Test Tube to Table

College of Agriculture
University of Missouri-Columbia
March 1976 SR 186

Missouri Agricultural Experiment Station

This is a report of the Missouri Agricultural Experiment Station emphasizing accomplishments that contribute to Missouri's agricultural leadership and every citizen's food supply.

Other reports this year are SR 188, *Science for Nature's Sake* and SR187, *To Your Health.*

They are available from:

Publications,
211 Whitten Hall,
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Columbia, Missouri, 65201.

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.

Elmer R. Kiehl
Dean & Director

Richard J. Aldrich
Associate Dean & Director

Multiple cropping with minimum tillage is one way scientists get more out from an acre while reducing fuel costs and erosion.

Energy Savers

Energy conservation is a high priority for scientists in the Missouri Agricultural Experiment Station. Many examples are in this publication

These and other energy saving research efforts by Experiment Station scientists are aimed at avoiding energy debt●

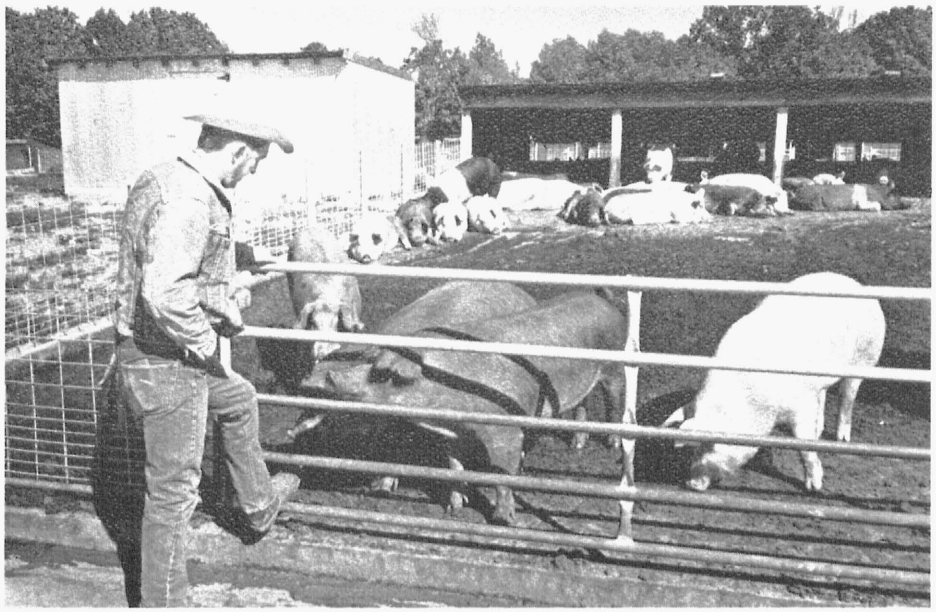
Energy from Manure. Livestock manure might be used to power the nation's farms if the energy crisis gets worse. UMC agricultural engineers designed waste treatment equipment which collects the methane gas produced when anaerobic bacteria break down manure. Natural gas is mostly methane. It's a clean burning energy source.

Producing methane can be expensive. However, methane generation will likely become a feasible process in waste management systems if energy and fertilizer shortages become more acute●

Think Six to Save Fuel. UMC agricultural engineers have found that tractor rpm shouldn't drop by more than 6 percent when a tractor is loaded. If it does, it's lugging down. If drops less than 6 percent, it's running too light to develop the tractor's horsepower. To check your tractor, set the throttle lever and watch the speed when the tractor is not loaded. The engine speed should drop 6 percent when the load is applied. If the tractor is lugging, shift to a lower gear or lighten the load. If "too light," shift to a higher gear and throttle back●

Careful farm management is more important now than ever before.

Missouri hog producers that are choosing to remain in the business are increasing production. More hogs and fewer farmers seem to be a national trend, according to a UMC study.



Farm Business

Million Dollar Farms. UMC agricultural scientists report that the average Missouri commercial farmer has about a half-million dollars worth of capital invested in his farm business—2½ times what he had 10 years ago. Of the increase, more than 60 percent is represented by land and improvements.

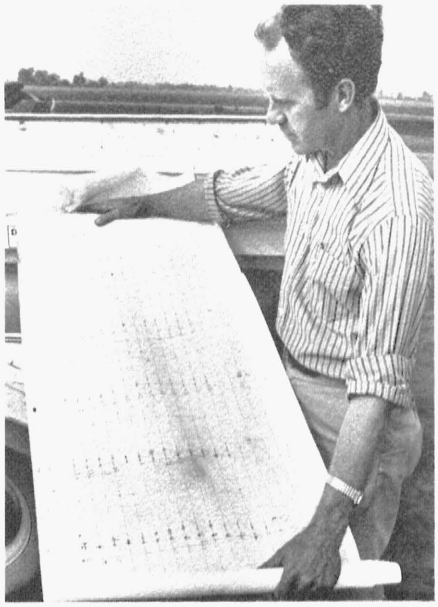
Missouri farms are becoming more "capital intensive" and are using relatively less labor to increase production. In addition, farm incomes have been rising steadily, as have farm costs. Careful farm management is more important now than ever before●

"New York Cowboys" Hurt Family Farm. UMC Agricultural economists have shown that outside financing caused cattle feeding to expand in the 1970s even after profits did not warrant it. These "New York cowboys," as they were sometimes called, were financing about 25 percent of U.S. fed beef in mid-1973—often because this offered an attractive tax shelter under existing laws.

UMC researchers showed that tax shelters brought millions of outside investors' dollars into agriculture, created large-scale farming operations and put the family farm at a disadvantage.

This comprehensive legal and economic analysis suggests the need for a careful examination of these aspects

Missouri farms are becoming more 'capital intensive' and are using relatively less labor to increase production.



of tax policies, because what happened in the beef industry could happen in other segments of agriculture●

Some Hog Producers Quit and Others Keep Getting Bigger. When Missouri hog producers were asked why they decreased production or quit altogether, they blamed diseases, labor problems, breeding difficulties and hog prices. As for the rest of the producers—those still going and growing—"commitment" was the big thing. They had too much invested to quit.

