To Your Health

College of Agriculture
University of Missouri-Columbia
March 1976 SR187

Missouri Agricultural Experiment Station

This is a report of the Missouri Agricultural Experiment Station emphasizing health research.
Other reports this year are SR 186, *Test Tube to Table* and SR 188, *Science–for Nature's Sake.*

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The Missouri Agricultural Experiment Station, headquartered at the University of Missouri-Columbia, combines the best efforts of 250 scientists in 13 departments, 2 schools, 1 division, and 2 colleges working on more than 175 major research projects.

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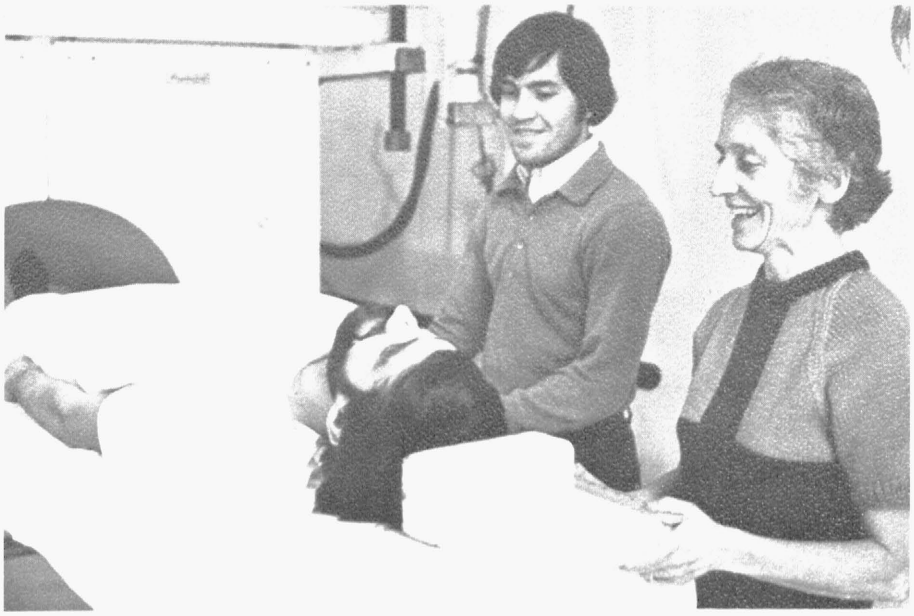
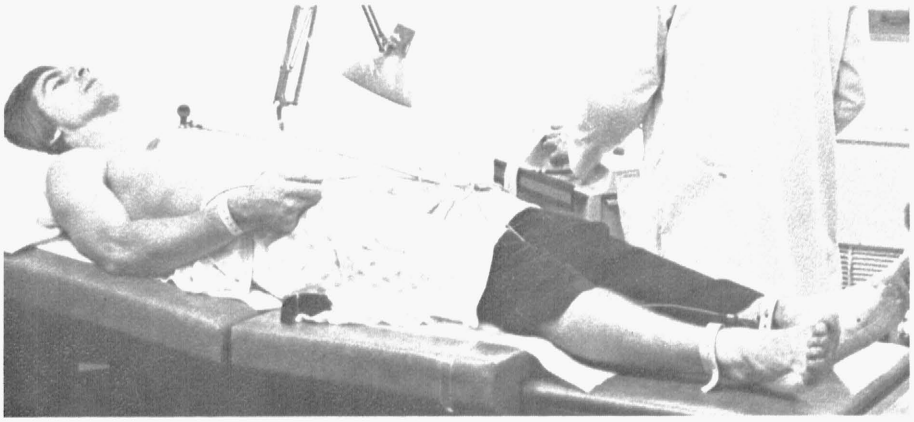


A low percentage of body fat improves your odds against a heart attack, Margaret Flynn, UMC nutritionalist, tells Gregory Brown, forestry professor. Brown registered less than 5 percent fat in UMC's Whole Body Counter where he had been tested by Larry Forkner, research technician. Normal among males is 15-20 percent; females, 25-30. Add 10 percent if you're over age 50.

