FY 2006 Annual Report of Accomplishments and Results
Oklahoma Agricultural Experiment Station
Oklahoma State University
Stillwater, OK 74078

Goal 1. An agricultural system that is highly competitive in the global economy

Overview

Oklahoma agriculture competes in a marketplace that is both national and global. International markets have long been important for the state's forage and grain crops, and for the exports of the state's beef, pork, and poultry products. Applied and fundamental research programs in plant and animal agriculture and natural resources, including emphasis on value-added industry, will remain cornerstones of OAES's work. OAES programs are comprehensive, spanning animal-host pathogen interactions; bio-based products; cattle and forages; commercial horticulture; community resources and economic development; consumer horticultural and urban forestry; crop management; ecosystem management, conservation, and restoration; environmental quality and waste management; family economic well-being; family resiliency; bio-energy production and conversion, farm and agribusiness management; food processing; food safety; function and regulation of genetic processes; homeland security-agricultural security; host-pathogen/parasite interactions in plants; human nutrition and health; integrated pest management; leadership and community volunteer development; natural resource education; Oklahoma Mesonet; plant stresses – abiotic and biotic; sensor based technology; stored products; structure and function of molecules; turf production; wheat - multiple uses; and youth environmental education – water quality.

Research regarding the development of sensors and sensor-based technology to assess and apply crop nutrient needs has been highly successful. This research will revolutionize the way chemicals are applied to wheat, corn, bermudagrass, and a variety of other crops to include turf applications for golf courses and create new business opportunities. Thirteen years of research has led to the development of a new machine, "GreenSeeker" that utilizes optical sensors and variable rate nozzles on a 60' boom mounted on a self-propelled sprayer. The "smart sprayer" gives the plants a physical, assesses their nutrient needs, and delivers the proper fertilizer amounts in fractions of seconds as it moves across the field at 15 mph. It has the capability to assess and apply variable rates of fertilizer every 4 ft^2 instead of given amounts applied over entire fields. More recently hand held sensors and smart sprayers with less precision, i.e. variable rates every 200 sq. ft., have gained popularity due to lower equipment expense. Utilization of enriched N strips and smaller hand-held sensor equipment is revolutionizing fertilizer application recommendations.

Standard practice is to take approximately 20 soil samples from a field that would be managed the same, analyze for nutrients, and apply a uniform rate across the entire field. Using "GreenSeeker" technology is equivalent to applying fertilizer based on 10,000 individual soil samples per acre instead of a composite sample of 20 soil cores that might represent 40, 60, or more acres. The new 'smart sprayer' technology assesses soil spatial variability, computes total plant nitrogen and biomass, computes nutrients already taken up in the plant, computes soil nutrient supplying power for the remainder of the season, determines the plant response to additional nitrogen fertilizer, and applies the correct amount of nitrogen in each 4 ft^2 within the field. The machine can be operated day or night. Additionally, the machine can be used to spot spray weeds and map sensor measurements and actual application rates. New research is underway to assess soil moisture at the time of fertilizer application and its relationship to yield potential.

For the land-grant system and the Oklahoma Agricultural Experiment Station, this is truly meeting our mission of serving the citizens of Oklahoma, the nation, and globally. New technology has been developed through research, proof of concept has been provided, licensing agreements have been entered into, an emerging new business has been formed, jobs have been created, and we have prepared young professionals for careers that can make a difference in protecting the environment while maximizing the efficiency of inputs in crop production. Fertilizer input costs will be reduced without a reduction in yield and the environment will be protected because only the required amount of nutrients will be applied to each individual 4 ft^2 area in the field. Benefits to clientele could be as much as $18 to $20 per acre in winter wheat production in the Southern Great Plains. More than 5 million acres of winter wheat are planted annually in Oklahoma. Assuming this technology is applied to half of the wheat acreage in Oklahoma, savings in fertilizer costs would exceed $45 million annually. As the technology moves into the corn belt of the US even greater savings in fertilizer costs will occur. Included with this technology are benefits derived from maintaining clean water supplies by reducing the potential from NO_3 run-off into streams, lakes and the eventual movement to ground water supplies. The technology can be adapted globally to most cultivated crops where ever nitrogen is applied. To date emphasis has been placed mostly on winter wheat production and turf management. New thrusts and applications will include corn and bermudagrass forage production. Additional research is underway to adapt the sensor based technology to phosphorus management in both grain crop and forage production systems.
Rising energy costs for fertilizer and fuel in the future will only enhance the adoption of sensor based technology to improve profit margins for crop production.

While total expenditures from federal formula funds (Hatch) for the precision agricultural effort were small, $65,000, contributions were a result of input from 5.0 FTE's representing three major disciplines. State appropriated funds, industry, commodity groups and associations, and grants and contracts have contributed more than 100 fold to the federal funds directed toward precision agriculture.

Oklahoma wheat producers need new cultivars that are more broadly adapted, have higher yield potential, possess long term leaf rust resistance plus resistance to other biotic and abiotic stresses, and have acceptable industry quality. Plant variety and germplasm development programs have been highly successful and have focused on agronomic crops and forages important to Oklahoma, surrounding states, and climatic zones in which new releases may be adapted. Results from formula funds have led to the development of a "new crop" with the OAES release of 'Intrada', which was the first hard white winter wheat variety to emerge from the new breeding program. This new variety was released eight years after initiation of the program. This past year another new hard white winter wheat, 'Guymon', was released. This variety also has superior milling and baking characteristics and will further the progress in developing the white wheat industry in Oklahoma. The emergence of white wheat production in Oklahoma has the potential to develop new markets both regionally and internationally and provide an economic boost to selected producers and grain marketers that choose to handle it as a special crop. The federal incentive program will further promote the growth of hard white winter wheat in Oklahoma.

- Hard red winter wheat germplasm releases with disease and insect resistance complement the variety development program for wheat, both red and white. This past year two new hard red winter wheat varieties were released: Duster and Centerfield. These varieties provide producers with addition superior traits and characteristics compared to currently grown varieties. Duster has enhanced ability for establishment under less than optimal moisture conditions and has improved Hessian fly resistance. Centerfield is unique in that it carries Clearfield technology making it adaptable to areas with heavy bromus species infestation. Clearfield also possesses good SBMV/SSMV and leaf rust resistance. Additional varieties are being evaluated for potential release in the coming year.

Natural genetic diversity contained in wild and domesticated plant populations is vitally important in maintaining the security of food, feed, and fiber resources demanded by a growing human population. Collection, evaluation, and preservation of plant germplasm in the face of increasing erosion of genetic diversity in wild populations of many agriculturally important plant species protects against loss of genes of realized or potential importance. 'Midland 99', a forage type bermudagrass, has gained statewide and regional acceptance and is now considered the premier variety for new establishment of bermudagrass pastures in the southern region. 'Ozark' a sister line to 'Midland 99' has gained extreme popularity in northern Oklahoma, Kansas, and Missouri due to the increased cold-hardiness trait. 'Patriot', a new turf type bermudagrass recently released has gained national and international recognition for its superior turf quality and characteristics and is currently licensed for production in Oklahoma, Maryland, and Missouri, Georgia, Tennessee, and North Carolina. Plant patents have been filed for both 'Ozark' and 'Patriot'. A new forage-type bermudagrass and an improved switchgrass with improved biomass production potential are being evaluated for possible release in 2007.

Cattlemen and alfalfa producers need a secure supply of well-adapted alfalfa varieties. Improved cultivars improve the sustainability and profitability of forage production. Alfalfa germplasm releases have also enhanced the genetic diversity available for breeding programs.

