35TH BIENNIAL REPORT

AGRICULTURAL RESEARCH IN KANSAS

Director's Report for the Biennium July 1, 1988 to June 30, 1990

Agricultural Experiment Station, Kansas State University

Letter of Transmittal

Office of the Director

To the Honorable Joan Finney,
Governor of Kansas

It is my pleasure to transmit herewith the report of the Agricultural Experiment Station of the Kansas State University of Agriculture and Applied Science for the biennium ending June 30, 1990. This report emphasizes more diversified and sustainable agriculture for Kansas. The research highlights include animal and crop production, water resources, environmental studies, animal and human health, and economic aspects of agriculture. In addition, there are lists of publications by Station scientists, lists of research projects still active and those terminated during the biennium, a record of personnel changes, and a financial statement for each year of the biennium.

Walter R. Woods, Director

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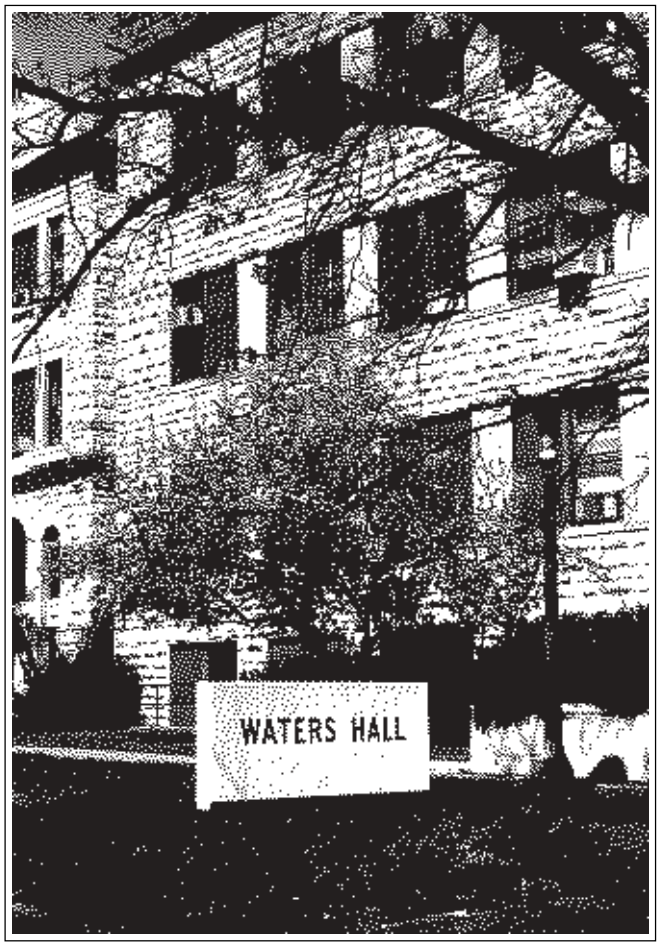
Agricultural Research in Kansas

35th Biennial Report of the Kansas Agricultural Experiment Station

Report of the Director for the Biennium Ending June 30, 1990



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A Message from the Director

The Kansas Agricultural Experiment Station, through effective planning and implementation, has directed research efforts toward new areas of concern for Kansas agriculture. These involve diversity and sustainment of agriculture, value-added products, biotechnology, water quality, the environment, communities, and families. Concurrently, the critical base of agricultural programs has continued to be addressed through research. These include such areas as animal health and production, range management, and crop protection and production.

These programs are funded from a variety of sources, including base or formula funds, support from industry and agribusinesses, and grants obtained by faculty. All of these sources are vitally important. Without an aggressive and talented faculty to obtain extramural funding, the agricultural research program at Kansas State University would be less comprehensive and respected.

The accomplishments of Kansas Agricultural Experiment Station researchers are abundantly evident in this 35th Biennial Report. For the two-year period from 1988 to 1990, Station scientists published nearly 1000 research articles in journals, books, proceedings, trade publications, Station publications, and other forms for disseminating scientific information.

Looking ahead, Agricultural Experiment Station programs will benefit from several developments that took place during the biennium. New greenhouse space has helped strengthen research efforts in the departments of Plant Pathology, Agronomy, Horticulture, Forestry, and Entomology. In addition, planning moved forward with the Plant Sciences Center, which is critically needed for the support of research. Improved facilities help attract and retain quality faculty and also provide state-of-the-art capabilities in research and development for Kansas agriculture.

Walter R. Woods
Dean of Agriculture and Director
Agricultural Experiment Station

Research Departments, KAES

COLLEGE OF AGRICULTURE

Agricultural Economics
Agronomy
  provides soil testing service
Animal Sciences and Industry
  includes International Meat and Livestock Program
  provides chemical analyses of feedstuffs
Entomology
  provides Scanning Electron Microscope service
Forestry
Grain Science and Industry
  includes Food and Feed Grains Institute, International Grains Program, and Agricultural Institute
Horticulture
Plant Pathology
  includes Wheat Genetics Resource Center

COLLEGE OF ARTS AND SCIENCES

Biochemistry
Biology
  provides plant identification service
Chemistry
Economics
Physics
  provides laboratory equipment repair service
Sociology, Anthropology, and Social Work
Statistics
  provides statistical consultation and assistance

COLLEGE OF BUSINESS ADMINISTRATION

Marketing

COLLEGE OF ENGINEERING

Agricultural Engineering
Chemical Engineering
Civil Engineering
Nuclear Engineering

COLLEGE OF HUMAN ECOLOGY

Clothing, Textiles, and Interior Design
Foods and Nutrition
  includes Sensory Analysis Center
Hotel, Restaurant, Institution Management and Dietetics
Human Development and Family Studies

COLLEGE OF VETERINARY MEDICINE

Anatomy and Physiology
Laboratory Medicine
Pathology
Surgery and Medicine
Veterinary Diagnosis

BRANCH STATIONS/CENTERS

Fort Hays Branch Station
Northwest Research-Extension Center
Southeast Kansas Branch Station
Southwest Kansas Research-Extension Center

EXPERIMENT FIELDS

Cornbelt♠
East Central♠
East Central Horticulture♣
Harvey County♠
Irrigation♠♦
Kansas River Valley♠♦
North Central♠
Pecan Field♣
Sandyland♠♦
Sedgwick County♣
South Central♠

♠Agronomy
♦Agricultural Engineering
♣Horticulture

More Diversified and Sustainable Agriculture

Diversification refers to a broadening of the agricultural base in Kansas to help stabilize the economy of the farm sector. Achieving this goal requires more than identifying new crops or other farm-based enterprises. It also involves new uses for traditional crops or products. In addition, producers must examine suitability to the Kansas environment; costs of production; consumer demand as reflected in price stability, availability, and proximity of markets; and long-term and short-term effects on the overall farm economy. When coupled with adequate market development, diversification can expand opportunities for Kansans engaged directly or indirectly in agriculture.

Sustainable agriculture involves practices, technologies, and social organizations that sustain the long-term production of crops and animals, while also conserving natural resources. Sustainment requires that agriculture be profitable to producers and supportive of rural communities and their quality of life. This approach involves reduced use of synthetic chemicals and increased use of management practices that protect the environment, like crop rotations to maintain soil fertility and biological control measures to check insects.

■ ALTERNATIVE CROPS

Although hard red winter wheat, grain sorghum, corn, soybean, and alfalfa will continue to be major crops in Kansas, several alternatives are being studied. Most of the crops mentioned below and many others in early stages of evaluation are grown each year at the Agronomy Research Farm north of the KSU campus.

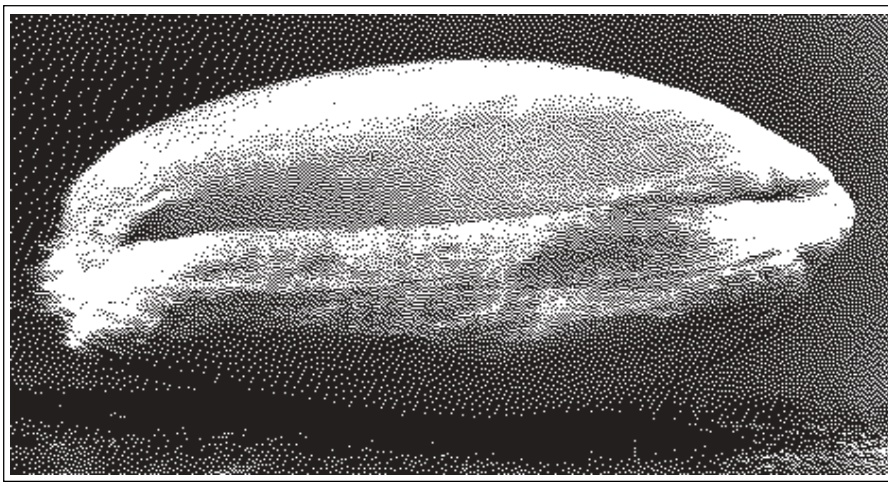
White Wheat

Hard white winter (HWW) wheat has several potential advantages over hard red winter (HRW) wheat. Its flour extraction rates are 2 to 3 percent higher, and the flour contains more protein. Some consumers prefer the less bitter taste and lighter color of products made with white wheat. Also, white wheat is preferred overseas, so it could help to expand export sales.

Successful introduction of HWW wheat into Kansas requires development of adapted varieties that are resistant to environmental stresses, pests, and preharvest sprouting and have excellent milling and baking qualities. The wheat also must be adaptable to current production practices used in the major growing areas of the state. Finally, a market for white wheat must be available. To accomplish these goals, the departments of Agronomy, Plant Pathology, Grain Science and Industry, and Agricultural Economics plus the Fort Hays Branch Station are cooperating in research projects.

Several selections of HWW wheats were evaluated for yield, and five of them consistently performed well. Other new crosses are being crossed again with Karl, a HRW wheat, to incorporate certain quality attributes. Five germplasm lines that are resistant to preharvest sprouting were registered in 1989. Seeds are available to breeders for developing improved varieties of HWW wheats.

Some adapted germplasm lines containing resistance genes were developed for use in breeding programs for HRW and HWW wheats. These include resistance to Hessian fly, greenbug, soilborne mosaic virus, and leaf rust. In addition, sources of resistance to Russian wheat aphid have been identified. One experimental line has improved capability for emergence, better than that of most semidwarf HRW wheats. The breeding program continues to further increase the protein level in HWW wheat kernels.



Hard white winter wheat has potential as a profitable crop in Kansas.

Hard wheat farina can be used to make pasta and is less expensive than durum semolina. In a milling test, HWW wheat produced 45 percent farina (slightly more than HRW wheat) and made acceptable spaghetti.

Flour from HWW wheat was used to make whole wheat hamburger buns. It can pro-

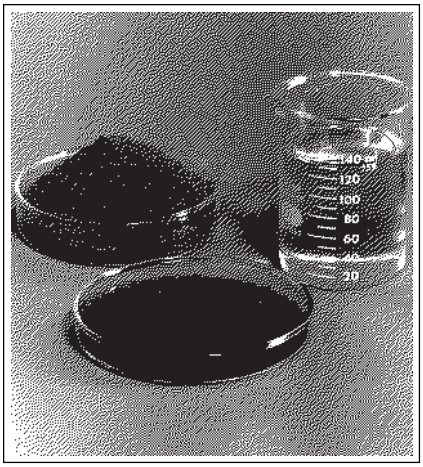
vide the nutrition of whole HRW wheat flour but with a lighter color and blander taste. Some adjustments in the baking formula were needed. Trained panelists were able to distinguish the HWW wheat buns by color and liked the taste as well as that of HRW wheat buns.

A market study examined the potential for food products that use wheat as an ingredient. Per capita consumption increased in the 1980s for white and whole wheat flours, pasta products, wheat-based breakfast cereals, whole wheat bread, and snack foods. HWW wheat could be used in the manufacture of many of these items.

Other economic studies are underway to determine the price premium that flour mills would be willing to pay for HWW wheat and the costs to elevator operators for separate handling and storage of HWW wheat.

Oil Crops

Some members of the Mustard Family have potential as alternative crops in Kansas for production of both edible and industrial oils. Rapeseeds are already being grown as sources of canola oil. This oil contains no cholesterol and has the lowest content of saturated fat of any edible oil. Most canola is produced in Canada, but the crop is suitable for the Great Plains area.



Rapeseed processing yields edible or industrial oil and meal for animal feed.

Production in Kansas has increased, but late planting and unsuitable varieties have limited yields. Planting should be done no later than Sept. 15. Some recommendations on varieties already have been made, but nearly 100 will be tested this year at five sites in different areas of Kansas. Results of these tests will allow producers to make better choices next year.

Other varieties of rapeseed and a related plant, crambe, contain oil that is not edible but has industrial uses. The plants require management similar to that used for the canola varieties. An analysis done in the Department of Agricultural Economics indicates that yields achieved in Kansas tests are high enough to bring a profitable price for the seed. Rapeseed and crambe seed are less expensive to process than soybeans because of their higher oil content. They could be crushed at existing facilities during the slack season with only minor adjustments to equipment. The industrial oil has many uses, particularly as a substitute for petroleum products.

A by-product of processing these seeds for either kind of oil is meal that can be fed to animals. An antinutritional chemical in the meal must be removed during processing or eliminated in the breeding of new varieties. Research is progressing in both areas.

A market already exists for more canola oil. Recently, the USDA organized a research effort in several states, including Kansas, to establish rapeseed and crambe as commercial crops by promoting markets for industrial oil and meal. In the future, producers may be able to choose varieties of rapeseeds on the basis of demand and price for several products.

Sunflower

The acreage of sunflowers grown in Kansas is increasing (195,000 acres in 1988). New marketing opportunities have been provided by two processing facilities for confectionary seed in Kansas and oil mills nearby in Oklahoma and northern Texas. However, the sunflower moth has become a major pest. The young larvae feed on pollen and flowers, and older larvae enter and feed in developing seeds. One larva can destroy nine seeds.

Entomologists at the Fort Hays Branch Station have noted that changing the planting date so that blooming is not synchronized with adult moth activity may be a partial and economic solution to the problem. Tests showed fewer larvae in sunflowers planted after mid-June. Numbers were so low that insecticide was not needed. Flowers of the late May plantings had the most larvae.

Further research at several locations in central Kansas gave similar results. Planting dates from late June to early July reduced sunflower moth infestations. Late planting would allow sunflowers to be used as a double crop after wheat. A slight reduction in yield may result, but limited application of insecticide may compensate and provide a good net return.

Delayed planting also may reduce damage by the sunflower stem weevil and a disease that it carries.

Pearl Millet

Pearl millet is a dietary staple in many areas of the world and is being proposed as an alternative, drought-resistant crop for Kansas. One problem in using this grain is its goitrogenic effect, which is caused by certain chemicals. The concentration of these antithyroid compounds is much higher in the bran. The small size of pearl millet grains and their firmly embedded germ have made fractionation difficult with traditional dry-roller milling. Recently, researchers in

the Department of Grain Science and Industry found that semiwet-roller milling could successfully separate the grain into fractions.

Feeding the various fractions to rats showed that the bran had the most adverse effects on thyroid function, as expected. Millet flour had the least adverse effects. The researchers tested yellow- and brown-seeded millet in addition to the more commonly grown gray-seeded. They found that the three varieties had different levels and activities of the antithyroid compounds. Therefore, the content of these chemicals could be reduced by selection and breeding. In the meantime, a semiwet milling process can be used to produce nongoitrogenic foods from pearl millet.

Pecan Production

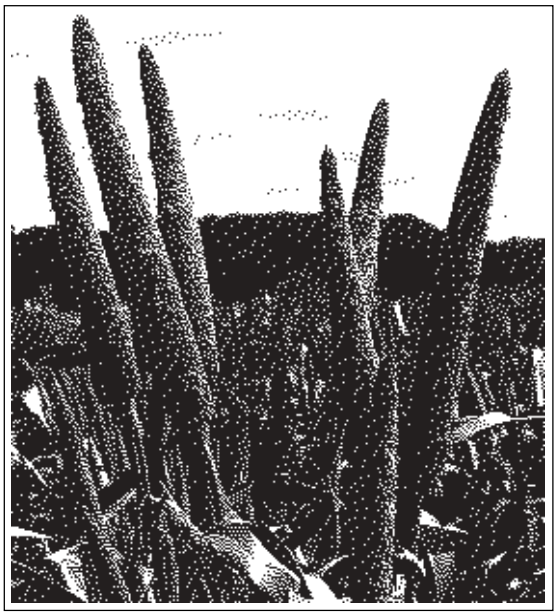
Growing pecans in eastern Kansas is a $3.5 million-a-year industry. Pecan production in the state is based on native trees, which account for 90 percent of the acreage. In recent years, prices received for native pecans have remained fairly steady, whereas costs for production inputs have increased. This situation has led to a decrease in profits for producers.

Research by a horticulturist at the Pecan Experiment Field has shown that growers can improve profits by adopting a management plan that increases yields. Pecan trees need sunlight to produce nuts, so an orchard should be thinned to allow 10 feet between branches of adjacent trees. Individuals that bear few nuts, are damaged, or are susceptible to diseases can be removed. Proper nitrogen fertilization is probably the most effective way to increase yields. However, improved varieties that bear more nuts are available.

In addition, production costs can be reduced by limiting pesticide use. Economically damaging populations of insects do not occur every year. Scouting procedures can be used to determine when pesticide applications are really needed.

Improved Fruit

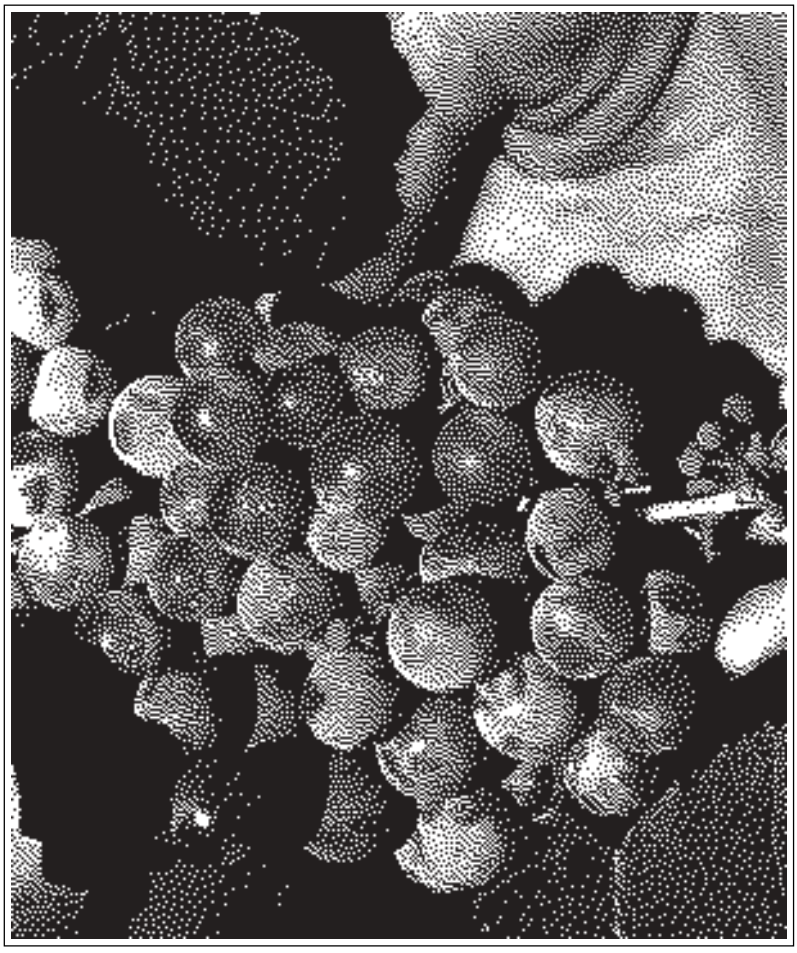
Crenshaw melons are high quality, orange-fleshed muskmelons. The new bush varieties of muskmelon permit commercial growers to use high plant densities and harvest more melons earlier in the season. Home gardeners can grow bush varieties in areas too small for standard vining varieties. Now researchers in the Department of Horticulture have developed a bush crenshaw melon adapted to the hot summers of Kansas. The immature melon is light green, which protects it from sunscald. As it matures, the skin turns golden yellow, making determination of ripeness easy.



New processing methods make pearl millet more useful.

The once large and prosperous grape industry in Kansas is experiencing a revival. Grapes now are grown commercially in at least 18 counties, but favorable environments and soils exist throughout the state. Grapes are marketed fresh or made into juice or jelly. Two commercial wineries are in operation, and several more are under construction.

Grapes are making a comeback in Kansas



Grape research includes evaluation of 40 cultivars for adaptation; fruit quality; and potential for processing into juice, wine, or raisins. Other projects involve grapevine sensitivity to herbicides, testing of chemical bird repellents, and tissue culture. The latter has identified cold-tolerant lines of grapes that will survive the winters in Kansas. Trials are underway to regenerate whole plants from some of these lines.

Marketing Christmas Trees in Kansas

Kansas growers of Christmas trees compete with growers from other states and sales of artificial trees. In 1989, the Kansas Christmas Tree Growers Association funded a study of marketing, which was conducted by two researchers in the Department of Forestry and an agricultural economist. Telephone interviews were conducted with members of 465 households.

The results showed that 82 percent of the respondents had purchased a Christmas tree in the previous year; 34 percent had natural trees, 46 percent had artificial trees, and 2 percent had both. Those who purchased real trees had the following characteristics: they were members of 2- to 4-person households, middle to upper income, and middle aged; they lived in houses; and they had family gatherings. Forty-seven percent of those purchasing artificial trees said that they would consider buying a real tree again. Eighty-three percent of respondents preferred a Kansas-grown tree, but 57 percent did not know in what state their last tree had originated. Important selection criteria included shape, freshness, color, price, and friendliness of salesperson.

Several marketing strategies are suggested by these results. One is putting labels on Kansas-grown trees. Producers also need to be aware of buyers' preferences and provide the right kind of trees, as well as better information on tree care. Sellers need to locate along major routes or in shopping areas that are convenient to consumers. Marketing also needs to address the social aspects of family members choosing a tree together. Finally, disposal of trees by recycling them for wildlife or fish habitat should be advertised for buyers with environmental concerns.

■ *VALUE-ADDED*

The term value-added refers to increasing the value of an agricultural commodity by further processing. Some value-added products, like meat and cheese, have been made in Kansas for years. However, many other commodities have been shipped to other states for processing and manufacture. Now there is a facility to develop more value-added activities in the state.

During the biennium, an Agricultural Value-Added Processing Center was established at Kansas State University. The Center will conduct research in marketing, manufacturing, and packaging and will provide technical assistance, consulting, and regulatory guidance. It will encompass horticultural food products, meat, food and feed grains, and any other relevant products. Many KAES research projects will benefit from such expertise.

Meat Processing

A new laboratory processing center for meats was part of the recent renovation of Weber Hall. The facilities include an abattoir; state-of-the-art systems for processing and chilling beef carcasses; and complete processing capabilities, simulating current industry practices, for cured and fresh meats. Research by animal scientists is designed to improve the marketability of retail-ready meat cuts and includes restructured, precooked, and vacuum-packaged products. Packaging techniques that prolong product shelf-life, ensure meat safety, and maximize consumer acceptance are being studied, as well as marketing, lighting, and display systems. Such work could have great economic impact. For example, if 20 percent of boxed red meat in Kansas were cut into retail-ready pieces, 1,500 meat-cutting jobs would be created, with annual wages of $25 million. The value of the product would be increased by $58 million each year.

Restructured Meats

Consumers demand meat products that are nutritious, palatable, convenient, and competitively priced. Research is underway in the Department of Animal Sciences and Industry to restructure less valuable carcasses and carcass parts into convenient, precooked, steak- and roast-like products. Scientists hope to reduce or eliminate salt, reduce fat, and increase dietary fiber of these products while maintaining taste.

Restructured meats have some problems, such as development of a rancid flavor. Tests with precooked, restructured beef roasts showed that cooking to a higher internal temperature and adding glucose along with salt and phosphate reduced the rancid flavor and did not affect other characteristics.

Better Frankfurters

Using a product from corn, a researcher in the Department of Foods and Nutrition has found a way to improve the nutritional quality and texture of frankfurters and bologna. Corn germ protein is used as a filler, extender, or replacement for meat proteins. This material provides more juiciness and better texture than currently used substitutes, such as nonfat dried milk and soybean protein. The corn germ protein also decreases fat and cholesterol content, making frankfurters and bologna more appealing to consumers.

More Healthful Hamburgers

In another project in the Department of Foods and Nutrition, flour made from corn germ protein was incorporated into ground beef patties. It had several beneficial effects It increased water-holding capacity and decreased shrink and total losses during cooking, resulting in juicier and more tender patties. Also, contents of several mineral elements were increased and fat and cholesterol contents were lower.

Soybean Yogurt

The useful soybean already provides soy sauce, tofu, and a meat substitute. Researchers in the Department of Animal Sciences and Industry have developed a method to make yogurt from soy "milk," a liquid derived from the beans. The latter is very popular in China, where cow's milk is scarce. It can be fermented into yogurt that is high in protein and has no cholesterol. Calcium is also lacking but can be added during manufacture. A sensory taste panel gave the soybean yogurt a favorable rating, when some fructose was added to overcome the slightly beany flavor.

Extrusion Center

New facilities in the Department of Grain Science and Industry will allow the development of many value-added products. The Extrusion Center includes two large extruders, a dryer, and handling equipment, either donated by private companies or purchased through grants.

To make extruded products, the desired ingredients are blended into a fine powder and fed into the extruder. Steam, water, vitamin mixes, and other materials are added to the powder in a conditioning chamber, then the moist mixture enters a barrel with screw components. The mixture is pushed to the end of the barrel, where various attachments determine the shape of the end product.

The new equipment will be used for research on all types of extruded food and feed products, including ready-to-eat cereals, pet foods, textured proteins, and pasta. A major thrust will be to develop value-added products from regional commodities, like grains and oil seeds.

Research continues to make processed meat products more healthful.