Electrocardiogram (EKG) is part of the cardiac risk study. Joe Marks, science news director for the Agricultural Experiment Station, is being tested.



Results of EKG are explained to Willard Summers, UMC landscape architect, by David Trantham, medical resident.

Health Research for Humans

I Want Your Body! In 1970, nutritionist Margaret Flynn sent out word she was looking for male volunteers to be "guinea pigs" in a continuing study that would help answer some questions about the risk of heart attacks.

Response was overwhelming.

Nearly 1,000 University of Missouri-Columbia faculty agreed to regular checks of their hearts (electrocardiograms), body fat, serum cholesterol, and blood pressure.

"We're making these men conscious of their health," says Flynn. "Most are watching their weight, smoking less, and getting more exercise."

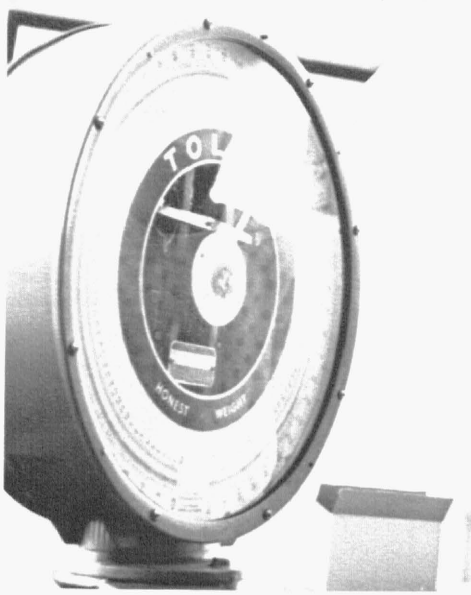
Offshoots of the project, supported by the Missouri Agricultural Experiment Station and the School of Medicine, are having a big impact on human health.

For example, 140 volunteers from this study recently went through an egg-a-day experiment to test the effects of eggs on cholesterol. All of those in the study had kept their serum cholesterol levels within the normal range for five years. No changes were made in diets or life styles.

Half of the volunteers ate an egg each day for three months and the other half ate no eggs. Then at the end of the three months, the first group went off eggs and the other went on. *Results showed that egg or no egg made no difference in the average cholesterol in these men who had proven genetic ability to control cholesterol.*

These are the managers of Experiment Station Chemical Laboratories (ESCL) who have earned an international reputation for developing fast, automated, precise analysis procedures. ESCL is headed by Prof. Charles W. Gehrke (right). Larry L. Wall, Sr. (left) is assistant manager, and Paul R. Rexroad is associate manager.

Ben Londeree, UMC exercise physiologist, is one of 1,000 UMC faculty participating in a cardiac risk study directed by Margaret Flynn. Non-smoking, exercise, and a trim body reduce chances of a heart attack.



This and other studies show most people have low risk cholesterol levels and can probably eat eggs, butter, cheese, ice cream, and marbled beef without fear of increasing the risk of coronary heart attacks. Those who have family history of heart disease should see a doctor and be advised on precautions.

In another project, Flynn developed a set of standard norms for the way children grow in lean mass from infancy through adolescence. The norms can support a "good health" diagnosis or they can show where a child may need further tests for hidden health problems.

In an offshoot of this project, Marjorie Rutledge, dietitian in the UMC Clinical Research Center, and Flynn showed that babies will put on the same amount of lean mass whether breast- or bottle-fed. But the bottle-fed infant may put on more fat if overfed —and the plump child has a tendency to become a plump adolescent and an overweight adult●

Biological Markers in Cancers. An advanced research program is under way in the Experiment Station Chemical Laboratory (ESCL) to develop and apply methods for the detection and analysis of biological markers in cancer patients. These markers help doctors follow the course of malignant disease before, during and after therapy. The markers also serve as a diagnostic tool and provide additional knowledge of the biochemistry of cancer.

Methods developed by ESCL have been used in screening 3,000 patients. Results have been of great value to medical doctors and have been published in various journals of cancer research●

Fat Is a Family Affair . . . And so is dieting.

That's why food scientists at UMC teamed with those at Lincoln University in Jefferson City to develop a weight control program that involves the whole family's "behavior management" from shopping to storing to serving.