The outcomes of the variety and germplasm development programs have been significant in all agronomic crops produced in the state and have greatly benefited the clientele we serve and stakeholders that provided input to the process. The OAES is extremely pleased with the accomplishments in the plant variety and germplasm development programs and expects continued success in the future. It is imperative that plant variety and germplasm development programs progress using conventional and biologically enhanced techniques as rapidly as possible to meet the growing needs of the clientele we serve. Total federal formula fund expenditures (Hatch) for this effort during the reporting period were in excess of $200,000. State appropriated funds, industry, commodity groups and associations, and grants and contracts have been leveraged to several fold to enhance the the federal effort in the total plant variety and germplasm development program.

Prior economic research reported by the Cattle-Fax organization revealed that a 20-30% decline in the value of beef round and chuck occurred in the 5 years preceding the request for proposals. The purpose of this phase of research was to characterize the muscles with the ultimate goal that such knowledge would be communicated to all phases of the beef industry. It is our intention that the optimal use of each muscle can be found, thereby returning the optimal value. The Food and Agricultural Products Center at Oklahoma State University works toward the development of an outstanding research program emphasizing the chemical or biochemical aspects of further processing of livestock, poultry, and aquatic muscle, as well as other food-producing species for value-added products. The Oklahoma Beef Quality Summit was organized and has the objective to teach attendees a part of each segment of the entire beef industry with particular emphasis on conforming to the consumer's requirements. Past statistics have indicated that approximately $100 per head of every slaughtered animal is lost. Studying muscle tenderness and developing processing methodology has been shown to reduce this loss to $25 per head.

Fungal decay of fruit in postharvest storage results in tens of millions of dollars of economic loss annually. Fungal decay also produces human mycotoxins. Fungicide residues on fruit are also of concern. Understanding how biocontrol microbes interact with the fruit host and the fungal pathogen will lead to more effective control. This also expands into fresh-cut fruits and vegetables. Samples in several discrete steps in processing have been collected and evaluated for the presence of and numbers of selected microorganisms, including bacteria, yeast, and molds. Models have calculated the survival, growth, and destruction of these microorganisms

with time and other processing treatments. This work will lead to more effective food safety standards to serve our consumers.

Conversion of underutilized low-cost biomass to liquid fuel and other useful products at a price competitive with fossil fuel is one of the prime objectives of renewable energy research. The income derived from production of the raw materials plus the value-added income from jobs at bioconversion plants has also sparked the attention of groups interested in revitalizing rural America. Our research bio-fuels team has been instrumental in the development of the bio-conversion process for converting switchgrass to ethanol. The gasification process is unique in that it utilizes all types of cellulosic materials which are abundant in the Southern Great Plains. The process also utilizes the syn-gases for other uses in process which lends additional profits. The future is bright for the continuations of the development of economical bio-fuel conversion processes. One conversion technology was licensed in 2006, and it is hopeful that this will eventually lead to commercialization.

Over 1,000,000 million stocker cattle, both imported and domestic, graze wheat pasture in Oklahoma in a typical year. Wheat forage is utilized on part of the over five million acres of small grain pasture in Oklahoma. The stocker cattle industry is the largest livestock enterprise in Southwest Oklahoma and adds millions of dollars in gross income to the economy. Stocker cattle health management, management of growing programs, forage supplementation and other general management issues, are key factors that affect the profitability of stocker cattle producers.

Key Theme – Adding Value to New and Old Agricultural Products

a. Brief description – The Oklahoma food and agricultural business community has need for identifying value-added products and processes for the traditional products and agricultural commodities, and the value-added products, to be safe and secure for human consumption and be capable of withstanding regional, national, and international competition. Work is being done to coordinate science and technology core competencies at the Food and Agricultural Products Center to focus on improved methods to 1) harvest Eastern red cedar to competitively manufacture interior and exterior cedar particleboard for the building trades industry; 2) extract lycopene from field culled watermelons to capture a value-added crop; 3) capture and process food manufacturing facility waste into a value-added energy stream by gasification; 4) effect a greater and more efficient yield of Xanthan gum through a novel enhanced aerobic fermentation process; 5) add value to peanut butter by manufacturing individual slices; 6) improve methods of oil extraction from oilseeds; 7) improve extraction methods of oil extraction from oilseeds, herbs and nuts by a novel supercritical fluids extraction column and process; 8) identify manufacturing friendly processes to kill food pathogens and reduce risk in fresh and processed packaged foods; 9) identify and develop pro-biotic/competitive exclusion technology for the human food and animal feed industries; 10) identify and help in the commercialization value-added recovery products and processes for waste products from the vegetable products industry; 11) identify and develop understandings between wheat protein quality and quantity and the value of the finished products; and 12) improve business and marketing planning in Oklahoma businesses to improve competitiveness. Many muscles from the chuck and round are under utilized, but when prepared correctly and applied in a different manner, they can become more tender and flavorful and thus more valuable. Thirty-nine muscles from the chuck and round have been described and characterized for tenderness, flavor and many other variables. One hundred-forty-four chucks and rounds that represented various quality grades, yield grades and carcass weights were used to capture as much variation as possible. Each chuck and round was fabricated into those individual muscles weighing over 0. 5 lbs. Each muscle was subjected to numerous chemical analyses, including composition, water holding capacity and bind capacity.

Dimensional characteristics, yield and tenderness, both from an objective (shear force) and subjective (taste panel) perspective were measured. Various chuck and round muscles were studied to determine: 1) a baseline for tenderness, juiciness, flavor, shelf life, and chemical composition of enhanced (pumped) beef products currently availaose individual muscles weighing over 0. 5 lbs. Each muscle was subjected to numerous chemical analyses, including composition, water holding capacity and bind capacity. Dimensional characteristics, yield and tenderness, both from an objective (shear force) and subjective (taste panel) perspective were measured. Various chuck and round muscles were studied to determine: 1) a baseline for tenderness, juiciness, flavor, shelf life, and chemical composition of enhanced (pumped) beef products currently availar to enhancement, the paired subprimals (excluding the chuck tender) were cut into equal halves to produce a total of four pieces. Each piece was assigned to one of four treatment force groups. Treatments consisted of two enhanced levels (5% and 10%) and two enhancement solutions. Generally, shear force values for all treatments were clearly superior. Sensory analysis showed a distinct advantage for tenderness, juiciness, and overall acceptability. Panelists were able to detect a slight salt flavor in the high salt solutions in some of the beef cuts. However, steaks with slightly detectable salt flavors were generally ranked higher in acceptability. Soapy flavors were similar among all treatments and only detected in a few steaks. The recommendation for each steak varied depending on steak type. These recommendations have been utilized in day to day operations of meat processing of case-ready beef facilities. Yeast protects wounds of apple fruit from infection by decay fungi. They are more competitive than fungi for sugars in the wounds. A new discovery is that yeasts also deplete acetate esters from wounds, depriving the fungi of non-nutritive chemical cues needed to activate spore germination. This novel mechanism suggests that chemical ecology plays a strong role in the process.

b. Impact – Twenty-one percent of the direct food processing and 31% of the indirect food processing jobs in Oklahoma are the result of activities of the Food and Agricultural Product Center. The Center has assisted in over 1,000 technology and business projects with over 750 Oklahoma businesses, resulting in over 130 startup companies in Oklahoma, adding an average of over 25 jobs per year for the past 6 years into the Oklahoma economy. Research results have allowed for the improvement of chuck and round cuts, which were historically classified as tough, to now be marketed in a new value-added manner. The information gained allows for higher value marketing opportunities for these muscles and the profiling study helps meet consumer demands for convenient beef meals by identifying a wider variety of chuck and round beef cuts that are easy to prepare. Each muscle has been matched to complimentary cooking methods producing more tender and flavorful products. The technologies developed in case ready beef have resulted in over 100 new products that have improved shelf life, tenderness, flavor, and consistency. A new mechanism for the suppression of fungal decay by yeasts in apple fruit has been discovered. This mechanism may operate in other fungal pathogen-plant host-biocontrol yeast systems. Yeasts that rapidly use nutritive and non-nutritive cues that activate spore germination can be genetically engineered. These yeasts would be more effective than current biocontrol yeasts in postharvest storage of fruit. Some yeast protects wounds of apple fruit from fungal decay by two mechanisms: (1) competition for nutrients (sugars) and (2) competition for non-nutritive cues (acetate esters) that activate spore germination. Yeasts that use only one mechanism (1) are less effective than yeasts that use both mechanisms. Chemical ecology plays more of a role in the biocontrol of fruit decays than previously thought. The overall impact of these activities have resulted in the employment of 8,400 people directly and 22,000 indirectly. Total direct sales were over $545 Million and indirect sales resulting from these activities were over $2.1 Billion.

