ANNUAL REPORT OF ACCOMPLISHMENTS

Alabama Agricultural Research Programs (AARP)

at the

Alabama Agricultural Experiment Station
(Auburn University)

and

The Winfred Thomas Agricultural Research Station
(Alabama A&M University)

and

The George Washington Carver Agricultural Experiment Station
(Tuskegee University)

for

Federal Fiscal Year
2003

October 1, 2002 – September 30, 2003

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EXECUTIVE SUMMARY

Alabama is fortunate to have three land-grant universities - Alabama A&M University, Auburn University, and Tuskegee University - with distinct programs at each institution based on clientele needs. As administrators of Alabama Agricultural Research Program (AARP), we are working cooperatively to enhance partnerships among our universities in all areas of research, education, and extension; with other universities in the region, nationally, and internationally; and with state and federal laboratories and agencies. Alabama's three land-grant universities have played key roles in the development of agricultural enterprises in Alabama. The agricultural research programs of these universities have formed a partnership, via a memorandum of understanding, known as the Alabama Agricultural Land-Grant Alliance (AALGA) to better address critical issues in food, agriculture, and natural resources in the state, region, and nation through multidisciplinary, multi-institutional, science-based teams that focus on opportunities and challenges facing farmers, consumers and agribusinesses. AALGA also seeks to provide quality education that prepares professionals for career opportunities in food, agriculture, and natural resources. AALGA received state funding in support of this partnership in FY 2002, 2003 and 2004.

In recognition of the importance of international agriculture programs in promoting the competitiveness of U.S. agriculture in the global market place, Alabama's agricultural research programs support and participate in the efforts of international program offices at the three institutions.

This Annual Report of Accomplishments and Results is a reflection of research activities for the 2003 fiscal year as reported in the Plan of Work required by the Agricultural Research, Extension and Education Reform Act (AREERA) of 1998.

Five state programs are reported in the Five-Year Plan of Work under the various REE goals. These state programs are:

State Program 1:	Attain Globally Competitive Alabama Agricultural and Forestry Production Systems
State Program 2:	Enhance Food Safety, Quality and Processing Technologies
State Program 3:	Improve Human Nutrition and Health
State Program 4:	Develop and Enhance Sustainable Ecosystems to Protect Natural Resources and Bio-diversity
State Program 5:	Ensure Socioeconomic and Self-Empowerment of Families and Communities

Several multi-disciplinary research projects are grouped under the Key Program Components associated with each state program.

ANNUAL REPORT OF ACCOMPLISHMENTS AND RESULTS FOR AGRICULTURAL RESEARCH PROGRAMS IN THE STATE OF ALABAMA

POINTS of CONTACT: This plan is jointly submitted by: *Dr. John Jensen* (Auburn University), *Dr. Walter Hill* (Tuskegee University) and *Dr. McArthur Floyd* (Alabama A&M University). Although questions and other comments regarding the document can be directed to any of us, technical concerns should be addressed to John Jensen, who is providing leadership in this effort.

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Adoptions by Reference:

- Alabama Agricultural Research Plan for the 21st Century
- Programs School of Agricultural and Environmental Sciences
- Handbook for Research Project Leaders for the Alabama Agricultural Experiment Station
- Administrative Manual for Evans-Allen Cooperative Agricultural Research-Project Approval
- Globalizing Agricultural Science and Education Programs for America (GASEPA)

ANNUAL REPORT OF ACCOMPLISHMENTS AND RESULTS

PLANNED PROGRAMS

Following is the Annual Report of Accomplishment and Results for FY 2003 for the Alabama Five-Year Plan of Work which is based on the five national goals within the Research, Education and Economics (REE) Mission Area of USDA:

Goal 1: An Agricultural System that is Highly Competitive in the Global Economy

State Program 1: *Attain Globally Competitive Alabama Agricultural and Forestry Production Systems*

Overview

Effective functioning of America's agricultural system in a highly competitive global economy is a major contributor to the national economic growth and well-being of the American people. The ability of Alabama farmers and agriculturally-based products to successfully compete in today's aggressive national and global markets depends on careful market analysis research on the development of new alternative and innovative products and dissemination of information on new production methods based on sound scientific data to farmers. The land-grant universities in Alabama have initiated research programs to keep the agricultural industry in Alabama competitive.