The results have been amazing. Family members in the program lost weight and reduced their food bills—without going on a diet! Families

A diet that works is one that involves food portion control—and a little help from your friends, according to nutritionists Barbara Paulson, left, of Lincoln University, and Ruth Lutz, of UMC.

concentrated on good nutrition and decreasing total intake. With the whole family involved, there was plenty of reinforcement for the dieter.

On the average, women in the study lost about a pound a week for the 15 weeks they were in the program. The program works so well, said the dieters, because it concentrates on changing behavior patterns and following some rules that help control weight.

Fast Method for Protein Analysis. A fast, precise, automated method has been developed in the Experiment Station Chemical Laboratory (ESCL) for the analysis of total protein nitrogen in all kinds of agricultural products—milk powder, raw and cooked meat, egg products, swine feces, and cereal grain rations. At least 250 samples can be completed in a 9-hour day.

Fast, accurate analyses are becoming critical to world food production. Scientists all over the world rely on ESCL and the methods they have developed.

The method for analysis of total protein nitrogen was adopted as "official first action" by the Association of Official and Analytical Chemists in October 1975. In addition, simple automated methods have been developed for total nitrogen in fertilizer. These methods replace the long and time consuming Kjeldahl methods developed in 1883●

Infant's Amino Acid Needed By Adults, Too. UMC food scientists have evidence of a "new" essential acid for adults. It's histidine, which had been considered essential only for infants.

Histidine is present in all protein-containing foods, so deficiency isn't much of a danger. But it was important for doctors and nutritionists to know more about histidine. For example, if you were fed intravenously for a long time, you could suffer from histidine deficiency unless you were given a solution containing the amino acid. If you did have the histidine deficiency, you would eventually suffer from anemia and would not be as efficient in using nitrogen in protein●

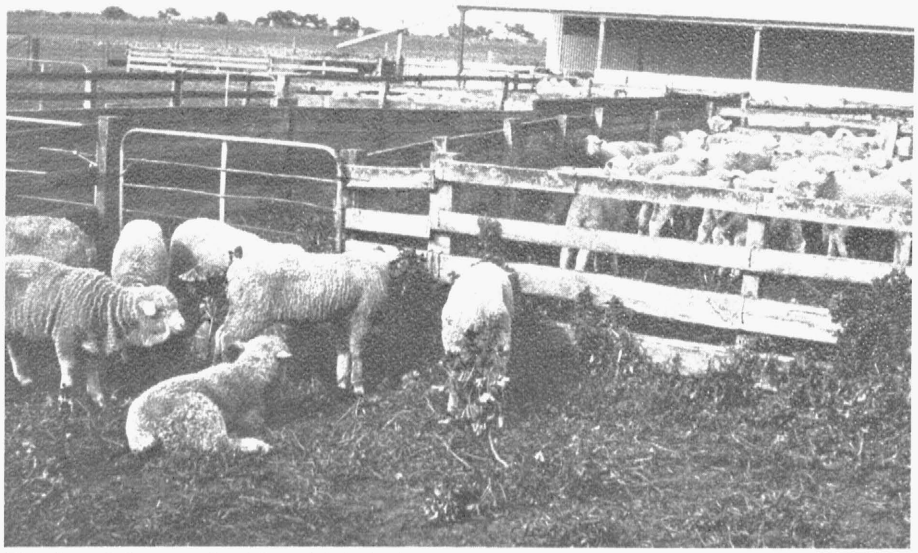
Blood test for alcohol is administered by Mike Tumbleson who heads up alcoholism research at the University of Missouri's Comparative Medicine Research Farm. Pigs, because they are so biologically like humans, are valuable for studying aging and chronic diseases like alcoholism.

Finding Will Stop Killer Stress Disease. UMC scientists blame a genetic defect for a stress disease that causes its victims to "self-cook" and kills hundreds of humans and thousands of farm animals each year. Their findings will help put an end to this killer disease.

Soon they expect to pinpoint the specific defective enzyme that causes malignant hyperthermia which kills 70 percent of the humans who develop the disease syndrome. And they'll virtually eliminate the porcine stress syndrome (PSS), thus knocking out a disease that kills over $250 million worth of U.S. pigs each year.