c. Source of Funds – Hatch Act, Special Research Grants, and State Appropriated Funds

d. Scope of Impact – Multistate Integrated Research and Extension

Stakeholder Input Process

Stakeholder input for the Center occurs as follows: 1) The Center has an advisory board of 15 industry executives and professionals, appointed by the Governor, by the State Senate President Pro-Tempore, by the Speaker of the State House of Representatives, and by the Dean of the Oklahoma State University Division of Agricultural Sciences and Natural Resources, that provide oversight and input on Center goals and Center projects; 2) the Center maintains excellent and close relationships with the State Commissions and Industry Trade Associations that offer recommendations on direction of work and individual projects; 3) the Center Director is on the State Health Department of Food Safety that allows insight and focus of public health needs of the state; 4) a Center representative serves on the Oklahoma Economic Diversification Advisory Board that recommends funding for business and agri-business economic development; 5) the Center hosts monthly Food Safety Roundtables to promote discussion and answer questions on food safety issues for the State food industry; and 6) the Center maintains continuous contact with over 1,000 client stakeholder list for technology and business marketing updates. In addition, input is solicited from the Oklahoma Beef Council, National Cattlemen's Beef Association, Beef Producer's of Oklahoma, and the State Beef Check-Off Program for meat research and extension programs. Vegetable and fruit commodity groups are also solicited to provide input. It is the Oklahoma Agricultural Experiment Station's opinion that the advisory sessions with their input and the input received from the varying workshops and extension programs are very helpful in refocusing or reaffirming priorities and identifying emerging issues.

Program Review Process

There have no significant changes in review for other program activities.

Evaluation of the Success of Multi and Joint Activities

Each faculty member and professional staff member are evaluated annually and required to develop yearly performance files for research, extension, and outreach programs. The Center is evaluated annually by the Director, Vice-President, Dean, and Director of Agricultural Sciences and Natural Resources, and the Advisory Board by interactive questions and answer discussions at each of the semi-annual board meetings.

Integrated Research and Extension Activities

The Center has developed and funded a Food Research Initiative Program and a Food Extension Initiative Program that draw scientists from all Departments in the Division and from off-campus to collaborate in science and technology programs at the Center that are focused on value-added products and processes for Oklahoma food and agri-business industries.

Key Theme – Animal Production Efficiency

a. Brief description – When considering beef production costs from conception through the finishing phase, the largest cost is that of investment cost of the land for cowherd followed by the costs associated with purchased feed and harvested forage. Development of practices that reduce land and feed costs for the cowherd must take into account effects on reproduction, subsequent effects on efficiency of calves to the carcass end point and beef product quality. Utilization of whole, raw oilseeds in winter supplements has the potential to reduce beef cow winter feed costs, improve reproduction and improve beef production. Forages frequently comprise the total or the major portion of the diet for beef and dairy animals. Consequently, the National Research Council developed nutritional guidelines for beef and dairy that is predicated

on the use of a metabolizable protein system. Optimization of forages in cattle diets require advances in our ability to accurately describe forage protein characteristics. Research results have improved the timing and duration of the need for protein supplementation for cattle grazing warm season grasses and dormant forages in the winter.

b. Impact - Whole raw soybeans and sunflower seeds are effective protein and energy supplements for beef cows grazing winter range or consuming harvested forage during the winter. A minimum of 40% greater value for soybeans and sunflower seeds can be gained when used as a feed supplement compared to their standard price. Winter feed costs utilizing whole soybeans priced at $5.50/bu can be reduced $9.50 per cow compared to traditional supplemental programs. If only 5% of Oklahoma cow/calf operations took advantage of this opportunity, production costs could be reduced $1 million annually. This impact does not consider the potential improvements in reproduction and carcass quality. Greater efficiency in the formulation of diets and the performance of cattle has occurred as a result of forage protein characterization.

c. Source of Funds – Hatch Act; Special Research Grants, State Appropriated Funds

d. Scope of Impact - State Specific; Integrated Research and Extension

Stakeholder Input Process

Frequent interaction occurs with producers relative to their research needs and the University's research activities. Formal feedback is acquired through producer surveys and informal feedback is provided during on-farm visits and educational programs. Additional interaction occurs with the National Cattlemen's Beef Association Producer Services Committee, Oklahoma Cattlemen's Association Research and Education Committee, Oklahoma Cattlemen's Association and the Oklahoma Grain and Stockers Association.

Program Review Process

There have been no significant changes in program review.

Evaluation of the Success of Multi and Joint-Activities

The animal production efficiency program has been identified in the strategic planning process within our division as one of the comprehensive initiatives, thus it will continue to receive high priority in both extension and research programs. The research and extension programs have benefited producers, processors, and consumers as well as the under-served and under-represented populations of the state and the nation.

Integrated Research and Extension Activities

Field and laboratory experiments and programs have been developed jointly by research and extension faculty thus increasing the effectiveness of the program. Research publications and extension fact sheets have been utilized to disseminate best management practices.

Key Theme – Biofuels

a. Brief description – The research project utilizes a unique biomass-to-ethanol conversion process compared to the standard corn starch fermentation. Biomass is combusted in a gasifier under conditions of controlled oxygen supply where all of the components (cellulose, hemicellulose, and lignin) are pyrolized to a gas known as synthesis gas (carbon monoxide, carbon dioxide, and hydrogen) or syngas. The syngas then flows through a cleaning and cooling sysem, and is subsequently directed to a bioreactor where it is microbially catalyzed to a mixture of ethanol, inert gases,

water, and other potentially useful products such as acetic acid. From the bioreactor, the mixture is further processed to separate and recover the essential products, especially ethanol, which is then distilled into a fuel grade product. Since the total biomass, including lignin, is utilized in the bioconversion process, ethanol yield could be increased by more than 20 percent over standard fermentation processes. This project will address the critical research and education needs from the production of biomass to the production of ethanol, which are important in moving our bioconversion process to commercialization. Recent funding through the Department of Transportation and the President's emphasis on conversion of switchgrass to ethanol has boosted interest in developing bio-conversion processes. The Sun Grant Initiative and the five regional centers in the U.S. have also gained visibility in moving forward with alternative fuels and energy sources. Oklahoma State University is designated as the regional center for the eight-state South Central region and will be working the surrounding states in research and extension activities to promote alternative fuel sources. The addition of additional scientists in the Biosystems and Agricultural Engineering Department has led to additional research on sugar fermentation from sweet sorghum as an ethanol source, and enzymatic hydrolysis conversion technology.

b. Impact – While the development of this new technology is awaiting proof of concept with building a pilot plant and then moving the technology to commercialization, the potential economic impact to farmers in rural America could be significant. In addition to stimulating the rural economic, placing highly erodible land into perennial biomass crops such as grasses will abate erosion and improve the water quality in streams, rivers, and lakes.

c. Source of Funds – Hatch, Special Research Initiatives, State Appropriated Funds

d. Scope of Impact – Multi-State Research with: MS

Stakeholder Input Process

Input for OAES research is received from numerous sources. Research Scientists, extension personnel, and administrators meet with commodity groups and other groups such as advisory committees for the counties as well as industry groups. The Sun Grant Initiative meets regularly with a U.S. Department of Transportation advisory group which has representation from USDA, EPA, and DOE. These discussions promoted the research idea to seek an alternate bio-energy source to assist the petroleum industry in supplying a supplement to our current energy source. Corn is not an option for Oklahoma in most areas due drought stress, thus an alternate fuel source such as switchgrass was chosen with the help and input from stakeholders as a crop that could be produced in thin highly erodible soils in the uplands as well as in the more productive soils of the lowlands. Switchgrass is now used for the model for the gasification process.

