed mushrooms have an attractive pure white color, destructive fungi were more prevalent than on unwashed mushrooms. The fungi and bacteria he found, however, are not considered harmful to man.

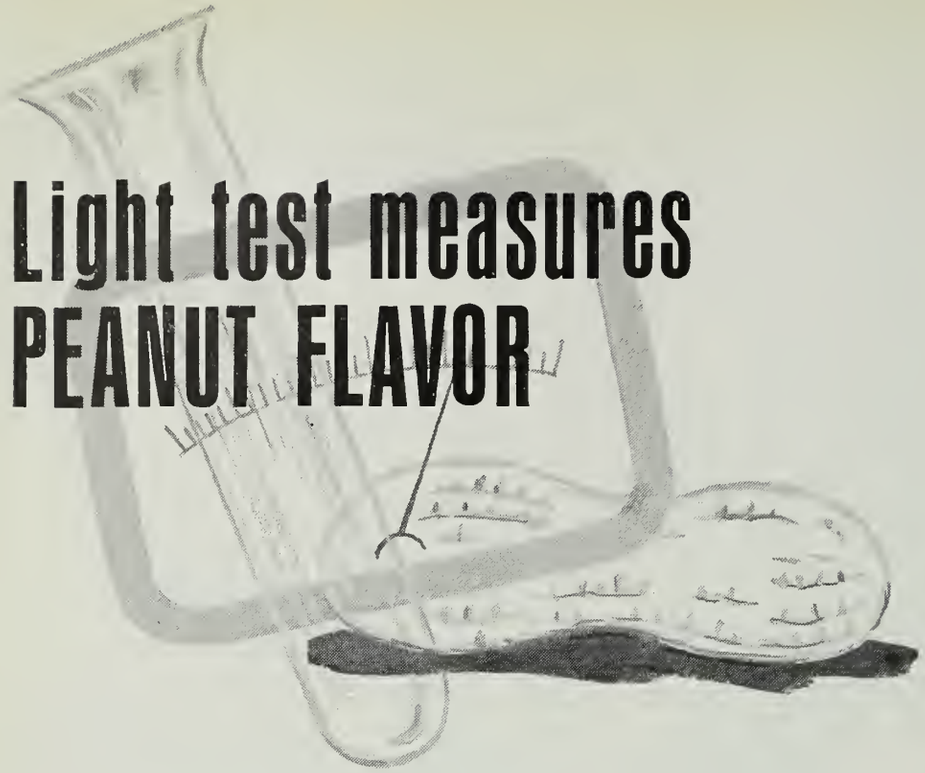
The scientist tested mushrooms from 19 growers to determine the extent of microbial deterioration occurring in transit from the packer to the retail outlet. During his investigation of the possible correlation of postharvest blemishes with the occurrence of infection, he detected no difference between the amounts of fungi and bacteria on healthy-looking and blemished mushrooms. Bacteria and fungi were found on all the mushrooms.

Fordyce also determined that fungal and bacterial as well as autoenzymatic (self-breakdown of tissues) action was responsible for the short shelf life of fresh mushrooms. Store managers estimate the life of fresh mushrooms at 1 to 3 days. Spoilage and deterioration can destroy as much as 30 percent of the retail value of the mushrooms.

As part of the tests, Fordyce collected samples weekly for 6 weeks, from the cold storage rooms of chain stores in the Washington, D. C., area. He selected an equal number of healthy-looking mushrooms and those showing spots, bruises, and fungi growths. The mushrooms were taken back to the laboratory in sterile glass jars where sections were dissected from each mushroom and placed on agar plates. Most of the microorganisms that grew on the plates were isolated and identified; a few fungi remained unidentified.

The scientist suggests that measures such as controlled-atmosphere storage and gamma irradiation might extend the shelf life of mushrooms. Careful sanitation before harvest could also help.■

Light test measures PEANUT FLAVOR



IF YOU'VE EVER CRUNCHED into an off-flavored peanut, you know that its appearance doesn't always indicate its flavor.

Peanut processors have the same problem. They need a way to measure flavor potential objectively so that unacceptable peanuts can be rejected before they reach consumers.