Basically, the study emphasized a national trend: more hogs and fewer farmers. What does all this mean? Here's what UMC agricultural economists say:

- Adequate financing will become increasingly important as producers expand their units.
- Hog farmers will be so committed to production that they will be relatively inflexible and less sensitive to fluctuating prices. A large commercial hog producer will be slow to increase or decrease production drastically when his hog enterprise is a major or only source of income.
- Hog producers will seek qualified employees with management expertise. And they will pay good wages for this expertise.
- Pollution and waste disposal problems will become of even greater concern. Large capital investments will be needed to comply with current and future waste management regulations●

Inflation-Recession Issues. UMC scientists and extension specialists often team up to "spread the word" when a crisis arises. A good case in point was the effort made by our agricultural economists to analyze the forces at work as our country was rocking through a period of inflation and recession. They presented an overview of the economy and explained the market "power structure" to hundreds of Missourians—farm and non-farm. As with any educational process, tangible results are difficult to measure. However, many Missourians became better informed and better able to cope with current economic problems●

Dr. Trygve Veum, UMC swine researcher, watches as a machine precisely feeds a young pig.

Animal Science

Watch Potassium When Fescue Freezes. UMC animal scientists have shown that there are times when potassium levels in fescue get so low that cattle and sheep need a potash supplement in their rations. This happens when a very hard freeze is followed in a few days by several hours of drizzling rain or ice that covers the fescue and melts slowly. This combination of circumstances can occur in January, February or early March.

If this happens, potash supplement should be available if animals have no feed other than the stand-over pasture.

Potash supplement will not be needed if hays and protein supplement are fed, because they provide the animal with adequate potassium●

Pig Factories. "Programmed piggyhood" is about to turn sows into "pig factories" while their pampered, machine-raised offspring get to market in unprecedented numbers.

UMC animal scientists proved they can reduce pig mortality 15 to 20 percent by taking day-old pigs away from the sow, putting them in cages and feeding them with machines. Without any mothering responsibilities, sows can be bred within 10 days after they give birth instead of the normal five to six weeks waiting period (normal weaning age for baby pigs).

A research goal is to get these sows to farrow large litters. UMC animal researchers are perfecting techniques that will "program" sows so they will breed and give birth at the

"Programmed Pigs" are more than a remote possibility in the opinion of Bill N. Day, UMC animal husbandry professor and scientist. He hopes to use hormones to get pigs to breed and give birth at the convenience of the farmer.

More beef from fescues is the goal of these agronomists; William Murphy (left), UMC, and A. G. (Jerry) Matches, USDA Agricultural Research Service.

convenience of the farmer—a sort of "planned piggyhood." Using hormones, the scientists not only get sows to breed when they want them to, but they can also get them to superovulate—a factor that would mean a 40 to 60 percent increase in the number of pigs per litter●

Machine Feeds Pig. Dr. Trygve Veum, UMC swine researcher, says pig mortality is reduced 15 to 20 percent when machines, instead of sows, "mother" the pigs. The pigs on the controlled diets in the artificial rearing machine were lighter at three weeks of age compared to the pigs nursing sows at the farm. However, the mortality of three-week-old pigs was five times greater at the farm●

A Cattle Drive To The Brewery? Lately, some cattlemen have been taking a liking to their local brewery.

But it isn't the brew they want. It's the brewer's grains—barley, corn and rice that remain after some of the carbohydrates are extracted in brewing beer and ale.

It is 22 to 29 percent protein and is often cheaper on a cost-per-pound-of-protein basis than protein sources like soybean meal.

It's superior to urea or other non-protein nitrogen sources as a livestock feed due to the quality of the vegetable protein it contains.

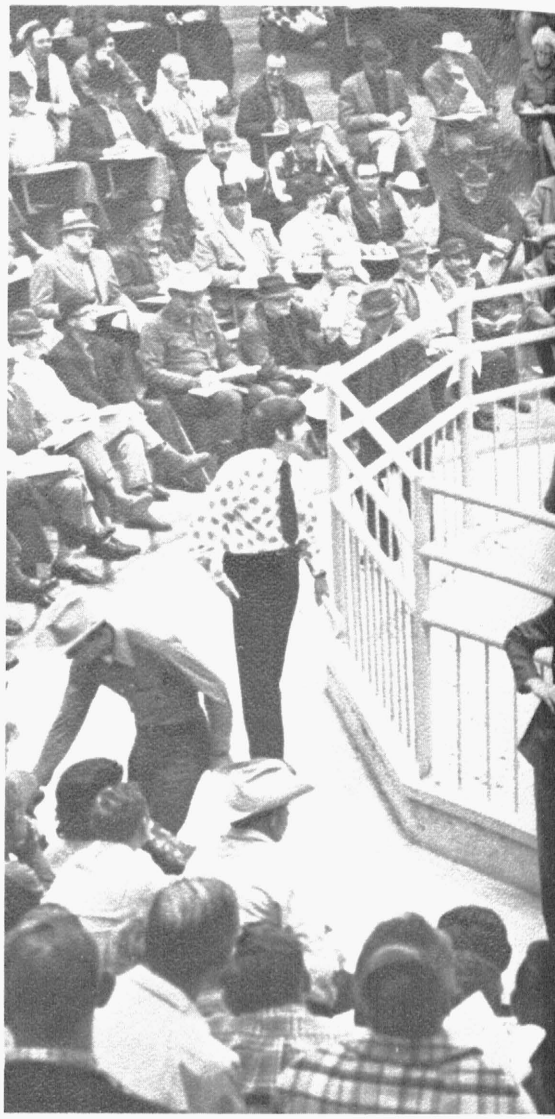
Also, it contains a much needed roughage, making it well suited to self-feeding operations.

The brewers' grains are good for cattle health, too.

Scientists found that brewers' grains aid in the prevention of liver abscesses in cattle and certain digestive disturbances, including bloat and foundering. Lab studies indicate that the grains may keep the rumen from becoming too acid.

Finally, UMC scientists see an advantage of brewers' grains as an energy source. About 68 percent of the given weight of the brewers' grains will provide digestible nutrients for cattle. The figure for corn is 80 percent●

Double lamb production is the aim of UMC scientists. They've done it by breeding ewes twice a year and raising lambs artificially.



Ammonia "Super-Slurper". Why not save quality protein for human nutrition and feed ruminant animals a nonprotein nitrogen substitute that people cannot utilize?