Program Review Process

There have been no significant changes in program review.

Evaluation of the Success of Multi and Joint Activities

The multidisciplinary, multiuniversity, and multistate activities have been extremely successful. These scientists have worked hand-in-hand with each other and similar scientists at Mississippi State University and the University of Oklahoma. Thus, it is one of our most successful multi and joint activities and this group are the first to produce ethanol by this unique gasification process. Research activities are reviewed annually by the Departments and the Oklahoma Agricultural Experiment Station.

Integrated Research and Extension Activities

The biofuels team consisting of scientists from the Plant and Soil Sciences Department, the Biosystems and Agricultural Engineering Department, the Agricultural Economics Department and the Food and Agricultural Products Center within the Division of Agricultural Sciences and Natural Resources and the Department of Chemical Engineering at Oklahoma State University in conjunction with the Microbiology Department at Oklahoma University were the first to produce ethanol from the gasification process.

Key Theme – Grazing

a. Brief description – Wheat is utilized as a multipurpose crop in Oklahoma. It is grown under three different management regimes. The regimes are grain production, grazing plus grain production, and graze out. Over 1,000,000 million stocker cattle graze Oklahoma wheat in a typical year. After reaching the desired weight (600 to 750 lb.) these stocker cattle move on into the feed lot. Many precondition programs have been developed through research to add value to the sale price of the calves. One notable program has been the Oklahoma Quality Beef Network (OQBN). This is a program that has a series of preventive vaccinations to reduce the incidence of shipping fever and promote over all animal health and is a certified program.

b. Impact – Producers have gained key economic skills in determining the proper amount and type of feed supplements to provide to stockers on wheat pasture. Knowledge has been gained for utilizing available feed grains or by-product feeds as low cost alternatives for wheat pasture supplementation and in efficient holding/growing programs prior to grazing wheat forage. Specific results have been improved health management via proper vaccination procedures and feed supplement programs. The result has been increased profit of $18 to $20 per calf at the sale barn. With 1,000,000 stocker calves grazing wheat pasture annually in Oklahoma, the economic impact in the state is approximately $18 to $20 million dollars annually. The impact of the success of the program also is prevalent the wheat grazing areas of Texas, Kansas, New Mexico, and Colorado. The success of this program can be attributed to the joint efforts of research scientists in OAES and the high quality of Extension programs in OCES.

c. Source of Funds – Hatch, Special Research Initiative, State Appropriated Funds

d. Scope of Impact – OK, TX, KS, NM, CO

Stakeholder Input Process

Input is received from various sources in the state to include county educators, area livestock specials, state extension specials, county advisor groups, The Oklahoma Wheat Stockers Association, The Oklahoma Wheat Commission, The Oklahoma Beef Commission, rural educational meetings held by Extension personnel, and field day programs.

Program Review Process

There have been no significant changes in program review.

Evaluation of the Success of Multi and Joint Activities

This program is unique and has had great success and acceptance with the stocker cattle producers in Oklahoma, Texas, Kansas, New Mexico and Colorado. The program has been identified as a high priority research and extension initiative in our strategic planning process. We are extremely please with interdisciplinary input from agronomists, plant breeders to

develop the forage varieties, soil scientists for the fertility programs established to maximize forage growth, and animal scientists for their nutrition, health management input, and to the agricultural economists for their overall analysis for profitability of the program.

Integrated Research and Extension Activities

This is truly an integrated program that involves stocker cattle producers, county educators, area livestock specialist, state extension specialist and researchers in multiple departments. Researchers and Extension Specialist are working hand in hand to increase the profitability of the wheat stocker program and have had great success.

Key Theme – Plant Germplasm

a. Brief description - Oklahoma Agricultural Experiment Station researchers are developing new improved plant varieties and germplasms that are adapted to abiotic and biotic stresses that are encountered under Oklahoma climatic and environmental conditions, as well as those existing in surrounding states. Plant germplasms have been gathered from around the world to enhance genetic diversity in the wheat, peanut, forage, turfgrass, and alfalfa breeding programs. Molecular, physiological, and morphological traits are being identified in developing germplasm of wheat, peanut, forage, turfgrass, and alfalfa and used in the selection criteria to enhance disease and insect resistance, seedling vigor, cold hardiness, earliness, tolerance to environmental stress, and yield. Cultivar improvement for the varying species encompasses several scientific disciplines in the OAES; where research initiatives are identified and implemented by a group of multidiscipline scientists known as improvement teams. The team approach has proven highly beneficial for peanut, forage, turfgrass, and alfalfa and has been employed in selection to enhance disease and insect resistance, seedling vigor, cold hardiness, earliness, tolerance to environmental stress, and yield. Over 1,300 three-way crosses have been made between introduced germplasm and adapted winter wheat. The most advanced populations (F3's) are currently being evaluated at multiple sites. Additionally, a cooperative winter wheat breeding effort has been established with CIMMYT, and a strong cooperation has been established with the breeding programs in Kansas and Texas. These joint efforts will insure continued access to new sources of genetic variability that will prove to be vital in the future. Four alfalfa (Medicago sativa) cultivars, OK 169, OK 199, OK 200, and OK 201 were developed and released. Strain crossing and indirect selection among and within adapted alfalfa cultivars for pest resistance, tolerance to environmental stress, seed production, and general adaptation were the general selection criteria for the four cultivars. Fall dormancy similar to OK 49 and somewhat less dormant than Cimarron VR and WL 320. Winter hardiness has been adequate. OK 200 is more dormant than OK 49. OK 201 has a wild gene base, fewer falls dormant than OK 49, and has presented no evidence of winter sensitivity. All of these new cultivars have yielded well in extensive testing in Oklahoma. Persistence appears to be acceptable and overall performance is superior or equal to the best cultivars in the southern plains. Ten alfalfa germplasms were released. Six are varying levels of enhancement of World Collection Material. Three germplasms possess resistance to a new blue alfalfa aphid and one germplasm was the result of the convergence of three lines of breeding for pest resistance, spotted alfalfa aphid, blue alfalfa aphid, and phytophthora root rot.