Use for Wheat By-products

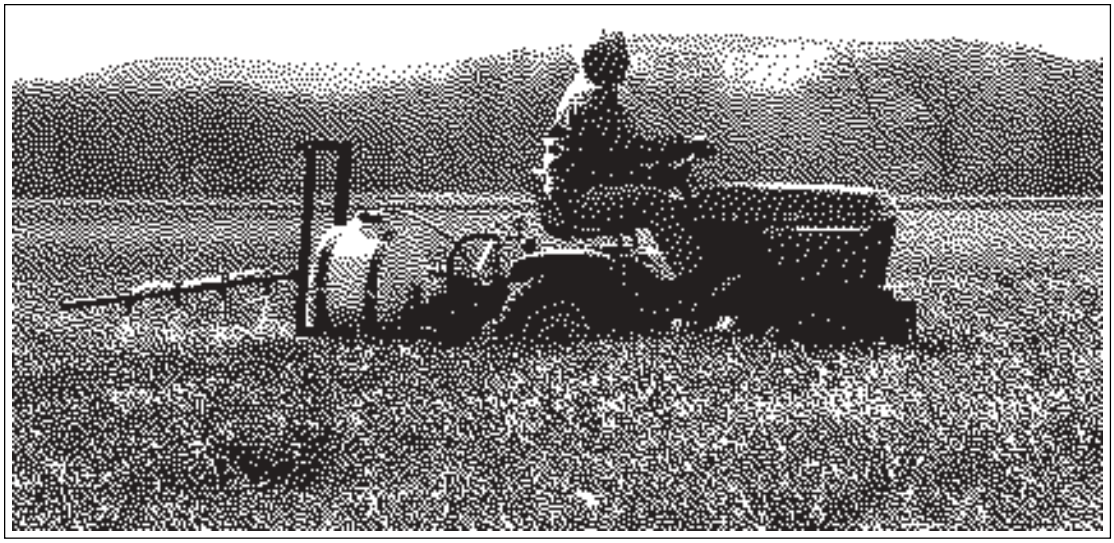
A researcher in Animal Sciences and Industry is studying new sources of protein supplementation for livestock. Such supplements can stimulate animals' appetites and improve digestion of forages.

Wheat milling by-products have potential for use as pelleted supplements. As much as 25 percent of wheat fractions are lost during flour milling. These wheat middlings are high in fiber and protein. Their use in a supplement could provide millers with additional income and provide cattle producers with a low-cost protein source.

Many value-added products can be made in this extruder.

Wheat Starch

Starch from wheat can be used in baked goods and a variety of other food products. Researchers in the Department of Grain Science and Industry have modified wheat starch so that it forms a paste with thickening power, clarity, and cold temperature stability. A specialty starch has been developed for use in the paper industry. Other formulations are being tested for applications as building-trade adhesives, cooking starches, and instant starches.



Applying the right amounts of nitrogen can limit soil degradation.

■ *SUSTAINABLE AGRICULTURE*

Many KAES research projects include aspects of sustainable agriculture. A few examples of relevant results are mentioned below; conservation tillage and other examples are discussed in the Research Highlights section.

Correct Use of Nitrogen

Nitrate leaching can occur in all types of soils. If excess nitrogen is applied, it is likely to move as water percolates through the soil.

Alfalfa is a forage crop that adds nitrogen to the soil.

Crop yields are increased by applications of nitrogen only up to a certain level. Additional applied nitrogen is wasted. Research by agronomists on several crops, grown continuously or in various rotations, seeks to find the best fertilizer rates for each situation. Other projects aim to minimize immobilization of nitrogen in surface residues. Consistent yield advantages have resulted from injecting rather than broadcasting liquid nitrogen fertilizer. The increased yields more than cover the expense of the knifing application.

Adverse Effects of Nitrogen

Research in the Department of Agronomy has shown that continued use of high rates of ammonium-based fertilizer can severely degrade soil. Even slightly excessive amounts of ammonium, when applied for a period of 20 years or more, can greatly lessen the soil's ability to retain critical nutrients. The excess nitrogen causes the soil to become acidic. This is accompanied by a buildup of aluminum, which is toxic to many crops. These results emphasize the importance of proper management of soil to avoid long-term damage.

Natural Nitrogen

Use of nitrogen fertilizers can be avoided by planting legume crops (e.g., clover, alfalfa, beans), which are able to convert atmospheric nitrogen to a form usable by plants. Adding a legume to a crop rotation instead of applying nitrogen can save at least $5 to $7 per acre.

Tests by agronomists indicate that corn or grain sorghum following soybeans can have higher yields than continuous crops without any nitrogen fertilizer. Yields can be increased even more by addition of moderate amounts of nitrogen.

Other benefits of a legume rotation are breaking the cycles of insects or diseases and discouraging growth of weeds like shattercane and Johnson grass.

Control of Stable Flies

Stable flies are pests that bite and suck blood from cattle, causing irritation and reduced performance. They are particularly prevalent around large feedlots in western Kansas. A tiny wasp that occurs naturally in these feedlots can help control flies.

An entomologist at the Southwest Kansas Research-Extension Center found that the wasp attacks fly pupae, so they never develop into adults. However, greater numbers are needed for effective control, so the natural populations must be supplemented by wasps raised by commercial insectaries. As research results continue to show the effectiveness of biological control, more parasitic insects will be available commercially.

Beneficial Beetles

Scale is a major insect pest of ornamental trees and shrubs in Kansas and throughout the United States. In particular, euonymous scale probably has caused millions of dollars of damage statewide. Spraying infested plants has been the only available remedy, but it is costly, hazardous to the environment, and not always effective. An entomologist is experimenting with natural control of scale by the lady beetle from Korea, distributed by USDA.

Lady beetles have been released on scale-infested euonymous shrubs. Their progress will be followed to see how well they control scale and how they adapt to the Kansas climate. This is the first introduction of lady beetles in the Midwest, so several attempts may be necessary to establish populations that can effectively battle scale.

Fighting the Russian Wheat Aphid

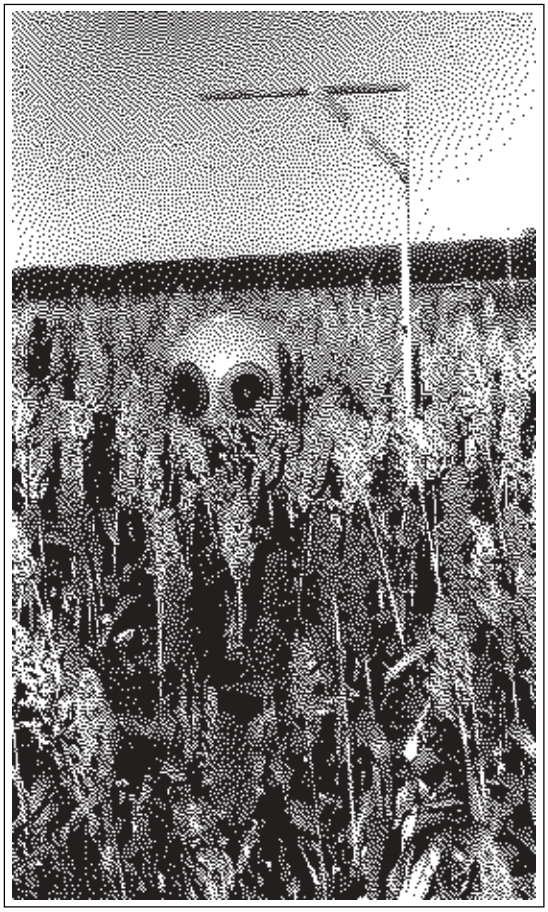
All plant breeding programs at KSU emphasize resistance to insects and diseases. Progress often is complicated by the appearance of new pests, such as the Russian wheat aphid (RWA). Insecticide treatments are available for immediate control of RWA, but sources of resistance to the insect are being tested as well.

An entomologist and a wheat breeder at the Fort Hays Branch Experiment Station have screened over 5,000 accessions of hard red winter wheat for resistance to RWA. Plants were grown to the seedling stage in a greenhouse and infested with descendants of RWA collected in a Kansas wheat field. Forty-three of the wheats showed significant resistance. Most of these came from the USSR, Iran, and Afghanistan, the area where RWA originated.

Some of these promising wheats are being bred for further evaluation under field conditions and for study of how the resistance is inherited.

Biochemical Resistance to Insects

Amylase is an enzyme that breaks down starch in the digestive system of animals and insects. Many plants, including cereals like wheat, sorghum, corn, oats, and pearl millet, contain amylase inhibitors. These prevent the digestion of starch. Biochemists are isolating amylase inhibitors from cereals and trying to identify those that strongly attack insect amylase but have little or no effect on mammalian (human) amylase. So far, several promising inhibitors with activity against insect amylase have been isolated from wheat. The next step is to identify the genes controlling these inhibitors and to transfer these genes into desirable varieties of wheat. The presence of a chemical detrimental to insects would protect the plants from damage.



This "scare-eye balloon" keeps birds away from sorghum fields.

Research Highlights 1988 to 1990

■ ANIMAL PRODUCTION

Animal Breeding

Many private breeders cross animals to attain superior genetic traits. Therefore, KAES scientists in the Department of Animal Sciences and Industry have concentrated on basic research to discover procedures for genetic improvement. Such research frequently involves long-term projects.

Various studies include research on the effects of inbreeding on shorthorn cattle. Such research can lead to publication of sire evaluations, which provide genetic information for commercial producers. Another project considers the growth and feed-conversion efficiency of beef cattle. A new study of sheep and cattle considers genetics of reproduction.

Poultry have been studied from the viewpoints of social organization and behavior patterns. The goal is to determine which genetic stocks of chickens are best suited to living in the high-density, enclosed environments used by commercial producers.

Improving Feed for Cattle

Several studies by animal scientists have evaluated variations in diets and their effects on cattle performance. Additions of fat to finishing diets can increase the energy content, while making the particles more cohesive and reducing the dustiness of the feed. Tallow added to a corn-based diet lowered feed intake slightly, but average daily gains were similar from diets without fat or with lower levels of tallow. Feed efficiency was best with 4 percent tallow, so this may be the optimum amount for use with corn.

Many research projects seek to improve the performance of beef cattle in Kansas.

Diets based on steam-flaked corn or sorghum with and without added fat also were tested for finishing steers. The addition of 4 percent yellow grease increased average daily gains and feed efficiency. Steam-flaking the sorghum increased its net energy value nearly to that of corn. In fact, carcasses from the sorghum-fed cattle received a slightly higher yield grade.

Ultrasound—A New Tool

Continued research with ultrasound technology is improving its accuracy and expanding its applications in cattle production. A study at the Fort Hays Branch Station evaluated the repeatability of ultrasound measurements of backfat in live cattle and compared them to traditional carcass measurements. The differences between two ultrasound measurements of more than 200 cattle were very small. Overall, ultrasound measures for over 500 cattle averaged 8 percent less than carcass measures. Discrepancies were greater when backfat was thicker. However, traditional methods of evaluating carcasses have far more potential for error than ultrasound.

In addition to backfat thickness, marbling of muscle can be determined by ultrasound. Speckling in the ultrasound images from live cattle was highly correlated with carcass marbling scores. Ultrasound scanning to predict carcass grade as much as 148 days before slaughter could allow producers to cluster feedlot cattle into outcome groups for more efficient marketing.

Breed Differences in Meat Tenderness

Bos indicus breeds often are used in crossbreeding programs, because they provide the maximum amount of hybrid vigor when crossed with *Bos taurus* breeds. However, meat from *B. indicus* breeds often is less tender. Because tenderness is a major palatability trait that determines consumer acceptability, understanding what makes meat from these animals less tender is important.

Many factors can influence tenderness, including postmortem rates of pH and temperature decline, collagen content, type and length of muscle fibers, and postmortem activity of proteases (enzymes that break down proteins). Animal scientists tested all these factors in meat from Hereford-Angus cattle and crosses with Sahiwal cattle. Meat quality was similar, except for tenderness. Meat from H-A cattle was rated more tender by mechanical tests and trained taste panelists. The only biological trait that differed was the amount of a protease inhibitor present at 24 hours postmortem. This inhibitor slowed down protein degradation in the muscle during aging, making the meat tougher.

Custom Feedlots in Kansas

Increasing incentives exist for cow-calf producers or backgrounders to retain their cattle through the finishing phase. Although this can be more profitable, many producers lack the necessary facilities and must place cattle in a custom feedlot. To determine the services offered by such feedlots in Kansas, an agricultural economist conducted a survey. Questionnaires were returned by 66 custom feedlots, representing about 30 percent of those licensed in the state.

Results showed that the majority of cattle were sold live. All feedlots offered finishing of steers, heifers, and Holsteins, and 95 percent would finish calves. About 68 percent offered backgrounding, and less than 40 percent offered wheat or summer grazing. Few feedlots had a resident veterinarian or nutritionist, but most consulted such experts regularly. For most feedlots, the minimum acceptable lot size was 30 head.

About 88 percent were willing to feed cattle on a partnership basis; 62 percent charged interest rates similar to those of local banks. On arrival, cattle were processed at an average charge of $5.31 per head. Average yardage charges were 5 cents per head per day. Average feed markup was 23 percent for feedlots not charging yardage and 16 percent for those charging yardage.

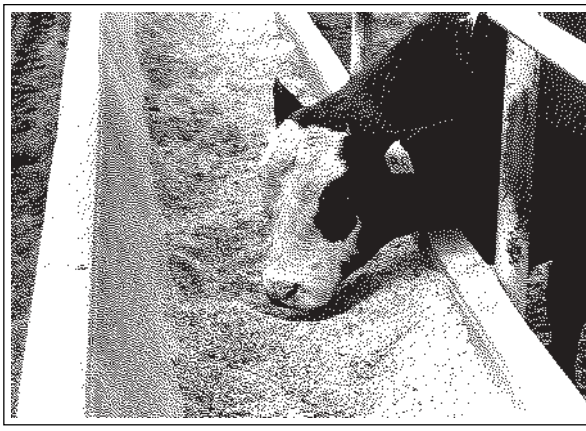
The results of this survey should help cattle producers choose a custom feedlot that best suits their operation.

Vitamin Beneficial to Swine

Folic acid is one of the B vitamins found in green, leafy plants. When breeding herds of swine move off pasture into drylots or confinement systems, this vitamin is missing from their diets. Researchers in the Department of Animal Sciences and Industry added folic acid to diets for gilts and found positive results. Feeding folic acid at a rate of 1.5 grams per ton of feed (costing less than $1) resulted in one more live pig per litter. Folic acid is involved with protein and DNA synthesis, which are important for placental and embryo growth. Its presence in the diet increased embryo survival.

Better Diets for Swine

Early weaned pigs are fed a high nutrient-density diet containing 40 percent milk products and 10 percent added fat. Although sow's milk also is high in fat, some young pigs have trouble utilizing the dietetic fat. Another nutrient, carnitine, is quite high in sow's milk and may be involved in digestion of fat. A recent study in the Department of Animal Sciences and Industry considered the effects of adding carnitine to starter diets. Results showed an improvement in feed efficiency of pigs receiving carnitine. However, the optimum dose must be determined.



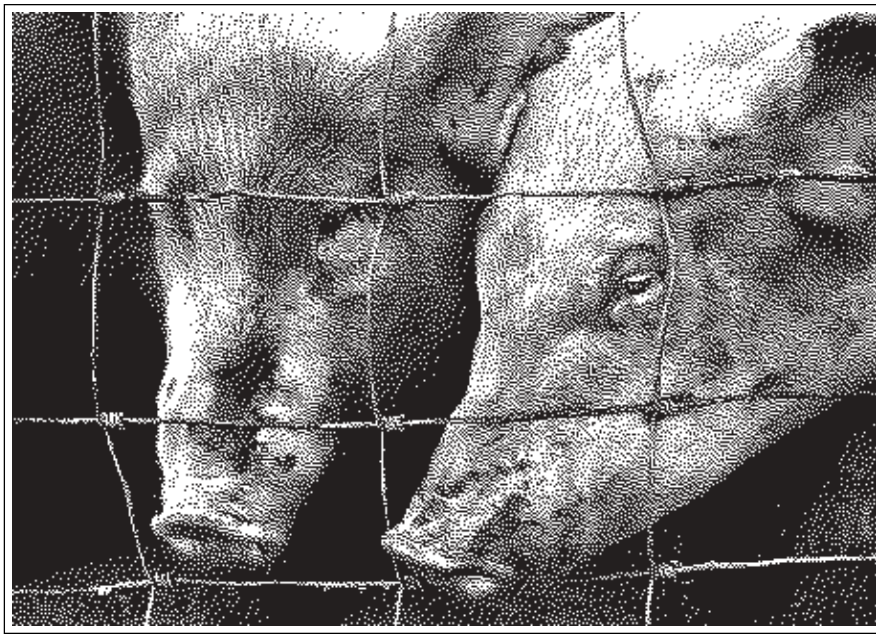
Custom feedlots in Kansas offer a variety of services.

The nutritional value of raw soybeans is limited by the presence of proteins called trypsin inhibitors. However, new types of soybeans lacking these inhibitors are available for use in pig diets. Animal scientists tested two methods of processing these soybeans: roasting and extrusion. In a 35-day trial with 100 pigs, the extruded, inhibitor-free soybeans gave the best average daily gain and feed efficiency.

In a related study of finishing pigs, animal scientists compared diets containing soybeans and/or sorghum in grain form or extruded. Extrusion involves heat and compression, which disorganize the structure of starch granules in cereal grains. The starch is then more easily attacked by digestive enzymes and may be used more efficiently by pigs. Use of extruded soybeans and sorghum separately or together improved efficiency of gain. The best growth performance resulted from the combination of both extruded grains.

Marketing Feeder Pigs

An agricultural economist examined the potential, profitable, hedging opportunities that the live hogs futures market has offered



Additives and processed grains in swine diets improve feed efficiency.

Some breeds of sheep frequently produce twins.

feeder pig finishers from 1980 through 1988. Results indicate that profitable hedging opportunities were frequent but generally were not sustained at high frequencies beyond 6 months. Opportunities to improve returns by hedging relative to cash marketing were often present, although not always at a profit. Overall, the results suggest that the live hog futures market is a valuable tool for a feeder pig finisher to consider in a marketing plan.

Better Packaging for Pork

Packaging with a modified gas atmosphere offers a longer product life for pork cuts, including loins. Researchers in the Department of Animal Sciences and Industry tested various combinations of carbon dioxide and nitrogen or oxygen gases with conventionally and ultra-chilled pork sides. Ultra-chilling reduced carcass shrink but had no other effects. The mixture with oxygen had the most adverse effects: more off-odor, higher microbial counts, less desirable color, and reduced display life. Other treatments showed variable results in comparison to vacuum-packaging.

Use of 100 percent carbon dioxide for packaging gave better results. Length of storage was the primary factor influencing shelf life of whole pork loins and their retail chops. Although microbial counts were acceptable in loins stored up to 19 days, discoloration of meat was obvious after 11 days and greatly reduced display life. Overall characteristics of bone-in pork loins were superior with this modified atmosphere packaging than with more traditional systems but for a limited time span.

Improved Sheep Production

The number of sheep raised in Kansas has increased in recent years, partly because of the opening of a lamb slaughter facility in the state. Kansas ranks 12th in the nation for producing sheep.

Research at the Northwest Research-Extension Center included further study of the effects of artificially extended photoperiod on lamb growth. Previous work showed a small but positive response. The combination of extended daylight hours and zeranol implants was tested with over 300 crossbred lambs.

During the 58-day trial, implanted lambs in natural light showed improved daily gain and the greatest feed efficiency. In the extended photoperiod, implanted and non-implanted lambs grew at similar rates. At the end of the feeding period, the implanted, natural-light lambs weighed 3.9 pounds more than the non-implanted, natural-light group. Both groups in extended light were intermediate. In this case, the response to an implant predominated over any response to increased light.

Researchers also continued looking for ways to increase the number of lambs born each year. The Rambouillet ewes popular in Kansas are not as productive as such other breeds as Finn and Booroola Merino.

Rambouillet ewes have been bred to Booroola and Finn rams, as well as Rambouillet rams, and their female offspring subsequently have been bred several times. The crossbred ewes consistently produced more lambs than the straightbred Rambouillets, with the number of lambs born per ewe ranging from 15 to 33 percent greater. However, preweaning death losses were higher for lambs born to Booroola-cross ewes. This may be related to their smaller size, which limits their ability to consume enough feed to meet their gestation and lactation needs.

Bison Thriving on Prairie

In the autumn of 1987, bison were introduced to the Konza Prairie Research Natural Area. The animals adjusted quickly to their spacious, fenced-in area, and their numbers have increased every year. Biologists have begun to study their grazing habits and effects on the vegetation.

Results from 2 years show that bison grazing has a significant impact on big bluestem, a dominant, warm-season grass in eastern Kansas. Grazing was limited mostly to areas that had been burned at the beginning of the year. Within areas, bison selected patches with a high cover of big bluestem and other grasses

but few forbs. Tiller density of big bluestem decreased throughout the year. At the end of the season, aboveground biomass was 80 percent lower for grazed than for ungrazed big bluestem. Plants grazed in 1988 had lower total leaf areas throughout the 1989 season and lower relative growth rates early in the season.

Animal scientists have taken advantage of the presence of bison to study aspects of their digestion. They have compared the microbial populations in the rumens of bison and cattle, noting some organisms in common and some unique to each species. They have identified all members of one major group of rumen organisms, ciliated protozoa, typically present in bison. In feeding studies, they have observed the effects of these microbial populations on digestion of high- and low-quality forage.

■ ANIMAL HEALTH

Preventing Liver Abscesses

The grain diet of feedlot cattle causes excess acid, which irritates the inner lining of the rumen and causes bleeding. The blood transports bacteria from the rumen to the liver, where they form abscesses. Cattle with abscesses gain slower and are less efficient, and the damaged livers are condemned for human consumption.

Researchers in Animal Sciences and Industry developed a method of detecting liver abscesses in live cattle via ultrasound scanning. Further work will determine when in the finishing period the abscesses start to form. Antibiotics administered at that time would be most effective. A vaccine to prevent formation of abscesses also is being tested with the aid of ultrasound to check its effectiveness.

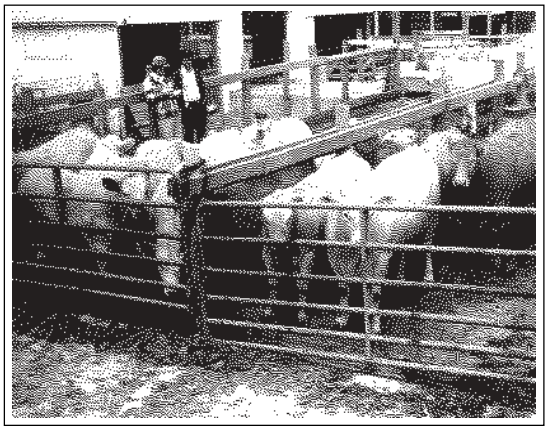
The combination of these new techniques could reduce the $15 million annual loss to the U.S. cattle industry caused by liver abscesses.

Immune System of Cattle

The immune system is a complex mechanism that living organisms use to recognize invading pathogens and protect themselves against infections. Several current research projects are seeking to understand exactly how this system works and to improve immunity of cattle against several diseases.

One project in the Department of Anatomy and Physiology is studying stress-induced and viral-induced suppressions of the immune system. Results show that a hormone, interleukin, can alleviate this suppression. The combination of a conventional vaccine followed by treatment with recombinant interleukin-2 greatly boosts the immune system of calves. The optimal dose of interleukin-2 has been found, and now interleukin-1 is being tested. Hormones must be used carefully; too little will not be effective and too much will cause illness.

Another study in the Department of Laboratory Medicine is developing a better type of



Crowded conditions in feedlots cause health problems in cattle.

vaccine against the virus that causes bovine respiratory disease. Annual losses from this disease amount to over $50 million in Kansas. Most vaccines use live or modified viruses, which always carry the risk of introducing the disease to healthy animals. The new vaccine contains anti-idiotypes, which are structurally similar to the virus and fool the immune system into responding.

Tracking Face Flies

Face flies are serious pests of livestock in Kansas. They cause eye irritation and transmit the pathogen that causes pink eye. In the winter, these flies hibernate in church steeples and the attics of houses. They tend to return year after year to the same buildings.

An entomologist has found some fly-infested buildings near Manhattan. By studying the behavior of the flies and the characteristics of the buildings, he hopes to find out why they migrate to the same place and how to control them. Results so far indicate that flies prefer buildings with steep, gabled roofs and congregate near the tops, where temperatures are colder. In warmer areas, the flies remain active, use up their energy reserves, and die. Owners of susceptible buildings should screen all vents leading to the attic to prevent flies from entering.

Rabies in Kansas

All animals in Kansas that are suspected of having rabies are submitted to the Veterinary Diagnostic Laboratory at KSU for examina-

tion. Data concerning the number of animals submitted and the number diagnosed as rabid have been recorded since 1966. These data were compiled to serve as baseline information to detect any changes that might occur in the status of rabies in the state.

The striped skunk was the primary animal with rabies. Although about 15 times less frequently diagnosed, domestic cats were second, followed by bats. A correlation was found among the number of cases of rabies for these animals. Thus, an increase in the number of rabid skunks may indicate that the incidence of rabies in other animals also will increase. When many rabid skunks are found, veterinarians should remind cat owners to be sure that their animals are vaccinated. The general public also should be informed that a higher risk of exposure to rabies exists from cats and other domestic animals.

KAES received a significant donation of hard red winter wheat germplasm in 1990.

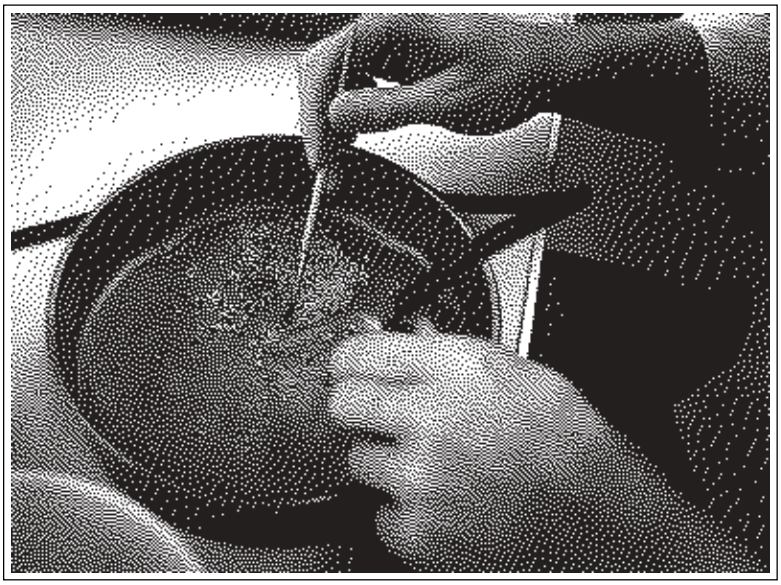
■ CROP PRODUCTION

Plant Breeding

The wheat breeding program is one of the oldest KAES projects and has contributed greatly to the state's wheat industry and economy. Many Kansas-adapted varieties have been released, each representing 10 to 12 years of research.