In humans, the genetic defect is a dominant characteristic and seems to stay within certain family lines. There's a family in Nebraska, for example, that is affected so badly that family members develop a fever and muscle stiffness just from riding in a car. Many members of this family have died at an early age. By knowing the enzyme defect that is responsible, some forms of early therapy can be applied to humans.

In the case of pigs, where PSS ranks as the most serious disease affecting that animal, genetic selection will take care of the matter. Even though the defect is dominant, scientists believe that they should virtually eliminate it within the next five to 10 years●



This hog takes a refreshing drink during a heat stress experiment.

Sheep that graze pasture low in copper give birth to lambs with "swayback" and ataxia or stumbling gait. While these copper deficiencies are not common in America, UMC researchers did find them in Australia. And, in studying the neurological disorder, they found that it resembles Parkinson's disease.

The sheep disease can be corrected by supplementing diets with copper. And the copper-deficient lambs can be used as models in studying Parkinson's disease. That's important to medical doctors who need "guinea pigs" for experimentation.

Health Research for Animals

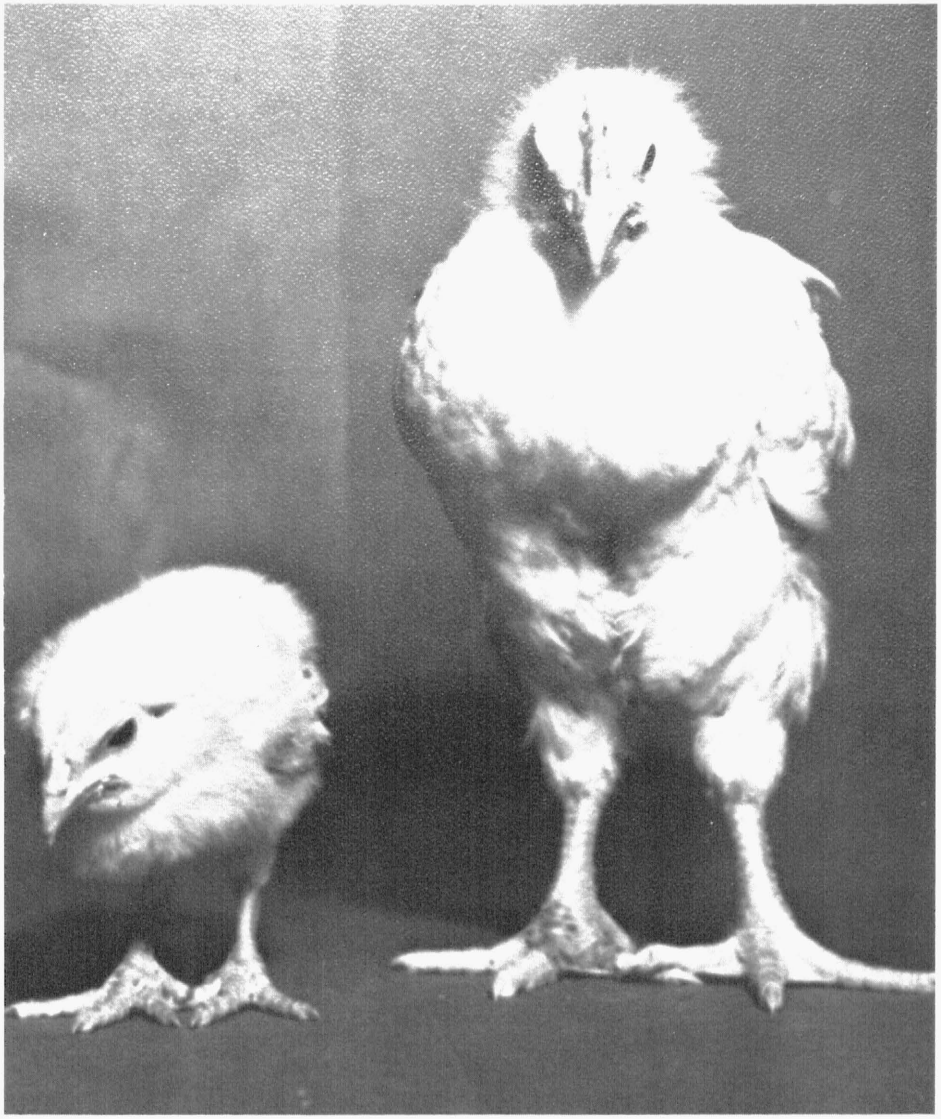
Hormone Cure for Cystic Ovaries. UMC scientists have shown the effectiveness of a relatively inexpensive treatment for cystic ovaries in cows that will have no "carryover effect" on the animals. The likely treatment will be an intramuscular injection of gonadotropin releasing hormone (GnRH).