For example, scientists at Tuskegee University have continued to focus their research on functional and new alternative food products, plant and animal genomics, food production efficiency, biotechnology, and small farm viability. The programs have resulted in the development of new sweetpotato- and peanut-based products, profitability of small farms, alternative animal feed from agricultural by-products, new sweetpotato varieties, gene mapping of chickens and other poultry species, development of transgenic sweetpotato plants with a high protein content, and biosafety testing of transgenic products.

At Auburn University, scientists have initiated research in multiple areas of plant and animal research. These programs have resulted in new and improved cropping methodology in agronomic and horticultural crops, including research on plant growth regulators for improving production of various horticultural crops. Research has also led to reduced pesticide use in Alabama by demonstrating the efficacy of certain cultural practices, such as use of intercropping, that can increase the effects of beneficial insects against detrimental ones. Other research is looking into ways to improve detection of causal organisms of disease in poultry and fish production.

Research efforts at Alabama A&M University have focused on the economics and social well-being of families and farmers, improved crop production via enhanced agronomic performance and manipulation of genetic structures, agroforestry, natural resource management, and the development of alternative specialty crops.

The three universities have placed high emphasis on providing experiential learning and graduate education opportunities for undergraduate and graduate students enrolled in various academic programs associated with the research described above and throughout each goal.

Allocated Resources ($) and Scientists Years (SY) for State Program 1

Inst.	FY 2000		FY 2001		FY 2002		FY 2003		FY 2004	
	Approximate Expenditures ($)	SY	Approximate Expenditures ($)	SY	Projected Expenditures	SY	Projected Expenditures ($)	SY	Projected Expenditures ($)	SY
1862 (AL)	15,411,148	56	13,957,013	42	14,654,863	42	15,378,606	42	16,156,987	42
1890 (ALAX)	1,247,000	7	1,408,995	8	1,479,444	8	1,593,700	14	1,590,000	14
1890 (ALX)	775,250	6	820,938	6	861,984	6	1,248,991	8	1,312,800	8
Totals	17,433,398	69	14,918,846	56	16,220,501	56	18,221,297	64	19,059,787	64

Key Theme: Value-added Foods:

Statement: At Tuskegee University, studies continue with the development of novel functional foods using food crops such as pursalane, sweetpotato greens, and muscadine grapes. These crops were evaluated for their phytosterol and antioxidant phytochemical content and as functional food sources. Phytochemicals in these foods are known to reduce blood cholesterol levels and decrease overall heart disease risk. Several isoflavones were identified in the pursalane and sweetpotato greens. Several sensory research analyses have shown that these novel vegetables are generally accepted in the diet. Incorporation of such novel functional foods in diets of at-risk communities will assist in the reduction of heart disease, and the risk of atherosclerosis and increase the nutritional well-being of the targeted underserved communities.

Statement: The poultry and livestock industry must continue to serve as sources of high quality protein in Alabama, the U.S. and the world. Consumer preference for certain muscles from meat animals continues to remain high. Traditional attempts to improve muscle yield focuses on genetic selection and optimum nutrition and management. At Auburn University research is being conducted on the development of a high protein snack from traditionally lower value poultry products.

Key Theme: Economics

Statement: Auburn University researchers are evaluating economies of size and of adopting new technologies in poultry operations and sod production, among others. With sod production, costs per acre were shown to decline with increasing size of operation. These results indicate larger operations have substantial ability to adjust price and remain profitable in a market with price competition.

Key Theme: Improved Crop Systems

Statement: Sweetpotatoes continue to attract attention as an important food source with health benefits. It is also an efficient producer of dry matter and beta carotene for industrial use. Using state-of-the-art technology and rapid assessment techniques, Tuskegee University scientists have developed these traits in breeding populations. These techniques have resulted in the selection of several high yielding sweetpotato cultivars and are being tested in farmers' fields for adoption.

These cultivars have consistently produced higher yields than the traditional cultivars currently being grown in Alabama. These cultivars are also suitable for both American as well as specialty Asian, African and the Caribbean markets. Adoption of these cultivars will increase market opportunities for sweetpotato farmers in Alabama.