Soybean breeding aims at developing drought- and disease-resistant varieties. Although many private companies also are working on better soybean varieties, university research is still needed.

High quality seed improves establishment of wheat seedlings.



A corn breeding program was started years ago by the USDA. The main emphasis has been to increase drought and heat tolerance of corn grown in Kansas. Additional work has increased the yields of both yellow and white corn.

The breeding program for sorghum is the newest. It focuses on resistance to drought, diseases, and insects. Researchers are developing germplasm with the desired characteristics. Then the germplasm will be released to private companies that produce hybrid sorghum seeds.

A smaller project involves improving the seed production of gamagrass, a native perennial species. Gamagrass has potential as an alternative crop for forage.

These programs are centered in the Department of Agronomy, with a unit for wheat at the Fort Hays Branch Station.

Gift to Wheat Breeding Program

Pioneer Hi-Bred International, Inc., donated to KSU the hard red winter wheat (HRWW) germplasm and commercial varieties it had developed over the past 20 years. The company dropped its HRWW breeding program because it was unprofitable. KSU was chosen to receive the materials because it has excellent research facilities and an outstanding reputation as a provider of certified seed.

This gift is an important contribution not only to KSU but also to breeding programs and wheat producers across the Great Plains. This source of diverse genetic material will enhance the Wheat Genetics Research Center and the breeding research in Manhattan and Hays. In addition, germplasm will be available to other universities, and industry will have access to commercial varieties.

Quality of Wheat Seed

Seed quality is related to size, weight, and protein content. Seedling development in wheat can be determined partly by growth (length and weight) of the coleoptile, a protective covering of the emerging shoot, and by emergence in the field. A study at the Fort

Hays Branch Station examined the relationship of seed quality to coleoptile growth and field emergence of two semidwarf varieties of winter wheat. Large size and high kernel weight resulted in both greater coleoptile growth and emergence; high protein content also increased coleoptile growth. Thus, using wheat seed of high quality can enhance seedling performance and establishment of the crop.

Plant Reactions to Greenbugs

Entomologists at the Fort Hays Branch Station compared the reactions of sorghum hybrids that were resistant and susceptible to greenbugs. The insects damaged seedlings of both hybrids within 7 days. However, when the greenbugs were removed, the hybrids responded differently. The resistant plants resumed normal growth, whereas growth of the susceptible plants was reduced. Twenty-one days after insect removal, the fresh weight of roots from formerly infested, susceptible plants was 33 percent that of roots from noninfested plants. This reduction in root growth could predispose sorghum plants to drought injury and increase lodging.

Sorghum Adapts to Drought Stress

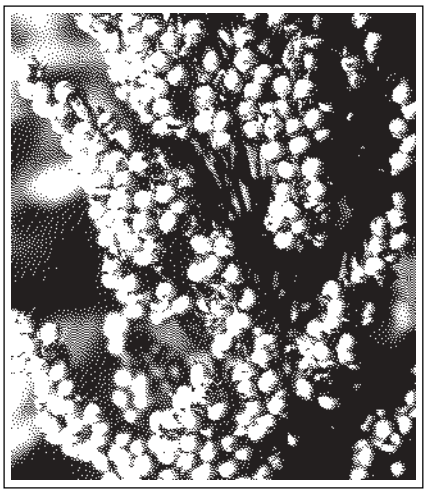
Ethylene is a gaseous hormone that is produced by all plants in small amounts. However, when plants are stressed by temperature, mechanical damage, flooding, or drought, they produce more ethylene. Researchers in the Department of Agronomy measured the ethylene production of sorghum plants grown in dry conditions. Cultivars known to be drought-resistant generated more ethylene than cultivars that are drought-sensitive.

The adaptive advantages for resisting drought provided by ethylene relate to its role in leaf abscission and reducing stem elongation. A cultivar that can reduce its leaf area and decrease its height during drought may have a better chance of survival than a cultivar that keeps growing. The smaller plant will lose less water through its leaves and, thus, conserve water in its tissues.

Profitable Soybeans

An evaluation of 8 years of data from the Southeast Kansas Branch Station showed that yields from double-cropped soybeans after wheat can vary greatly. In a good year, they are comparable to yields of full-season soybeans. Agricultural economists conducted a risk analysis of a representative farm in the area. For all classes of risk preference, a 2-year rotation of wheat, double-cropped soybeans, and full-season soybeans was preferred. In cases where labor, machinery, or field time limit the number of acres planted, producers may prefer to double-crop on just part of the wheat acreage or not at all.

In Kansas, rainfall usually is low in late summer, when soybeans are flowering and setting seed. Also, soybean prices frequently are lower in the fall harvest season. If soybeans could be planted in spring and mature by midsummer, yields and profits might be increased. In southeast Kansas, short-season soybeans (maturity groups 00, 0, and I) planted in April yielded as much as full-season soybeans planted in June. Economic analysis showed that the most profitable plan was planting group I soybeans in April.



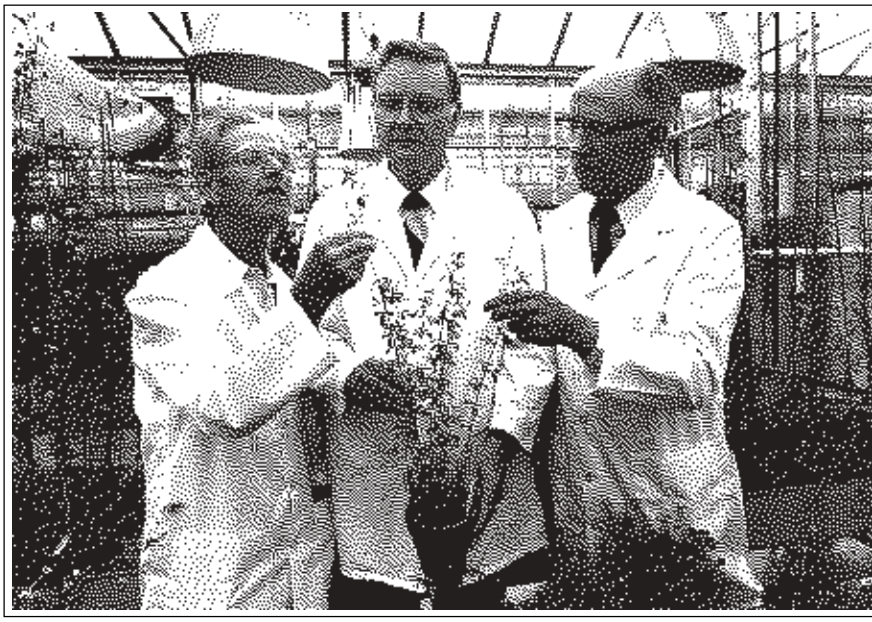
Sorghum may resist drought by producing more ethylene.

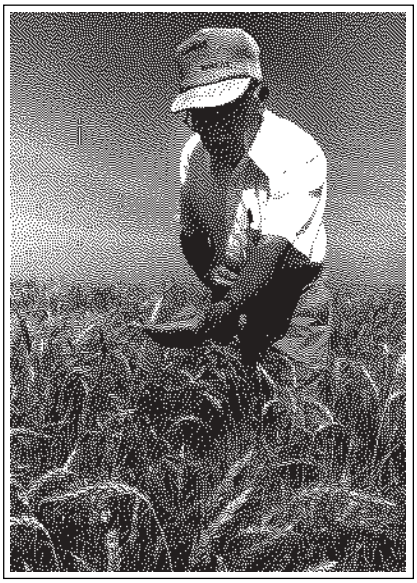
Better Alfalfa

Cooperative work among researchers in the departments of Agronomy, Entomology, and Plant Pathology has resulted in development of 25 pest-resistant types of alfalfa. The process can take as long as 20 years.

Seeds of two alfalfas, KS71 and KS153, were released to plant breeders in 1989. Both are resistant to several diseases plus pea aphid, spotted alfalfa aphid, and blue alfalfa aphid. In addition, KS71 has tolerance to alfalfa weevil, and KS153 has tolerance to frost damage. Another recent release, KS208, is resistant to five diseases and three insects. KS206 is derived from a plant with resistance to pea aphid, spotted alfalfa aphid, and bacterial wilt. It shows high in vitro regeneration of

New varieties of alfalfa are grown and tested in a greenhouse.





Karl Finney inspects the new cultivar of hard red winter wheat named for him.

plants and can be used in developing new germplasm.

Varieties of alfalfa with glandular hairs on their stems and leaves have been introduced into the breeding system. The glands excrete a sticky substance that repels or traps insects, thus preventing further infestation. Glandular hairs are excellent defense mechanisms, because they simultaneously control several insect pests.

Resistant plants contribute to the establishment and maintenance of crops and to forage quality and yield. Frost-tolerant plants show superior growth in autumn, which could give growers one additional harvest.

Kansas is an important battleground for diseases and pests of alfalfa because of its central location. Insects and diseases can enter from all regions of the country. Research by KAES scientists has developed alfalfa populations that are among the most resistant in the world.

Other New Releases

Several new wheats were released during the biennium. Hard red winter wheats included KS89WGRC3 and KS89WGRC6, both resistant to biotype D Hessian fly; KS89WGRC4, resistant to biotype D Hessian Fly and biotype E greenbug; KS89WGRC5, resistant to Hessian fly, greenbug, and soilborne mosaic virus; and KS89WGRC7, resistant to leaf rust. In addition, Karl wheat was registered. This cultivar is best adapted to central and eastern Kansas. It has yield and grain volume weight superior to those of Arkan and Newton, excellent milling and baking qualities, and high protein content. Karl is resistant to soilborne mosaic virus and spindle mosaic virus and has improved tolerance to tan spot. The name honors Karl Finney, an internationally known cereal chemist, who made outstanding contributions to improving the milling and baking qualities of hard red winter wheat in Kansas.

A cultivar of eastern gamagrass, Pete, was registered for use in the eastern Great Plains. It resembles wild types but matures earlier than other native warm-season grasses and remains green until frost. It's useful for pastures (grazing), hay, and reestablishment of native prairie.

■ *RANGE MANAGEMENT*

With more than 40 percent of Kansas land used for grazing livestock, KAES researchers are examining ways to improve range management.

Burning of Range

Investigations into the benefits of range burning have been conducted since the early 1900s, longer than at any other university. Early studies showed that burning pastures in late spring did not reduce range productivity and resulted in 30 pounds of added weight gain per steer.

Spring burning is essential to maintain native grasses.

Current research focuses on the long-term effects of burning on the ecosystem. Properly timed burning improves forage quality and does not decrease nutrients available in the soil. One study showed that photosynthesis of the canopy of prairie plants was greater in a burned area when plenty of water was available. However, after a dry period, the plants in the unburned area were more productive. Thus, the benefits of burning can be affected by environmental conditions.

Stocking Rate

Intensive-early stocking of range (2.5 times more than the normal rate) promotes the growth of warm-season grasses. These predominate in the tallgrass prairie, where this system works well. However, farther west near the Fort Hays Branch Station and beyond, this high rate would damage the grass. Lower rates of early season grazing can still provide advantages there. Stockers can be put on feed sooner or sold during the traditionally strong midsummer market.

Controlling Weeds

Weed control is a consideration in maintaining productive range. Burning eliminates many types of weeds and brush but not all. Tall shrubs and trees cause more problems than herbaceous weeds, because they shade

the grasses and decrease forage production. An agronomist is experimenting with combined burning and herbicide application to control certain kinds of brush, like blackberry.

To reduce environmental pollution, herbicides are sprayed directly on trunks of trees, spotted near roots, or used as pellets that are scattered on the ground around plants.

Yucca is a particular problem in western Kansas, where pasture burning is limited. It's a very hardy plant with a woody base and long roots. The amount of yucca has doubled in recent years, since use of the one effective herbicide was suspended. A new herbicide is being tested. It's applied only once, but then requires 4 to 6 years to kill the plant.

Intensive early-season grazing can be profitable to producers.

■ GRAIN RESEARCH

A New Tester for Wheat Hardness

The Federal Grain Inspection Service (FGIS) still relies on the traditional, visual method for classifying wheat. However, this method is not adequate for identifying new varieties, which often combine traits of hard and soft wheats. For example, Arkan has kernels that look like soft wheat but mill and bake like hard wheat.

A federal working group on wheat classification has been formed to develop a new system. The FGIS will designate an official standard to measure hardness. A single-kernel hardness tester developed by an agricultural engineer and grain scientists at KSU is being considered for use.

This hardness tester measures the force it takes to slice or crack a wheat kernel. It can slice 200 kernels a minute and records force readings at one-half millisecond intervals, taking from 300 to 500 readings per kernel. In a test of more than 1,000 commercial samples from all over the United States, the instrument misclassified less than 1.5 percent of the samples as compared to FGIS visual classification. Maximum force to cut the kernel is the most reliable indicator of hardness, but researchers are continuing to improve the instrumentation to give better separation between hard and soft wheats. The tester has been patented and is ready for commercial production.

When a more sophisticated classification system has been established, millers and bakers may be able to contract with farmers to grow a particular wheat for a specific purpose. Certainly, the economic and milling problems associated with mixtures of hard and soft wheats will be eliminated.

Stable Form of Vitamin C

Vitamin C is an essential nutrient in the diets of cultivated fish and shellfish, some birds, guinea pigs, and primates. However, vitamin C is one of the least stable ingredients in formulated feeds and processed foods. A researcher in the Department of Grain Science and Industry has developed a new, modified form of vitamin C, known as ascorbate 2-polyphosphate (AsPP), which is hundreds of times more stable than ascorbic acid. AsPP is already being used around the world in diets for cultured fish. It also may be useful in foods as an antioxidant and antibrowning agent, as well as a nutrient.

New varieties of wheat have kernels that are difficult to classify.

Crop stubble reduces soil erosion and conserves water.

photo by Larry Murphy

■ CONSERVATION TILLAGE

Scientists from several departments and branch stations/centers of KAES are developing a strong research base on which to make recommendations to farmers practicing conservation tillage. An increasing number of farmers produce crops with reduced tillage, many in compliance with the 1985 Food Security Act. That legislation asked farmers to complete conservation plans for highly erodible cropland.

Kansas has more than 10 million acres of cropland that fit into that category. Most conservation plans include reduced tillage practices, which involve managing straw and stubble left from crop harvests. Recent surveys indicate that 35 to 40 percent of the state's farmers practice conservation tillage, with 2 percent using no tillage.

KAES research by agronomists in Manhattan and at the branch stations clearly shows that conservation tillage is a desirable and beneficial management system in most areas of the state.

Saving Soil

Organic matter has been declining in Great Plains soils. The decline is related to biological oxidation of humus when soil is aerated by tillage and to physical loss of topsoil by water and wind erosion. More surface residue and less tillage should reduce or at least stabilize loss of soil organic matter. In fact, several years of conservation tillage can restore significant amounts of organic carbon and nitrogen to soils. Rotations including crops that produce a lot of residue (like sorghum) also increase organic content of soil.

Increased Yields and Water

A long-term study at the Southwest Kansas Research-Extension Center has indicated that reduced tillage increased yields of both crops in wheat-fallow and wheat-sorghum-fallow (WSF) systems. Reduced tillage also increased the amount of soil water at planting by 1.2 and 1.8 inches for wheat and sorghum, respectively. Water use efficiency was increased for these crops in the WSF system under reduced tillage.

Fertilizer Use

A fertilizer study at Manhattan compared application methods in grain sorghum grown under conservation tillage. Urea-ammonium nitrate solution was surface broadcast or knifed into the soil. Sorghum receiving the surface application performed poorly, whereas that receiving the knifed-in application produced significantly higher grain yields. It also had high nitrogen contents in grain and tissue. These results indicate that the most efficient use of nitrogen fertilizer can be achieved by avoiding residue contact during application.

Fertilizer management for wheat and sorghum with several tillage systems was investigated at the Fort Hays Branch Station.

With no tillage, starter nitrogen applied with the seed gave the highest net return on dollars invested. However, additional nitrogen applications sometimes were required for highest yields.

Controlling Diseases

Wheat residue left on the soil surface can harbor organisms that cause diseases (tan spot and cephalosporium stripe) in the next crop of wheat. Therefore, reduced-tillage systems for wheat, especially in central and south-central Kansas, must involve rotation with other crops. Research has shown that growing another crop for just one year can reduce early-season tan spot by 55 percent, even with the maximum amount of residue. Moldboard plowing to bury the infected residue had a similar effect.

Economic Advantages

The benefits of conservation tillage are clear, but is it profitable? A study by agricultural economists and agronomists showed that returns depend on the combination of tillage systems and crops. Three tillage systems were compared for continuous corn, continuous soybeans, and a corn-soybean rotation in northeast Kansas. The highest net returns for each tillage system resulted from the corn-soybean rotation. The no-till system had the highest net returns when corn was included. Conventional tillage had the highest returns only with continuous soybeans. When payments for corn from government commodity programs were included, variation in returns but also net returns were reduced. Under the conditions used in this study, producers who seek to reduce risk would prefer a no-till corn-soybean system without participation in a government program.

Predicting Wind Erosion

Although conservation tillage can reduce its effects, wind erosion is still a major problem in Kansas. A team of USDA researchers associated with the Department of Agronomy is developing a new system to predict wind erosion. It will replace the current system initially produced at KSU in 1965.

The new prediction system consists of a computer model that generates simulated weather patterns and soil surface conditions to calculate the amount of erosion that will take place on a particular piece of land. The submodels include crop, soil, weather, erosion, decomposition, tillage, and hydrology. These furnish information to each other in various combinations, just as the conditions they describe interact to affect the occurrence and extent of erosion.

The model uses data collected at frequent time intervals, because conditions can change rapidly. For example, soil can dry out within a few hours after a heavy rain and be susceptible to wind erosion again. Validation of the model against data from field studies has shown it to be very accurate in predicting erosion under various conditions.

With a better tool for predicting soil erosion, soil conservation agents will be able to recommend preventative measures to avoid further loss of valuable cropland.

During droughts, wind erosion can cause severe loss of soil.

photo for Wichita Eagle Beacon by Fernando Salazar

■ *WATER RELATIONS*

More Efficient Water Use

Effective scheduling of irrigation conserves water and energy. Because soil moisture measurements are costly and time consuming, KAES researchers have developed a scheduling system using stage of plant growth. Water applied at the right time will be used more efficiently by the plants. Corn that was irrigated three times (at 8, 9, and 10 weeks after emergence) yielded almost as much as fully irrigated corn (five or six applications). Soybeans did equally well with only two irrigations at the correct growth stages.

Better Production of Vegetables

A cropping system developed by a researcher in the Department of Horticulture can double vegetable or fruit production, while conserving water resources. The system involves use of drip irrigation with a mulch of black plastic film and is applicable to small gardens or large commercial plots.

The plastic tube for irrigation, with holes for water release, is buried about 3 inches deep in the soil, and then the plastic mulch is laid on top of the soil. Holes are cut in the film for transplanting or seeding vegetables and fruits.

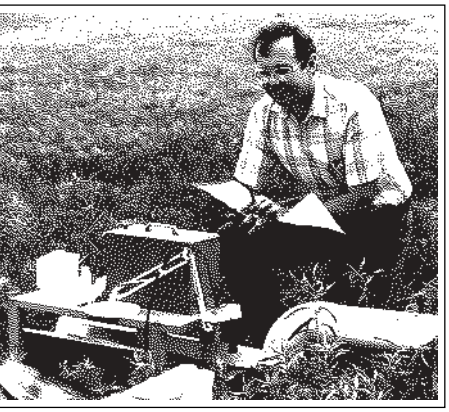
The system has several advantages for crop production. The soil warms up faster in the spring, plants grow more quickly, water can be supplied slowly to the roots, weed control is excellent, and produce is cleaner. Growers usually can market their produce 10 to 14 days earlier than usual, which often means getting a higher price.

Environmental benefits include less water use and less contamination of groundwater. For the same acreage, drip irrigation uses only half the water required for overhead irrigation. Fertilizer can be injected into the irrigation water in small amounts. The tube prevents leaching into the soil. Photodegradable plastic film, which slowly breaks down from exposure to sun, is being tested. It would eliminate the problem of removing and disposing of the mulch every year.

Drip irrigation reduces water use and improves crop production.

Irrigating Crops

Drip irrigation also can be adapted for use with field crops like corn. Agricultural engineers are testing a system at the Northwest Research-Extension Center. The system involves a network of underground pipes with small holes along their lengths through which water seeps out and wets the soil. Successful implementation of drip irrigation could reduce water use for crops by 20 to 35



This specific ion meter measures chemicals in groundwater.

percent. The system delivers water near the crop's roots, where it is needed, and evaporative losses are reduced. Such savings are important in the dry climate of western Kansas, where irrigation is prevalent but water supplies are limited.

Chemical Movement in Soil

Extensive use of pesticides and fertilizers threaten water quality. The movement of chemicals in soil depends on climate, rainfall, soil properties, and management practices. Agronomists are cooperating with researchers in other departments to determine how agricultural chemicals move into groundwater. Results show that atrazine movement is limited to sandy soils, where low concentrations have been detected at depths as great as 15 feet. In heavier soils, atrazine decomposes rapidly. Alachlor tends to degrade quickly and does not seem to move through soil.

Information like this can help producers to use pesticides more wisely and avoid further contamination of water.

■ *ENVIRONMENTAL RESEARCH*

Climate of Northwest Kansas

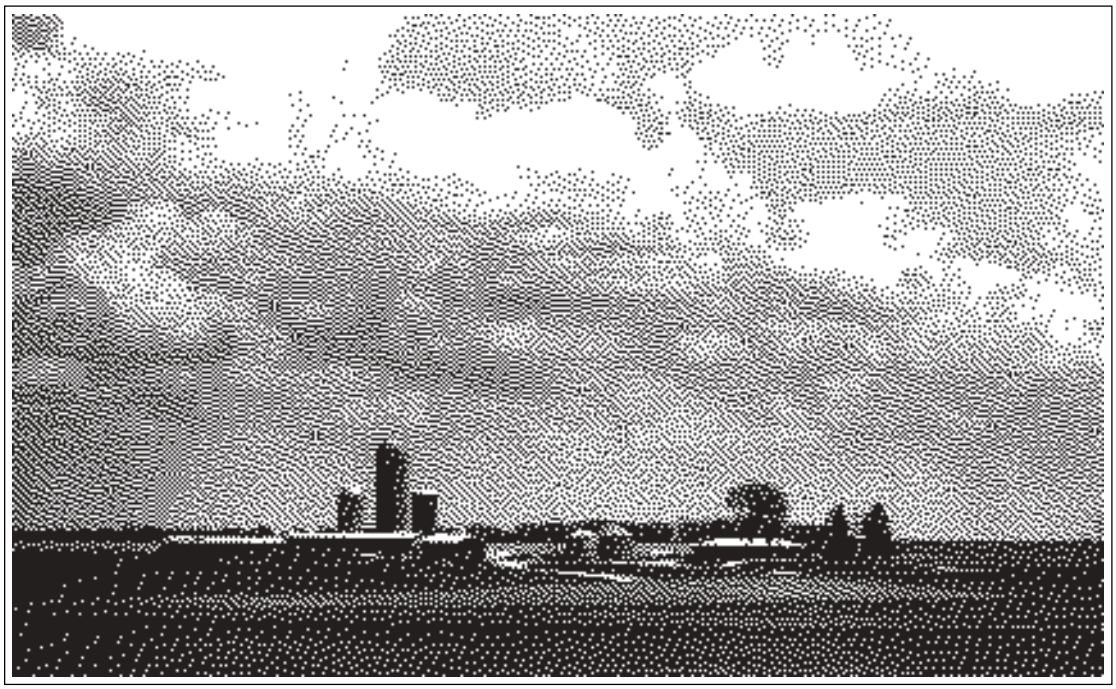
The climate of a region is an important natural resource. It determines the type of vegetation that predominates and the adjustments necessary for comfortable life styles. Through centuries of influence, it has played a major role in determining the types of soil that develop. Understanding climate and its variability is important for predicting future climate and for evaluating activities that impact the environment.

A report from the Northwest Research-Extension Center reviews the physical causes of climate and the history and types of weather data collected at Colby. A series of tables and figures summarize 100 years of weather observations.

The physical factors include the Rocky Mountains, which run north and south and lie across the path of the jet stream flowing from the west. They cause the air to rise and become cooler. Most of the moisture in the air falls on the western slopes, so that the area east of the mountains (including western Kansas) is very dry. Elevation above sea level influences temperature. Because western Kansas is higher, minimum temperatures are lower and temperatures cool more at night than in eastern Kansas.

A weather station was established at Colby in 1888-89 but then was closed and reopened in 1892. Daily records have been kept there ever since. The Colby Branch Station was established in 1914 and also began keeping weather records. In 1957, the official weather station was moved to the branch station. A network of weather stations was set up in 1980, linking the five branch stations and experiment fields around the state. The network was automated by 1984, and data are collected and stored by a computer. Data in-

The climate of Kansas is variable: perfect weather can follow a severe storm.



clude daily maximum and minimum temperatures, rainfall, wind direction and speed, relative humidity, solar radiation, and soil temperatures.