b. Impact – The OAES has had a long history of cultivar and germplasm development of numerous agronomic and horticultural commodity crops to meet state, regional, national, and international needs. During this reporting period, the OAES released its first hard white winter wheat variety, 'Intrada' that has excellent international market opportunities. This new release represents a "new crop" opportunity for wheat producers in western and panhandle counties of Oklahoma and the western high plains of Texas and Kansas. White wheat must be kept identity preserved throughout the entire production and

marketing cycle to prevent contamination of the traditionally grown hard red winter wheat in the area. Consequently, new production and marketing opportunities for farmers and grain elevators have been provided with the release of the "new crop". The federal incentive program will further promote the production of hard white winter wheat in Oklahoma. Grain yield of this cultivar is superior to other white wheat varieties that are currently available from other state programs and similar to most hard red winter wheat varieties currently in production. Maturity and dormancy is intermediate while reaction to wheat soil borne mosaic is mixed. It is moderately susceptible to tan spot and leaf rust during the early stages of growth but shows an intermediate reaction in adult plants. Tolerance to soil acidity is moderate, plant height is medium-short, kernel hardness is acceptable, grain protein is adequate, and kernel size is uniform. The cultivar has a medium-short mixing time, good mixing tolerance, and excellent loaf volume and texture. OAES, Kansas Agricultural Experiment Station, and USDA-ARS developed this variety cooperatively. It was jointly released by OAES and USDA-ARS. Six new hard red winter wheat varieties, 'Ok101' and 'Ok102', Deliver, Endurance, Ok-Bullet, and Duster and six new wheat germplasm lines that carry leaf rust and soil borne mosaic resistance designated as OAES-1 through OAES-6 have been released. The incorporation of new genetic diversity offers the potential to break the yield plateau that has existed for more than 25 years and the new genes for leaf rust resistance from CIMMYT spring wheat's could lead to a long-term stable resistance in new varieties. A modest improvement in yield potential combined with "durable leaf rust" genes could easily result in more than 10 billion bushel increase ($30 billion) in production in Oklahoma. Two improved forage-type bermudagrass, 'Midland-99' and 'Ozark'; a new seeded turf bermudagrass, OKS95-1; 'Patriot', a new turf type bermudagrass; a Virginia peanut, 'Jupiter'; two new peanut varieties jointly released with Texas A&M and ARS, Olin and Tamrun OL01 were released. New alfalfa cultivars and germplasm generated assure high yielding varieties for the southern Great Plains. The alfalfa cultivars are higher yielding and require less production inputs. Improved cultivars represent an important impact on the increased value of the alfalfa in Oklahoma. The value of quality germplasm collections is measured indirectly by the protection they grant from genetic erosion and from their contribution through better varieties through breeding and associated scientific use. Improved varieties are planted on a majority of Oklahoma's cropped acreage. Studies of breeding gains made over the last 50 years have been generally in the order of 10 to 30%. In Oklahoma, this gain in winter wheat alone, which is the number one crop in Oklahoma have increased annual production by about 18 million bushels and annual income $54 million.

c. Source of Federal Funds – Hatch

d. Scope of Impact – Multi-state Research with:
VA, AK, TX, KS, CO, NE, NM, GA, FL,

Program Review Process

There have been no significant changes in program review.

Evaluation of the Success of Multi and Joint Activities

The planned variety and germplasm development programs addressed the critical issues of strategic importance, including those identified by the stakeholders. The needs of the under-served and under-represented populations were included within the critical issues of strategic importance. Planned variety and germplasm development programs describe the expected outcomes and impacts and resulted in improved program effectiveness and/or efficiency.

The effectiveness and efficiency of the plant variety and germplasm development program has been greatly enhanced due to multidisciplinary activities of plant breeding, molecular genetics,

soil and crop specialists, entomology, plant pathology, plant physiology, and biochemistry within the Division of Agricultural Sciences and Natural Resources. Much of the progress can be attributed to joint research and extension activities and multistate cooperative efforts. Scientists in other states have evaluated OAES plant materials considered for variety release. This information has been extremely helpful in determining the climatic zone of adaptation of the varying species that are forthcoming in variety and germplasm release programs.

The Southwest Wheat Research and Extension Center is a classic example of multi-state/multi-institutional/multi-agency/multi-disciplinary activities that consists of scientists from Oklahoma, Texas, and Kansas as well as individuals representing commercial seed companies and independent foundations. This group represents Land-grant Universities, USDA/ARS, industrial research scientists, independent foundation agronomists and State Cooperative Extension personnel that are working together toward a common goal of variety and germplasm improvement of wheat. Other similar groups represent improvement in variety and germplasm development of soybean, peanut, forage and turf bermudagrasses, and alfalfa. The OAES is extremely pleased with outcomes and impacts of our multi and joint activity programs.

Integrated Research and Extension Activities

Name of Planned Program/Activity: Promotion of the Use of Improved Alfalfa Varieties

Brief Progress Report: As part of the alfalfa breeding program, an extensive variety testing program is conducted throughout the state. Test results are published on the Internet at http://alfalfa.okstate.edu/var-test/alf-var.html. The best varieties for Oklahoma in these tests are promoted in articles in the Oklahoma Alfalfa Hay & Seed Association NEWS and in oral presentations organized by County Extension Educators. This activity is responsible for the high level of acceptance of improved alfalfa varieties in the state.

Name of Planned Program/Activity: Promotion of Forage Legumes in Oklahoma Pastures

Brief Progress Report: As part of our pasture management and legume breeding programs, we plant trials and demonstrations of forage legumes adapted to Oklahoma. The best species are promoted as part of tours and demonstrations at research stations and in commercial pastures. The plantings also serve as a source of material for images on our Oklahoma Forages web page at http://forage.okstate.edu/ .This activity assists County Extension Educators and Area Extension Specialists promote improved pasture management.

Name of Planned Program/Activity: Integrated Management of Peanut Diseases

Brief Progress Report: Field research trials were completed in 2000 that management of Sclerotinia blight of peanut. Biological, chemical, and cultural management strategies were evaluated. The cultivars Tamspan 90, Tamrun 98, and Tamrun 96 have been identified as moderately resistant to Sclerotinia blight. Despite the improved performance of these varieties in infested fields, yields of all varieties were increased by the experimental fungicide fluazinam. Therefore, the effects of deploying the resistant cultivars and using an effective fungicide are additive. Results were transferred to clientele through extension publications, popular articles, and mass media. Greater than 90% of the peanut acreage infested with Sclerotinia blight was planted with a moderately resistant variety in 2000. In addition, data from the applied research was used to support an emergency exemption request for use of fluazinam on peanuts was approved for the first time 2000.

Stakeholder Input Process

The OAES receives stakeholder input for plant breeding and germplasm development programs from numerous sources. Research scientists, extension personnel, and administrators meet quarterly with representatives from crop commodity groups and more frequently in scheduled

meetings with producers to seek their input regarding varietal needs and other management inputs.

The Oklahoma Wheat Commission, Oklahoma Wheat Research Foundation, Oklahoma Wheat Growers Association, Oklahoma Grain and Feed Association, Oklahoma Seedmen's Association, and Oklahoma Grain & Stocker Producers' Association regularly provide input regarding desirable characteristics to include in both the hard white winter wheat and hard red winter wheat breeding programs.

Members of the Oklahoma Peanut Commission and Oklahoma Peanut Growers Association are providing stakeholder input for the peanut breeding programs. The Oklahoma Alfalfa Hay & Seed Association provides input for the alfalfa-breeding program and for forages. Representatives from the Oklahoma Golf Course Superintendents Associations and the U.S. Golf Association provide input for the development of turf bermudagrasses.

A Dean's Advisory Group for the Division of Agricultural Sciences and Natural Resources that consists of 40 key agricultural leaders throughout the state meets biannually with scientists and administrators and discusses needs and provides suggestions for improvement of cultivars that are adapted to the state.

Extension Specialists, Area Agronomists, and County Educators meet with area producers and commodity groups and relay information to OAES researchers regarding desirable characteristics and phenotypic traits to be included for the varieties of the wheat, peanut, alfalfa, and forage and turf bermudagrasses developed.