ARS and North Carolina State University agricultural engineers may have found the basis for such a test. Experiments by J. W. Dickens of ARS and E. O. Beasley of the University show that the flavor of peanuts is related to the amount of light transmitted by oil from those peanuts.

Peanuts that are immature, cured at a high temperature, or unripe rank lowest in taste tests. The researchers found that oil from peanuts with any or all of these characteristics generally transmits less light than oil from the mature, ripe peanuts cured at low temperatures.

Beasley and Dickens feel that it might be possible to grade peanut flavor objectively by establishing a scale of light transmittance values. More research, however, will be necessary to determine whether such a technique would be practical.

The light tests indicate that immature peanuts contain light absorbing constituents—probably carotenoid pigments—which decrease in concentration as the peanut matures. Curing before the peanut reaches ripeness or curing at high temperatures evidently interferes with the decrease of this constituent.

The development of objective measures of peanut quality has been stimulated not only by the increased demand for better peanuts and peanut products, but also by the adoption of mechanized harvesting and curing practices, which can, if mismanaged, adversely affect quality.■

Hybrid Yeasts make good Shoyu

HYBRID YEAST similar to hybrid corn in the way it outperforms its parents has been developed by Japanese scientists to make shoyu, a soy sauce produced by fermenting soybeans and wheat.

Working under a Public Law 480 grant, the Japanese scientists bred hybrids of *Saccharomyces rouxii*, the chief fermentation yeast used in making shoyu. Microbiologist C. W. Hesseltine, ARS sponsoring scientist at the Northern utilization research laboratory, Peoria, Ill., calls the achievement one of the most significant applications to date of yeast breeding for the production of fermented soybean foods.

ARS microbiologists L. J. Wickerham and K. A. Burton of the Peoria Laboratory were the first to determine that sexes in strains of *S. rouxii* are separate.

This knowledge enabled the Japanese investigators to make the numerous crosses required to combine in a stable yeast hybrid the characteristics which promote superior flavor, rapid fermentation, and high salt tolerance. High salt tolerance in the fermentation process is important because a heavy saline concentration prevents bacterial contamination.

The Japanese work, directed by Masatoshi Mogi at the Noda Institute for Scientific Research in Noda City, Japan, has demonstrated that it may be possible to breed many improved hybrids within species of yeast, just as hybrids in higher plants and livestock are bred. The difference is that stable yeast hybrids—unlike higher life forms—could reproduce themselves indefinitely without regressive mutations.

By increasing the rate of production and improving the flavor of shoyu, the improved strains of yeast resulting from this research could lead to increased consumption of soybeans and wheat in Japan. Already the largest single importer of U.S. soybeans, Japan also imports large amounts of U.S. wheat.■

AGRISEARCH NOTES

Science Featured in New Yearbook

Agricultural research, which has brought a better life to all Americans, is featured in the 1968 Yearbook, "Science for Better Living."

The preface points out that all of us benefit from agricultural research "because it improves the meals we eat, the clothes we wear, the wood we build much of our homes with, and the plants and trees that make our surroundings more livable."

Dr. George W. Irving, Jr., Administrator of ARS, served as chairman of the Yearbook Committee. Most of the chapters were written by scientists who work in ARS laboratories, other Federal and State agencies, universities and in private industry. In 432 pages and more than 250 photographs, including 53 in color, the Yearbook tells how science has provided hundreds of new products for better living.

The book reports on such research developments as the detection of crop diseases from satellites, the breeding of oblong tomatoes to cut harvesting costs, the use of plants as air pollution detectives, and the development of better insect and weed control methods.

"Scientists come to life in these pages," the preface to the Yearbook notes. "Keith E. Gregory pioneers crossbreeding in beef production. William C. Crow plans markets big enough to feed city areas of 15 million people. B. Jean Apgar, mother of three, determines the structure of a nucleic acid for the first time."

"Science for Better Living," is available for $3 from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

Nitrates in Playas

Water virtually free of nitrate pollution is running off the heavily fertilized Texas High Plains.

About 130,000 tons of nitrogen fertilizer are spread each year in the irrigated fields of the High Plains. And each year, flat-floored basins called playas impound 2.5 to 3 million acre-feet of surface runoff water from these fields. Water from these playas infiltrate ground waters which feed wells and streams.