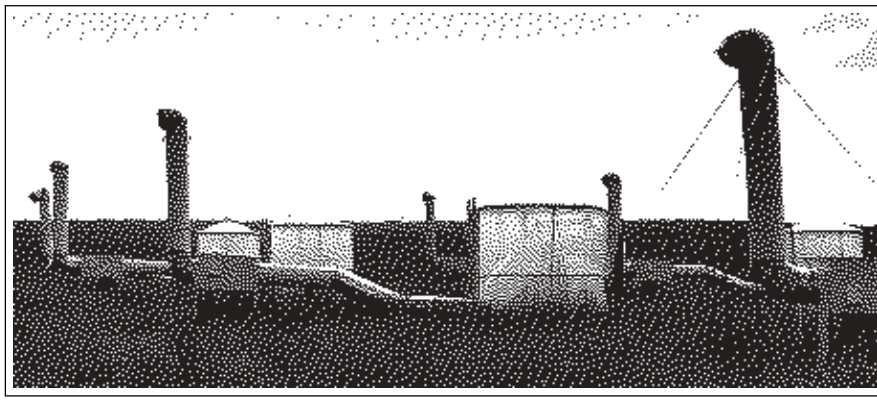
Excess Carbon Dioxide—Good or Bad?

Scientists agree that carbon dioxide in the atmosphere is increasing every year and probably will be double the present level by 2050. However, no one knows how this increase will affect the plants that are the basis of our food supply. Research is underway at 13 sites in the United States to determine the effects of carbon dioxide on major crops and native plants of economic value. The research plots in Kansas are located in Manhattan and Hays.

The concern here is how the tallgrass prairie would react to increased carbon dioxide and how changes in the grasses would affect grazing animals. Researchers are considering the growth, water use, and forage quality of plants.

Small closed chambers have been placed on the prairie, and carbon dioxide is pumped into them at normal and twice-normal levels. Fans exchange the air every 20 seconds, and the environment is monitored continuously by computers.

Larger open chambers are used for grazing tests with sheep. Cattle did not fit in the chambers, and sheep are more discriminating grazers. They tend to choose a higher quality diet and, therefore, should provide more data about the plants. Every 2 weeks, the sheep graze in the chambers where plants have been growing in either normal or elevated amounts of carbon dioxide. Each sheep has a surgical opening in the esophagus, whereby plant material it swallows is shunted into a collection bag for later analysis.



High-tech "dinosaurs" are used to study effects of carbon dioxide on plants.

Preliminary results indicate that many prairie grasses thrive in increased carbon dioxide. However, big bluestem (a warm-season grass) does not react as much as cool-season grasses. Thus, higher levels of carbon dioxide could change the species composition of the prairie. Because less nitrogen is available in the soil when cool-season grasses predominate, this shift could decrease overall productivity. Other variables that affect these results are being studied as well.

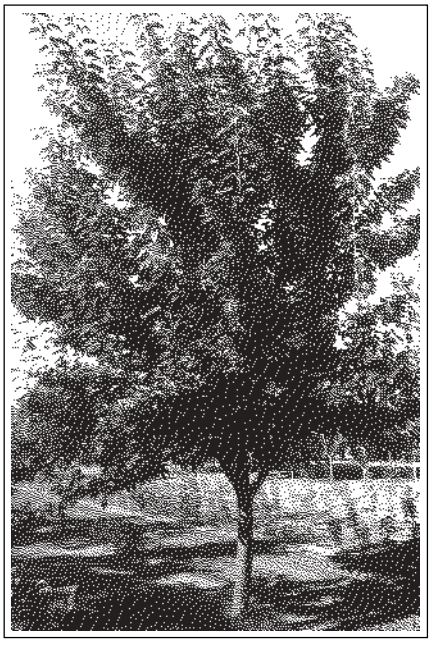
In a related study, wheat and sorghum also showed favorable reactions but only under drought stress. The increased carbon dioxide seemed to compensate for lack of water and allow plants to grow normally. This effect could be important, because temperatures are supposed to rise along with carbon dioxide levels. The Great Plains could be warmer and drier in the future.

■ *HORTICULTURAL RESEARCH*

The Wichita Center

The 20th anniversary of the Horticulture Research Center in Wichita was celebrated in 1990. The center started because of local interest by horticulturists, businesses, and civic groups. With encouragement by the Wichita Chamber of Commerce, the Wichita Area Development (WAD) purchased 40 acres of land and leased it to KSU as a site for conducting research on horticultural crops. Today the center conducts research on woody ornamentals, turfgrass, fruits, and vegetables. It includes a headquarters building, two equipment-storage and shop buildings, and a greenhouse.

At the anniversary celebration, WAD announced plans to transfer the property to KSU. This is an expression of confidence in the horticultural research programs planned and supervised by two horticulturists at the center.



Wichita Osage orange is a tree suitable for landscape use.

A recent success of that research is the release of a cultivar of Osage orange (named Wichita) for landscape planting. Wichita is a male, thornless tree that grows to about 10 meters in height and has no fruit. It can be propagated readily by hardwood cuttings.

Osage orange trees are grown in windbreaks and shelterbelts throughout the Great Plains. They also have potential as street trees in polluted urban areas and as landscape trees in dry areas. However, for these additional uses, the large

fruits and hazardous thorns are undesirable. A male tree that was nearly thornless was discovered near Wichita and was used to develop the new cultivar.

Colorful native flowers like Echinacea can be adapted to cultivation.

Other projects include developing a dogwood and several rhododendrons that will thrive in the hot, dry conditions of Kansas.

Wildflowers for Cultivation

Many of the colorful wildflowers of the Great Plains would be suitable for cultivation in gardens. However, germination of seeds is often poor in cultivated situations. A researcher in the Department of Horticulture has determined the best conditions for germination of purple coneflower (*Echinacea purpurea*) and two related species. These plants have showy pink to purple flowers. Exposure to light or to cold temperatures was needed for germination of all species. Only one species grew from direct seeding into the field in the spring. Greenhouse-grown transplants gave the best stands of the other two species.

Turfgrass

Creeping bentgrass (*Agrostis palustris*) is a cool-season turfgrass that is often used on golf course fairways. Atrazine can control weeds in warm-season grasses and does not damage them. However, it can damage cool-season grasses. It also poses environmental threats because it gets into groundwater and runoff from sprayed areas.

To test atrazine's effect on creeping bentgrass, small amounts were applied in irrigation water for 20 days. The results showed that this grass is very sensitive to atrazine. Toxic effects were noticed at concentrations much below those recommended for use of the herbicide.

■ *ECONOMICS OF AGRICULTURE*

Economic Linkages

An economist produced the most recent of a series of input-output models that was started over 20 years ago. An input-output model is a quantitative framework of analysis for examining the complicated interdependence within the production systems of an economy. KAES is particularly interested in the current linkages of agriculture with the rest of the state's economy. The model used survey data collected in Kansas through interviews by trained personnel plus data from federal and state government agencies.

The model includes four large tables. The inter-industry transactions matrix describes the flow of goods and services between all individual sectors of the economy in a given year. The direct requirements matrix indicates the requirements needed from each industry for a particular industry to produce an average $1.00 of output. The last two—the direct and indirect requirements matrix and the direct, indirect, and induced requirements matrix—measure the interactions among industries. Each matrix includes 68 industry sectors, 6 final payment sectors, and 7 final demand sectors.

Use of this model can answer practical questions such as: What is the impact of a drought on the Kansas economy? or How will policies to control water quality and quantity affect specific sectors of the Kansas economy?

A new method more accurately estimates the value of old tractors.

Estimating Value of Old Tractors

Estimating the value of farm equipment is an important aspect of farm management. An agricultural economist has developed a better way to determine the value of used tractors. The method uses a simple worksheet to calculate the value. Three facts about the tractor are required: list price of the model when new, current age, and PTO horsepower. The KAES report on this research includes a sample worksheet and a lengthy table listing brands, models, and prices.

This method provides an alternative to using the undepreciated value, which is unsatisfactory for new income tax procedures. Recent

changes in tax laws have underpriced the equipment value that farmers report on their net worth statements.

Kansas Farmland

A group of agricultural economists gathered data from 23, 637 sales of farmland in Kansas totalling nearly 5 million acres for the period 1971-1987. They found that the statewide, weighted-average price per acre increased from $158 in 1971 to $659 in 1980 then dropped to $297 in 1987. Generally, smaller tracts of land had higher prices per acre. Seventy-three percent of the sales were of 160 acres or fewer. The highest prices per acre occurred in the Northeast and Southcentral districts and the lowest prices in the Northcentral and Northwest districts. Thirty-five percent of total sales occurred in the months of March, April, and May. Farmland sales by financial institutions increased from 4 percent of total sales in 1984 to 37 percent in 1987. Farms with the highest percentage of cultivated acres sold for the highest prices.

Grain production and transportation are interdependent and affected by other links in the state's economy.

■ LAND USE IN KANSAS

Public Access to Private Land

Most of the land in Kansas is privately owned and used for agriculture. Studies were conducted by a researcher in the Department of Forestry to determine the feasibility of expanding the recreation resource base in Kansas by utilizing private, forested land. A survey included 11 counties in eastern Kansas and 8 counties in western Kansas; 1,460 responses were received.

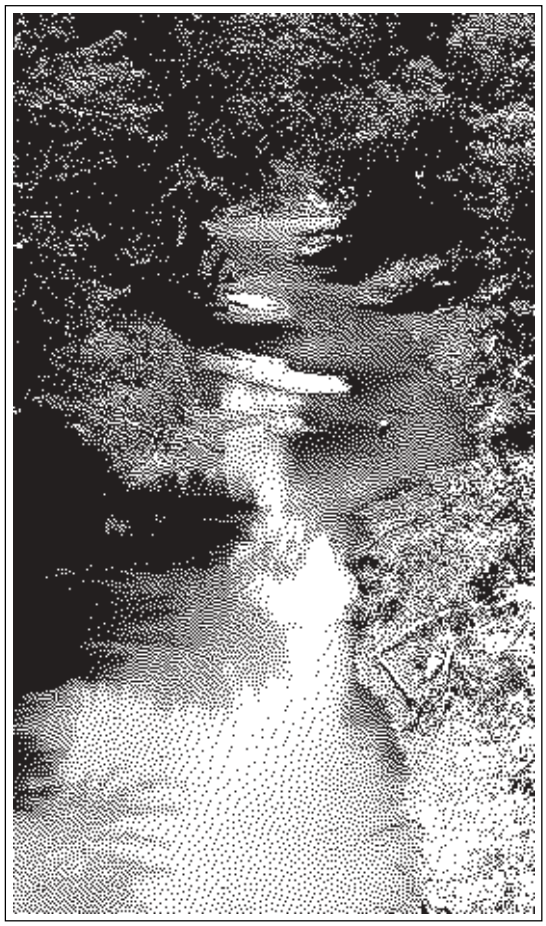
Nearly 40 percent of the respondents allowed nonrelatives to use their land for recreation, especially hunting, fishing, observing nature, and hiking. Fifty-seven percent of respondents reported problems, like trespassing on posted land, property damage, and littering. Most respondents were not informed about liability laws relating to recreational access to their land.

The number of land owners who indicated interest in a state-assisted, public access system was sufficient to provide the acreage proposed by the Department of Wildlife and Parks. However, if such a plan is implemented, land owners need more information about liability, and recreationists need to be educated to respect people's land.

Use of Windbreaks by Hunters

Windbreaks are planted around agricultural land for their obvious effect of reducing wind erosion. However, they also serve as habitats for wildlife that would otherwise be scarce because of the lack of forests in the Great Plains. Two researchers in the Department of Forestry surveyed licensed hunters in Kansas about their use of windbreaks. Useable questionnaires were returned by 842 individuals.

Kansas hunters spend 41 percent of their hunting time in or adjacent to windbreaks. If more windbreaks were available, 80 percent of the respondents would hunt in them more often. The mean amount of time spent in windbreaks was 55 percent for quail hunters, 40 percent for deer hunters, and 23 percent for pheasant hunters. Important attributes of windbreaks for hunting were being adjacent to crops, having ground cover, and having dense vegetation. Extending these results to all hunters in the state gives an estimate of 1.4 million hunter days annually in windbreaks and accounts for $31 million in revenue.



Private land is available for recreational use.

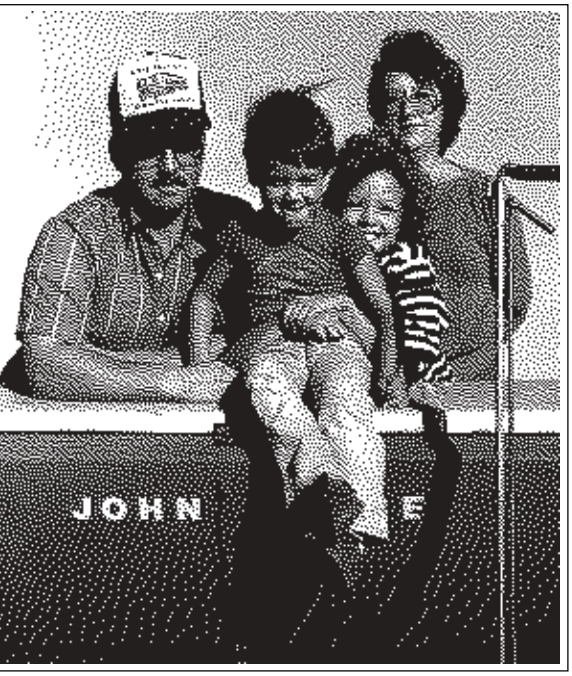
Windbreaks provide habitat for wildlife and hunting opportunities.

Throughout the Great Plains, the number of windbreaks is declining and their quality is deteriorating. If this trend continues, wildlife populations may decrease, and both the quality and quantity of hunting opportunities will be affected negatively. This would have adverse economic consequences, especially for small, rural communities that depend on income from hunters.

■ CHILD DEVELOPMENT

Rural Children's Environment

Three groups of rural children, initially 3, 6, and 9 years old, and their families were assessed during three, annual, home visits. Researchers in the Department of Human Development and Family Studies gathered information on the home environment and parental relationships and administered intelligence tests to the children.



Childrens' development can be affected by home environment.

The results indicated that the quality of children's home environment and their mother's alienation have strong effects on later intelligence scores. Maternal alienation can lower their I.Q. estimates, whereas a good home environment can enhance intellectual performance. Effects of socioeconomic status can be mediated by the quality of the home environment.

Rural communities are particularly vulnerable to the consequences of social isolation, because their members are more reluctant to seek external support than are their urban counterparts. Mothers who feel alienated spend less time with their children, which explains the negative impact on their intellectual development.

The Value of Pets

Research in the Department of Human Development and Family Studies has confirmed what children already knew: they need pets. Parents were questioned about themselves, their homes, and their preschool-age children, and the children were tested. Results showed that young children learn skills that improve their social competence with their peers. For example, children with pets showed more empathy towards other people than those without pets. In addition, having a pet tended to improve children's verbal intelligence scores and their ranking on an age-adjusted developmental scale.

■ HUMAN HEALTH

Rapid Tests for Microorganisms

Part of the food science program in the Department of Animal Sciences and Industry is developing and testing rapid methods to identify microorganisms that contaminate food. One of these is *Clostridium perfringens*, which was grown in the laboratory in broth and ground beef. Four methods of recovering the bacterium were compared. Fung's double tube method (developed at KSU) gave higher recovery in less time and at the lowest cost per test.

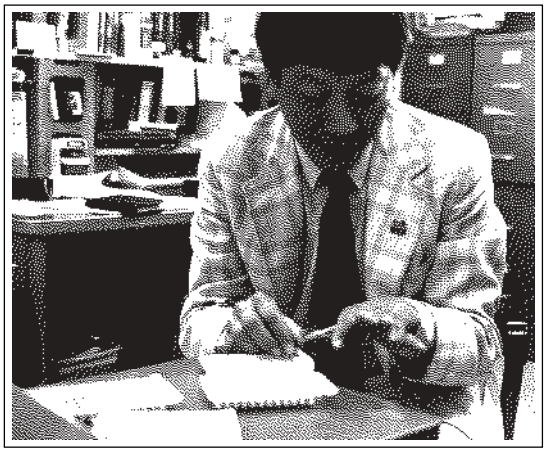
While testing several media containing dyes, KAES researchers discovered one that encourages growth of *Candida albicans* and makes it fluorescent. This yeast is a major pathogen of humans, often found in environmental samples. Its rapid identification is important. After 24 hours of incubation, the medium is exposed to ultraviolet light and then put under fluorescent light. *Candida* is the only organism visible under these conditions. Further tests at a medical center showed that the new method is 99.5 percent specific for quickly identifying this yeast.

Seeking Basis of Inherited Blindness

Retinitis pigmentosa (RP) is the term applied to a set of inherited eye defects. The condition starts as a kind of night blindness in the teen years; then the retina slowly deteriorates until complete blindness ensues by middle age. No cure is known.

Occasionally, eye tissue is donated by RP sufferers who die at a young age, before severe damage occurs. Because of this lack of research material, scientists study the molecular chemistry of defective animal eyes for clues to the onset of the disease. As a result of generations of close inbreeding, certain dog breeds have developed retinal defects similar to RP.

A researcher in the Department of Biochemistry uses eye tissue from these dogs, mice, and occasionally humans to study the most basic chemical messengers of sight. These are the proteins and enzymes that convert incoming light into electrical impulses, which the brain remembers as an image. Cell products called antibodies are used as probes to identify the many retinal proteins. Each antibody binds only with a specific kind of protein, so the same tissue can be used many times. In this long-term project, the roles of important proteins that have been identified will be determined. Understanding how they work when they are correctly assembled will help discover which proteins, when not correctly assembled, contribute to retinal deterioration.



These trays are used in a rapid test for microorganisms.

Such basic research may lead to diagnostic screening tests for genetic retinal defects and even to a cure for RP.

■ *INTERNATIONAL AGRICULTURE*

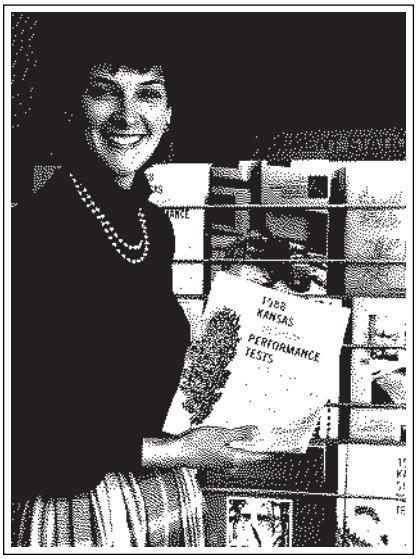
A team of scientists, including agricultural economists and agronomists, was involved for several years in an agricultural improvement program in Botswana. The program ended in 1990. Botswana is a sparsely populated country that borders the northern edge of the Republic of South Africa and imports about 80 percent of its food. The researchers showed farmers how to adapt methods to the harsh and varying climate, as well as involving them in experimental projects to improve production.

Available and low-cost inputs can help farmers to reduce risk and optimize labor use. One project addressed recycling two on-farm resources, cereal stover (stalks left after grain harvest) and manure, in grain sorghum production. Results after 3 years showed that manure gave the greatest increase in grain yields. Stover used on the soil surface to possibly lower soil temperature and control wind and water erosion had a negative impact on grain yield. Incorporating stover into the soil also increased yields but not as much as using manure. Returns to labor were very positive. Increased yields gave income equivalent to that from at least 30 days of off-farm work.

Other projects in Botswana involved production of grain sorghum and pearl millet, including effects of seed quality on stand development, grain and forage yields and stover quality from different varieties, and effects of tillage on soil moisture and grain yield.

Agronomists also have worked in Morocco, evaluating the effects of weeds on grain crops, testing various herbicides for weed control, and developing methods to improve the production of fall-planted cereals.

Research has improved sorghum production in Botswana.



KAES publishes at least 25 Reports of Progress each year.

■ *EDITORIAL OFFICE*

A total of 1,150 manuscripts received contribution numbers during the biennium, and 837 (73 percent) were edited. The average number per month was 48. A record number of 603 manuscripts was processed in 1990. The categories of manuscripts were:

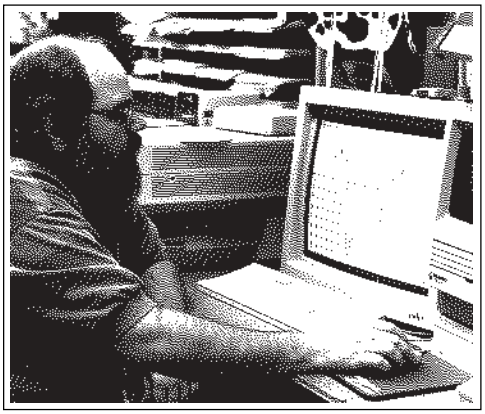
Journal articles	**800**
Proceedings of meetings	**124**
Department reports	**71**
Station publications including 4 Bulletins	**63**
Books or chapters	**61**
Trade publications	**14**
Extension publications	**9**
Computer programs	**8**

A survey of users of KAES annual Reports of Progress showed that the current format is acceptable. Articles are written in a concise but technical style with several tables and/or figures to illustrate results. County agents and other readers indicated that the detailed information is useful.

During the annual, combined conferences of KAES and Cooperative Extension, the editorial staff again helped organize successful poster sessions. This chance to share progress on current projects is a popular part of the conference.

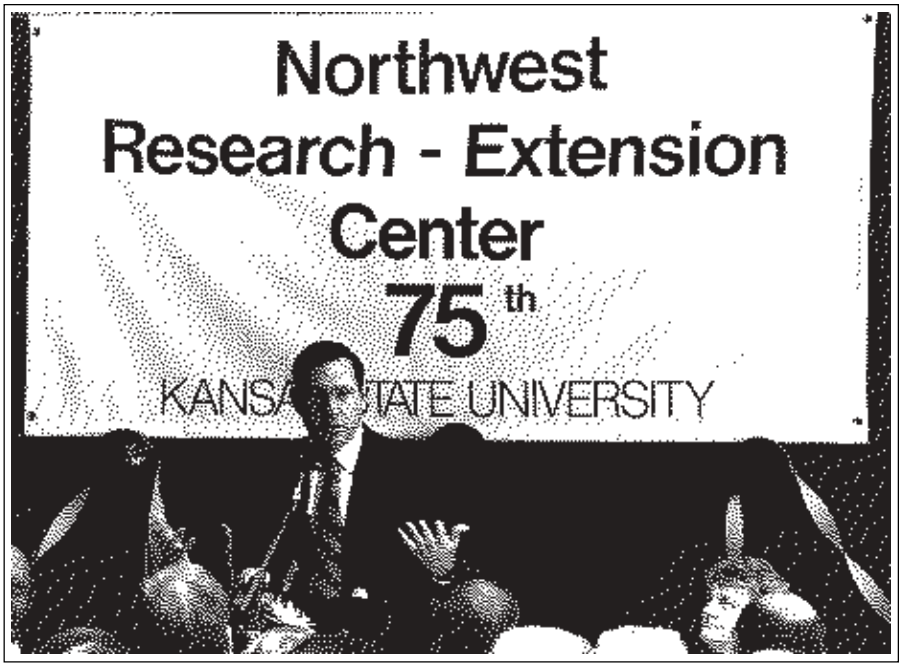
The editorial staff has taken on a new responsibility; writing and publishing the semiannual Ag Report. This update on research, extension, teaching, and alumni activities is distributed to all alumni of the College of Agriculture. Publication of the report involves conducting interviews, editing submitted articles, taking photographs, and preparing camera-ready copy on a computer.

The part-time position of Assistant Editor has been replaced by a student intern position. Each year, an outstanding senior in Agricultural Journalism is sought for the job. This student helps prepare the Ag Report and also conducts interviews and writes news releases about KAES research.



Many KAES publications are designed on a computer.

Former Governor Michael Hayden was one of the speakers at this anniversary celebration in Colby.