Statement: The peanut is an economically important crop in the state of Alabama and southeastern United States. Tuskegee University is employing biotechnology, including genetic engineering and tissue culture, to map and clone disease-resistant loci in the peanut. A genetic map was constructed using peanut mutants resistant to late leaf spot and leaf rust diseases. DNA markers consisting of several linkage groups have been mapped. One hundred and ninety five microsatellite sequences have been submitted to the GenBank.

Statement: Tuskegee University scientists are using genetic engineering to improve the nutritional content and the quality of the sweetpotato, an important crop in Alabama. Artificial storage protein genes have been successfully incorporated in several sweetpotato cultivars. This has resulted in the development of high protein sweetpotato transgenic lines. Transgenic plants had normal growth and did not show any yield reduction in several greenhouse tests. Biosafety and field tests are in progress.

Statement: The improvement of cotton, a principal textile fiber and a prominent oil crop in Alabama, depends on the addition of new genes, either through breeding or genetic engineering. Researchers at Alabama A&M University have examined several strategies for dissecting fiber-specific genes using cotton mutants. Parental DNAs were amplified in a polymerase chain reaction using SSR and ITS primers to screen the F1 and F2 DNAs. SSR bands are now being cloned and processed for sequencing to determine SNPs.

Statement: Auburn University researchers are studying the mechanisms by which particular bacteria elicit plant responses that increase resistance to diseases and increase plant growth. The bacteria that elicit such responses can be applied to plants as seed treatment, and can be used in sustainable production systems. These production systems may require fewer pesticide inputs, thus reducing costs and decreasing potential environmental harm associated with some pesticides.

Statement: The demand for high strength fiber in raw cotton has increased. Improvement of cotton fiber quality through conventional breeding is limited because of the complexity of fiber quality genetics. Scientists at Alabama A&M University are identifying and characterizing genes related to cotton fiber quality through biotechnology. DNA clones expressed in a twenty day-post-anthesis (dpa) fiber tissue of 3-79 cotton were subjected to higher levels of expression in the fiber than in other tissues tested. This is one of few reports related to fiber-associated gene expression in G. harbadense that could lead to better understanding the mechanism of fiber development in cotton.

Statement: Reniform nematode has no known resistance in cultivated cotton. Genetic engineering offers hope for overcoming this actively spreading pest. The most consistent and economical means for evaluating reniform resistance without resorting to field tests are root cultures. Alabama A&M University scientists have amplified single nematode DNA using gel-based markers. A root culture system for several cotton cultigens has been established. Liquid cultures with no hormones provided the greatest root growth based on length. DNA forms positively identified reniform nematodes using ITS1 and 18S ribosomal primers and bands.

Statement: Improved soybean cultivars will help Alabama soybean growers be more efficient in production and stay competitive in the world market. In particular, breeder seed of a new

Roundup-Ready soybean line was produced in 2003 and clearance for further development of this line is being sought from Monsanto. A second year of tests on the performance of experimental lines with the "long-juvenile" (lack of photoperiod response) trait has also been completed.

Statement: Researchers at Alabama A&M University have developed a neural network model for detecting deficiencies of nitrogen and calcium in leaves of wheat from spectral reflectance readings. This allows determination of a deficiency situation without destructive sampling or tedious extraction and evaluation. It also enables rapid assessment of nutrient status and thus immediate remediation before a substantial negative impact occurs upon the growth or yield of the crop.

Key Theme: Improved Poultry Systems

Statement: Improved control of economically important diseases of commercial poultry will lead to a cheaper cost of production, which will ultimately lead to lower costs for consumers of poultry products at the supermarket. One area of research is looking into the origins of E. coli in individual poultry houses. The information obtained indicates that many E.coli isolates come from common sources. As those sources are eventually traced back, the potential for eliminating them becomes more probable. The elimination of bacterial sources will increase the health and welfare quality for the bird and decrease the potential for the transmission of animal origin pathogenic bacteria to the consumer.