A good idea, except that urea, most commonly used nonprotein nitrogen source for ruminant animals, is found to release toxic levels of ammonia in the animal. Agricultural Experiment Station biochemists have discovered how to treat abundant agriculturally-produced starch so that it will detoxify ammonia in the animal body. With this new ammonia "super-slurper," ruminant animals can be safely fed nonprotein nitrogen instead of eating protein food that is good for humans●

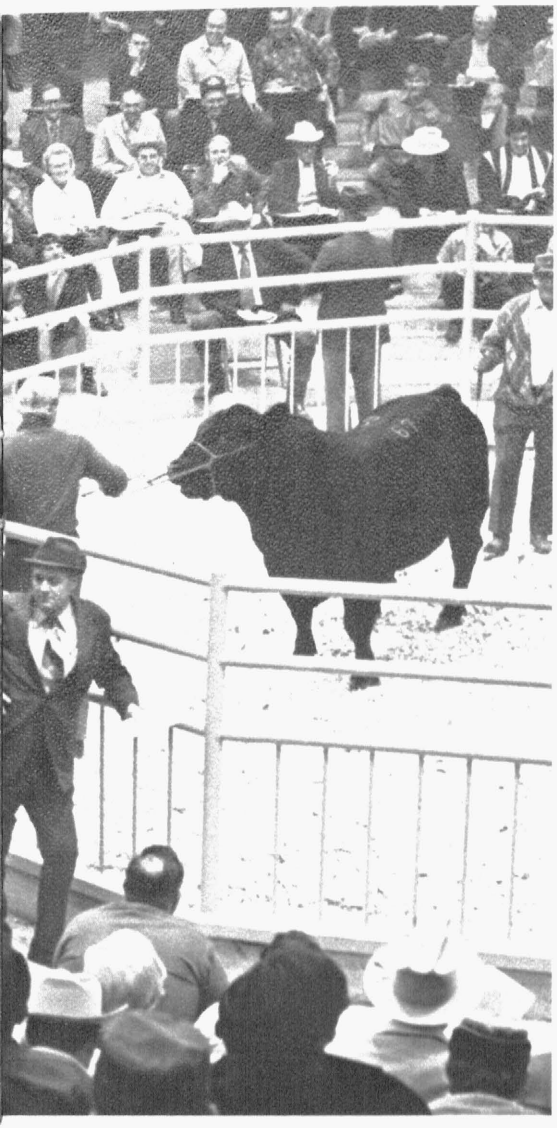
Livestock Producers Count on Counter. The UMC Whole Body Counter is helping cattlemen produce leaner beef. Animal scientists use the counter to measure radioactive potassium (^{40}K). Since potassium is primarily located in the muscle, it is one of the best ways to evaluate red meat in a live animal.

Progressive purebred breeders use the Whole Body Counter to evaluate carcass traits in their bulls. Heretibility for most carcass traits is 60 to 70 percent. The information on individual animals using the Whole Body Counter is equal to testing nine progeny of that individual.

The important information provided by the counter—plus a bull's growth, efficiency and structural soundness—are valuable tools for the livestock producer selecting bulls for a breeding program●

Are All Crossbreds Really More Efficient? Crossbred cattle gain more, but they may not be more efficient. Research shows Hereford-Angus crosses outgain the parent breed in the feedlot by 2.2 percent. And crosses of hereford-angus-charolais outgain parent breeds by 4 percent.

But research shows feed required per pound of gain is almost the same for straightbreds as it is for crossbreds. For example, the black-white faced steer is likely to gain faster, but he will probably eat more and wind up with the same feed conversion in the feedlot as the breeds from which he came●



Better bulls, those that carry genes for good growth and lean carcasses, bring better prices. UMC's Whole Body Counter helps producers select these better bulls.

"Let them eat grass" is becoming the byword of beef producers who are trying to cut production costs by saving on "high energy" feeds.

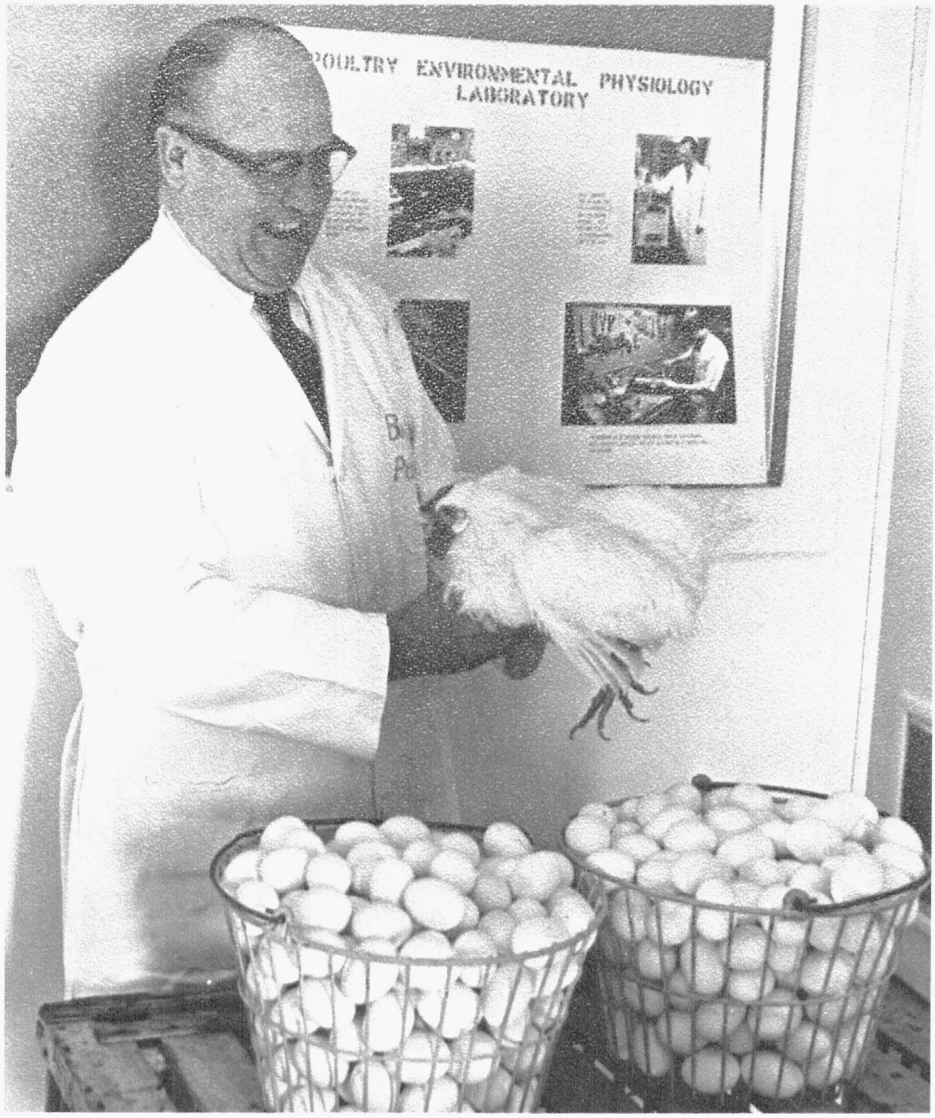
High Forage/Low Grain Systems for Beef Production. Food and animal scientists are studying beef production efficiency under different management systems and making detailed carcass evaluations. The data indicate that approximately 20 bushels of corn fed to steers previously grazed on grass will produce acceptable quality beef. Other systems using silage in a growing phase and then followed by varying lengths of a high corn ration are also being evaluated. These data should allow producers to select their management system based upon the supply and costs of feedstuffs available and the value of the potential product produced by the various systems●

Good Beef from Less Grain. Animal Scientists are teaming with agronomists to produce beef from less grain, to save energy.