Key Theme – Precision Agriculture

a. Brief description – Research leading to a better understanding of nutrient variability in soils has prompted the development of new sensor-based technology to satisfy nutrient needs of plants. Previous solutions have been the use of composite soil cores to represent the nutrient status of fields. The new technology identifies the nutrient status of plants in every 4-ft^2 area and adjusts fertilizer rates accordingly. A new machine, 'GreenSeeker', has been developed that can operate day or night at up to 15 mph to apply fertilizer based on crop needs in each small 4 ft^2 area. Efficiency of applied fertilizer applications has been improved and risks to the environment have been minimized. More recently, hand held sensors in combination with N rich strips have gained popularity in our extension education programs. Additionally, smart sprayers with less precision, i.e. variable rates every 200 sq.ft. have gained in popularity.

b. Impact – New sensor-based technology to assess fertilizer needs of crops has been developed and mounted on a commercial machine with a 60' boom. Adoption of this new technology will result in savings of approximately $18 per acre in winter wheat production systems. If half of the acreage in Oklahoma utilizes this technology, savings in input costs would exceed $45 million dollars for the more than 5 million acres of wheat planted annually. The technology can be adapted for multiple crops such as corn, forages, spinach, turf, or where ever the need for nitrogen fertilization exists. Results of the new technology will be improved efficiency of nitrogen fertilization while maintaining high quality yields. The potential of run-off and/or leaching of NO_3 into groundwater and drinking water supplies will be reduced thus protecting the environment. High costs of fertilizer N demand greater efficiency to maintain profit margins.

c. Source of Funds – Hatch Act; Special Research Grants; State Appropriated Funds, Commodity Groups – Oklahoma Wheat Commission, Oklahoma Wheat Research Foundation, Oklahoma Fertilizer Advisory Board; Private Foundations.

d. Scope of Impact – Multi-state Research with: NE, VA

Stakeholder Input Process

The OAES receives stakeholder input from numerous sources. Research scientists, extension personnel, and administrators meet quarterly with crop commodity groups, biannually with the Fertilizer Advisory Board, and more frequently throughout the year with farmer/producer groups to seek their input for efficiency of fertilizer application needs.

The Fertilizer Advisory Board, Oklahoma Wheat Commission, Oklahoma Wheat Research Foundation, and farmers and producers regularly provide input regarding the desirable characteristics of the new sensor-based 'GreenSeeker' machine. Their input and experiences were recorded and became instrumental in developing boom height control and trouble shooting mechanisms for the sensor-based machine. In addition, this group has been instrumental in promoting educational programs with the N rich strips and hand held sensors.

Program Review Process

There have been no significant changes in program review.

Evaluation of the Success of Multi and Joint Activities

The planned sensor-based development program addressed the critical issues of strategic importance, including those identified by the stakeholders.

The effectiveness and efficiency of the sensor-based precision agricultural program has been greatly enhanced due to the multidisciplinary activities of agricultural engineers, agronomists, soil scientists, and turf grass research and extension scientists. This is truly a multidisciplinary effort and has been highly successful in identifying a need that benefits the farmer and as well as being friendly to the environment. Research has been conducted to solve a problem; proof of concept under full-scale field conditions has been provided; undergraduate and graduate students have been trained in new technology; and the basis for development of new businesses has been provided that will bring new jobs into the state of Oklahoma. This technology will eventually encompass the Great Plains; the Corn Belt; golf courses throughout world; and wherever nitrogen is applied globally to meet crop requirements. The OAES is extremely pleased with the outcome and impacts of this multi and joint activity program. OAES utilizes this program as a perfect example of meeting the expectations of programs conducted under the land-grant mission.

Integrated Research and Extension Activities

More than 50 field experiments are established annually on farmer cooperators fields to conduct soil fertility research and to provide a basis for development of fertilizer recommendations for crops and forages grown in Oklahoma. Many of these same plots are utilized in refining and the development of the new sensor-based technology. This research information is collected, analyzed, and interpreted and extension publications and media information outlets are identified. In conjunction, farmer and commodity group meetings are scheduled to present the latest information regarding traditional fertilizer applications and the new sensor-based technology that has been developed.

Evaluation of the Success of Multi and Joint Activities

Integrated Research and Extension Activities

Goal 2. A safe and secure food and fiber system

Overview

Our nation's food supply is considered to be among the safest in the world. However it is vulnerable to attacks with pathogen or toxic chemical at any one of several points between the farm/ranch and the consumer. The microorganisms that cause smallpox, anthrax, bubonic plague, Ebola, tularemia, and botulism are most often considered as potential threats. Crop species are vulnerable to attack by various fungi, viruses, and nematodes. Because of the often remote and rural locations of our farms and ranches, plant and animal diseases may go undetected for an extended period of time. For example, the occurrence of karnal bunt in U.S. wheat did little actual damage to the wheat crop, but it disrupted national and international trade, incited consumer alarm and substantially undermined the financial well being of local rural communities. Domestic pathogens of particular concern to U.S. crops include the fungi that cause wheat stem rust, wheat leaf rust, head blight (scab) of grains, karnal bunt, Asian soybean rust, and rice blast. The plum pox virus was not known to occur in the U.S. until recently. However, it has caused significant losses and was quarantined only with great difficulty.

Livestock production is likewise extremely vulnerable due to the concentration of animals into small areas, which may also be geographically remote in rural parts of the country. Examples of areas with major livestock concentrations would include western Oklahoma (swine), eastern Oklahoma and Arkansas (poultry), and the south-central Great Plains, including parts of Texas, Kansas, and all of Oklahoma (cattle). Foot and Mouth Disease, African swine fever, hog cholera, rinderpest, lumpy skin disease and related pox diseases, exotic bluetongue viruses and related orbiviruses, pathogenic avaian influenza viruses, and pathogenic Newcastle disease viruses are animal pathogens that devastate production. Zoonotic diseases that attack livestock and poultry may also cause human disease outbreaks. The highest threats among these are Venezuelan equine encephalomyelitis and related equine encephalitides, Rift Valley fever, avaian influenza, Japanese encephalitis and Nipah, Hendra and related viruses. Food borne pathogens such as *Salmonella,* enteropathogenic *Esherichia coli, Listeria,* and *Campylobacter* can cause wide spread illness, tremendous disruption in daily lives, and significant economic loss as well as affect the health of thousands of consumers over a large geographical area if the outbreak is involved in large food processing plants.

A world-class program that addresses emerging areas in safe and secure food supplies has been developed by building a team of scientists that have expertise in plant pathology, food microbiology, veterinary medicine, food engineering, biochemistry and molecular biology, plant and soil sciences, and plant breeding. The interdisciplinary research program developed focuses on developing and utilizing state-of-the-art detection methods as well as newly developed molecular probe technology for targeted microbial pathogens and/or toxins to determine critical points in the food chain (i.e. production, harvest, processing, and/or distribution) in which surveillance should be maintained.

Because of potential harm to human health in food borne outbreaks, there is a zero tolerance for Listeria monocytogenes in ready-to-eat foods. D-values, which are the times at a particular temperature to obtain a 10 fold reduction in cell counts, for the various products ranged from 4.0 – 9.3 seconds at 160 F, 12.5 – 24.4 seconds at 155 F, 29.6 – 73.5 seconds at 150 F, and 67.6 – 416.7 seconds at 145 F. It was previously believed that spontaneous kill of bacteria occurred once temperatures reached 160 F. Results indicate that cooking regimens used by Oklahoma processors of fully cooked sausage links and meatballs are sufficient to render a high reduction of incidental Listeria monocytogenes. Oklahoma Cooperative Extension has conducted the "Oklahoma Food Safety Program" to increase the safety of the food supply in our state. By increasing awareness and knowledge of safe food behavior and choices and by teaching them to take responsibility for the safety of their food has reduced their risk of food borne illness.

Both food manufacturers and individual clientele have benefited from food safety research, which has lessened risk of illness associated with ready-to-eat foods and home processed foods. Although this work is continuing and much progress has been made in our understanding of providing safe and secure food supplies, much more work must be accomplished. We are pleased with the outcome of our program and they have made great strides in helping both manufactures and individual clientele in the general area of food safety.