Key Theme: Improved Animal Systems

Statement: Scientists at Tuskegee University continue their research on developing resource management for a sustainable small ruminant industry in Alabama. Studies continue to focus on the determination and use of alternate feed including cottonseeds, yeast culture and copper feed additives and supplements, and several different types of hay. These studies have resulted in increased weight gain and improved carcass quality of the animals. Good resource management that incorporates alternative feeds such as plant byproducts and feed additives and supplements provides a beneficial effect on diet digestibility and animal performance which can be transferred into less input for better animal output and more profitable production systems.

Statement: Auburn University researchers are evaluating the effects of dietary supplements on pork production. Results show that withholding phosphorus while feeding either low or high levels of vitamin D does not affect metabolism of calcium nor meat quality. Other studies on cattle indicate that readily fermentable structural carbohydrates, such as those found in soybean hulls are a better source of supplemental energy for high quality forages than supplements containing rapidly fermentable carbohydrates such as those in corn.

Key Theme: Development of Alternative Specialty Crops

Statement: Researchers at Alabama A&M University are evaluating canola genotypes and plant introductions to develop new winter-type canola lines for the mid-south region. The discovery of the clover stem borer (Laguria mozardi Latreille) in the pith of several canonal cultivars was found to be less than the previous year. The cabbage seedpod weevil (Ceutorhynchus obstrictus) was the most prevalent insect found this year.

Statement: Auburn University economists explored consumer preferences for satsumas in grocery stores located in nine Alabama and Georgia cities. Some 605 people were surveyed and were asked to look at 20 posters that had a photo of the orange and other information about the crop. They also were questioned about the visual and other marketing attributes of satsumas, such as color, size, blemishes, seeds, price, whether they were grown organically, and whether they were grown in Alabama or the United States. Three consumer segments were identified by cluster analysis of strength of preferences: the "no blemish" segment (37% of sample), the "price sensitive" segment (23% of sample), and the "no seeds" segment (41% of sample).

Key Theme: Fisheries and Aquaculture

Statement: Auburn University researchers have been examining the effects of water salinity on fish production. Results show that different species of fish have different responses to water salinity, and the response of each species should be considered when evaluating the long-term effect of salinity. In addition, this research indicates that salinity does not have a major impact on fish diseases in production.

Statement: Auburn University researchers are seeking to determine the factors that keep these reefs from being productive and are seeking practical solutions to restoring these reefs, including the use of hatchery-produced oysters and volunteers to grow juvenile oysters for stocking. In larvae of Melibe leonine, research results support the hypothesis that sensory dendrites are part of a system that regulates the orientation, and perhaps ciliary activity, of the larva's feeding and swimming organ. Such regulation may be important in the larval settlement response to metamorphic induction.

Key Theme: Water Quality

Statement: Tuskegee scientists are evaluating the effect of cropping practices on water quality in the lower Tallapoosa River basin. The water quality of Alabama streams and rivers is very important to the well-being of the citizens of the state. The effect of land use and cropping practices on water quality is important in determining whether to place streams and rivers on the impaired list. Currently, little data are available for determining whether streams and rivers in Alabama are impaired or not. Understanding the water quality of streams and the effect of land use on the quality of the water is important to adopting management systems which result in efficient food production while protecting water quality. Results of these studies are being compared to the PLOAD model to determine whether to put these streams on the impaired list. These studies will also help to develop agricultural management systems which will help protect water quality while maintaining efficient production. Tuskegee University scientists continue to provide water quality tests of well water samples for Alabama citizens.

Statement: Auburn University researchers are evaluating the potential effectiveness of rotational stocking systems to improve productivity and utilization of desirable forages, to reduce grazing animal activity in riparian areas and streams, to allow recovery of riparian vegetation, and to improve stream water quality. Alternative water and shade sources failed to attract cattle away from riparian areas for significant amounts of time. High-quality shade appeared to play a more important role than forage or water availability in increased use of riparian areas by cattle during the warm season in the lower south. Thus, access to water or shade, alone or in combination, may not be effective alternatives to reduction of cattle concentration in riparian habitats. When other

highly attractive landscape features, such as preferred forage or more favorable microclimate, are present. Reduction of livestock impacts on riparian habitats associated with smaller pastures may be achieved more effectively through design of rotational stocking systems with portions of the riparian habitat included in separate subunits. These subunits would be stocked for shorter periods of time to reduce damage to riparian areas.