In one feeding system successfully tested, the animal gets only forage until it reaches 750 pounds. Then it gets just enough grain to "finish" it to a market weight of 1,000 pounds. In that system, the animal eats 14 pounds of forage and only 2 pounds of grain for each pound of live weight it produces. This is a total production system which includes the forage fed to the breeding herd besides that actually fed to the calf●

Research Makes Chicken Waste Worth Millions. Research by UMC scientists shows that waste from a broiler-hatchery or egg-type chicken hatchery can be ground, heated and processed into high quality chicken feedstuffs.

The protein content of processed hatchery byproducts from the broiler industry is 22 percent; the protein level from chicken hatchery waste is 32 percent. When fed to laying hens, feed consumption, egg production and feed conversion was as good with either of these byproducts as it was when layers were being fed a corn-soybean diet●



Harold Biellier, UMC poultry scientist, admires an egg-a-day producer. Biellier is selecting and breeding birds that will not take a break in their laying cycle and produce 365 eggs a year.

"Lamb Factories." Future ewes may be "lamb factories" as UMC scientists work to intensify lamb production. They can double lamb production by breeding ewes twice a year instead of once. They've greatly increased the percent of lambs raised by taking them away from the ewe within 24 hours after they're born.

Over the last two years, ewes on intensive lamb production at UMC have averaged 2.46 lambs per year. The ewes were bred twice a year in spring and fall.

Under natural conditions ewes seldom breed except in fall. But UMC scientists overcame that by using adapted breeds, hormones like progesterone to synchronize estrus (controlled breeding) and others to increase ovulation.

The next step was to raise the lambs artificially. The day-old lambs were taken away from their mothers and raised with a milk replacer. Ordinarily, sheep producers lose about 10 to 15 percent of their lambs when ewes raise them. These losses were only 1 to 2 percent with artificial rearing●

Three-Breed Crosses Produce 20-22 Percent More Pounds of Calf/Cow. Three-breed beef crosses are 20 to 22 percent better than either two-breed crosses or backcrosses, according to UMC animal husbandry researchers.

The three-breed cross in the UMC experiments involved Angus, Hereford and Charolais. Two breeds were crossed, then the cross-bred offspring were bred to the third breed.

Hybrid vigor makes the difference. In studies of 477 cows bred, the three-breed cross has meant more calves and heavier ones●

"Breakless" Chickens on the Way. A strain of chickens that will lay an egg-a-day for a year straight is being developed by UMC poultry scientists. Because the birds don't take a break in their laying cycle, they'll produce one-third more eggs a year than the average hen—365 instead of 270.

UMC researchers have been selecting for these birds by using inbreeding and artificial daylengths of 23 hours. Those hens able to produce eggs every 23 hours for extended periods are being selected and bred to develop the super chicken of the future●

Measuring leaf transpiration loss in relation to the amount of soil water. This basic study at UMC will help growers determine the best time to irrigate.

Us Versus Nature

Let the Sun Do It. Photosynthesis is undoubtedly the major key to food production. It's that process by which plants convert the sun's energy into food energy. Simply put, if you can improve a plant's photosynthetic efficiency, you can improve food production efficiency.

UMC horticulturists have already shown that you can greatly increase the production of crops like greenhouse tomatoes by using supplemental artificial lighting. For example, during the dark winter of 1972-73, tomato yields were almost doubled by using top lighting (19.54 lamp watts per foot sq.). When top lighting was combined with side lighting (39.09 lamp watts per foot sq.) yields were 3.3 times what they were on plants grown under natural light.

That much artificial lighting now would be far too expensive to be practical. But UMC scientists know they're on the track of a real yield booster. So, they are combining that information with breeding techniques to literally "reshape" plants to make better use of light energy. They are also changing cultural techniques, like row spacings, to get the most efficient food production from every acre●

"Let there be light." Professor E. R. Graham, left, and Kenneth Cook, UMC agronomists, measure the photosynthetic rate of a corn plant with a 20-second exposure to sunlight and radioactive air. Light intensity is measured at the same time. Their aim is to improve the photosynthetic ability of plants so they do a better job of converting sun's energy into food energy.

"All shook-up" is the wheat evolution theory, thanks to UMC agronomist Gordon Kimber. He showed that the species *Triticum speltoides* ("goat grass") was not one of the main genetic contributors to wheat as scientists had believed.

Shake Wheat Evolution Theory. Scientists are no longer sure how wheat got to be wheat, because UMC agronomists have refuted the long-standing theory about wheat evolution. Now they're on the track of the real "missing link" which, if found, could greatly increase possibilities of improving wheat.

Until recently geneticists had thought that much of wheat's genetic basis came from *Triticum speltoides,* often called "goat grass," a species related to wheat. But UMC research showed that it was not. The result is a major change in what scientists had believed was the evolutionary pathway of wheat. This is causing many of them to reconsider how they should introduce desirable characteristics from related species.

If the real "missing link" can be found——and UMC scientists have the procedures to do just that—it would add variability to wheat genetics. That variability could be used to greatly improve wheats of the world●

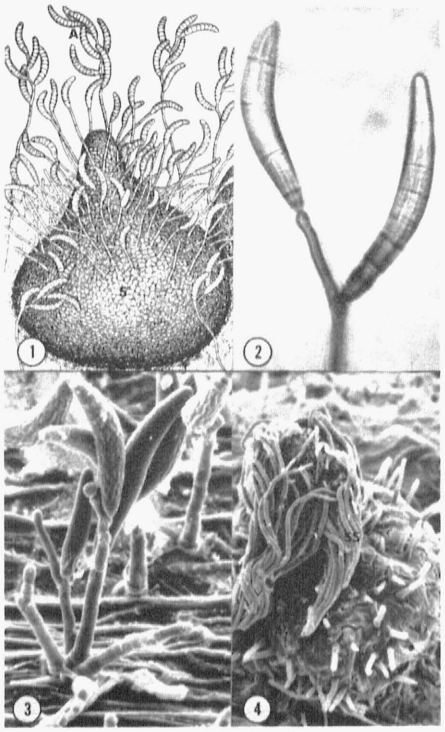
They Care About Climatic Changes on Planet Earth. UMC atmospheric scientists are working toward an understanding of long range climatic changes. This kind of information could be critical to such things as world food production or even man's survival on this planet.