Personnel Changes*

■ APPOINTMENTS

Duane Acker, animal sciences and industry
Mark J. Arns, animal sciences and industry
Andrew P. Barkley, agricultural economics
Janet E. Benson, sociology, anthropology, and social work
Leonard E. Bloomquist, sociology, anthropology, and social work
Gary W. Brandt, surgery and medicine
Gerald Buonopane, foods and nutrition
Judy H. Cox, surgery and medicine
Cody P. Coyne, surgery and medicine
Gary Dick, entomology and southwest Kansas research-extension center
Penelope Diebel, agricultural economics
Hermann J. Donnert, head,nuclear engineering
Barry C. Dover, entomology
Steven S. Duncan, agricultural economics
Glenn S. Elliott, laboratory medicine
A. Steve Freeman, southwest Kansas research-extension center
Casey B. Frye, animal sciences and industry
Roch E. Gaussion, horticulture
Robert Goodband, animal sciences and industry
Barry Goodwin, agricultural economics
W. Barney Gordon, agronomy
Jeffrey Gwirtz, grain science and industry
Jay Ham, agronomy
Joe Hancock, animal sciences and industry
Dale Hawley, head chemistry
Louis A. Heaton, plant pathology
Reinee Hildebrandt, forestry
Scot H. Hulbert, plant pathology
Alan Knapp, biology
William Lamont, horticulture
Nancy Lewis, foods and nutrition
Linda Clarke Martin, animal sciences and industry
Judy B. Miller, hotel, restaurant, institution management and dietetics
Richard Oberst, pathology
Martin Oppenheimer, head,sociology, anthropology, and social work
Joseph V. Paukstelis, chemistry
Gary Pierzynski, agronomy
Prasad Potnis, clothing, textiles, and interior design
Channa Rajashekar, horticulture
Randal Raub, animal sciences and industry
Charles W. Rice, agronomy
J. Scott Smith, animal sciences and industry
Alan B. Stevens, horticulture
Johna R. Veatch, veterinary diagnosis
Larry Wagner, agricultural engineering
Dennis Whyte, clothing, textiles, and interior design
David W. Wrisht, human development and family studies

■ RESIGNATIONS

David E. Cox, biochemistry
Cornelia B. Flora, sociology, anthropology, and social work
Jan L. Flora, sociology, anthropology, and social work
G. William Fortner, biology
Peter Gibbs, animal sciences and industry
George V. Granade, southeast Kansas branch station
Robert G. Helgesen, entomology
William G. Ikins, animal sciences and industry
Edward T. Kanemasu, agronomy
David E. Kissel, agronomy
Nancy Lewis, foods and nutrition
Steven E. Lommel, plant pathology
Don W. Morishita, southwest Kansas research-extension center
James A. Robbins, horticulture
Dennis Sigler, animal sciences and industry
James B. Sisson, agronomy

■ RETIREMENTS

Lewis E. Browder, plant pathology
James E. Cook, pathology
Lester J. DePew, entomology and southwest Kansas research-extension center
Louis R. Fina, biology
E. Beth Fryer, foods and nutrition
George Herron, southwest Kansas research-extension center
Ernst K. Horber, entomology
Paul L. Kelley, agricultural economics
John B. Sjo, agricultural economics
Robert J. Raney, agronomy
Oliver G. Russ, agronomy
E.L. Sorensen, agronomy
Marian C. Spears, hotel, restaurant, institution management and dietetics
John G. Wingfield, grain science and industry

■ STAFF CHANGES

L. Dean Bark
from: physics
to: computer systems office

Kurt C. Feltner
from: associate dean and associate director KAES
to: director-at-large, north central regional association of agricultural experiment station directors

George E. Ham
from: head, agronomy
to: associate dean and associate director KAES

James J. Higgins
from: professor, statistics
to: head, statistics

Gerry L. Posler
from: professor, agronomy
to: head, agronomy

**permanent appointments at rank of Assistant Professor or above, from July 1, 1988 through June 30, 1990*

Station Publications *(July 1, 1988 to June 30, 1990)*

■ BULLETINS

654 Analysis of Net Returns to Conservation Tillage Systems for Corn and Soybeans in Northeast Kansas
655 The Kansas Input-Output Model: A Study in Economic Linkages
656 Rapeseed and Crambe: Alternative Crops with Potential Industrial Uses
657 Frequency of Profitable Hedging Opportunities and Improved Returns for Feeder Pig Finishers, 1980-1988

■ REPORTS OF PROGRESS

551 1988 Kansas Performance Tests with Winter Wheat
552 Estimating the Value of Used Farm Tractors
553 1987 - 1988 Floriculture Investigations
554 Dairy Day 1988
555 1988 Cattle Feeder's Day
556 Swine Day 1988
557 Chemical Weed Control for Field Crops, Pastures, Rangeland, and Noncropland, 1989
558 1988 Fruit Research
559 1988 Vegetable Investigations
560 1988 Kansas Corn Performance Tests
561 Kansas Fertilizer Research 1988
562 1988 Kansas Sorghum Performance Tests
563 1988 Kansas Sunflower Performance Tests
564 1988 Kansas Soybean Performance Tests
565 1988 Kansas Variety Tests. Spring Oats, Spring and Winter Barley, Spring Wheat
566 1988 Kansas Alfalfa Performance Tests
567 1989 Cattlemen's Day
568 Kansas Sheep Research 1989
569 Kansas Farmland Sales and Characteristics: 1971-1987
570 Roundup 1989
571 1989 Agricultural Research. Southeast Kansas Branch Station
572 1989 Field Day Report. Southwest Kansas Research-Extension Center
573 A Survey of Custom Cattle-Feeding Practices in Kansas
574 1989 Turfgrass Research
575 Geraniums: Cultivar Evaluations 1989
576 1989 Agricultural Research. Northwest Research-Extension Center
577 1989 Kansas Performance Tests with Winter Wheat Varieties
578 39th Annual Report of the Wheat Quality Council 1988
579 Marketing Christmas Trees in Kansas
580 Dairy Day 1989
581 Swine Day 1989
582 Public Access to Private Kansas Lands for Recreation
583 1989 Kansas Corn Performance Tests
584 Chemical Weed Control for Field Crops, Pastures, Rangeland, and Noncropland 1990
585 1989 Vegetable Investigations
586 1989 Kansas Sorghum Performance Tests
587 Kansas Fertilizer Research 1989
588 1989 Kansas Variety Tests Spring Oats, Spring and Winter Barley, Spring Wheat, and Winter Triticale
589 1989 Kansas Alfalfa Performance Tests
590 1989 Kansas Sunflower Performance Tests
591 1989 Kansas Soybean Performance Tests
592 Cattlemen's Day 1990
593 Kansas Sheep Research 1990
594 Climate of Northwestern Kansas
595 1989 Bedding Plant Field Trials
596 1989 Fruit Research
597 Roundup 1990
598 Conservation Tillage Research 1990
599 1990 Agricultural Research. Southeast Kansas Branch Station
600 1990 Field Day Report. Southwest Kansas Research-Extension Center
601 1990 Woody Ornamental Evaluations
602 1990 Agricultural Research
603 1990 Turfgrass Research
604 Farmers and Cattlemen: Survey of Kansas Farm Operators' Opinions on Agriculture and Public Policy

■ KEEPING UP WITH RESEARCH

99 Pinching Poinsettia Cultivars
100 Economic Evaluation of Season-Long and Intensive-Early Stocking Systems

■ SPECIAL PUBLICATIONS

- Agricultural Research in Kansas: Thirty-fourth Biennial Report of the Agricultural Experiment Station, 1986-88
- Ag Facts

SUFFIX LETTERS FOR CONTRIBUTION NUMBERS *(pages 33—80)*

A Proceedings of Meeting or Symposium
B Bulletin published by KAES; Book or Chapter for Book
C Computer Program
D Department Report
E Extension Publication (co-authored by a KAES researcher but published by Cooperative Extension or externally as educational material) or research by an Extension person to be published in a refereed journal.
J Journal
S Station Publication: Report of Progress, Keeping Up With Research, Special Publication
T Trade Publication

Categories are based on information received before manuscripts are published. Place of publication sometimes changes after the contribution number is assigned.

Station publications including Bulletins are available from KAES Editorial Office. Department Reports are available only from the appropriate department office. Copies of journal articles or other outside publications must be obtained from the authors.

Publications of Station Scientists *(By Department and Station Contribution Number)*

1. Agricultural Economics

87-81-J A Microcomputer Model for Irrigation System Evaluation
J.R. Williams, O. Buller, G.J. Dvorak, and H.L. Manges
So. J. Agric. Econ. 20(1):145-151. 1988

87-470-J A Risk Analysis of Conservation Tillage of Grain Sorghum and Soybeans
J.R. Williams, C.L. Mikesell, and J.H. Long
J. Am. Soc. Farm Man. and Rural Apprais. 52(2):61-69,1988

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Adee, E.A. (25)	89-288-J
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Chung, O.K. (17)	87-328-J, 88-533-J
Claassen, M.M. (3)	88-337-J, 89-35-S, 89-214-A, 89-254-S, 89-285-J, 89-437-D, 90-36-S, 90-209-J, 90-259-S, 90-272-S, 90-283-S, 90-354-A, 90-522-D
Claflin, L.E. (25)	88-244-J, 88-324-J, 89-194-J
Clark, B.K. (7)	89-406-J
Clarke Martin, L.S. (5)	89-324-S, 90-361-S
Claus, J.R. (5)	89-70-J, 89-360-J, 89-400-J
Clayberg, C.D. (18)	89-172-S, 90-237-S
Cochran, R.C. (5)	88-289-J, 88-330-J, 88-472-J, 88-488-J, 89-154-J, 89-238-J, 89-252-J, 89-253-J, 89-324-S, 89-402-J, 90-275-S
Coffey, K.P. (32)	89-324-S, 89-401-S, 90-361-S, 90-448-S
Collins, R.D. (14)	90-89-J
Consigli, R.A. (7)	88-452-J, 89-246-J
Converse, H.H. (2)	88-37-J, 89-109-J
Coons, W.J. (7)	90-62-J
Corah, L.R. (5)	88-288-J, 88-289-J, 88-505-J, 89-15-J, 89-57-J, 89-253-J, 89-324-S, 89-508-J, 90-361-S, 90-448-S
Cox, T.S. (3)	88-68-J, 88-149-J, 88-316-A, 88-340-J, 88-392-J, 88-425-J, 89-147-J, 89-183-A, 89-367-J, 89-368-J, 89-369-J, 89-396-J, 90-274-J
Craig, J. (15)	89-150-J
Craig, J.V. (5)	87-499-J, 88-263-J, 88-292-J, 88-449-J, 89-88-J, 89-454-J, 89-465-J, 89-505-J
Creighton, D.W. (17)	89-322-J, 89-323-J
Crisostomo, M.F. (1)	89-299-D, 89-382-J, 90-448-S
Cunningham, F.E. (5)	89-70-J
Cupit, B. (14)	90-541-S
Curran, S. (17)	90-90-S
Czapla, T.H. (14)	89-196-J, 89-229-J, 89-356-J, 89-418-J, 90-88-J
Daniels Hetrick, B.A. (25)	87-79-J, 87-439-J, 87-476-J, 88-24-J, 88-85-J, 88-364-B, 89-16-J, 89-66-J, 89-168-J, 89-388-J, 90-4-J, 90-55-J
Danler, R.J. (5)	89-149-S
Davis, A.B. (17)	88-113-J, 88-138-J, 88-167-J
Davis, D.L. (5)	88-66-J, 88-174-J, 88-181-J, 88-336-J, 88-454-J, 89-9-J, 89-149-S, 89-242-J, 89-302-J, 90-163-S
Davis, L.C. (6)	88-455-J, 88-456-J, 89-48-J, 90-159-J
DelCurto, T. (5)	88-330-J, 89-252-J, 89-253-J, 89-324-S, 89-402-J, 90-361-S
Dennis, S.M. (23)	85-320-B, 86-215-J, 86-476-J
De Pew, L.J. (14,33)	89-188-A, 89-189-A, 89-326-J, 89-404-S
Deyoe, C.W. (17)	87-328-J, 89-55-J
Dickerson, J.T. (5)	90-361-S
Dikeman, M.E. (5)	86-450-J, 88-524-A, 88-525-A, 89-324-S, 90-356-A, 90-361-S
Dixon, A.G.O. (3)	88-588-J, 88-589-J
Doescher, L.C. (17)	89-329-J
Edmunds, J.I. (25)	88-544-A, 90-7-A
El Bouziri, M. (17)	89-111-J
Elliott, J.K. (33)	89-129-S
Elzinga, R.J. (14)	88-486-J
Emerson, M.J. (13)	89-395-B, 90-154-J
Emmons, T. (7)	89-118-J, 89-175-J, 90-22-J
Erickson, B.K. (4)	89-89-J
Erickson, H.H. (4)	86-394-J, 87-356-J, 88-428-J, 89-89-J, 90-173-T
Estrada, J. (5)	90-140-S
Eusebio, V.E. (1)	89-130-D, 89-131-D
Eustace, D. (17)	90-90-S
Evans, B. (14)	89-205-A, 89-206-A, 89-207-A

*This record includes graduate students and staff members who could be identified as working with KAES scientists during the biennum.

Publication Record of Scientists (Continued)

Publication Record of Scientists (Continued)

Research Projects Active June 30, 1990

Federal Projects

No.	Title	Department
F005	Interaction of Nematode - Host Variability and Abiotic Factors on Crop Losses	Plant Pathology
F124	Occurrence of Mycotoxins in Feeds and Foods and Their Effects on Animal and Human Health	Grain Science and Industry
F144	Bionomics, Vector Capabilities, and Management Strategies for Face Flies	Entomology
F162	Water and Carbon Economy of Plants in Relation to Rhizospheric and Atmospheric Dynamics	Agronomy
F195	Improvement of Thermal Processes for Foods	Foods and Nutrition
F196	Marketing and Delivery of Quality Cereals and Oilseeds in Domestic and Foreign Markets	Grain Science and Industry, Entomology
F207	Methods for Improvement of Fertility in Cows Postpartum	Animal Sciences and Industry
F278	Integrated Irrigation Water and Nitrogen Management to Sustain Groundwater Quality and Quantity	Agronomy
F280	Regulation of Photosynthetic Processes	Biology
F285	Improving Dairy Cattle Genetically	Pathology
F287	Introduction, Maintenance, Evaluation, and Utilization of Plant Germplasm	Agronomy
F434	Advanced Technologies for the Genetic Improvement of Poultry	Animal Sciences and Industry
F500	Characterization and Management of Soil Water and Solutes in Field Soils	Agronomy
F573	The Planning and Coordination of Cooperative Regional Research - Travel	Director's Office
F579	Stress Factors of Farm Animals and Their Effects on Performance	Anatomy and Physiology
F581	Impact of Integrated Crop Management Practices on European Corn Borer and Related Stalk Boring Insects	Entomology
F582	Biological Control in Pest Management Systems of Plants	Entomology
F586	Environmental and Genotypic Control of Assimilate Allocation in Crops	Agronomy
F587	Determinants of Farm Size and Structure in Northcentral Areas of the U.S.	Agricultural Economics
F588	Dairy Herd Management Strategies for Improved Decision Making and Profitability	Animal Sciences and Industry
F628	Development of New Processes and Technologies for the Processing of Poultry Products	Animal Sciences and Industry, Foods and Nutrition
F631	Family Resource Utilization as a Factor in Determining Economic Well-Being of Rural Families	Human Development and Family Studies
F634	Rural Development Strategies to Mediate Farm Crisis Impacts on Families and Communities	Agricultural Economics
F635	Financing Agriculture in a Changing Environment: Macro, Market, Policy, and Management Issues	Agricultural Economics
F644	Integrated Methods of Parasite Control for Improved Livestock Production	Laboratory Medicine
F691	Domestic and International Marketing Strategies for U.S. Beef	Agricultural Economics
F704	Metabolic Relationships in Supply of Nutrients for Lactating Cows	Animal Sciences and Industry
F707	Performance of the U.S. Grain Marketing System	Agricultural Economics
F708	Reducing Pesticide Exposure of Applicators through Improved Clothing Design and Care	Clothing, Textiles, and Interior Design
F709	Chemistry of Atmospheric Deposition—Effects on Agriculture, Forestry, Surface Waters, and Materials	Biology
F710	Improved Systems of Control for Pecan Arthropod Pests	Horticulture
F711	Market Quality of Hard Wheat for Domestic and International Foods	Grain Science and Industry
F729	Seed Production of Breeding Lines of Insect-Pollinated Legumes	Agronomy
F748	Forage Protein Characterization and Utilization for Beef Cattle	Animal Sciences and Industry
F767	Quantifying Long-Run Agricultural Risks and Evaluating Farmer Responses to Risk	Agricultural Economics
F768	Rural Retailing: Impact of Change on Consumer and Community	Clothing, Textiles, and Interior Design
F771	The Genetics of Body Composition in Beef Cattle	Animal Sciences and Industry
F773	Conservation Tillage Systems	Fort Hays Branch Station
F779	Variables in Agriculture-Weather Information Systems	Computer Systems Office
F785	Reproductive Performance in Domestic Ruminants	Animal Sciences and Industry
F803	Nutrient Management in Conservation Tillage to Improve Productivity and Environmental Quality	Agronomy
F831	Bovine Respiratory Diseases: Risk Factors, Pathogens, Diagnosis, and Management	Laboratory Medicine
F835	Changing Patterns of Food Demand and Consumption Behavior	Agricultural Economics
F838	Chemistry and Bioavailability of Waste Constituents in Soils	Agronomy
F841	Utilization of Range Forage for Rangeland and Domestic Ruminate Animal Production	Fort Hays Branch Station
F849	Pathogenesis, Epizootiology, and Control of Avian Respiratory Diseases	Biology
F865	Increased Prolificacy in Sheep and Its Impact on Nutritional Needs	Northwest Research-Extension Center, Animal Sciences and Industry
F891	Food Quality Changes Associated with Thermal Processing in Food Service Systems	Foods and Nutrition
F923	Biological Control of Soil-Borne Plant Pathogens in Integrated Crop Management Systems	Plant Pathology
F966	Impact of Transportation Changes on Agricultural Marketing and Local Communities	Agricultural Economics
F990	Prevention and Control of Enteric Diseases of Swine	Veterinary Diagnosis, Surgery and Medicine
F991	Rootstock and Interstem Effects on Pome and Stone Fruit Trees	Horticulture
H033	Biosystematics of Insects and Arachnids	Entomology
H036	Corn and Sorghum and Wheat Arthropod Pests and Their Management	Entomology
H042	Accelerated Cheese Ripening and Whey Utilization	Animal Sciences and Industry
H048	Konza Prairie Research Natural Area Vegetation Research	Biology
H101	Biology and Control of Arthropod Pests on Corn in Southwestern Kansas	Entomology, Southwest Kansas Research-Extension Center
H203	Genetic Improvement of Thermal Processes for Foods	Horticulture
H397	Planning and Coordination of Cooperative Research	Director's Office
H407	Nitrogen Fertilizer Use Efficiency	Agronomy

Research Projects Active June 30, 1990 (Continued)

H416	Plant Cell Culture for Disease Physiology and Crop Improvement Research	Plant Pathology
H421	Increasing Productivity and Well-Being of Egg-Type Chickens	Animal Sciences and Industry
H428	Sorghum and Corn Ecology and Management	Agronomy
H466	General Administration of Federal Grant Fund Research	Director's Office
H488	The Absorption, Solubility, and Kinetics of Reactions of Phosphorus in Soils	Agronomy
H496	Functions, Nutritive Composition, Quality, Stability, and Efficient Production of Pork Products	Animal Sciences and Industry
H541	Biochemistry of Cyclic GMP	Biochemistry
H547	Genetics and Physiology of Fusaria Species	Plant Pathology
H548	Grasshopper Feeding and Plant Chemistry	Entomology
H561	Ruminal Lactate Metabolism in Cattle	Animal Sciences and Industry
H564	Biology, Distribution, and Control of Insects Affecting Man and Animals	Entomology
H574	Improvement of Eastern Gamagrass as a Domestic Forage Crop in Kansas	Agronomy
H591	The Influence of Soil Microorganisms on Mycorrhizal Plant Growth	Plant Pathology
H595	Genetic Improvement of Corn by Breeding for Greater Production Efficiency in Environmental Stresses	Agronomy
H597	Physiology of Crop Plants	Agronomy
H603	Genetic Improvement of Sorghum	Agronomy
H613	Within-Plant Distribution and Sampling of Two Mite Species on Corn in Kansas	Entomology
H615	Effect of Nutrition on the Immune System of the Calf	Animal Sciences and Industry, Laboratory Medicine
H620	Physiological and Ecological Response of Weeds to Control Measures	Agronomy
H622	High Heat and Limited Oxygen in Controlling Oxidized and Stale Milk Flavors	Animal Sciences and Industry
H640	Herbaceous Ornamental and Native Perennial Plant Species as Florist Crops	Horticulture
H642	Crop Production in Stressful Environments	Agronomy
H656	Grain Cleaning and Separation for Grading	Agricultural Engineering
H658	Crop Improvement and Germplasm Development through Chromosomal and Cytoplasmic Manipulations	Agronomy
H659	Development of Premium Quality Hard White Winter Wheat Varieties	Agronomy
H661	Monoclonal Antibodies Specific for Bovine Interleukin 2 and Interleukin Receptor	Biology
H663	Livestock Price Analysis and Marketing Strategies	Agricultural Economics
H667	Host-Pathogen Interactions in a Model System: Bacterial Blight of Rice	Plant Pathology
H668	Functional Properties of Certain Components from Cereals in Baked Products	Grain Science and Industry
H669	Fertilizer Management Technology for Western Kansas	Agronomy
H670	Epidemiology and Management of Fusarium Seedling Blight of Grain Sorghum	Plant Pathology
H673	Development of Multiple Pest-Resistant Alfalfas	Agronomy, Entomology, Plant Pathology
H676	Etiology, Epidemiology, and Control of Phytopathogenic Bacteria in Sorghum	Plant Pathology
H681	Genesis, Classification, and Mineralogy of Kansas Soils	Agronomy
H684	Utilization and Improvement of Jet-cooked Soymilk Product	Grain Science and Industry
H686	Breeding Soybeans for Increased Productivity	Agronomy, Plant Pathology
H687	Nutritional Management and Grazing Behavior of Beef Cattle on Bluestem Range	Animal Sciences and Industry, Agronomy
H693	Changes in Agriculture and Agribusiness Linkages in the Kansas Economy	Economics
H696	Effect of Kernel Hardness on Wheat Millability	Grain Science and Industry
H698	Innovative Red Meat Production and Processing Systems for the Modern Consumer	Animal Sciences and Industry, Agricultural Economics, Foods and Nutrition
H701	Expanding the Foreign Export Potential of the Midwestern Grain and Oilseed Sector	Agricultural Economics
H713	Diet and Metabolic Influences on Splanchnic Nutrient Supplies	Animal Sciences and Industry
H714	Nutritional Implications of Exercise	Foods and Nutrition
H715	The Biology of Puccinia recondita and P. graminis as Parasites of Wheat	Biology, Plant Pathology
H717	Molecular Biology of Wheat and Corn Viruses of Kansas	Plant Pathology
H719	Thermal Inhibition of Crop Growth and Development	Horticulture
H720	Cytogenetic Analysis of Host Plant Resistance in Common Wheat	Plant Pathology
H721	Gathering, Cleaning, and Yield Mapping Processes in Grain Harvesting	Agricultural Engineering
H722	Integrated Control of Wheat Tan Spot by Reduction of Straw-borne Inoculum	Plant Pathology
H723	Photoperiodic Influences on Endocrine Functions	Animal Sciences and Industry
H724	Range Improvement Investigations	Agronomy
H725	DNA Restriction Fragment Length Polymorphism Analysis	Plant Pathology, Agronomy, Biochemistry
H726	Cause and Prevention of Grain Feedlot Bloat in Cattle	Animal Sciences and Industry
H727	Utilization of Wheat and Corn Milling By-Products in Water-Stable Diets	Grain Science and Industry
H728	Biology and Management of Arthropod Pests on Wheat, Sorghum, Alfalfa, and Sunflower	Entomology
H730	Atrazine and Nitrate Leaching through Soil and into Groundwater	Agronomy
H733	Bacteriophage T4 Modification of Escherichia coli valyi TRNA Synthetase	Biology
H735	Air Quality in Agricultural Buildings	Agricultural Engineering
H736	Nutrition of Gestating and Lactating Swine	Animal Sciences and Industry
H737	Nutritional Requirements of Finishing Swine Administered Porcine Somatotropins	Animal Sciences and Industry
H739	Cow/Calf Nutrition and Management in Kansas	Animal Sciences and Industry, Surgery and Medicine, Laboratory Medicine, Fort Hays Branch Station
H740	Relationship of Nutrient Intake and Exercise to Equine Growth and Development	Animal Sciences and Industry
H741	Mechanisms of Insect-Plant Interactions: Sorghum Resistance to Insect Pests	Entomology, Agronomy

H743	Metabolic Roles of Guanine Nucleotides in Hepatic Metabolism	Biology
H744	Biochemistry of Genetic Systems	Biochemistry
H745	Electrical Energy Use and Load Management for Grain Processing and Handling	Agricultural Engineering
H746	Loss Avoidance and Objective Condition Criteria of Stored Grain or Grain Products	Grain Science and Industry
H747	Water Quality Protection Strategies for Private Groundwater Supplies	Civil Engineering
H764	Optimum Use of Harvested Forage Crops for Ruminant Livestock Production	Animal Sciences and Industry
H765	Pelvic Area of Bulls as a Predictor of Maternal Calving Ease	Surgery and Medicine, Animal Sciences and Industry
H766	Genetics of Biotypes in the Hessian Fly (Mayetiola destructor)	Entomology
H768	Rural Retailing: Impact of Change on Consumer and Consumption	Clothing, Textiles, and Interior Design
H769	Determination of the Inheritability of Episodic Weakness due to Hyperkalemia	Surgery and Medicine, Pathology
H772	Fungal Diseases of Wheat and Their Control	Plant Pathology
H774	Micro-Environment Modification for Field/Greenhouse Vegetable Production	Horticulture
H775	Impact of Agricultural Policy on Producers, Consumers, and Taxpayers	Agricultural Economics
H776	Resistance of Wheat and Sorghum Arthropod Pests and the Control of Horn Flies	Entomology
H777	Immunological Expression of Proteins Pertinent to Bovine Respiratory Syncytial Virus	Pathology
H778	Improvement of Bread Quality: Role of Fats in Bread Staling	Grain Science and Industry
H780	Ruminal Microbial and Metabolic Development in Neonatal Calves	Animal Sciences and Industry
H781	Forage Management and Utilization	Agronomy, Agricultural Economics
H782	Glycosphingolipid Interactions with the NA+, K+ -ATPase	Biology
H783	Evaluation of Landscape Plants for Kansas	Horticulture
H784	Mechanism of Seasonal Reproduction in Diverse Breeds of Sheep	Animal Sciences and Industry
H786	Mechanism of Pentaiodide Resin Disinfection on Parasite Cysts, Bacteria, and Viruses	Biology, Chemistry
H787	Embryo-Uterine Interaction for Pregnancy Establishment and Embryo Survival	Animal Sciences and Industry
H788	Electrophoretic Characterization of Cryptosporidium parvum	Biology
H789	Reproductive Strategies in the Hessian Fly	Entomology
H790	Improvements in Irrigated Water Management for the Central Great Plains	Northwest Research-Extension Center
H791	Analysis of Animal Feeds and Products by Near Infrared Reflectance Spectroscopy	Animal Sciences and Industry
H792	Characterization of the MI Locus Conferring Resistance to Meloidogyne incognita in Tomato	Plant Pathology
H793	Changing Characteristics and Structure of Kansas Farms	Agricultural Economics
H794	A Search for Restrictive Fragment Length Polymorphisms (RFLP) in Bovine Genome	Pathology
H795	Studies of Staphylococcal Toxins	Biology
H796	Differentiation and Activation of Macrophage Cytokine Genes after Immune Stimulation	Laboratory Medicine
H797	Evaluation of Factors Affecting Biological Control of the Squash Bug	Entomology
H798	Ecology of Vegetative Reproduction in Tallgrass Prairie Perennials	Biology
H799	Respiratory Disease and Environmental Stress in Food Animals	Animal Sciences and Industry, Veterinary Diagnosis
H800	Local Economic Development Efforts and Community Well-Being	Sociology, Anthropology, and Social Work
H802	Stress-Induced Dormancy in Turfgrass and Its Alleviation	Horticulture
H804	Regulatory Regions of Barley Alpha-Amylase Genes	Biology
H805	A Proportionate Mortality Study of Cancer among Kansas Farmers	Sociology, Anthropology, and Social Work
H813	Gelatin Kinetics in Macromolecular Solutions	Physics
H819	NMR Studies of Structure and Dynamics of Nitrite Reductase	Biochemistry
H820	Improved Methods for Agricultural Chemical Application	Agricultural Engineering
H821	In Vitro Expression of Antigens and Toxins by Pasteurella haemolytica in an Iron-Variable Environment	Laboratory Medicine
H822	Kansas Wheat Quality Profile	Grain Science and Industry
H823	Large-Scale Milling and Baking	Grain Science and Industry
H824	An Economic Analysis of the Impact of USDA Farm Programs on Cropping Systems and Rural Income in Kansas	Agricultural Economics
H828	Therapist Characteristics: Retention in Rural Areas and Therapy Outcome	Human Development and Family Studies
H829	Evolutionary and Systematic Studies of Plants in the Great Plains and Cordillera	Biology
H830	Effect of Selected Dietary Fibers on Cholesterol Metabolism	Foods and Nutrition
H832	Morphometric Analyses of Experimentally Induced Lesions in Cattle and Swine	Anatomy and Physiology
H833	No-Till Wheat-Sorghum-Corn Rotation for South Central Kansas	Agronomy
H842	NH_4:NO_3 Ratio Management on Corn	Agronomy
H844	Effects of Processing on the Nutritional Impact of Dietary Fiber	Grain Science and Industry
H851	Nutritional Status and Physical Activity of Older Rural Women Living Alone	Foods and Nutrition
H872	A Kansas Agricultural Transportation Policy Analysis Model	Economics
H883	New and Nutritionally Improved Food Products from Wheat and Other Cereal Grains	Grain Science and Industry
H884	Reduced Tillage and Crop Rotation Systems for Winter Wheat and Grain Sorghum in Central Kansas	Agronomy
H947	Increased Reproductive Efficiency in Beef Cattle	Animal Sciences and Industry, Anatomy and Physiology, Pathology
M502	Energy Production from Mixed Species Woody Biomass Plantations in the Plains States	Forestry
M596	Public Access to Private Forest Lands in Eastern Kansas	Forestry
M632	Economic Analysis of the Recreational Use of Windbreaks and Shelterbelts in Kansas	Forestry
M742	Tree Improvement in Kansas	Forestry
M836	Economic Benefits of Urban and Community Forestry Program Participation within Business Areas	Forestry