Statement: Researchers at Alabama A&M University monitored eighteen different streams at a total of fifty-four (54) locations throughout the Wheeler Lake Basin to evaluate the effects of individual seasonal trends in nutrient concentrations. Although seasonal variations did occur, these variations reflected differences associated with rural and urban activity and not land use types. The highest concentration of nutrients was detected in the summer season. Counties and streams in northern Alabama were ranked based on the nutrient concentration levels.

Key Theme: Economics and Social Well-Being of All Families and Farmers

Statement: Alabama A&M University scientists, in collaboration with Tuskegee University and six other Historic Black (1890) Land-grant Universities are addressing the educational deficit of agricultural biotechnology in underserved communities of the south. Educational outreach biotechnology teacher training workshops have been held at several locations in collaboration with faculty and staff from the University of California-Davis. Also, on-farm demonstrations using biotech crops or products (with controls) such as Bt sweet corn, virus-resistant yellow straight neck and zucchini squash, Messenger-treated sweet pepper and Roundup-Ready soybean have been evaluated for limited resource farmers. More than 700 individuals, including extension agents, small farmers/producers and high school teachers, have benefited by becoming associated with this biotechnology.

Statement: Research at Auburn University contributes to American market competitiveness by developing a better understanding of consumers' product choices in multiple textile categories using an online format. The home furnishings sector has been slow to exploit new research capabilities that would increase efficiency. Product development and style changes are dependent on consumer preferences which are being assessed through web-based testing procedures.

Key Theme: Recruitment and Education of Individuals for Career Professions in the Food and Agricultural Sciences

Statement: Scientists at Tuskegee University continue to provide mentorship to high school students through the Summer Apprenticeship Program. This program allows rising high school seniors and juniors to work alongside the scientists in their laboratories during the summer to expose the students to scientific research. This has resulted in increased high school student interest in the sciences and subsequent enrollment in these disciplines in college.

Key Theme: International Collaborations

Statement: Tuskegee University continues to provide technical assistance to targeted communities in several African and Caribbean countries to assist them in their efforts to increase agricultural production and improve the quality of life of the rural poor in these countries. Collaborative programs with the Sokoine University of Agriculture in Tanzania have resulted in the development of sustainable agricultural and aquacultural practices through sustainable natural

resource management and enhanced micro enterprise development in four regions in Tanzania. These programs have resulted in an increase in farm family income of targeted villages and communities and use of preservation practices of natural resources. In Ghana, a nutritional enhancement program was developed and targeted at farm families in the Volta region through the use of sweetpotato green leaves and other green leafy vegetables. This program that improves the nutrition of the families, particularly women and children, was successfully adopted by both targeted groups as well as other communities and villages. Collaborative Farmer-to Farmer and Volunteer Technical Assistance Program with Winrock International provided volunteer technical assistance to several farmers, producers, processors and small and medium size agribusiness organizations in Ghana and Nigeria. In Ghana, the program trained over 200 hotel management and food management staff in principles of food safety and food service business development and management, as well as customer service in efforts to enhance the tourism industry in the country. Tuskegee University is also involved in the training and building capacity of 16 African countries in sanitary and phyto sanitary procedures in risk assessment in efforts to increase these countries' ability to export food products to the US. Over 100 scientists from these countries have been trained in risk assessment. Tuskegee University is also involved in training scientists in several African countries in effective communication of biotechnology issues and awareness to policymakers and the public. Regional training workshops are being conducted in Africa.