In UMC trials, 80 percent of the cows given optimum doses of hormones responded to one treatment. Most of these cows came into heat 18 to 24 days later. Of the cows responding to treatment, nearly 80 percent became pregnant, averaging 1.7 services per conception.

Can Hot Hogs Take It? UMC research shows it pays to keep hogs cool—if you just want to get them to market fast with a good growth rate. But if feed efficiency is your only concern, you may not have to go so far.

UMC agricultural engineers put hogs through different levels of heat stress. One group was kept at 73 degrees, one at a constant 86 degrees, another at a constant 92 degrees, another at constant 97 degrees, another with "normal day" fluctuations from 72 to 100 degrees. The best growers were those kept at 73 degrees. But those with the best feed efficiency were those kept at a constant 86 degrees.

Another thing: research showed that heat stressed animals do have the ability to compensate—to recover weight losses under stress—if given a reasonable time to cool down. For example, those heat stressed to 86



The bird on the left suffers from zinc deficiency. UMC biochemists have shown poultry feeds containing phytin, which is found in all seeds like corn and soybeans, require zinc supplementation. The zinc has a dramatic effect on growth rate and health in chicks and saves the broiler industry thousands of dollars each year.

degrees weighed 10 pounds less than the control group at the end of 17 days of stress. But they fully recovered in 11 days at 73 degrees.

There is a threshold beyond which the animals don't recover, however. Those stressed at 97 degrees weighed 32 pounds less than the control group at the end of 17 days. And they never fully recovered.

The ability to compensate and the heat stress threshold are common to both steers and pigs. Obviously, it's worth the time and trouble to cool down animals suffering from high heat over a long time. But UMC researchers are finding that animals can take much more heat—and recover from it—than was once believed●

Fertility Finding. UMC biochemists have developed a basic research technique which could ultimately solve fertility problems which plague the livestock industry.

UMC scientists developed a method for isolating sperm head membranes which play an important role in fertilization. The method not only allows study of the membranes' function, but it also has wide application in determining how sperm enzymes participate in fertilization●

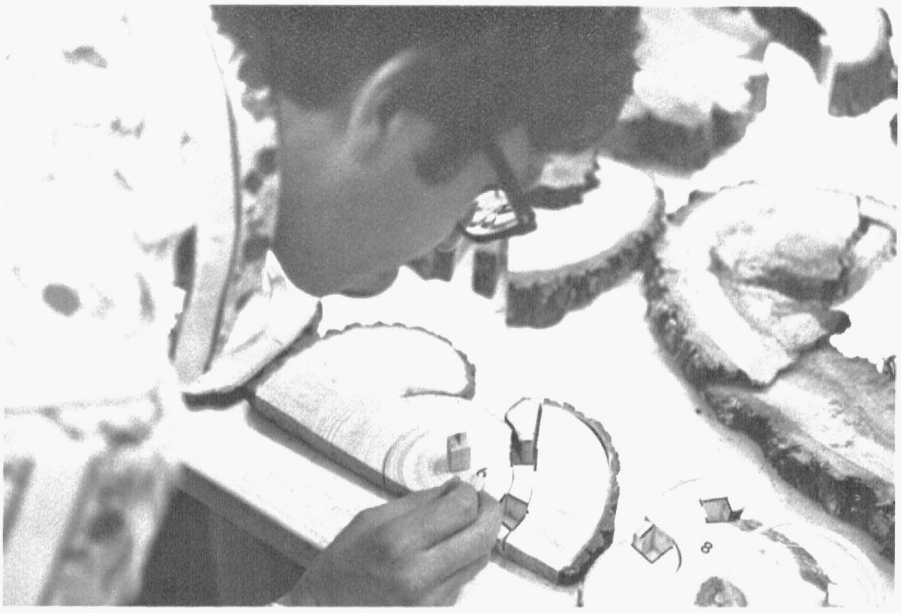
Cow Needs "Fine-Tuning." A cow's maximum productive efficiency should be about 50 percent. She should be able to produce milk at a rate equal to one half the total energy she consumes. For example, a 1700-pound cow should produce 50,000 pounds of milk and 2,000 pounds of butterfat.