State Projects

R097	Forage Production and Use in Southeastern Kansas	Southeast Kansas Branch Station
R098	Field Crop Evaluations for Southeastern Kansas	Southeast Kansas Branch Station
R099	Evaluations of Alternatives in Soil and Water Management Practices in Southeast Kansas	Southeast Kansas Branch Station
R121	Horticultural Investigations in Northwest Kansas	Northwest Research-Extension Center
R170	Studies on the Flora of the Grasslands	Biology
R174	Beef Cattle Production and Management in Southeast Kansas	Southeast Kansas Branch Station
R211	Genetic Improvement of Wheat	Fort Hays Branch Station
R247	Characterization of Genes for Storage Proteins of Wheat Grain	Biochemistry
R252	Beef Cattle Feeding Investigations	Fort Hays Branch Station
R255	Beef Cow Herd Management	Fort Hays Branch Station
R291	Management of Soil in Dryland Regions	Fort Hays Branch Station
R293	Crop Improvement in Northwest Kansas	Northwest Research-Extension Center
R294	Soil Management in Northwestern Kansas	Northwest Research-Extension Center
R304	Weed Control Investigations	Fort Hays Branch Station
R378	Coordination of Crop Variety Testing	Agronomy
R400	Design, Development, Construction, and Maintenance of Research Equipment	Physics
R403	Agricultural Research Publications	Director of Research
R443	Biology and Control of Feedlot Insects in Western Kansas	Southwest Kansas Research-Extension Center
R462	Soil Fertility and Water Management in Semi-Arid Cropping Systems	Southwest Kansas Research-Extension Center
R474	Efficient Irrigation and Drainage Systems	Agricultural Engineering
R479	Assessing Lime Needs in South Central Kansas	Agronomy
R503	Flavor Panel Analysis of Food Products	Foods and Nutrition
R513	Crayfish Culture in Kansas	Biology
R522	Wheat Utilization: Nonfood and Nonfeed Uses	Grain Science and Industry
R523	Development and Evaluation of Wheat Hardness Tests	Grain Science and Industry, Agricultural Engineering, Physics
R525	Wheat as a Feed	Animal Sciences and Industry, Fort Hays Branch Station, Southwest Kansas Research-Extension Center
R535	Flavor Changes and Interactions of Alternative Sweetener Systems as Used in Food Products	Foods and Nutrition
R545	Genetic Improvement of Melon (Cucumis melo)	Horticulture
R550	Field Crop Variety Identification and Pure Seed Maintenance	Agronomy
R593	Utilization of Starch in the Small Intestine of Ruminants	Animal Sciences and Industry, Southwest Kansas Research-Extension Center
R594	Efficient Beef Cattle Production	Southwest Kansas Research-Extension Center
R600	Agriculture Institute - International Grains Program	Grain Science and Industry
R602	Increasing Efficiency of Feeding Program for Dairy Replacement Heifers	Animal Sciences and Industry, Agronomy
R605	Improvement of Crop Plants for Southwest Kansas	Southwest Kansas Research-Extension Center
R608	Propagation and Culture of Landscape Plants	Horticulture
R617	Communication Patterns and Family Relationship Satisfaction among Rural Families	Human Development and Family Studies
R619	Development of New Methods of Chemical Analysis in Agriculture	Chemistry
R621	Dryland Cropping Systems for Southwest Kansas	Southwest Kansas Research-Extension Center
R630	Growth Potential of Royal Paulownia in Kansas	Forestry
R637	Design, Development, Construction, and Maintenance of Glass and Quartz Research Equipment	Chemistry
R641	Developing Weed Management Systems for Southwest Kansas	Southwest Kansas Research-Extension Center
R643	Farmer Buyer Behavioral Model for the Purchase of Seed and Pesticides in Kansas	Marketing
R645	Managing Range to Increase Forage-Conversion Efficiency	Fort Hays Branch Station
R646	Freezing Tolerance and Injury in Peach Flower Buds and Brambles	Horticulture
R647	Drought Tolerance and Water Use of Turfgrasses	Horticulture
R648	Efficiency of Nitrogen Fixation	Biochemistry
R649	Slowly Activating Carboxylase of Wheat	Biochemistry
R650	Exploratory Research in Animal Health and Disease	Veterinary Medicine
R651	Epidemiological, Immunological, and Animal-Agent Interactions in Disease	Laboratory Medicine
R652	Pathological Aspects of Infectious and Non-Infectious Diseases	Pathology
R653	Anatomical, Physiological, and Pharmacological Mechanisms in Health and Disease	Anatomy and Physiology
R654	Medical, Surgical, and Pathophysiological Aspects of Animal Disease	Surgery and Medicine
R655	Diagnostic Pathogenesis and Epidemiology of Livestock and Poultry Diseases	Veterinary Diagnosis
R657	Screening, Selection, and Propagation of Chlorosis-Resistant Pin Oaks	Horticulture
R660	Improvement of Pearl Millet and Sunflower	Fort Hays Branch Station
R662	Nematode Ecology and Host-Parasite Relations in Natural and Agronomic Systems	Plant Pathology
R664	Heat Stress of Small Fruit Crops and Methods for Stress Alleviation	Horticulture
R665	Genetic Improvement of Sorghum	Fort Hays Branch Station
R666	Changes in Energy Product Price Ratio and Water Availability	Agricultural Economics
R671	Soil Conservation Systems	Agricultural Engineering

R672	Management Systems for Optimizing Beef Production	Animal Sciences and Industry, Surgery and Medicine
R674	Evaluation of Frozen Meals for Home-Delivery for the Rural Elderly	Hotel, Restaurant, Institution Management and Dietetics
R675	Neutron Activation Analysis Research Services	Nuclear Engineering
R677	Thermal Conversion of Woody Biomass	Chemical Engineering, Forestry
R678	Use of Tall Fescue Pastures Infested by the Endophyte Acremonium coenophialum	Southeast Kansas Branch Station
R679	Process Modification for Production of Whole Wheat Bread	Grain Science and Industry
R680	Testing Wright's Theory of Olfaction Using Deuterated Molecules	Chemistry
R682	Immunologic and Biochemical Characterization of Porcine Serum Immunoglobulins	Pathology
R683	Swine Reproduction Efficiency	Animal Sciences and Industry
R685	Efficient Resource Management for Dryland and Irrigated Soils	Southwest Research-Extension Center
R688	Swine Production Efficiency - Nutrition and Management of Weaned Pigs	Animal Sciences and Industry, Anatomy and Physiology
R690	Isolation and Characterization of Porcine Defensins	Pathology
R692	Kansas Family Data Bank	Human Development and Family Studies
R694	Impacts of Rodents on Rangeland and Cropland: Beneficial or Detrimental?	Biology
R695	Preparation of Polymers to Selectively Remove NO_3-, PO_4-3, and CRO_4- from Water	Chemistry
R697	A Reassessment of the Iron Requirements of Neonatal Pigs	Pathology
R699	A Surface Antigen of Pasteurella multocida	Laboratory Medicine
R700	Production Methods for Increased Efficiency of Ewe-Lamb Enterprises	Northwest Research-Extension Center
R703	Antimicrobial Properties of Textiles	Clothing, Textiles, and Interior Design
R705	Developing and Improving Kansas Grain-Based Products	Foods and Nutrition
R712	Water Vapor Movement in Stored Grain	Agricultural Engineering
R718	Soybean Cultivar Evaluation in Southeastern Kansas	Southeast Kansas Branch Station
R731	Fruit and Vegetable Adaptation and Production Systems for South-Central Kansas	Horticulture
R732	Adaptation, Propagation, and Stress of Ornamentals and Turfgrass in South-Central Kansas	Horticulture, Plant Pathology
R738	Kansas Water Resources Research Institute	Kansas Water Resources Research Institute
R749	Transport of Agricultural Chemicals through Soil	Agronomy, Civil Engineering, Agricultural Engineering
R750	Insecticidal Activity of Soybean Oil Soap	Biochemistry, Entomology
R751	Reduced Tillage Weed Management with Minimal Chemical Input	Agronomy
R752	Plant Improvement for Low-Input Agriculture by Gene Transformation	Plant Pathology, Entomology
R753	Sustaining Irrigated Agriculture in Kansas with Drip Irrigation	Northwest Research-Extension Center, Agricultural Engineering
R754	Use of a Legume-Grain Sorghum Rotation in a Crop-Livestock System	Southeast Kansas Branch Station, Agricultural Economics
R755	Evaluation of Exotic Parasites for Biological Control of the Russian Wheat Aphid	Entomology
R756	Genetic Engineering of Grain Resistance to Stored Product Insects	Biochemistry, Entomology
R757	Microbial Control of Winter Annual Grass Weeds in Winter Wheat	Fort Hays Branch Station, Agronomy
R758	Use of Non-Enzymatic Browning Products as Antioxidants in Restructured Beef	Animal Sciences and Industry
R759	Processing and Alternate Uses of Hard Red and Hard White Winter Wheats	Grain Science and Industry
R760	Kansas Cereals as a Source of Antifungal Proteins	Plant Pathology, Biochemistry
R761	Non-Food Uses of Soybean Protein and Oil in Textile Manufacturing, Printing, and Finishing	Clothing, Textiles, and Interior Design, Foods and Nutrition, Chemistry
R762	Impact of Community Well-Being on Rural Children and Families	Human Development and Family Studies
R763	The Effect of Agricultural Commodity Programs on Kansas Farm Family Consumption	Agricultural Economics
R770	Advances in Human Ecology Research	Human Ecology
R806	Cornbelt Experiment Field	Agronomy
R807	East Central Kansas Experiment Field	Agronomy
R808	Irrigation Experiment Field, Scandia, Kansas	Agronomy, Agricultural Engineering
R809	Harvey County Experiment Field	Agronomy
R810	North Central Kansas Experiment Field, Belleville	Agronomy, Agricultural Engineering
R811	Sandyland Experiment Field	Agricultural Engineering, Agronomy
R812	South Central Kansas Experiment Field	Agronomy
R814	East Central Kansas Horticulture Field	Horticulture
R816	Pecan Experiment Field	Horticulture
R817	Analytical Services Laboratory	Animal Sciences and Industry
R818	Kansas River Valley Experiment Field	Agronomy, Agricultural Engineering
R825	Statistical Laboratory	Statistics
R826	Scanning Electron Microscope Service	Entomology
R834	Irrigation Management for Southwest Kansas	Southwest Research-Extension Center
R839	The Impact of Non-Traditional Immigrants on Kansas Communities	Sociology, Anthropology, and Social Work
R847	Forestry Investigations in the Great Plains of Kansas	Northwest Research-Extension Center, Southwest Kansas Research-Extension Center, Fort Hays Branch Station, Agricultural Engineering
R909	Function and Regulation of Mammalian Alpha-Keto Acid Dehydrogenase	Biochemistry
R927	Transmission Electron Microscope Service Facility	Biology
R987	Near Infrared Wheat Protein Screening	Grain Science and Industry

■ *Sponsored Projects*

481858	Protein Expression of Recombinant DNA to Bovine Viral Diarrhea Virus	Pathology
481859	Isolation and Sequencing of a Neutralizing Epitope of Bovine Viral Diarrhea Virus	Laboratory Medicine
481860	Identification of Important Protein of Pleuropneumonia: A Molecular Approach	Pathology
481861	Immunomodulation of Mastitis with Bovine Recombinant Cytokines	Anatomy and Physiology
481862	Evaluating DNA Probe to Eperythrozoon suis and Determining Prevalence in Swine	Pathology
481863	The Molecular Genetics of Heritable Diseases of Cattle	Anatomy and Physiology
481864	Pharmaceutical Inactivation of Endotoxin from Gram-Negative Bacteria	Surgery and Medicine
481865	Epizootic Potential of Lyme Disease in Kansas	Biology
481866	Effect of Hydrocortisone and Restraint-Isolation Stress on Endocrine and Immune Functions of Lambs	Animal Sciences and Industry
481867	Ultrastructural Demonstration of Lipid Peroxidation	Pathology
481868	Vaccine Potential of P. haemolytica Growth-Condition Dependent Antigens	Laboratory Medicine
481869	Development of a DNA Probe to Chlamydia psittaci for a Diagnostic Tool	Veterinary Diagnosis
481870	Induction of Detoxification Enzymes as a Source of Insecticide Resistance of the Horn Fly	Entomology
481871	Changes in Feedlot Cattle Ruminal Contents: Correlation to Animal Health Status	Anatomy and Physiology
520002	Management Information System for Local Governments	Agricultural Economics
520005	Studies in Professional Farm Management and Rural Appraisals (Training, Practices, Fees)	Agricultural Economics
520007	Breeding White Corn for Milling Use	Agronomy
520010	Water Use Efficiency in Corn	Agronomy
520021	Measurements of Micrometeorological Parameters for Testing Large-Scale Models	Agronomy
520024	Genetic Improvement of Sorghum for Sustainable Agroecosytems	Agronomy
520033	Soil Fertility and Soil Management Investigations	Agronomy
520035	Crop Physiology - Production Research	Agronomy
520040	Crop Performance	Agronomy, Northwest Research-Extension Center, Fort Hays Branch Station, Southwest Kansas Research-Extension Center, Southeast Kansas Branch Station
520044	Range and Pasture Brush and Weed Control	Agronomy
520046	Corn and Grain Sorghum Production and Management	Agronomy
520050	Seed and Plant Parts Certification	Agronomy
520052	Field Herbicidal Evaluations	Agronomy
520053	Fertilizer Tests and Demonstrations	Agronomy
520065	Food Security Management (FSM) Project	Food and Feed Grains Institute
520074	Plant-Insect Interaction Research	Entomology
520080	An Evaluation of Luprostiol as an Abortifacient in Beef Heifers	Animal Sciences and Industry
520099	Connection with the Development of a Flour Mill Sanitation Manual	Entomology
520100	Insecticide Management of Foliar and Stalk-Boring Insects Affecting Alfalfa, Corn, and Soybeans in Northeastern Kansas	Entomology
520101	Insecticide Management of Field Crop Insect Pests in Southwestern Kansas	Entomology
520103	Chemical Control of Insect Pests of Corn and Other Field Crops, Small Grains, and Forages	Entomology
520106	Biology and Control of Arthropod Pests of Livestock	Entomology
520107	Biology and Control of Insect Pests of Stored Products	Entomology
520116	Starch Retrogradation and Staling	Grain Science and Industry
520150	Large-Scale Milling and Baking Trials of New Wheat Varieties	Grain Science and Industry
520152	Turfgrass Investigations	Horticulture
520159	Horticultural Herbicides	Horticulture
520161	Fertilization of Woody Landscape Plants	Horticulture
520163	Herbicides for Weed Control around Woody Plants	Forestry
520164	Provenance Variation in Native Populations of Pinus virginiana for Christmas Trees in Kansas	Forestry
520165	Evaluation of Garlon 3A Herbicide and Related Formulation	Forestry
520166	Great Plains Energy Forest	Forestry
520171 & 520172	Training of Personnel of Northeastern State-Nigeria	International Agriculture
520177	Benue State Nigeria	International Agriculture
520179	IAP Borno State Nigeria	International Agriculture
520187	Testing Alfalfa Introductions for Pathogens	Plant Pathology
520190	Wheat Rust Fungicide Field Tests	Plant Pathology
520193	Characterization of Fusarium moniliforme Populations Isolated from Sorghum in Kansas	Plant Pathology
520194	Characterization of Fusarium moniliforme Populations Isolated from Corn in Kansas	Plant Pathology
520198	Identification and Quantification of Nematodes in Interaction with Bacterial and Fungal Incitants in Stalk Rot Complexes of Millet	Plant Pathology
520199	Soybean Foliar Fungicide and Seed Treatment Tests	Plant Pathology
520201	Evaluations and Testing of Fungicides and Nematicides on Horticultural Crops	Plant Pathology
520202	Seed Treatment	Plant Pathology
520203	Field Evaluations of Chemicals for Controlling Fungi, Bacteria, and Nematodes of Kansas Crops	Plant Pathology
520205	Chemical Control of Phytoparasitic Nematodes	Plant Pathology
520208	Cooperative Educational Preceptorship Program for University Students to Gain Specialized on-the-Job Knowledge and Experience in Various Research Projects in the Agricultural Sciences	Director's Office

520209	Agricultural Research Activities	Director's Office
520236	Seed Quality of Winter Wheat as Related to Crop Management Practices	Northwest Research-Extension Center
520239	Breeding for Wheat Improvement and Wheat Pest Control in South-Central Kansas	Fort Hays Branch Station
520241	Development of Grain Sorghum Resistant to Production Hazards	Fort Hays Branch Station, Entomology
520247	Management of Fertilizer and Irrigation Water in High Plains	Southwest Kansas Research-Extension Center
520249	Evaluation of New Products to Improve the Efficiency of Production in Feedlot Cattle	Southwest Kansas Research-Extension Center
520251	Herbicides for Weed Control on Fallow Ground	Southwest Kansas Research-Extension Center
520254	Weed Control in Farm Crops	Southeast Kansas Branch Station
520262	Breeding for Resistance to Charcoal Rot	Agronomy
520290	Molecular Biology of Rice Storage Proteins	Biochemistry
520321	Pathogenesis and Diagnosis of Congenital Defects in Cattle	Pathology
520333	Pioneer Plant Breeding Fellowship	Agronomy
520336	Yield and Quality of Hay from Sudangrass and Pearl Millet Lines	Southeast Kansas Branch Station
520342	Insecticide Management of Field Crop Insects at Hays, Kansas	Entomology
520347	Insecticide Management of Field Crop Insects in Southwestern Kansas	Entomology
520348	Postharvest Grain Systems Research and Development	Food and Feed Grains Institute
520349	Mined-Land Reclamation	Agronomy
520350	Pearl Millet Breeding	Fort Hays Branch Station
520353	Seedling Vigor, Stand Establishment, Plant Growth and Development, Water Use, and Drought Resistance of Pearl Millet	Agronomy
520354	Water Use Efficiency...and Crop Rotation of Sorghum/Millet in Botswana	Agronomy
520360	The Role of Fire and Other Disturbances in Determining Ecosystem Processes and Patterns in the Konza Prairie, Manhattan, Kansas	Biology
520361	The Use of Serum Ferritin and Iron to Diagnose the Anemia of Chronic Disorders in Cats	Pathology
520363	Chinch Bug Dietetics	Entomology
520365	Sunflower Performance Testing Program	Northwest Research-Extension Center
520407	Rapid Non-Destructive Assessment of Sorghum Resistance to Greenbugs	Entomology, Agronomy
520412	Breeding Sorghum for Tolerance to Fusarium Stalk Rot	Agronomy, Plant Pathology
520452	Management of Stored Grain Insect Problems	Agricultural Economics, Grain Science and Industry, Entomology
520453	An Economic Comparison of the Kansas State Data Bank Farm Records and Those Randomly Surveyed by USDA	Agricultural Economics
520455	Soybean Cultivar Development for Southeastern Kansas	Agricultural Economics
520456	Kansas Value-Added Center-Ag Economics	Agricultural Economics
520458	Impacts of Forward Contracting and Market Structure in the Fed Cattle Industry	Agricultural Economics
520651 & 520652	Support of Agricultural Research of Mutual Interest	Agronomy
520656	Estimation of Nitrogen Mineralization from Soil Organic Matter	Agronomy
520660	Evaluation and Improvement of Wheat Germplasm for Tolerance to Heat Stress	Agronomy
520663	Breeding Grain Sorghum for Improved Dryland Production	Agronomy
520665	Grazingland Establishment and Renovation	Agronomy
520666	Editorial Expenses for Refereed Journals	Agronomy
520667	Ash Reclamation for Kansas City Power and Light	Agronomy
520668	Bioregulation of Soil Fertility	Agronomy
520669	Breeding Soybeans for Increased Productivity	Agronomy, Plant Pathology
520670	Estimating Yield Loss from Cutworm Damage to Sorghum	Agronomy
520671	Development of Computer Software to Assist Soybean Growers in Selecting Their Most Optimum Soybean Varieties	Agronomy
520672	In Vitro Production of Haploids via Anther Culture and Artificial Induction of F1 Hybrid Seeds in Corn	Agronomy
520674	Study to Estimate Plant Residue from Spectral Reflectance Measurements	Agronomy
520676	Fertilizer Recommendation Computer Software	Agronomy
520677	Assessing Soil Phosphorus Availability in Low-Input Systems	Agronomy
520678	Substituting Legumes for Fallow in U.S. Great Plains Wheat Production	Agronomy
520679	Utilization of Wild Relatives of Sorghum bicolor for Genetic Improvement of Adapted Germplasm	Agronomy
520680	Genetic Improvement of Winter Wheat for Kansas	Agronomy
520681	Improving Wheat Varietal Development by Selecting for High Photosynthesis during Grain Filling	Agronomy
520682	Determining the Force Exerted by Wheat Coleoptiles	Agronomy
520683	Development of a System to Double-Crop Corn after Corn for Southeastern Kansas	Agronomy
520684	Identifying Acetanilide Herbicide Tolerance in Grain Sorghum	Agronomy
520685	Breeding Sorghum for Improved Digestibility and Feed Efficiency	Agronomy
520686	Dryland Corn Management for Western Kansas	Agronomy
520687	Degradation of Atrazine in Soil Columns	Agronomy
520688	Simulation of Soil Stability, Wetness, and Range Vegetation for WEPS	Agronomy
520689	Cooperative Trueness to Variety Testing of Seed	Agronomy
520690	Synchrony and Contribution of Legume Nitrogen for Grain Production under Different Tillage Systems	Agronomy
520691	Stratification and Fate of N in Soil Profiles: Management-Induced Changes	Agronomy
520692	Protecting Soybean Production Using Cyst Nematode Resistant Cultivars	Agronomy
521651	A Study of Quality Evaluation Criteria and Lactic Acid Bacteria Addition to Alfalfa, Corn, and Sorghum Silages	Animal Sciences and Industry

Research Projects Active June 30, 1990 (Continued)