The meat industry has been in recent years dramatically impacted by recalls made necessary due to the detection of Escherichia coli 0157:H7 in beef. New and novel methods of controlling this pathogen and others can help reduce the risks associated with their occurrence in foods such as meat. Such methods also can reduce the potential impact of intentional or deliberate introduction of the pathogens into the food supply by persons such as terrorists wanting to cause wide spread illness outbreaks.

Approximately 5 FTE's are working in this general area and sources of funds include Hatch, state appropriated funds, and grants and contracts from private industry. Total federal formula expenditures (Hatch) for this effort during the reporting period were $27,085. State appropriated funds; industry, commodity groups and associations; and grants and contracts have contributed more than 20 fold in the total safe and secure food and fiber program.

Key Theme – Food handling

a. Brief description – D-values, which are cooking times at various temperatures to reduce pathogen levels 10 fold, have been determined for processed meats. Results indicated that time of cooking to reduce pathogen level vary greatly with temperature of cooking for poultry, beef, and pork. D-Values range from 4.0 – 9.3 seconds at 160 F, 12.5- 25.4 seconds at 155 F, 29.6 – 73.5 seconds at 150 F, and 67.6 – 416.7 seconds at 145 F. Although microbial reduction is most rapid at 160 F, bacteria are not killed instantaneously at that temperature and complete elimination is a time-and-population dependent phenomenon.

b. Impact – These temperature profiles with length of cooking time provide information to insure that processed meats are cooked adequately with minimum risk of illness. The data are applicable to both manufacturers and individual clientele. This information has been provided in workshops to manufacturers and through extension programs throughout the state. The result has been fewer cases of food borne illness.

c. Source of funding – Hatch and state appropriated funds

d. Scope of impact – Multistate integrated research and extension with: ME

Stakeholder Input Process

Input for research is solicited from the Food and Agricultural Research and Technology Advisory Board and from individuals participating in workshops and extension programs throughout the state. The advisory board consists of individual producers and representative members of manufactures in the food industry. Their ideas for research and needs of the industry as well as individuals are recorded, assessed, and priorities for research are set. It is the Oklahoma Agricultural Experiment Station's opinion that the advisory sessions with their input and the input received from the varying workshops and extension programs are very helpful in refocusing or reaffirming priorities and identifying emerging issues.

Program Review Process

There have been no significant changes in program review.

Evaluation of the Success of Multi and Joint-Activities

The effectiveness and relevance of food safety research has been enhanced with the involvement of research faculty in Colleges of Veterinary Medicine and Arts and Sciences as well as the input and cooperation from private industry firms. The food safety program addresses the critical issues of strategic importance, including those identified by the stakeholders. The effectiveness and efficiency of the food safety program has been greatly enhanced by the multidisciplinary approach, which includes faculty from the Colleges of Veterinary Medicine and Arts and Sciences. Faculty that have expertise in plant pathology, food microbiology, veterinary medicine, food engineering, biochemistry and molecular biology, plant and soil sciences, and plant breeding are working together in many multidisciplinary activities. Research has benefited both manufacturers and individual clientele reducing the risk of food borne illness to include the under-served and under- represented populations of the state and U.S. The planned programs address the critical issues of strategic importance identified by the stakeholders. They also represent the needs of the under-served and under-represented population of the state.

Integrated Research and Extension Activities

The research conducted has been an integral part of the information provided in the Oklahoma Food Safe Program, which works primarily with consumers to increase their safety of the food supply in our state. By increasing their awareness and knowledge of safe food behavior and choices and by teaching them to take responsibility for the safety of their food they reduce their risk of food borne illness. In-service training to county educators, leader training for Oklahoma Family & Community Educators, and public service announcements, has increased the awareness of food safety issues.

Key Theme – Food Safety

a. Brief description – Scientists at Oklahoma State University have found that cells of a selected bacterial culture of lactobacilli, when added to the surfaces of beef or pork carcasses caused reductions in numbers of Escherichia coli 0157:H7 and Salmonella. This was due to low levels of hydrogen peroxide produced by the cells of lactobacilli on the carcass at refrigeration.

b. Impact – The development of new novel methods of controlling food borne pathogens on meat carcasses could provide better control of these pathogens and thus increase the safety of meat. This should also reduce the incidence of massive recalls experienced by the meat industry in recent years. It should also reduce the risks associated with possible terrorist activity aimed at disruption of the food industry.

c. Source of Federal Funds – Hatch

d. Scope of Impact – Multi-state Research with: ME

Stakeholder input Process

The OAES receives input from numerous sources. Research scientists, Extension Specialists, and administrators meet biannually with the Oklahoma Food and Agricultural Products Research and Technology Center Advisory Board, and more frequently throughout the year with individual food processors and companies. Their input and experiences are recorded and become instrumental in developing research related to food safety.

Program Review Process

There have been no significant changes in program review.

Goal 4. Greater harmony between agriculture and the environment

Overview

Oklahomans want to provide a reasonable measure of security for future generations while continuing to use natural resources to meet their needs. The range of environmental concerns of the public includes real or perceived threats to air, water and soil quality as well as to wildlife and ecosystem health. The goals of protecting and managing natural resources, expanding and promoting strategies for integrating pest management in rural and urban environments, and achieving effective and efficient waste management systems, particularly from intensive animal production systems, provide opportunities for OAES research in the area of agriculture and the environment. There are also opportunities for improved land stewardship that integrates wildlife and natural resource management with agricultural production.

The Oklahoma Panhandle is the most productive agricultural region in the state and Texas County is the heart of the most highly concentrated cattle and swine feeding area in the US with over 1.8 million head. The state of Oklahoma has 2.3 million head of hogs, which has increased 1.0 million head in the last six years. Significant factors causing the increase are: available land for animal production facilities, grain production, land available for manure applications, and a large relatively new processing facility. It is essential that economical, sustainable, and environmentally prudent waste management principles and practices be developed for the rapidly expanding animal industry in this semiarid region. The semiarid agroecosystem is unique, which renders much of the management information gained from more humid environments inapplicable.

Current needs of the animal industry related to waste management dictate that a balanced research program be pursued which searches for both and short and long-term solutions to problems. Faculty from Biosystems and Agricultural Engineering, Plant and Soil Sciences, Animal Science, and Agricultural Economics have joined together to form a waste management team to identify, investigate and improve efficiency of swine operations and manure applications to soil/crop systems.

Odor has been identified as a number one priority for research by the animal industry. Therefore current research work is focused on evaluation of sources of odor, odor abatement, and odor dispersion in the atmosphere. A computer model has been developed that utilizes real-time climatic data that can be derived from 110 locations within the state with the objective of predicting the probability of odor becoming a problem to neighbors surrounding confined animal operations. This model provides the best possible information regarding existing climatic conditions and their potential affect on dispersion and the probability of creating a nuisance during effluent application. Concurrently, research has been conducted to determine ideal operating conditions and biota for lagoon and how to best utilize the 3 million gallons of swine lagoon effluent produced each year as a fertilizer without affecting existing water supplies and damaging the environment. Soil and crop management practices have been developed that will fully utilize the nutrients in the effluent and minimize odor emission into the atmosphere. Research with sprinkler irrigation systems has shown that more than 50% of the ammonia-N may be lost during application. Timing and application rates have been adjusted to minimize these losses. Research with subsurface irrigation systems will be initiated in the coming year to provide further information regarding improving the efficiency of effluent applications in cropping systems.

Benefits of the research thus far have provided information leading to the proper timing, application method, and prudent use of swine effluent in cropping systems while minimizing odor dispersion and nuisance complaints as well as minimizing risks of damaging water

supplies and the environment. Information generated has been disseminated to clientele attending waste management conferences held annually and via conventional publication outlets. This information has been invaluable in assisting producer/operations to remain in compliance of legislative man-dates as well as minimizing risks to the environment.