This earth has had a steady decrease in global temperatures since the early 1940s and, if this continues, it would have a serious impact on agriculture. We don't know if this is a natural cycle that will reverse itself in a short time, or if it is something that will continue until we have a return of the Ice Age. The atmospheric science study will help answer these questions and determine the effects man may have on climate (air pollution, thermal pollution, etc.).

As scientists learn to evaluate climatic changes and make long range predictions, they will also be able to direct man's activities in such a way that he won't cause detrimental climatic shifts●

Weather Vs. Plants. UMC atmospheric scientists and agronomists are collaborating to help plants get along better with nature.

Views of the spores that cause southern corn leaf blight. See story below, *Plant Disease Catalog,* for full description of this photograph.



For example, researchers are examining the soybean plant to see which varieties and management schemes make the best use of water and sunlight. As part of the study, researchers have found that the soybean is a very "extravagant" water user that will take up ¼ to ⅓ inch a day—if the water is available. But soybeans can be misers, too. In the case of drought, soybeans can stay in a "holding pattern" much better than other crops (like corn) with relatively little ill effect.

As scientists pinpoint how weather stresses affect plants, they can modify the plant to cope with these stresses. They are also better able to tell farmers which varieties are most likely to succeed in a given area●

Plant Disease Catalog. Using a high powered electron microscope and some excellent photographic techniques, UMC plant pathologists have authored a comprehensive catalog of more than 200 species of disease-causing fungi. The photos are so good, that pathologists have greatly improved their ability to identify and classify the fungi, as well as finding target spots for biological and chemical control. In effect, it shows the pathologist the "Achilles' heel" of the disease-causing fungus.

The pictures above show the evolution of this process at different views of the spores that cause southern corn leaf blight.

1) This is an interpretative drawing made after viewing spores through the microscope at a 150X magnification.

2) This is a light micrograph of a spore branch magnified at 1200 times. Details of these structures are indistinct because of the limitations of the light microscope.

3) Here is a scanning electron micrograph of the same structures as seen in figure 2. Spores and spore bearing branches are clearly identified.

4) Another view showing a scanning electron micrograph of the sexual stage of the fungus. The range of the electron microscope literally gives scientists a much better "picture" of disease-causing organisms and how to control them●

Professor Ernest Sears, UMC's only member of the National Academy of Science, is internationally acclaimed for his wheat research. He has established a more complete genetic understanding for wheat than has been established for any other plant in the world. He also provided the basis for all the genetic wheat stocks used in the world.

Multiple disease-resistant cotton is being developed by William Sappenfield, cotton breeder at the UMC Delta Center.

Row Crops

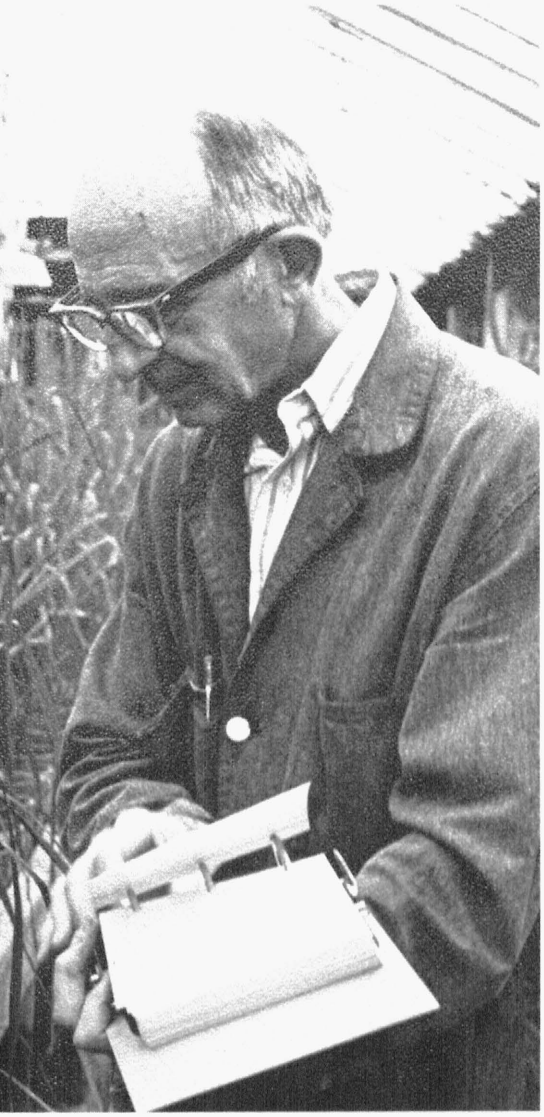
New Model Cotton. Scientists at the University of Missouri's Delta Center are working on a "new model" cotton that could double Missouri's cotton acreage. This would be a short-season cotton that could be planted after the normal crop (about May 15-20) and harvested ahead of that normal crop. It would produce the short, coarse fibers used in disposable wear. The new cotton would add 300,000 or more acres of cotton to the 400,000 already growing in Missouri's Bootheel.

Delta Center scientists are also developing multiple disease resistant cotton and are working on a "systems approach" to increasing yields. The latter includes developing new varieties, improved fertilization techniques, narrow row spacing, new harvesters and better control of weeds, diseases and insect pests●

Increasing Soybean Yields. Zapping lower pods to increase soybean yields is a part of the research effort of Maurice Gebhardt, USDA agricultural engineer, and David Johnson, UMC agronomist. Johnson found when soybeans lose their lower pods, they compensate and put their effort into producing more pods higher on the plant. Right now, growers are losing about 10 percent of their yields (worth over $100 million to Missouri farmers alone), because pods are too low to the ground and fall under the cutterbar.

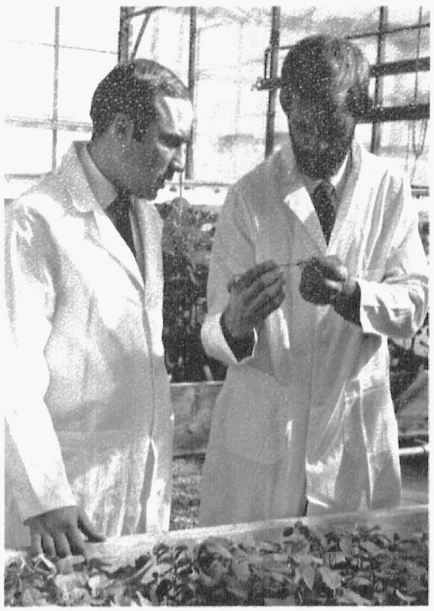
In other soybean research, scientists have . . . .

- Improved yields with narrow rows. UMC agronomists showed that soybeans grown in 15-inch rows will yield about 30 percent more than beans grown in 30- to 36-inch rows.