521655	A Study of Utilization of Niacin in Brood Sow Diets	Animal Sciences and Industry
521656	A Study of the Effects of Lactic Acid Bacteria Addition and Environmental Temperatures on Fermentation Dynamics and Silage Quality	Animal Sciences and Industry
521657	A Study of Utilization of Niacin in Brood Sow Diets	Animal Sciences and Industry
521663	Effect of Lasalocid in Rations for Young Dairy Heifers	Animal Sciences and Industry
521664	Support of Agricultural Research of Mutual Interest	Animal Sciences and Industry
521665	A Study of the Influence of Calcium Level and Fat Source in Cattle Finishing Diets	Animal Sciences and Industry
521668	Causes and Solution to the Problem of Cooked Beef Iridescence	Animal Sciences and Industry
521670	International Livestock Program - Internationl Trade Development	Animal Sciences and Industry
521673	A Study of the Influence of Pelleting on Ruminal Digestion and Fat Addition on Feed Intake of Heifers	Animal Sciences and Industry
521675	Effect of Tetronasin on Legume Bloat in Cattle	Animal Sciences and Industry
521676	A Study of the Effect of Folic Acid on Sow and Pig Performance	Animal Sciences and Industry
521678	A Study of the Effects of Biological and Chemical Treatments on the Preservation and Nutritional Value of High Moisture Corn for Growing/Finishing Pigs	Animal Sciences and Industry
521679	A Study of Dose-Response of the Newly Weaned Pig to Streptoccus faecium (Syntabac)	Animal Sciences and Industry
521680	An Evaluation of the Silage Potential of Corn Hybrids	Animal Sciences and Industry
521681	A Study of the Use of GNRH (Cystorelin R) in Repeat Breeders	Animal Sciences and Industry
521682	A Clinical Investigation of the Efficacious and Safe Use of Sponsor's Product in Lactating Dairy Cows	Animal Sciences and Industry
521684	A Study of the Effect of Steam-Flaked Grain Sorghum vs Corn-Based Finishing Rations with and without Added Fat on Cattle Performance, Carcass Characteristics, and Chemical and Organoleptic Properties of Beef	Animal Sciences and Industry
521686	A Study to Determine the Efficacy of Aspergillus oryzae as a Component of Calf Starter for Young Dairy Calves	Animal Sciences and Industry
521687	A Study to Determine the Efficacy of Hydrolyzed Spray Dried Plasma Protein as a Replacement for Milk Protein in Calf Milk Replacers	Animal Sciences and Industry
521688	Effects of Porcine Somatotropin and Supplemental Lysine Enhanced Growth on Pork Quality and Muscle Fiber Type and Diameter	Animal Sciences and Industry
521689	Effect of Modified Gas Atmosphere Packaging and Carcass Chill Rate on Pork Loin Color, Display Life, and Related Traits	Animal Sciences and Industry
521690	Effect of Dietary Aspergillus oryzae on Rumen Metabolism and Microbiology in Young Calves	Animal Sciences and Industry
521692	Palatability Improvement of Low-Fat Ground Beef	Animal Sciences and Industry
521693	Animal Science Food Safety Consortium KSU	Animal Sciences and Industry
521694	An Evalution of a Vaccine against Liver Abscesses in Feedlot Steers	Animal Sciences and Industry
521695	Textural and Sensory Characteristics of Bologna Containing Different Levels of Fat and Added Water	Animal Sciences and Industry
521696	An Evaluation of Biological Additives for Sudangrass and Sorghum	Animal Sciences and Industry
521698	Grain Sorghum plus Processed Tallow vs Corn as a Dietary Energy Source for Lactating Holstein Cows	Animal Sciences and Industry
521700	A Study of the Effect of Supplemental Niacin on Gestating-Lactation Sow Reproductive Performance	Animal Sciences and Industry
521701	Revalor Reimplant Study in Stocker and Feedlot Cattle	Animal Sciences and Industry
521702	A Study of the Use of Alza Mini-Pumps to Establish the Minimum Effective Norgestomet Dose Needed to Suppress Estrus	Animal Sciences and Industry
521703	A Study of the Postmortem Temperature Rise in the Deep Round of Beef Carcasses	Animal Sciences and Industry
521704	A Study of the Effect of Lasalocid on Grain Bloat	Animal Sciences and Industry
521705	Administration of Receptal during the Post-Insemination Luteal Phase of Dairy Cattle and Conception Rates at First Service	Animal Sciences and Industry
521706	The Effect of Feeding a Composite Fat in an Extruded Concentrate Form on Brood Mare Condition Scores during the Last Third Gestation	Animal Sciences and Industry
521707	A Replacement for Coconut Oil with Unsaturated Oils from Goco Milk Plants	Animal Sciences and Industry
521708	A Study of Parasite Control and Its Influence on First Pregnancy Fertility in Beef Heifers	Animal Sciences and Industry
521709	Experimental Induction of Liver Abscesses in Feedlot Steers	Animal Sciences and Industry
521710	Evalution of Tilmicosin for Prevention of Liver Abscesses in Cattle	Animal Sciences and Industry
521711	The Effect of Feeding a High Fat Concentrate in an Extruded Form on Brood Mare Lactation and Foal Growth	Animal Sciences and Industry
521712	A Study of the Utilization of L-Carnitine in Nursery Pigs	Animal Sciences and Industry
521713	Appearance Characteristics of Fresh Beef as Affected by Display Lighting for Two Packaging Systems	Animal Sciences and Industry
522252	Support of Agricultural Research of Mutual interest	Entomology
522254	Greenbug Toxins Injected into Sorghum	Entomology, Agronomy
522255	Regulation of Tyrosine Metablosim for Insect Cuticle Tanning	Entomology
522257	Development of Sorghum Resistant to Water Stress and Spider Mites	Entomology, Agronomy
522261	Quantifying Behavioral Responses of Adult Hessian Flies to Host and Non-Hosts	Entomology
522262	Management of Stored Grain Insect Problems	Entomology, Grain Science and Industry, Agricultural Economics
522263	Influence of Behavior and Environment on Microbial Control of Grasshoppers	Entomology
522264	Screening Common Wheat for Resistance to the Russian Wheat Aphid	Entomology
522265	Effect of Nitrogen Levels on Greenbug Populations Infesting Grain Sorghum	Entomology
522266	Development of Grain and Forage Sorghums Resistant to Chinch Bug	Entomology
522268	Genetic Potential of Banks Grass Mite Adaptation to Agroecosystem Structure	Entomology
522269	Impact of Indian Meal Moth Webbing on the Economics of Grain Aeration	Entomology
522271	Integration of Harborage Reduction into Insect Control Program in Army Dining Facilities	Entomology
522272	Insecticde Resistance Management in Horn Flies	Entomology
522273	Management of Insects Affecting Horticultural Crops in Kansas	Entomology
522274	Spider Mite Resistance to Miticides and Its Impact on Spider Mite Control in Kansas Corn	Entomology
522275	Safer Yet Equally Effective Corn Borer Insecticides for Conventional and Insectigation Use?	Entomology

522276	Validating the KSU European Corn Borer Model and Producing Publications of Mutual Interest	Entomology
522277	Determining Velvetleaf Radius-of-Influence Effects upon Intact and Injured Soybean Stands to Improve Profitability	Entomology
522278	Development of Species Specific DNA Probes to Monitor Levels of Parasitism of Greenbug on Sorghum	Entomology
522279	Evaluation of Resistance to Chinch Bugs among Sorghum P.I. Accessions	Entomology
522281	Resistance to Spider Mites in Field Corn	Entomology
522282	Evaluation of Exclusion Cage Techniques for Assessing Impact of Russian Wheat Aphids Biological Control	Entomology
522283	Evaluation of the Need for and Alternatives to Granular Carbofuran for Control of Chinch Bugs and Greenbugs on Seedling Sorghum	Entomology
522284	A Recombinant Map of Virulence Genes in the Hessian Fly	Entomology
522850	Support of Agricultural Research of Mutual Interest	Grain Science and Industry
522853	Improved Biological Utilization and Availability of Dry Beans	Grain Science and Industry
522856	Rancidity in Oat Products	Grain Science and Industry
522861	Factors Controlling the Viscosity of Batter Systems	Grain Science and Industry
522867	Determination of the Amount of Flax in a Flour Mix	Grain Science and Industry
522871	The Use of L-Ascorbate 2-Phosphate in Foods	Grain Science and Industry
522872	Management of Stored Grain Insect Problems	Grain Science and Industry, Entomology, Agricultural Economics
522877	Computer Interface to the Mixograph	Grain Science and Industry
522878	Baking Quality of Vital Gluten	Grain Science and Industry
522879	Variations in Cake Flour Quality	Grain Science and Industry
522880	Measurement of Dough Stickiness	Grain Science and Industry
522881	Isolation of Oat Starch and Protein from Oat Flour and Testing of Cationic Starch in Papermaking	Grain Science and Industry
522883	Effect of Particle Size and Other Factors on Cake Flour Quality	Grain Science and Industry
522885	Evaluation of End-Use Properties of Hard Winter Wheat Breeder's Progenies	Grain Science and Industry
522886	Effect of Fatty Materials on Swelling of Starch	Grain Science and Industry
522887	Study of Rheological Characteristics of Cookie and Cracker Doughs	Grain Science and Industry
522888	Isolation and Characterization of a Baking Factor Rye	Grain Science and Industry
522889	Factors Affecting the Apparent Density of Pelleted Dairy Feeds	Grain Science and Industry
522890	Support for a Research Extrusion Position	Grain Science and Industry
522892	Phosphate Source Attributes that Affect Pellet Mill Performance	Grain Science and Industry
522893	Dry Mix Development Laboratory	Grain Science and Industry
522851	Human Physiological Responses to Plants in Indoor Work Environments	Horticulture
523854	Environmental and Chemical Manipulation of Flowering of Herbaceous Perennial Plant Species	Horticulture
523855	Adaptability of Evergreen Rhododendron Cultivars to the Great Plains as Influenced by Landscape Exposure	Horticulture
523856	Pesticide Effects on Nitrogen Fixation in Legumes	Horticulture
522859	Effect of Cultivation Technique and Polyacrylamide Gels on Quality and Safety Factors of Sports Turfs	Horticulture
523860	Pecan Cultivar Evaluation	Horticulture
523861	Assembly of Data for the IR-4 Program	Horticulture
523862	Efficacy of Insecticides against Vegetable-Feeding Insect Pests	Horticulture
523863	Creeping Bentgrass Performance as Affected by Wetting Agents and Water-Absorbing Polymers	Horticulture
524050	Transmission Line Right-of-way Vegetation Control	Forestry
524052	Test of the Shelterbelt Habitat Suitability Index Model	Forestry
520456	Development of Minelands Canoe Trail	Forestry
524251	Agricultural Technology Improvement Project (ATIP)	International Agriculture
524252	Morocco/MIAC Dryland Agricultural Applied Research Project	International Agriculture
524454 & 524456	Support of Agricultural Research of Mutual Interest	Plant Pathology
524460	Use of Oligonucleotide Synthesizer	Plant Pathology
524462	Predictive Systems for Scheduling Foliar Fungicides on Soybeans in Kansas	Plant Pathology
524463	The Use of Roundup in Minimum-Till Wheat Residue for Control of Tan Spot	Plant Pathology
524465	Evaluation of Wheat Germplasm for Leaf Rust Resistance	Plant Pathology
524467	The Ability of Seedborne Strains of Fusarium moniliforme to Cause Stalk Rot in Corn	Plant Pathology
524468	Epidemiology and Management of Fusarium Seedling Blight of Grain Sorghum in Kansas	Plant Pathology
524469	Soybean Cyst Nematode and the Charcoal Rot Fungus with Specific Attention to the Effect of Soil Factors and Cropping Sequence on Their Interaction	Plant Pathology
524470	Breeding Soybeans for Increased Productivity	Plant Pathology, Agronomy
524471	Microbial Antagonism to the Wheat Tan Spot Pathogen in Conservation Tillage Straw	Plant Pathology
524472	Assessment of the USDA-ARS Rice Germplasm Collection for Bacterial Blight Resistance	Plant Pathology
524473	Cytogenetic Analysis of Fertility and Vitality and Resistance Genes in a Polyploid Plant	Plant Pathology
524475	Non-Conventional Plant Improvement Technology	Plant Pathology
524477	Wheat Genetics Resource Center at Kansas State University	Plant Pathology
524478	Fusarium Research	Plant Pathology
524479	Biology and Control of Seed Smut of Switchgrass	Plant Pathology
524480	Effect of Disease on Seed Quality in Resistant and Susceptible Wheat Cultivars	Pathology
524481	Development of Techniques for Determining the Cause(s) of Kernel Black Point in the Wheat Cultivars Arkan, Mustang, and Victory	Plant Pathology
524482	Determining the Role of Seed in Disseminating Bacterial Disease in Sorghum	Plant Pathology

Research Projects Active June 30, 1990 (Continued)

524483	Genetically Induced Chromosome Deletion Mapping in Wheat	Plant Pathology
524484	Rockefeller Foundation Unrestricted Grant	Plant Pathology
524485	Wheat Pathology	Plant Pathology
524486	Isolation and Characterization of Avirulence Genes from Zanthomonas campestris pv. oryzae	Plant Pathology
524487	Production of Antiserum against Wheat Spindle Mosaic Virus and Incidence of the Virus in Winter Wheat in Kansas	Plant Pathology
525050	Development and Commercialization of Rapeseed	Director of Research
525052	Research on Utilization of Remote Sensing/GIS Technologies for Land Management	Director of Research
525053	Mid-America World Trade Center Support for Agricultural Products	Director of Research
525055	Director-at-Large (D.A.L.) NCR-AES	Director of Research
525056	High Euric Acid Development Effort—Crambe and Rapeseed	Director of Research
525057	Agricultural Research Activities (Research Apprenticeship in High School Studies)	Director of Research
525058	Development and Commercialization of Crambe and Rapeseed	Director of Research
525167	Cashew Market Study (Guinea Bissau)	Food and Feed Grains Institute
525350	Support of Agricultural Research of Mutual Interest	Statistical Lab
525373	KWRRI - Administrative	Kansas Water Resources Research Institute
525374	Hydrogeochemistry of the Dakota Aquifier in Western Kansas	Kansas Water Resources Research Institute
525375	Leaching of Atrazine and Nitrate through Soil and into Groundwater	Kansas Water Resources Research Institute
525376	Stream Floodwave Propagation through the Great Bend Alluvial Aquifier: A Significant Recharge and Stream-Aquifier Interaction Mechanism	Kansas Water Resources Research Institute
525377	Management of the Kansas River Basin: A Systems Approach	Kansas Water Resources Research Institute
525378	Development of Empirical Models for the Effects of Cadmium, Lead, Manganese, and Zinc on Resident Biota in the Short Creek - Empire Lake Aquatic System, Cherokee Co., Kansas	Kansas Water Resources Research Institute
525379	KWRRI Administrative	Kansas Water Resources Research Institute
525380	Microbial Contamination of Surface and Groundwaters Adjacent to Agricultural Enterprises in Kansas	Kansas Water Resources Research Institute
525381	Leaching of Atrazine and Nitrate through Soil and into Groundwater	Kansas Water Resources Research Institute
525382	Denitrification in the Vadose Zone: A Mechanism for Nitrate Removal	Kansas Water Resources Research Institute
525383	Stream Floodware Propagation through the Great Bend Alluvial Aquifier: A Significant Recharge and Stream-Aquifier Interaction Mechanism	Kansas Water Resources Research Institute
525384	Hydrogeologic Characterization of Hazardous Waste Sites	Kansas Water Resources Research Institute
525385	Water Transfer Implementation Policy and Procedures Study	Kansas Water Resources Research Institute
525386	KWRRI Administrative	Kansas Water Resources Research Institute
525387	Microbial Contamination of Surface and Groundwaters Adjacent to Agricultural Enterprises in Kansas	Kansas Water Resources Research Institute
525388	Leaching of Atrazine and Nitrate through Soil and into Groundwater	Kansas Water Resources Research Institute
525389	Denitrification in the Vadose Zone: A Mechanism for Nitrate Removal	Kansas Water Resources Research Institute
525390	Biodegradation of Atrazine in Granulated Activated Carbon Columns	Kansas Water Resources Research Institute
525391	Hydrogeologic Characterization of Hazardous Waste Sites	Kansas Water Resources Research Institute
525392	Occurrence and Control of Atrazine Degradation Products in Kansas Drinking Water Supplies	Kansas Water Resources Research Institute
525393	Trend Analysis of Surface-Water Quality of the Upper and Lower Arkansas River Basin in Kansas	Kansas Water Resources Research Institute
525750	Effect of Seed Quality on Stand Establishment and Performance of Hard Red Winter Wheat under No-Till Cultural Practices	Northwest Research-Extension Center
525752	Winter Rape Testing Project	Northwest Research-Extension Center
525953	An Alternative to Landfills for Disposals of Yard Waste and Newspaper	Fort Hays Branch Station
526151	Weed Control Research in Southwest Kansas	Southwest Kansas Research-Extension Center
526152	Quality Testing of Fly Parasites for Cattle Feedlots	Southwest Kansas Research-Extension Center
526163	Devloping Weed Management Systems in Western Kansas Grain Sorghum Production	Southwest Kansas Research-Extension Center
526154	Variety Testing of Alternative Crops	Southwest Kansas Research-Extension Center
526155	Soil Fertility and Soil Management Research for Western Kansas	Southwest Kansas Research-Extension Center
526156	Yield Appraisal of Crops for Southwest Kansas	Southwest Kansas Research-Extension Center
526157	Water Management for Southwest Kansas	Southwest Kansas Research-Extension Center
526158	Performance of Feedlot Steers Fed High Energy Diets Containing Laidlomycin Propionate and Monensin with and without Antibiotics	Southwest Kansas Research-Extension Center
526159	Parasite Manipulation to Control Flies in Confined Livestock Operations	Southwest Kansas Research-Extension Center
526160	Weed Management System in Western Kansas Soybean Production	Southwest Kansas Research-Extension Center
526161	Frost Damaged Grain Sorghum-An Evaluation of Varying Grain Test Weight Sorghums as a Livestock Feed	Southwest Kansas Research-Extension Center
526364	Phosphorus, Potassium, and Chloride Effects on Leaf Rust, Speckled Leaf Blotch, and Tan Spot in Six Wheat Cultivars	Southeast Kansas Branch Station
526366	Kansas Crop Performance Test of Short-Season Soybeans in Southeastern Kansas	Southeast Kansas Branch Station
526357	Effect of Sulfur Fertilization on Tall Fescue and Winter Wheat in Southeastern Kansas	Southeast Kansas Branch Station
526372	Agronomic Effects, Profitability, and Riskiness of Long-Term Crop Rotations in Southeastern Kansas	Southeast Kansas Branch Station, Agricultural Economics
526373	Effect of Tillage Systems and Wheel Track Compaction of Soybean and Soil Properties	Southeast Kansas Branch Station
526375	Response of Cattle Grazing High Endophyte Fescue to Synovex Implant	Southeast Kansas Branch Station
526377	Supplementation for Steers Offered Ammoniated Wheat Straw	Southeast Kansas Branch Station
526379	Management of Cattle Grazing Tall Fescue	Southeast Kansas Branch Station
526381	Digestibility of Fescue Diets Supplemented with Amaferm (Aspergillus oryzae Fermentation Extract)	Southeast Kansas Branch Station
526383	Soybean Cultivar Development for Southeastern Kansas	Southeast Kansas Branch Station
526385	Effect of Supplementation on Performance of Steers Grazing Winter Rye and Fescue	Southeast Kansas Branch Station
526386	Effect of Pasture Management Practices on Subsequent Feedlot Performance	Southeast Kansas Branch Station

526387	Performance by Steers Grazing Rye/Bermudagrass Pastures	Southeast Kansas Branch Station
526388	Effect of Grazing Intensity on Steer Grazing Performance	Southeast Kansas Branch Station
526389	Grain Levels for Steers Grazing High-Endophyte Tall Fescue	Biology
526556	Alcon Research Institute Award	Biology
526559	Bioserve Space Technologies - A NASA Center for the Commercialization of Space	Biology
526560	An Evaluation of Disking as a Technique for Creating Wildlife Food Plots	Biology
526561	Membrane Dynamics of Glycophingolipids	Biology
526563	Developing and Testing a Beaver Population Monitor System	Biology
526564	Glutamine Synthetase from Root Nodules of Beans (Phaseolus vulgaris L.)	Biology
526566	Biological Control of Land Atmosphere Exchange: An Ecosystem Approach	Biology
526567	Effects of Bison Herbivory on Two Tallgrass Prairie Species: The Influence of Fire, Neighbors, and Pattern of Defoliation on Plant Responses	Biology
526568	Interaction of Sulfatide with the Sodium ATPase	Biology
526569	To Determine the Population Parameters and Spatial Characteristics of Selected Prairie Dog Colonies in Western Kansas	Biology
526570	Anti-Idiotype Probes for Toxin Detection	Biology
526571	Tumorigenesis and a Cell Growth Inhibitor	Biology
526572	The Role of Neuropeptides in Persistent Virus Infections of the Central Nervous System	Biology
526573	Influence of Resource Limitation on Plant Responses of Silphium integrifolium to Gall Insect Attack	Biology
526574	Non-Steady State Responses in Net Photosynthesis and Stomatal Conductance during Periods of Variable Sunlight	Biology
526575	Macrophage Binding and Response to Stressed Heart Cells	Biology
526576	REU Supplement to Study Non-Steady State Response in Plants	Biology
527160	Insulin Activation of the Pyruvate Dehydrogenase Complex	Biochemistry
527164	Manipulation of Cuticle Degrading Enzymes and Their Genes	Biochemistry
527166	Studies on Malignant Hyperthermia in the Pig	Biochemistry
527169	Mutant Inhibitors of Factor XIIA	Biochemistry
527168	Structural Studies of Pumpkin Seed Inhibitors of a Blood Coagulation Factor by 2D NMR	Biochemistry
527171	Mechanism of Action of Epidermal Growth Factor	Biochemistry
527172	Cloning and Site-Directed Mutagenesis of the Inhibitory Phosphodiesterase	Biochemistry
527173	Mutations Affecting the FE Protein of Klebsiella pneumoniae Nitrogenase	Biochemistry
527174	Structural Studies of Corn Trypsin Inhibitor by NMR Spectroscopy	Biochemistry
527175	Wheat Mitochondrial DNA and Cytoplasmic Male Sterility	Biochemistry
527176	Rockefeller Foundation Unrestricted Grant	Biochemistry
527177	Sheath Blight and Expression Chitinase and B-Glucanase Genes in Resistant and Sensitive Cultivars of Rice	Biochemistry
527178	Regulation of Hepatic Fatty Acid Synthesis	Biochemistry
527179	2D NMR of Protein-Inhibitors of Blood-Coagulation Factor	Biochemistry
527180	Solution Structures and Biopotencies of Chemically Modified and Native Insulins	Biochemistry
527181 & 527182	Domain Mapping of Cyclic Nucleotide Phophodiesterase	Biochemistry
527183	Mechanism of Action for Epidermal Growth Factor	Biochemistry
527184	Mutant Inhibitors of Factor XIIA	Biochemistry
527620	Local Self Development Strategies	Sociology, Anthropology, and Social Work
527621	Evaluation of Impact of Roads on Economic Development in Kansas	Sociology, Anthropology, and Social Work
527622	Rural Community Development	Sociology, Anthropology, and Social Work
527650	Development of a Wheat Hardness Tester	Agricultural Engineering
527651	Support of Agricultural Research of Mutual Interest	Agricultural Engineering
527653	Temperature Control as a Means to Control Insect Infestation in Corn and Grain Sorghum	Agricultural Engineering
527655	Evaluation of Laboratory Model Grain Cleaning and Separating Equipment	Agricultural Engineering
527656	Soil and Cropping Management Effects on Atrazine Movement in Soil Water	Agricultural Engineering
527658	Harmonics Produced by Variable Speed Fan Systems	Agricultural Engineering
527662	Food Product Development	Agricultural Engineering
527663	Alleviating Drought Problems in Kansas and Drip Irrigation of Corn	Agricultural Engineering
527664	Biomass Resource Assessment	Agricultural Engineering
527665	Grain Harvesting Technology	Agricultural Engineering
527666	Support of Agricultural Research of Mutual Interest	Agricultural Engineering
527667	Effects of Prime Mover Soil Compaction on Soil Physical Properties and Winter Wheat and Grain Sorghum Yields	Agricultural Engineering
527668	Hay Preservative Coatings	Agricultural Engineering
527900	Support of Agricultural Research of Mutual Interest	Chemical Engineering
527986	Support of Agricultural Research of Mutual Interest	Computational Research in Engineering
528001	Use of Soybean Derivatives in Textiles Processing	Clothing and Textiles
528053	Pet Adoption: Early Developmental Impact on Young Children	Human Development and Family Studies
528105	Replacing Carbohydrate Sweeteners in Cakes and Cookies	Foods and Nutrition, Grain Science and Industry
528106	Starch Gels in Food Products	Foods and Nutrition
528107	Effect of Selected Dietary Fibers on Lipid and Cholesterol Metabolism	Foods and Nutrition
528108	Food Product Development	Foods and Nutrition
528109	Functionality and Utilization of Wheat Germ Protein Flour in Model Systems and in Meat Products	Foods and Nutrition

Research Projects Active June 30, 1990 (Continued)