Special federal initiatives, state appropriated funds, and grants and contracts have contributed to more than 30 fold to the federal effort in animal waste management program.

Key Theme – Animal Waste Management

a. Brief description – Animal waste management research with emphasis on confined swine operations has been initiated in the semiarid region of the Panhandle. Rainfall is less, wind velocity and duration is greater, and summer temperatures are higher that in most other confined swine producing areas in the US. Thus, information generated in the more humid areas is not always applicable to this region. Research has developed a computer model to assist in minimizing the risks of creating odor nuisance problems during effluent applications. Ammonia-N losses from effluent during sprinkler irrigation applications have been determined and management practices have been adjusted. Best management practices for effluent application to soil/crop systems have been developed and appropriate rates of effluent to satisfy nutrient needs of the crops grown in the area have been identified. In the future, additional research will be initiated to determine the feasibility of utilizing subsurface irrigation systems to apply effluent in existing cropping systems in the region. Dietary manipulation to reduce nutrient and volatile organic compound excretion from swine has been investigated. Primary emphasis has been placed on nitrogen and phosphorus excretion. Environmental concerns are the most critical issues impacting the viability of the U. S. swine industry today.

b. Impact – Information gained has been disseminated to producer/operators via waste management conferences and conventional publication outlets. Most producers in the area have been anxious to adopt the best management practices developed in order to minimize odor nuisance complaints and reduce risks to the environment. The best management practices developed also helps them remain in compliance with legislative man-dates. Dietary manipulation has been shown to reduce nitrogen and phosphorus excretion 40% and 45% respectively without impacting the growth performance and carcass traits of finishing pigs. The decrease in nitrogen excretion leads to reduced concentrations of ammonia in the slurry and volatile emissions, thus improving air quality and abating odor. Reduction in phosphorus excretion reduces P concentration in effluent and has a direct impact on water quality, particularly in sensitive watersheds.

c. Source of Funds – Hatch Act, Special Research Grants, State Appropriated Funds, Oklahoma Pork Council, Private Grants

d. Scope of Impact – Multi State Research with:
NC, IA, MO

Stakeholder Input Process

Input for the research program comes from a variety of sources to include farmers and pork producers in the area as well as concerned citizens. Opportunity is provided to gather information at field tours, during conferences, and at farmer/producer meetings through out the state. Other organizations such as the Oklahoma Pork Council, the advisory board of the Oklahoma Panhandle Research and Education Center, the Guymon Chamber of Commerce, Panhandle Development of Oklahoma, irrigation organizations, commercial pork producers and

processors, and agricultural support groups provide valuable input toward establishing research objectives.

Program Review Process

There have been no significant changes in program review.

Evaluation of the Success of Multi and Joint Activities

The planned research program has addressed critical issues regarding animal waste management issues in the panhandle region that have been identified by the stakeholders and concerned citizens in the region. Expected outcomes and impacts of the research program have been described. Research is continuing and information will be disseminated as it becomes available. The overall efficiency of animal waste management has been improved as a result of the on-going research activities.

Integrated Research and Extension Activities

Field and laboratory experiments and program materials have been developed jointly with research and extension faculty. Field tours, waste management conferences, fact sheets and other publications have been utilized to disseminate both research and extension information regarding best management practices.

U.S. Department of Agriculture
Cooperative State Research, Education, and Extension Service
Supplement to the Annual Report of Accomplishments and Results
Actual Expenditures of Federal Funding for Multistate Extension and Integrated Activities
(Attach Brief Summaries)
Fiscal Year: 2006

Select One:	**	X	Interim	X	Final **
Institution:	Agricultural Experiment Station and Cooperative Extension Service				
State:	Oklahoma				

	Integrated Activities (Hatch)		Multistate Extension Activities (Smith-Lever)		Integrated Activities (Smith-Lever)	
Established Target %	9.2	**%**	5.7	**%**	8.1	**%**
This FY Allocation (from 1088) ***(Hatch column is Hatch plus Multi-State)***	$2,890,442		$5,096,446		$5,096,446	
This FY Target Amount	$265,921		$290,497		$412,812	
Title of Planned Program Activity						
An Agricultural System that is Highly Coompetitive in the Global Economy	$196,304		$120,855		$495,625	
A Safe and Secure Food and Fiber System	$0		$0		$0	
A Healthy , Well-nourished Population	$0		$4,955		$0	
Greater Harmony Between Agriculture and the Environment	$62,196		$40,945		$17,761	
Enhanced Economic Opportunity and Quality of Life for Americans	$48,734		$84,031		$119,993	
**** Comment: This report is Final for Hatch and Interim for Smith-Lever**						
Total	$307,234		$250,786		$633,379	
Carryover	$0		$39,711		$0	

Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays represented here accurately reflect allowable expenditures of Federal funds only in satisfying AREERA requirements.

Clarence Watson — Assoc. Dir.

April 6, 2007 — Date

FY 06 Summary Statements for the Five Year Plan
Oklahoma Agricultural Experiment Station
Oklahoma State University
Stillwater, OK 74078

Goal 1. An agricultural system that is highly competitive in the global economy

Major research accomplishments in the area of precision agriculture has led to a better understanding of nutrient variability in soils and has prompted the development of new sensor-based technology to satisfy nutrient needs of plants. The impact of this work has led to the development and commercialization of a new company in Oklahoma. If the technology was adapted to half of the wheat acreage in the state, savings in input dollars for nitrogen fertilizer would exceed $18/acre and net more than $45 million dollars annually.

Plant breeders have developed new varieties and germplasm that are adapted to abiotic and biotic stresses that are encountered under Oklahoma climatic and environmental conditions, as well as those in surrounding states. Improved varieties of hard red winter wheat (HRWW), hard white winter wheat (HWWW), alfalfa, forage bermudagrass and bermuda turfgrasses have been released. The release of HWWW and seeded bermuda turfgrasses have led to the development of new alternative crops, thus improving the rural economy. The impact of HRWW releases alone in the last 50 years have resulted in an increase of 18 million bushels annual production and annual income of $54 million dollars.

When considering beef production costs from conception through the finishing phase, the largest cost is that of the investment cost of the land for the cowherd followed by the costs associated with purchased feed and harvested forage. Research has improved the timing and duration of the need for protein supplementation for cattle grazing warm season grasses and dormant forages in the winter. The impact has been that a minimum of 40% greater value for soybeans and sunflower seeds can be gained when used as a feed supplement compared to their standard price. If only 5% of the Oklahoma cow/calf operations took advantage of this opportunity, production costs could be reduced $1 million dollars annually.

Goal 2. A safe and secure food and fiber system

Our nation's food supply is considered to be among the safest in the world. However, both animal and plant products are vulnerable to attacks with pathogen or toxic chemicals at any one of several points between the farm/ranch and the consumer.

D-values, which are cooking times at various temperatures to reduce pathogen levels 10 fold, have been determined for processed meats. The impact has been fewer cases of food borne illness.

Scientists at Oklahoma State University have discovered that cells of a selected bacterial culture of lactobacilli, when added to the surfaces of beef or pork carcasses caused reductions in numbers of Escherichia coli 0157:H7 and Salmonella. The impact has been the development of new novel methods of controlling food borne pathogens provide better control these pathogens and increases the safety of meat.

Goal 4. Greater harmony between agriculture and the environment

The range of environmental concerns of the public includes real or perceived threats to air, water and soil quality as well as to wildlife and ecosystem health. Animal waste management research with emphasis on confined swine operations has been initiated in the semiarid of the Panhandle. Primary emphasis has been placed on nitrogen and phosphorus excretion. Best management practices have been developed to reduce odor emission and phosphorus excretion and maximize nutrient utilization in cropping systems. The impact has been an improvement in air quality and risks to water quality have been reduced.