Long-term field experiments have been conducted on the UMC Sanborn Field, the oldest experimental field west of the Mississippi River. Agronomists, like C. M. Woodruff, test cropping systems here that could not be evaluated under any other field conditions.

David Johnson, left, and Virgil Luedders, UMC agronomists, research how soybeans make their own nitrogen.



Yields may be even higher when the beans are drilled in 7-inch rows, but UMC researchers like the 15-inch row because they can use a standard planter by simply changing the seed hoppers. They also showed that no-till planting of soybeans will yield as much as conventional tillage, as long as weed killers work.

• Devised a better way of controlling weeds. They direct herbicide sprays so they hit the stem no more than two inches above the ground. That gives farmers much better weed control and soybean yields than spraying stems up to a height of four inches.

• Found a way to predict soybean growth. If a scientist knows the name of a soybean variety and when and where it was planted, he can predict the date the soybean will emerge from the ground, start flowering, begin bean development, end flowering and be ready for harvest.

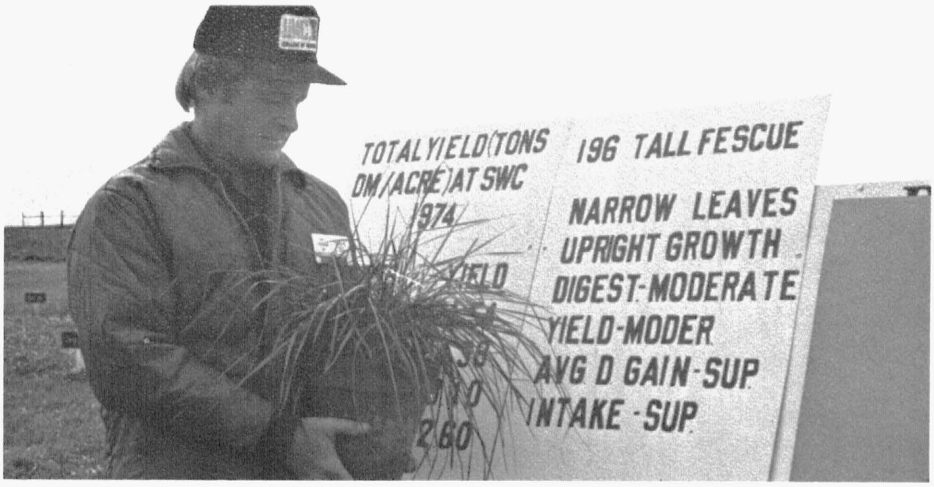
• Are zeroing in on a soybean variety resistant to race four of the soybean cyst nematode. Researchers at the UMC Delta Center and the U.S. Department of Agriculture are collaborating and expect to have resistant varieties for growers by 1980.

• Found a way to knock out Johnsongrass the first year, thanks to a "two-barrelled approach" tested and proven by scientists at the Delta Center. The trick is to combine the herbicides Treflan and Roundup.

• Found the "missing link" that helps explain how soybeans make their own nitrogen and convert it into protein. Until recently, scientists knew of only two systems by which soybean plants produced amino acids, the basic building blocks of protein. One way is for nitrates to be taken up from the soil to the roots and leaves where they are converted into amino acids. The other is for the nitrogen from the air to be converted into amino acids in nodules, those tiny bumps on a plant root that contain nitrogen-fixing bacteria. Now UMC scientists know of a third means by which soybeans can produce amino acids (protein): Nitrates are taken up from the roots and translocated to the nodules where they are converted into amino acids and then translocated to the above-ground plant parts. This information is critical to UMC scientists who are battling to break through the barrier which has kept soybean yields almost constant for the last decade●

Probing a hay bale, this agricultural engineer checks the effects of a preservative (proprionic acid.)

David Sleper, UMC agronomist, experiments with I-96 tall fescue.



Finer Forages

Better Hay from Early Fescue Harvest. Spring grown tall fescue is most valuable for summer and winter feed when harvested in the boot or early heading stage, according to UMC researchers.

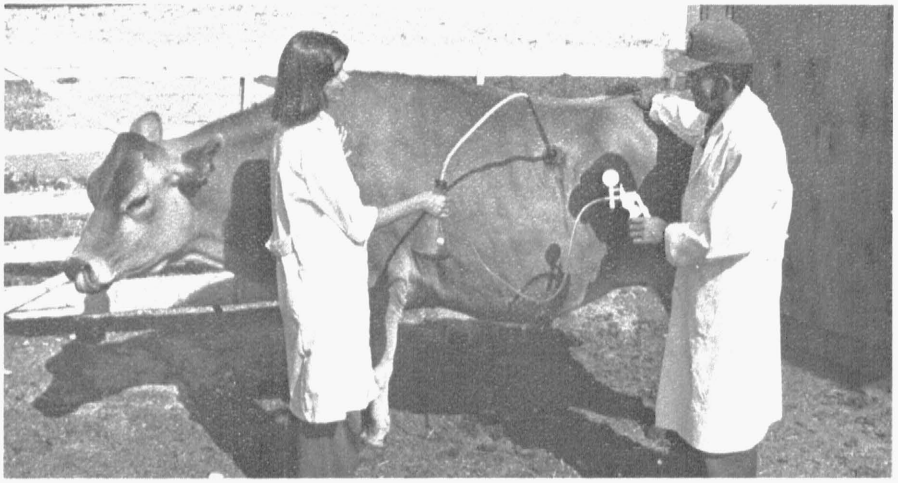
Studies show tall fescue made into hay in the early stages runs 10 to 13 percent protein and is about 53% digestible.

State-wide studies show that leaving round bales of the early cut forage in the field until July and August or even until winter can stretch low forage supplies. Also, August top-dressing with 90 pounds of nitrogen on fescue after spring growth was removed produced 0.8 to 1.8 tons per acre of high quality fall growth. This forage averages 12% crude protein and 58 percent digestibility when harvested in December●

Forage Digestibility Test. This test includes taking rumen fluid from the forage-fed cow, putting it into a test tube, and running it through some tests. Procedures used at UMC by A. G. Matches, USDA Agricultural Research Service agronomist, make it possible to run more than 5,000 such tests a year. That helps scientists learn more about forage quality and aids them in selecting improved varieties. With these tests, less than a teaspoon of fluid is needed for evaluation, compared to several hundred pounds in a regular livestock feeding trial●

A. G. Matches, USDA Agricultural Research Service agronomist, tests rumen fluid from a forage-fed cow.

Rumen fluid is taken from a forage-fed cow for a forage digestibility test.