528200	Editorship of School Food Service Research	Hotel, Restaurant, Institution Management and Dietetics
528250	Anti-Idiotypes of Bovine Respiratory Disease Viruses: Vaccine Feasibility Studies	Laboratory Medicine, Animal Sciences and Industry, Anatomy and Physiology
528251	Netobimin Efficacy-Dose Confirmation Trial Project-Bovine Oral Drench	Laboratory Medicine
528252	Comparison of Panacur and Tramisole against Bovine Lungworms and Stongyles	Laboratory Medicine
528350	Cell Mediated Immunologic Defense Mechanisms of Dolphins	Pathology
528351	Development of a Subunit Vaccine for Haemophilus pleuropneumoniae	Pathology
528353	Recombinant DNA Clones for Detecting Bovine Respiratory Syncytial Virus	Pathology
528354	Eradication of Porcine Pleuropneumonia: The First Steps	Pathology
528355	A Subunit Vaccine for Bovine Pneumonic Pasteurellosis	Pathology
528551	Immunomodulation and Stress Hormone Interactions in Bovine Lymphocytes	Anatomy and Physiology, Laboratory Medicine
528553	Cytokine Immunomodulation in Bovine Respiratory Disease	Anatomy and Physiology
528554	Role of Arachnidonic Acid Metabolites in Immunosuppression	Anatomy and Physiology
528555	Role of Cyclosporin A in Human T-Cell Proliferation	Anatomy and Physiology
528558	Racing Greyhound Dietary Requirements	Anatomy and Physiology
528559	The Role of Furosemide and Prostaglandins in Exercise-Induced Pulmonary Hemorrhage	Anatomy and Physiology
528560	Evaluation of Bovine Recombinant Interuekin-1B and Interleukin-2 in Cattle	Anatomy and Physiology
528561	Influence of Dietary Carnitine on Sprint Performance in the Racing Greyhound	Anatomy and Physiology
528562	Dietary Potassium Involvement in Exertional Rhabdomyolsis in the Racing Greyhound	Anatomy and Physiology
528563	Immunomodulation of Mastitis with Bovine Recombinant Interleukin	Anatomy and Physiology
528564	Requirements for Sprint Performance in the Racing Greyhound: Influence of Carnitine	Anatomy and Physiology
528751	Endangerment Assessment, Toxicology, and Hazard Assessment for Arkansas City Dump Site	Surgery and Medicine
528753	Application of the Toxi-Lab Drug Detection System for Monitoring Drug Use in Dogs	Surgery and Medicine
528754	Diabetes-Induced Hypo-Maturation of the Fetal Pulmonary Alveolar Wall: Detection by Quantifying Hydroxyproline and Lung Cytoproliferative Factors	Surgery and Medicine
528755	Changes in Serum Anylase, Lipase, and Trypsinogen during Dietary Adaptation in the Dog	Surgery and Medicine
528756	A Safety Study of Formula I in Dogs	Surgery and Medicine
528757	Dermal Safety Study in Dogs and Cats on Carpet Deodorizer	Surgery and Medicine
528758	Respirable Particle Concentrations in Swine Confinement	Surgery and Medicine
529004	Reconstruction of Channel-Forming Proteins	Biology
529012	Molecular Genetics of Human Ribosomal Proteins	Biology
529037	Electron Microscopy of Neurons, Axons, and Synapses	Anatomy and Physiology
529067	Studies in Polyoma Transformed Cells-Virion Proteins	Biology
529070	Studies on Staphylococcal Toxins	Biology
529085 & 529086	Regulation of Mammalian Pyruvate Dehydrogenase	Biochemistry
529094	Tumor Enriched Nonhistone Chromatin Proteins	Anatomy and Physiology
529145 & 529146	Modeling Wheat Response to Direct CO_2 Enrichment	Agronomy
529153 & 529154	Somatic Genetics of a Cloned Human Ribosomal Protein	Biology
529173	Nueroendocrinology of Reproductive Aging in Rats	Anatomy and Physiology
529183	Structure/Function Relationships of Rod Disc Membranes	Biochemistry
529193	Antecendents and Consequences of Teen Sexual Behavior	Human Development and Family Studies
538527	Design Optimization of Variable Speed Fan Systems	Agricultural Engineering
538534	Bi-Rotor Combine Harvester Development	Agricultural Engineering
538535	Influence on Water Treatment on Ruminal Metabolism and Digestion in Steers	Animal Sciences and Industry
538538	Development of the Hard White Winter Wheat Industry in Kansas	Agronomy
538687	Design Optimization of Variable Speed Fan Systems	Agricultural Engineering
538688	Utilization of Hard White Winter Wheat in Buns and Rolls	Grain Science and Industry
538689	Utilization of By-Product Gums from the Wheat Starch/Gluten Washing Industry	Grain Science and Industry
538694	Improvement of Hard Winter Wheat	Agronomy
538695	International Grains Program Support Project	Grain Science and Industry
538699	Evaluation of Wheat and its Milling Fractions for Water Stability Enhancement in Pelleted Shrimp Diets	Grain Science and Industry
538701	Dietary Requirements for the Racing Greyhound	Anatomy and Physiology
538703	Laboratory Milling Evaluation of Early Generation Hard White Winter and Hard Red Winter Wheats	Grain Science and Industry
538704	Wet Processing of Wheat and Other Kansas Grains	Grain Science and Industry
538706	Use of Hard Winter Wheat and Hard Red Winter Wheats in Developing Noodle-Snack Foods	Grain Science and Industry
538707	International Grains Program Support Project	Grain Science and Industry
538708	Utilization of Hard Winter Wheat in Buns and Rolls	Grain Science and Industry
538710	Genetic Development of Higher Disease Resistance and Grain Protein in Wheat Varieties	Fort Hays Branch Station
538711	Improvement of Market Quality of Kansas Wheats by Breeding	Agronomy
538712	Utilization of By-Product Gums from the Wheat Starch/Gluten Washing Industry	Grain Science and Industry
538713	Improvement of Hard Winter Wheat	Agronomy
538714	Wet Processing of Wheat and Other Kansas Grains	Grain Science and Industry
538715	Wheat Genetics Resource Center and Its Contributions to the Kansas Wheat Industry	Plant Pathology
538716	A Study of the Influence of Water Treatment on Ruminal Metabolism and Digestion in Steers	Animal Sciences and Industry

Research Projects Terminated *(Between July 1, 1988 and June 30, 1990)*

Federal Projects

F026 Management Strategies for Leafhoppers, Spittlebugs, and Aphids on Alfalfa
F027 Integrating Crop Culture, Chemicals, and Life Cycles to Control Persistent Weeds
F286 Improvement of Beef Cattle through Breeding Methods
F445 An Economic Analysis of Risk Management Strategies for Agricultural Production Firms
F494 Communication Strategies to Improve Nutrition Practices of Adolescents
F518 Vegetable Oils as an Alternative Fuel for Diesel Engines
F949 Dynamics of Forage Production and Utilization by Beef Cattle
H032 Soilborne Fungus Diseases of Wheat and Their Control
H037 Biology and Control of Arthropods on Wheat, Sorghum, Alfalfa, and Minor Crops in Southwestern Kansas
H038 Management of Arthropod Pests of Crops and Livestock in West-Central Kansas
H039 Growth Regulation of Landscape Plants
H238 Interactions Involving Calcium and the Alpha-Ketoglutarate Dehydrogenase System
H296 Genetic Stocks and Cytogenetic Analysis of Disease-Resistant Genes in Common Wheat
H402 Weed Control for Turfgrass
H417 Structures of Lipids: Effects on Physical Properties and on Performance as Fuels
H430 Nutrition of Gestating Swine
H470 Mechanisms of Plant-Insect Interactions
H526 Molecular Genetics of Wheat Soilborne Mosaic, Wheat Streak Mosaic, and Maize Dwarf Mosaic Viruses
H527 An Economic Study of the Anticipated Transition from Irrigated to Dryland Cropping
H533 Rumen Fermentation and Nutrient Absorption
H546 Evaluation of Natural Enemies for Biological Control of the Squash Bug
H551 Utilization of Forage Microstructures by Ruminants
H552 Epidemiology of Puccinia recondita and P. graminis on Wheat
H553 Cause and Prevention of Grain or Feedlot Bloat
H554 Rumen Development in Calves Raised on Early Weaning or Conventional Weaning Program
H562 Factors Affecting the Feeding Value of Sorghum Grain
H572 Effect of Crop Residues on Soil Water Conservation
H585 Transport Techniques for Interacting Systems
H618 Mechanism of Resin-I3 and I5 Disinfectants on Bacteria, Virus, and Protozoa
H625 Mate and Host - Finding Behavior in the Hessian Fly
H626 Rennin Extraction by Application of Ultrasound Energy
H633 Toxicity and Fate of Prospective Grain Protectants in Stored Grain and Their Milled Products
H716 Information Search Strategies of Consumers in Limited Market Area
H734 Regulation of Fatty Acid Chain Length during Synthesis in Oilseeds
H801 Effect of Thermal Stress on Livestock Performance
H995 Swine Embryo Development in Vitro
M476 Forest Tree Improvement through Selection and Breeding

State Projects

R108 Various Diseases of Animals
R227 Influence of Wheat Type, Flour Extraction, and Formulation on Quality of Leavened Flat Bread (Nan)
R284 Vegetable Crop Ecological and Physiological Investigations
R349 Utilization of Isotopes in Agricultural Research
R410 Systematic Studies of Plants in the Great Plains and Cordillera
R420 Loss Avoidance and Objective Condition Criteria of Stored Grain or Grain Products
R465 Evaluation of Landscape Plants for Kansas
R474 Efficient Irrigation and Drainage Systems
R479 Developing Soil Tests
R513 Crayfish Culture in Kansas
R514 An Analysis of Kansas Farm Implements Most Suitable for Remanufacturing
R515 Improvement of Bread Quality: Role of Fats in Bread Staling
R522 Wheat Utilization: Nonfood and Nonfeed Uses
R523 Development and Evaluation of Wheat Hardness Tests
R525 Wheat as a Feed
R531 Pathological Basis for Reproductive and Perinatal Conditions in Sheep and Cattle
R535 Flavor Changes and Interactions of Alternative Sweetener Systems as Used in Food Products
R538 Hydrology of Dryland Water Management Systems
R543 Advances in Home Economics Research
R555 Transfer of Positive Therapy Outcome from Child to Parents in Kansas Families
R557 Metmyoglobin Reducing Activity and Oxygen Exposure Effects on Meat Oxidation
R559 Water Management for Irrigated and Non-Irrigated Conditions
R560 Community Structure, Agricultural Technology, and Farm Structure
R565 Economic Analysis of Conservation Tillage Systems in Kansas
R566 Expanding the Market for Variety Meats in Midwest Retail Food Stores
R569 Protein Metabolism of Horses in Response to Intense Work
R570 Effect of Soluble Dietary Fibers on Carbohydrate and Lipid Metabolism
R571 Efficient Fueling of Engines Using Alternate and Conventional Fuels
R576 Respiratory Disease and Environmental Stress in Food Animals
R583 Histology of the Lung of Normal and Diseased Domestic Animals
R590 Financial Survival and Growth Strategies for Kansas Farms and Ranches
R598 Can Human Oncogenic CDNA Be Used to Localize Genes to Specific Chromosomes in the Bovine Genome?
R604 Glycosphinogolipid Interactions with the Na+, K+-ATPase (EC 3.6.1.3)
R606 Development of Plant Transformation Systems
R607 The Social Impacts of Four Water Management Alternatives in Southwestern Kansas
R609 The Increasing Number of Small Farms in Kansas: Causes, Characteristics, and Consequences
R610 Preservation of Agricultural Products Using Sulfur Dioxide
R611 Sociological Context of Farm Management Decisions: The Impacts of Value Structure
R612 Improved Methods for Agricultural Chemical Application
R616 Studies on the Flora of the Grasslands
R623 Studies of Staphylococcal Toxins
R624 Organization and Control of the Hydrolase Genes in Barley
R629 Climatological Data as a Predictor of L3 Strongyle Larvae Surviving on Pasture
R636 Effects of Burning and Competition on Plant Responses to Grazing in Tallgrass Prairie
R638 Biology of Cryptosporidium parvum
R639 Nuclear Magnetic Resonance: Protein Structure and Dynamics
R702 Factor Share Analysis: A New Measurement of Earnings for Land, Labor, and Capital
R706 Aggregation, Fragmentation, and Gelation Kinetics of Macromolecular Solutions
R878 Large-Scale Milling and Baking Evaluation of Hard Winter Wheat

Sponsored Projects

481820 Role of Lipoxygenase Metabolites of Archidonic Acid in BVD Immunosuppression
481821 Experimental Induction of Hepatic Abscesses in Cattle
481822 Lymphokine-Activated Killer Cells: Efficacy in Bovine Herpes
481823 Production of Monoclonal Antibodies for Major Membrane Proteins of Chlamydia psittaci
481824 Mechanisms of Exercise-Induced Pulmonary Hemorrhage: The Role of Blood Volume
481825 Sudden Death Syndrome in Running Horses: Role of Increased Serum Potassium
481826 Iron Acquisition as a Virulence Factor of Actinobacillus pleuropneumoniae
481827 Natural Immunity in Cattle
481828 The Characterization of the Immunologic Response of Pigs to Purified Eperythrozoon suis Bodies
481829 Effect of Feeding of High and Low Endophyte Fescue Hay on Splanchnic Metabolism
481830 The Role of Brachygnathia Inferior in Selection Procedures in Cattle
481831 The Effect of Lyophilization of Bovine Colostrum on Immunoglobulin Concentration and Activity
481832 Production of Monoclonal Antibodies to Bovine Viral Diarrhea Virus
481833 Neuroendocrine and Immunological Responses of Lambs to Acute Stress
481834 Effect of Vitamin E on Control of Mastitis in Dairy Cows
481835 Can C-Reactive Protein Be Used to Monitor Acute Phase Reaction in Horses?
481836 Use of Human Polymorphic DNA Marker in the Bovine Species
481837 The Effect of Diuretics on Serum and Urine Electrolytes in Cows with Udder Edema
481838 Cultivation of Coccidia in Vitro
481839 Role of Ruminal Ciliated Protozoa in Subacute Lactic Acidosis in Cattle
481840 Role of Protein Kinase-C in BVD Immunosuppression
481841 Cytokine Immunomodulation in Bovine Mastitis
481842 Identification of Dermonecrotic Toxin of P. multocida Using Monoclonal Antibodies
481843 Development of Endotoxin and Mediator-Binding Semisynthetic Conjugates
481844 The Role of Furosemide and Prostaglandins in Exercise-Induced Pulmonary Hemorrhage
481845 Influence of Bovine Milk Acyloxyacyl Hydrolase on Gram-Negative Mastitis
481846 Detection of Eperythrozoon suis in the Blood of Swine Using a Radiolabeled, Cloned, DNA Probe
481847 Characterization and Conjugation of a Unique Protein to Treponema hyodysenteriae
481848 Nature, Cause, and Frequency of Anthrogryposis in Angus Cattle

Research Projects Terminated (Continued)

481849 Characterization of Macrophage MRNA after Immune Stimulation
481850 Production and Characterization of Monoclonal Antibodies to Bovine Viral Diarrhea Virus
481851 Modulation of Endocrine and Immune Functions by Circadian Secretion of Melatonin and Dexamethasone
481852 Bovine Respiratory Syncytial Virus Recombinant Library and Expression
481853 The Rapid Diagnosis of Bovine Respiratory Syncytial Virus by Detection of IGM Antibodies
481854 Effect of Somatotropin on Immune Response and Metabolic Profile of Dairy Cows
481855 Can C-Reactive Protein Be Used to Monitor Acute Phase Reaction in Horses?
481856 DNA Studies of Campylobacter hyointestinalis and Campylobacter muscosalis
481857 Morphometric Studies of Pasteurella haemolytica-Infected Calves
520026 Management of Stored-Grain Insect Problems
520029 Chromosomal Mapping of Genes Controlling Tissue Culture Response in Wheat
520079 Effect of RO2-2985 & RO21-6447 on Cattle Feed Intake, Growth Improvement, and Rumen Volatile Fatty Acid
520081 Effects of Ralgro on Reproductive Performance of Heifers
520093 Interdisciplinary Pest Management: Effects of Shattercane and Second Generation European Corn Borer as Joint Stressors of Field Corn
520094 Integrated Pest Management-Confined Beef: The Relationship between Stable Flies and Heat Stress on Confined Feedlot Cattle
520098 Effect of Foliar and Soil-Applied Insecticides on Greenbug and Spider Mite Attacking Grain Sorghum and Their Impact on Natural Enemies
520109 Evaluation of Dryland Cropping Alternatives that Can Better Utilize Available Water Supplies
520115 Flour Quality for Saltine Crackers
520143 Optimization of Yecora Rojo Wheat Tempering Procedures
520157 Treating Iron Chlorotic Pin Oaks by Trunk Injections of Iron Sulfate
520196 Transfer of Genetic Information into Alfalfa through Protoplast Fusion
520215 Annual Hunter Activity and Upland Game Harvest
520255 Agronomic Comparisons of Three Cropping Sequences with Soybeans and Wheat in Southeastern Kansas
520257 Soybean Varietal Improvement for Southeastern Kansas
520261 Development of Screening Techniques for Wheat Spindle Streak Mosaic Virus and Their Application to the Study of Genetic Resistance in Wheat
520270 Sulfur Effects on Different Soybean Cultivars
520277 Plant Life Cycle Differences in Simulated and Natural Pocket Gopher Burrows
520288 Organization and Control of Gibberellic Acid-Inducible Genes in Barley
520318 A Search for Analytes to Estimate Body Iron Stores as a Means of Evaluating Nutrition Iron Adequacy and Response to Iron Therapy in Dogs
520320 Pathogenesis, Diagnosis, and Control of Spider Leg in Suffolk Sheep
520323 Interleukin Regulation in Stressed Feeder Calves
520331 Transformation of Tobacco with a Virus Coded Cell-to-Cell Movement Protein Gene and Its Implications in Inhibiting Virus Infection
520338 Sampling Stored Grain for Insects Using Plastic Probe Traps
520345 Embryonic Signals in Pregnancy Establishment in the Pig
520355 Cloning Sequencing and Structural Manipulation of the Enterotoxin D and E Genes from Staphylococcus aureus
520362 Role of Bicarbonate in HTST Extrusion
520364 Microwave Heating of Gluten Containing Product
520368 Survival Plan for Bobwhite Populations in Riley, Pottawatomie, and Geary Counties
520370 Pesticide Effects on Nitrogen Fixation in Legumes
520388 Study of Rheological Characteristics of Cookie and Cracker Doughs
520391 Kansas Soybean Cyst Nematode Survey
520395 Food Product Testing
520396 Development of Gas Retaining Capacity during Fermentation
520400 Grain Sorghum Marketing Economics
520404 Bacterial Investigations of Bovine Hepatic Abscesses
520405 Cooperative Research Project with Centro para Investigaciones en Granos y Semillas (CIGRAS)
520408 Assessing the Development of a Greenbug Biotype Injurious to Corn
520409 Identification of a Sorghum-Produced Agent that Protects Chinch Bugs
520410 Evaluation of Alternate Management Strategies for Spider Mite Control in Kansas Corn
520413 Breeding Sorghum for Improved Digestibility and Feed Efficiency
520414 A Study of the Effect of Levels of L. plantarum Addition on the Quality of Alfalfa and Corn Silages
520416 Investigation on the Role of Cell Walls in the Freezing Behavior of Plant Tissues
520436 Support of Agricultural Research of Mutual Interest
520450 Blueprint for Kansas Agriculture Study
520454 Regional Survey of Farm Operators
520650 Modeling the Behavior of Banded Urea and Ammonium Nitrate in Soil
521654 A Study of Quality Evaluation Criteria and Lactic Acid Bacteria on the Quality of Alfalfa, Corn, and Sorghum Silages
520655 Support of Agricultural Research of Mutual Interest
520659 Modeling 'Shattercane' and Second Generation European Corn Borer Effects on Corn
520661 Yield Losses due to Freeze Damage of Grain Sorghum
520662 Dryland Corn Management for Western Kansas
520673 Maintenance and Servicing of Bowen Ration Equipment on the FIFE Test Area
520675 Support of Agricultural Research of Mutual Interest
521650 International Livestock Program - International Trade Development
521653 A Study of the Effect of Compudose and the Rumensin Ruminal Delivery Device Alone and in Combination on the Average Daily Gain of Pastured Growing Steers
521658 A Study of the Effect of Lasalocid on Performance and Ruminal Development of Calves Raised on Early-Weaning Program
521659 A Comparison of the Relative Effectiveness of Rumen Mate vs. Sodium Bicarbonate on Milk Production of Dairy Cows
521662 The Study of the Effects of Supplementing Vitamin A, Vitamin E, and Selenium during the Dry Period of Cows and Heifers
521666 A Study of Fusobacterium necrophorum Vaccine for Prevention of Liver Abscesses
521667 Effects of Glucose and Cooking Temperatures on the Characteristics of Low Fat, Pre- and Post-Rigor, Restructured Beef
521669 A Study of the Effect of Administration of Lasalocid on Performance and Ruminal Development of Early-Weaned Calves
521672 A Study of the Utilization of Melengestrol Acetate (MGA) to Induce and Synchronize Estrus in Suckled Beef Cows
521674 Dose-Titration Study for Experimental Induction of Liver Abscesses
521677 An Evaluation of Water Oxygenation on Milk Production and Milk Composition and Somatic Cell Concentrations in Milk
521685 Utilization of Surimi-Like Products from Beef By-Products in Restructured, Precooked Beef Roasts
521691 A Study of the Influence of Water Treatment on Ruminal Metabolism and Digestion in Steers
521697 A Study of the Effect of Nutrient and Biological Additives on the Preservation and Feeding Value of Alfalfa Silage
521699 An Evaluation of the Effect of Niacin on Cattle Receiving a High-Endophyte Fescue Forage
522256 Influence of Behavior and Environment on Biological Control of Grasshoppers
522258 Validating the KSU European Corn Borer Model within Kansas
522260 Monitoring and Measuring Greenbug Effects on Sorghum
522267 Monitoring Greenbugs on Sorghum and Evaluating Low Rates of Insecticides Applied at Planting for Their Control
522270 Effect of Host Plant Condition on Resistance of Banks Grass Mite to Three Acaricides Approved for Control of Spider Mites on Corn
522855 International Grains Program Support Project
522862 Effects of Residual Salts on Chemically Leavened Bread
522864 Digestibility by Finishing Swine of Reconstituted Sorghum Grain Treated with Enzymes or Enzymes and a Bacterial Inoculant Prior to Ensiling
522865 Digestibility by Finishing Cattle of Reconstituted Sorghum Grain Treated with Enzymes or Enzymes and a Bacterial Inoculant Prior to Ensiling
522866 Special Application of Infraalyzer 450 Systems
522868 Utilization of Brewer's Spent Grains
522869 Flour Quality for Pizza Production: Roles of Flour Type and Protein Content
522870 Problems Associated with Extrusion of Cereals
522873 The Effect of Pelleting Soybean Meal on its Economic Value in International Markets
522874 D-Erythroascorbic Acid: Its Preparation, Chemistry, and Metabolism
522875 Flour Quality for Combo Shells
522876 Sorghum Starch: Removal of Color and Resistance to Shear Thinning
522882 Development of a Test Baking Procedure for Bagels
522884 Ethacal Pelleting Tests
523852 Screening of Pin Oaks for 'Resistance' to Iron Chlorosis
523853 Development of Guidelines for Evaporative Cooling of Strawberry
523857 Investigations on the Rootstock Effects on the Seasonal Changes of Cold Hardiness in Apple and Peach
523858 Minimal Growth Factors as Pregrowth Treatments for Cryopreservation of Ipomoea batatas
524051 Windbreaks as Breeding Habitat for Nongame Birds in Kansas
524053 Pre-Survey of Purchasing Natural vs Artificial Christmas Trees
524054 Prepare and Conduct a Survey of Western Kansas Landowners in Conjunction with Public Access to Private Lands
524055 Survey of Kansas Purchasing Habits for Natural vs. Artificial Christmas Trees
524250 Morocco/MIAC Dryland Agriculture Applied Research Project
524450 Physical Mapping of the Genome of Wheat
524451 Microbial Antagonism to the Wheat Tan Spot Pathogen in Conservation Tillage Straw
524452 Genetic Organization of Red Clover Necrotic Mosaic Virus
524453 Isolation of the Resistance Gene in Tomato to the Nematode, Meliodogyne incognita
524459 Restriction Fragment Length Polymorphism Analysis of the Xanthomonas campestris pv. oryzae Genome

524464 Cloning and Characterization of Capsid Protein and Other Genes from Wheat Streak Mosaic Virus
524466 Wheat Variety Development: Generation of Wheat Streak Mosaic Virus Resistance
524474 Incompatible Interactions between Xanthomonas campestris pv. oryzae and Rice
524476 Development of Synthetic Wheats and Their Use in Broadening the Genetic Base for Wheat Improvement at CIMMYT
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FY89 and FY90 Kansas Agricultural Experiment Station Income and Disbursement Statement

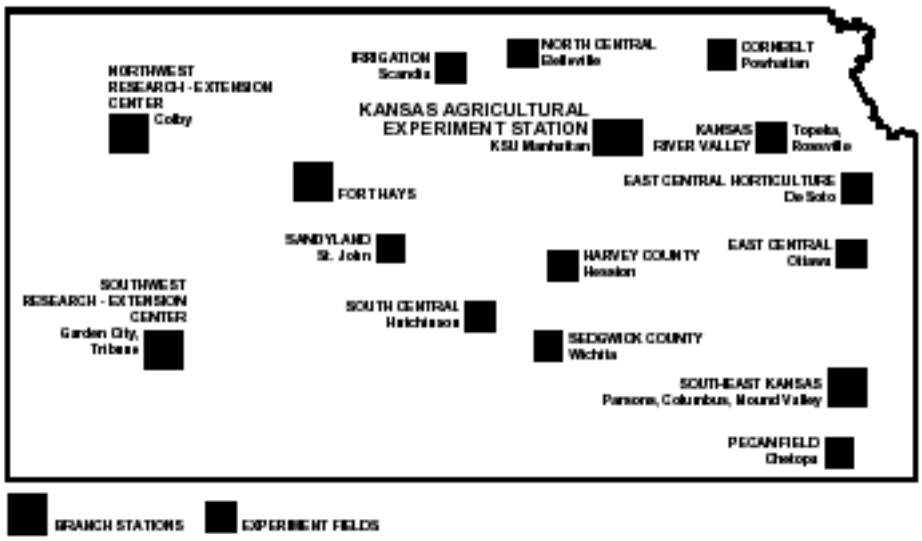
	8.4%	49.5%	13.8%	28.3%		
FY89 FUNDING	**$3,031,338**	**$17,876,478**	**$4,961,841**	**$10,226,654**	**$36,096,311**	
	Federal	**State***	**Fees**	**Sponsors**	**Total**	
FY89 EXPENDITURES						
Faculty & Administrative Salaries	$2,214,129	$9,879,262	$287,866	$5,025,266	**$17,406,523**	**48.2%**
Classified & Student Salaries	$421,935	$4,222,059	$620,330	$970,673	**$6,234,997**	**17.3%**
Contract Services & Travel	$195,314	$1,508,898	$811,688	$2,435,747	**$4,951,647**	**13.7%**
Supplies & Material	$140,893	$1,123,263	$2,072,234	$881,417	**$4,217,807**	**11.7%**
Equipment	$59,050	$1,137,206	$1,160,181	$783,952	**$3,140,389**	**8.7%**
Other	$17	$5,790	$9,542	$129,599	**$144,948**	**0.4%**
Totals	**$3,031,338**	**$17,876,478**	**$4,961,841**	**$10,226,654**	**$36,096,311**	**100%**

	7.4%	51.4%	15.0%	26.2%		
FY90 FUNDING	**$2,880,992**	**$19,890,877**	**$5,813,718**	**$10,142,867**	**$38,728,454**	
	Federal	**State***	**Fees**	**Sponsors**	**Total**	
FY90 EXPENDITURES						
Faculty & Administrative Salaries	$2,112,106	$11,645,323	$219,165	$5,069,147	**$19,045,741**	**49.2%**
Classified & Student Salaries	$368,702	$4,796,042	$582,116	$1,026,634	**$6,773,494**	**17.5%**
Contract Services & Travel	$180,014	$1,446,601	$963,058	$2,149,653	**$4,739,326**	**12.2%**
Supplies & Material	$126,581	$1,050,354	$2,239,143	$1,142,829	**$4,558,907**	**11.8%**
Equipment	$93,581	$949,459	$1,796,344	$540,906	**$3,380,290**	**8.7%**
Other	$8	$3,098	$13,892	$213,698	**$230,696**	**0.6%**
Totals	**$2,880,992**	**$19,890,877**	**$5,813,718**	**$10,142,867**	**$38,728,454**	**100%**

*Includes MOE, IGP, and ILP

ISSN Number 0749-2197

KANSAS STATE UNIVERSITY
STATEWIDE AGRICULTURAL RESEARCH SERVICES



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Special Publication April 1991

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