ARS agricultural engineer V. L. Hauser took samplings from 13 of these playas on five different dates. The highest nitrate content was .95 milligrams (mg.) per liter. Most samples contained less than .50 mg. per liter. Water with a nitrate content lower than 45 mg. per liter is safe for human consumption.

Nitrate content did not change appreciably with time in the playas. Moreover, nitrate content of water in a playa whose watershed was 95 percent native grass was essentially the same as that of two playas whose watersheds were 80 percent cultivated.

The Texas Agricultural Experiment Station, College Station, cooperated in the study.

Aerial view of playas and surrounding irrigated farm land in the Texas High Plains. Playa in foreground is more than ½ mile in diameter (N–1724).

Establishing Alfalfa and Red Clover

Up to 3 tons of alfalfa per acre can be obtained during the seedling year if the crop is seeded in the spring and herbicides are used to control weeds.

Alfalfa is frequently planted in late summer to avoid the weed problem, but summer seedings often fail because of dry weather or because plants do not reach adequate size to survive the winter.

ARS agronomist E. J. Peters, working in cooperation with the Missouri Agricultural Experiment Station, Columbia, found that preplanting treatments with 2 to 3 pounds per acre of EPTC or ¾ to 1½ pounds per acre of benefin will control weed grasses and reduce broadleaf weeds in alfalfa and red clover. If weed grasses are not a problem, post-emergence treatment with ½ to ¾ pounds of 2,4-DB ester or ¾ to 1 pound of 2,4-DB amine

will control broadleaved weeds.

Farmers should not use more than 4 pounds per acre of EPTC or 1½ pounds of benefin, and they should incorporate the herbicide into the soil immediately after application.

If farmers use 2,4-DB in their postemergence treatments, they should apply it when the weeds are less than 3 inches tall. They should not graze cattle on, or cut hay from the fields for 30 days after the treatment, and they should not use more than 2 pounds of 2,4-DB per acre.

Dalapon will also control weed grasses in alfalfa as a postemergence treatment. Not more than 2.2 pounds per acre should be used, and first-year growth should not be fed to dairy animals or to animals being finished for slaughter.

Resistant Beans for Central America

El Salvador and other Central American countries will soon have promising new high-yielding and disease-resistant beans.

Since 1950, there has been an alarming reduction in bean production in El Salvador, as well as other Central American countries. Beans are a vital source of protein in these countries.

Four years ago, ARS scientists went to El Salvador in a joint USDA-Agency for International Development effort to find out why bean production was so low. Plant pathologist W. J. Zaumeyer and entomologist F. F. Smith found plant disease and insect damage were among the principle causes.

Common bean mosaic was the biggest crop destroyer, and bean yellows, web blight, angular leaf spot, and rust also took their toll. The most damaging insects were bean pod weevils, leafhoppers, sweetpotato whiteflies, and spider mites.

Since 1964, Zaumeyer and Smith have been cooperating with the El Salvador researchers to develop resistant varieties that will increase bean production in Central America. One variety they developed, selection No. 184, will soon be named and offered for sale to bean growers in El Salvador. It resists common bean mosaic and several strains of bean rust.

The scientists found 17 bean lines resistant to the bean pod weevil. They are now looking for plants that resist bean yellows, a white fly-transmitted virus disease.

Magazine Indexes Available

With this issue, AGRICULTURAL RESEARCH initiates a policy of publishing an annual index each December. The current index covers issues from July 1967 through December 1968.

Indexes of Volumes 7 through 15, covering issues from July 1958 through June 1967, are now available and may be obtained by postcard request to: AGRICULTURAL RESEARCH, ARS Information Division, U.S. Department of Agriclture, Washington, D.C. 20250. Please use zip codes.

Requests will be filled as long as the supply lasts.

CAUTION: In using pesticides diseussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly careful where there is danger to wildlife or possible contamination of water supplies.

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UNITED STATES GOVERNMENT PRINTING OFFICE
DIVISION OF PUBLIC DOCUMENTS, WASHINGTON, D.C. 20402

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U.S. GOVERNMENT PRINTING OFFICE: 1968