Better Fescues Coming. Scientists at UMC and the Southwest Missouri Center are in the final testing stages of two new fescues which they believe will be superior to any now being grown in this part of the country. One is I-96, an upright growing fescue which proved superior in forage grazing trials. The other is Kenhy, tall fescue crossed with ryegrass. I-96 is a product of UMC research. Kenhy was first developed in Kentucky, but will be released jointly by Kentucky and Missouri, because UMC has one of the most extensive animal tests in the nation●

Wanted: Fast-Disappearing Hay. Farmers want a fast-disappearing hay for cows.

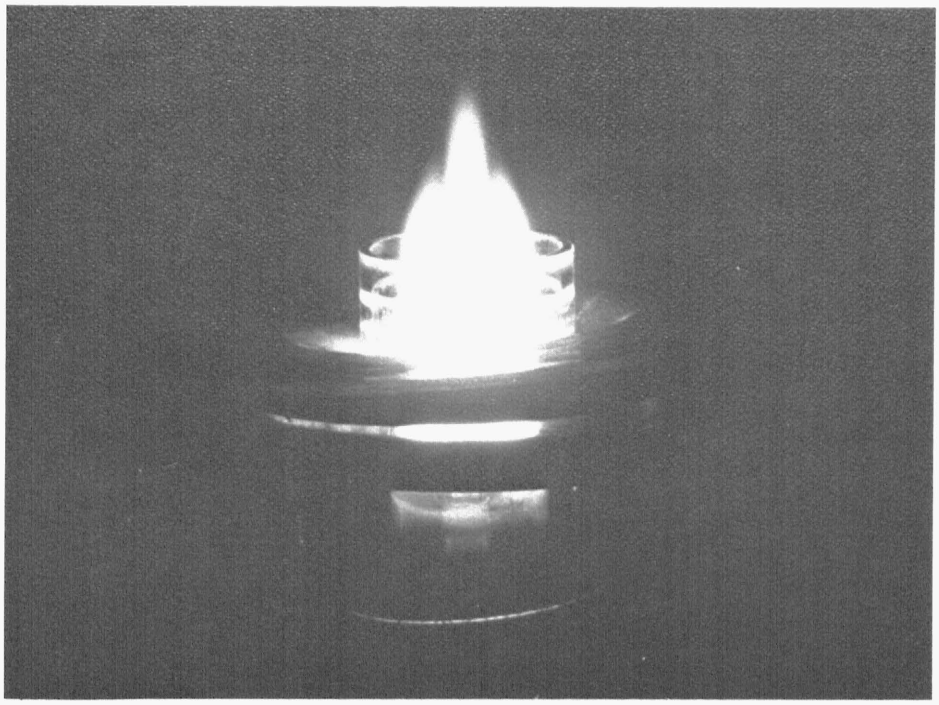
And UMC dairy scientists have developed a mathematical equation to find it.

A good forage is one that a cow can eat, digest and excrete as quickly as possible. That allows the cow to eat more, digest it better, and produce milk and meat more efficiently.

The UMC mathematical equation helps scientists predict how much forage an animal will eat and how good it is for producing milk and meat. It's also useful to the plant breeder who is striving to develop "ideal" forages. And it helps the farmer improve the efficiency of his ration by showing him how forage fits into the diet and how much grain is needed●

Engineers Check Hay Quality. They probe a hay bale to examine the effects of a preservative (proprionic acid) on hay quality. In studies of high moisture (40 to 50 percent) fescue, the preservative helped hay quality—but not enough to justify the expense of using the preservative. Engineers are trying to pinpoint best harvest methods for boosting hay protein and digestibility●

This hot flame could help give farmers better, inexpensive fertilizer recommendations. This is a high temperature plasma (over 10,000 degrees) formed in argon gas. Ashes of plant or soil samples are sprayed into the plasma, which causes elements to emit light with characteristic color or wavelength. Using a spectograph, scientists can measure up to 18 elements simultaneously, including trace elements.



Down to Earth

Missouri Steps Up Soil Fertility Research. In 1975, UMC soil scientists established 31 field experiments in a statewide effort to provide Missouri farmers with the best possible advice on how to fertilize and lime their soils for maximum crop production.

From this basis, new studies will be started each year to keep fertilizer recommendations current, to incorporate new technology, and to adapt to changes in cropping systems and management. The ultimate aim of the effort is to "fine tune" fertilizer recommendations so they are much more useful to individual farmers●

Superior "Soil" Developed. Superior "soil" has been developed by UMC horticulturists. More accurately, it's a "growth medium" made of vermiculite, perlite and clay particles.

The clay is the key to the media's superiority. It greatly increases the nutrient and water-holding capacity of the medium, so this does not have to be watched as closely as other media to make sure plant nutrient levels are where they should be.

Specific mixes for specific plants are being developed. These "tailor-made" media contain both fast and slow-release nutrients for best plant growth●

"Artificial soil" that's better than the real thing was developed by Victor Lambeth, UMC horticulturist. It's made of vermiculite, perlite, and clay particles. The clay increases its nutrient and water-holding ability.

James Brown, left, is in charge of the soil testing laboratory at UMC. He is assisted by technician Gene Busteed.

Computer Saves Fertilizer Costs. UMC agricultural economists have developed a "simulated computer model" that will save fertilizer retailers (and their customers) a considerable amount of money. The computer model is used to manage inventory so that dealers store neither too much nor too little fertilizer. That saves storage costs and prevents excessive tie-ups of facilities.

With over $160 million worth of fertilizer sold in Missouri each year, plus tight fertilizer supplies and higher interest rates, the computer model will be used extensively by researchers and managers in answering the "what-if" questions facing the industry●

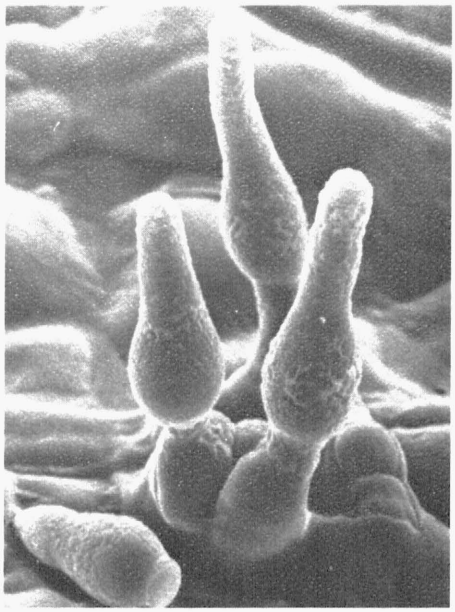
Inexpensive Plant and Soil Tests. Better, inexpensive fertilizer recommendations for farmers is the aim of UMC biochemists. A good method for accomplishing this goal is high temperature plasma (over 10,000 degrees) formed in argon (a gas).