There are ways to go beyond the cow's limits with hormones, like thyroxine.

But UMC scientists are concerned that accelerating bossy over and above her natural limits would only cause her to "burn out" sooner than she would normally. Several studies are under way to strike a balance between laws of nature and what *man* can do to increase milk production by fine-tuning the dairy cow●

This tower in the treetops gives UMC scientists a birds-eye view of environmental effects on forest growth. The crown is one of the two most important points for scientists to study trees (the other is at ground level—in and around the root system), because it reveals such things as photosynthetic efficiency.

A tree's response to injury is examined in UMC forestry lab. Scientists there analyze cell structure in the area where the tree grew around a man-made wound. Comparisons are made between the injured and uninjured area to record the tree's response to injury and how these injuries affect wood quality.



Health Research for Plants

Why Trees Shrink . . . and More. UMC foresters are making extensive studies of tree behavior under different environmental conditions and putting the collected information into a computer. For example, foresters can strip it of its branches, eliminate its neighbors, or otherwise manipulate it in a computer. Then they can check the results in the field.

One part of the research includes reporting the tree shrinkage by observing changes in tree stem size. The tree trunk, which is about 64 to 78 percent water, is second only to soil as a reservoir for a tree's water. Information like this helps scientists pinpoint trees' critical water level. Knowing this point, foresters can now advise tree growers of the best time to irrigate without wasting water●

In-furrow Treatment Best for Soybean Disease. In-furrow treatment is the best way to apply fungicides to soybeans, say UMC plant pathologists.

Research shows in-furrow treatments work better because farmers can apply about five times as much fungicide; the treatment lasts longer; and the seed gets more protection●

Fast Method for Finding Rust Resistant Wheat. UMC plant pathologists have developed a fast method for determining the genes that give wheat varieties resistance to stem rust fungus.

The new method takes only 2 to 3 months instead of the 1 to 2 years that had been required●

This cabbage looper larva is about to finish off a soybean leaf. Research shows the pest can defoliate soybeans by as much as 40 percent early in the season without decreasing yields even one-half bushel per acre. If defoliation occurs later, when pods are beginning to fill, yield losses may drop 15 percent.

Fireblight Toxin in a Test Tube. UMC plant pathologists can now produce fireblight toxin in a test tube.

That means pear and apple breeders can have the toxin when they need it to test potential new varieties for resistance to the fireblight disease. Until the UMC researchers were able to accomplish this, toxin could only be produced from green apple fruit available only at certain times of the year, thus slowing the process of breeding resistant varieties●

Toxic Metals Found on Southeast Missouri Crops. Heavy concentrations of toxic metals have been found on vegetables and forage grasses growing in the lead mining areas of Southeast Missouri.

The danger to humans isn't great, as long as people are aware of the heavy metals. Just washing the vegetables before they are eaten removes a large part of the metal contamination. Otherwise, there is a danger of long term chronic buildup of cadmium, for example.

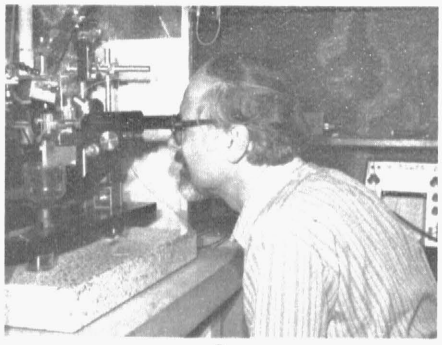
Lead concentration is another problem, especially on forage grasses. The lead concentrations in some areas have been known to kill horses and may have had something to do with some cattle deaths. In those areas, farmers can only keep their animals away from crops that have been contaminated.