Plant or soil samples are first burned in an oven and their ash is dissolved in acid. A small amount of the solution is sprayed into the plasma which causes elements to emit light with characteristic color or wavelengths. Using a spectrograph, scientists can measure up to 18 elements simultaneously, including trace elements.

Ultimately, UMC scientists hope to develop methods for accurate analysis which are so inexpensive that individual farmers can easily afford to use plant analysis and soil tests for fertilization decisions●

A modern soil testing laboratory was established at UMC in 1975. James Brown, who is in charge of the lab, says it can handle up to 20,000 samples a year and give farmers precise information on phosphorus, potassium, calcium, magnesium, organic matter, soil acidity and lime requirements●

A single application of benomyl (150 ppm) on an apple scab lesion produces these abnormally elongated spores which remain firmly attached. That means they aren't free to start new infections. The detached, normal spore in the foreground was produced before the treatment was made. (Magnification 25,000X).



Lawn and Garden

Ideal Apple Sought. Missouri growers want better apple trees—especially the dwarf kinds. That's because they can produce more apples by planting more trees per acre. Standard apple tree plantings run about 35 trees per acre; medium, 100 to 200; high, 200 to 500; and ultra high, over 500 an acre.

UMC horticulturists are searching the world for dwarfing apple rootstocks adapted to Missouri's climate. Many are winter-hardy enough to survive here, but they can't take our hot summers and droughts.

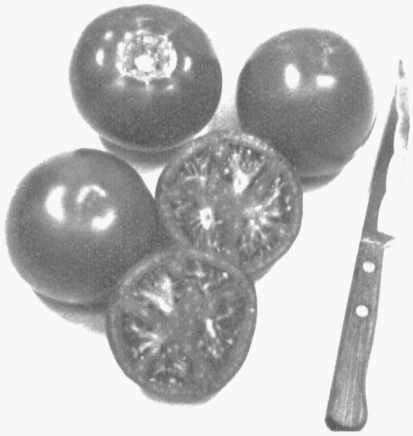
To get an "ideal" tree—a dwarf type that is well adapted to Missouri—UMC researchers are using European dwarfing stocks as "intermediates." The European stock becomes a section of the trunk and supplies the dwarfing characteristic, while another stock with heat- and drought-resistance is the root system●

New "Transition Zone" Lawn Grasses Coming. New grasses adapted to lawns in the "transition zone" between the South and North are only a couple of years away.

UMC scientists, who call this part of the country "the toughest place to grow a good lawn," are using a three-way approach to get better lawn grasses. They're screening and testing for more winter-hardy bermudagrass, more summer-tolerant bluegrass, and improved tall fescues that have fescue's hardiness, plus the fine, leafy texture homeowners like●

Trickle irrigation system at UMC orchard near New Franklin, Missouri, is examined by Aubrey Hibbard, UMC horticulturist. This system has a low power requirement and makes economical use of water. It's permanent , so labor isn't needed to move the irrigation pipe.

New pink market tomato line (31-St-21) was released by the Missouri Agricultural Experiment Station. It's smooth, crack resistant, and a high yielder.



Growth Regulators Make Plants More Compact, Tougher. Chemical growth regulators are being used to produce the dwarf, compact plants that are "in" these days just as compact cars are the trend in the automobile industry. The "new model" plants developed through UMC floricultural research, also have greener foliage and much more resistance to stress (such as drought, cold and air pollution).

So far, UMC researchers have produced compact lilies, poinsettias, mums, geraniums and foliage plants. In addition, they have developed cultural schedules (timing) for growing properly proportioned plants.

They also showed that A-Rest, a chemical growth retardant, works better than other currently available retardants for keeping terrariums from becoming a jungle●

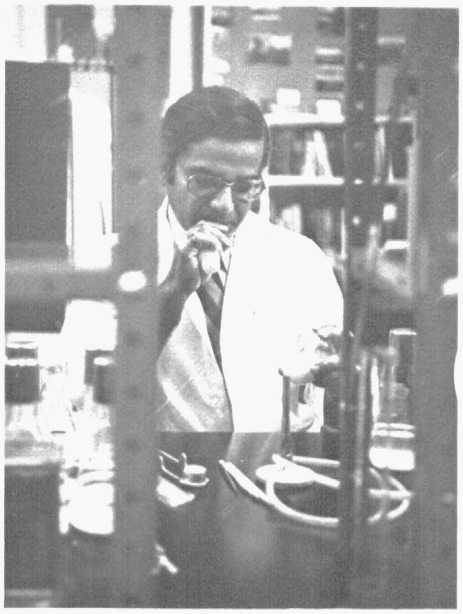
Missouri Releases Tomato Line and Hybrid. In 1975, the Missouri Agricultural Experiment Station released a tomato breeding line and a new, pink-fruited hybrid developed for fresh markets and shipping. The line, 31-St-6 is a horticultural type that produces pink fruits 6.5 ounces average size, which are globe-shaped and rank above average in fleshiness. It matures in about 70 days.

The hybrid, Pink Delight, uses 31-St-6 as a parent. Its fruit is slightly larger (about 6.7 ounces), and it has the same attractive red overtone, firmness and slicing qualities●

Home canning safety is the concern of food scientists William Lulves and Agnes Zamora. They check hundreds of jars to determine how tomato acidity and bean canning methods affect safety and quality of home canned foods.

Alfalfa leaf harvester, developed by UMC agricultural engineers, helps gather a versatile protein source.

Food for the 21st Century is already being developed in UMC food science laboratories. Bhabani Dey works with celluolytic bacteria that can use celluose as food. These protein-producing bacteria will likely be included in foods of the future, but first UMC scientists will run extensive animal feeding experiments and toxicity tests before trying exotic foods on man.



Futuristic Food

Look to Bacteria to Boost Food Protein. UMC food scientists believe that fermentation, the same process that gives foods like wine and cheese their special flavor, could be the answer to putting more protein power into foods that now lack it. They are working on a method whereby microorganisms are inoculated into foods like beans and convert carbohydrates into amino acids, building blocks of protein. In some tests, they increased beans' protein to a value equal to that of milk protein.

The fermentation process has great potential for improving diets around the world. Besides, it has special appeal for those who could use fortified foods but don't like the idea of "additives"●

Alfalfa Produces Protein Concentrate. Alfalfa leaf harvester, developed by UMC agricultural engineers, helps gather a versatile protein source. Using protein extraction methods, scientists can squeeze the juice from the alfalfa leaves, then separate the protein from the juice. One extraction method produces a green liquid that runs about 50 percent protein and is extremely useful as a protein concentrate for animal feeds. Another method produces a white protein that can be used in human diets and offers terrific possibilities as an additive for boosting food quality●

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