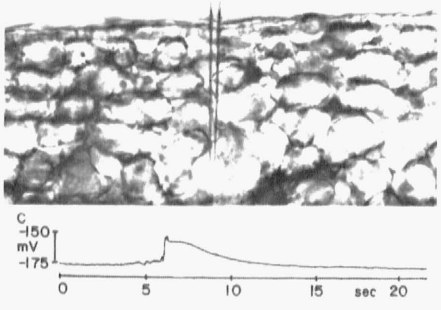
The UMC Agricultural Experiment Station leads an effort to measure concentrations of lead, cadium, zinc, and copper on food consumed by man and beast. Besides the forage grasses, highest concentrations are found on leafy vegetables. Also, some root crops (like radishes) will take them up from the soil. This may be a problem where sewage sludge containing heavy metals is sprayed or spread over the land.

The UMC scientists are continually monitoring suspect areas and passing the information on to people in the area. Meanwhile, efforts are being made to find and prevent the occurrence of toxic concentrations of heavy metals on crops●

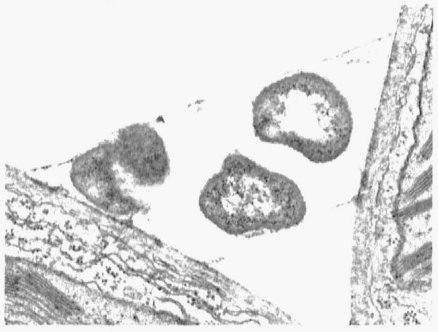
Gas Blamed for Greenhouse Disasters. When plastic greenhouses came on the scene, florists using ethylene gas units to heat them began to have a lot

Plant disease attack is measured by Dr. Anton Novacky, UMC plant pathologist. He developed this technique for fast, accurate detection of plant disease development. If the tissue is diseased, such as a root infected with a nematode, an electrical impulse in the cell membrane can be detected (below). Called electrophysiology, it enables pathologists to study, almost immediately, the first response of a plant to a disease invasion.





Plant defense system—(Top) Pathogenic bacteria are enveloped by a thick membrane and seem to be disintegrating between two plant cells. (Bottom) Three harmless bacteria have not caused the plant to mount this "enveloping" defense reaction. Magnification: 25,000 X).



of trouble. The greenhouses were so air-tight they weren't getting complete combustion of the gas. Result: complete failures of mums, poinsettias, and Easter lilies.

UMC floriculturists found that as little as 1 to 2 parts per million of ethylene gas in the atmosphere keeps short-day plants from flowering. Immediately, they sent warnings to greenhouse growers, and they made a complete check-list for diagnosing the problem and correcting it. That information is so important that growers from all over the country still call UMC for this information●

Nursery Stock Certified Virus Free. UMC plant pathologists developed a nursery virus certification program which is the first in the state and the model for similar programs around the world.

In effect, this program certifies virus-free nursery stock. Routine periodic testing has resulted in 20 to 50 percent more useable nursery trees and more uniformity. Nurserymen have been able to save costly grading and have virtually eliminated virus-infected discards from their stocks●

"Defense Systems" Found in Plants. UMC plant pathologists have discovered a new "defense system" in plants. And they hope to find ways to trigger that system so the plants will protect themselves against disease.

Researchers found that some plants, in effect, produce agglutinins (antibody-like compounds) against invading disease-causing organisms. This defense system limits the number of disease-causing organisms harming the plant. That explains why some bacterial diseases can kill one kind of plant and won't hurt another at all.

Here's how the defense system operates: as potential disease-causing organisms enter the plant, bacteria are "caught" (agglutinated) at the point of entry in the vascular stream of the plant. In other words, plant bacteria are held at or near the point of entry. This clump of bacteria subsequently disintegrates, and infection is stopped●

Written by Joe Marks.

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