Statement: Researchers at Auburn University have helped fish and shrimp producers in several nations (United States, Ecuador, Thailand, Madagascar, and Brazil) develop codes of conduct with best management practices for preventing negative environmental impacts of fish and shrimp aquaculture. They also have helped catfish farmers in Alabama develop best management practices, and served as their representative in discussions with state and federal government agencies related to environmental regulations. Shrimp agriculture in developing tropical countries is in crisis because increased populations and bad land husbandry practices are leading to land degradation and loss of productivity. Alley cropping, an agroforestry practice designed to sustain crop production while restoring organic matter and nitrogen to the soil, is one possible management technique for highly erodible lands. Auburn University researchers are exploring ways to adapt alley cropping to different growing conditions in countries like Haiti and Brazil. Results so far show that alley cropping is more effective than rock wall terraces, contour canals, or grass rows at sustaining crop yields. Alley cropping also reduces sediment loss and runoff from plots. Applications of leaves and stems from hedgerows to the soil double corn yield, and pruning three times per season increases yield by 50 percent. This group is the only research team exploring the use of alley cropping for soil erosion control in the Southeast and possibly in the world.

Goal 2: A Safe and Secure Food and Fiber System

State Program 2: Enhance Food Safety, Quality and Processing Techniques

Overview:

The safety of the food supply is a major concern to policymakers, consumers, distributors, processors, producers, and suppliers. All of Alabama's land-grant universities are striving to meet those demands and to address current and emerging food safety, food quality, nutrition, and health issues, particularly as they relate to consumers, society, industry, and regulatory concerns.

Scientists at Auburn University have initiated research to reduce and prevent food-borne illnesses, such as those caused by Campylobacter and Salmonella in poultry. They are also conducting research to identify and map proteins linked to biological processes, such as diet and

adaptation, and to delineate genomic and proteomic mechanisms of metabolic fat control in pigs.

Scientists at Tuskegee University have continued to focus on research programs that are aimed at developing methods to reduce pesticide usage and to prolong storage of fruits and vegetables. Other researchers are using natural anti-microbial agents to control food borne pathogens in meat and egg products.

Researchers at Alabama A&M University are focused on finding solutions to the problem of allergenicity of peanuts and to improving the texture, tenderness, shelf-life, and taste of poultry meat.

The success of the research efforts in this area will result in a safer fresh food supply, and an understanding of the effects of genetics, environmental stress, and pathogenic factors on proteins. We will also have a better understanding of food animals and their fattening process. Also, outcomes of the metabolic fat control study are relevant to human dietary concerns. Additionally, final results will provide non-chemical food preservation procedures for a safer food supply.

Allocated Resources ($) and Scientists Years (SY) for State Program 2

Inst.	FY 2000		FY 2001		FY 2002		FY 2003		FY 2004	
	Approximate Expenditures	SY	Approximate Expenditures	SY	Projected Expenditures	SY	Projected Expenditures	SY	Projected Expenditures	SY
1862 (AL)	4,837,516	23	3,928,689	13	4,112,123	13	4,331,380	13	4,547,948	13
1890 (ALAX)	196,200	1	116,865	1	122,708	1	424,491	4	422,000	4
1890 (ALX)	219,793	2	239,971	3	251,969	3	408,110	3	402,341	3
Totals	5,253,509	26	4,285,525	17	4,486,800	17	5,163,981	20	5,372,289	20

Key Theme: Food Safety – Animal Products

Statement: Alabama A&M University scientists are developing strategies to increase the efficiency of encapsulated butylated hydroxyanisole (BHA) activity in comminuted meats. Extending the shelf-life of ground meat increases the profit margin of producers without increasing the unit price to consumers. The rancidity of treated meat has been greatly reduced; however, the efficiency of encapsulation was not optimized in most recent evaluations. The commercialization of encapsulated antioxidants will add a new dimension to the processing of poultry meat when completed.

Statement: Determination of the endpoint cooking temperature in precooked meat and ready-to-eat meat products is important for food safety surveillance and product quality control. Most current methods are based on the measurement of a residual enzyme activity or decreased protein concentration after cooking. Auburn University researchers have developed a rapid assay for end-point temperature of cooked meat. Such assays, based on monitoring thermal-stable muscle proteins, are more indicative of the muscle condition and have the potential in a wide range of applications.

Statement: Researchers at Alabama A&M University studied the effect of dietary acid-detergent fiber (ADF) concentration on fecal shedding of E. coli O157:H7 in lambs. Fecal shedding of the pathogen by ruminants is the mode of entry into the human food chain. Diet is a major determinant of intestinal microflora. The potential exists to reduce E. coli O157:H7 shedding by ruminants through pre-harvest dietary intervention. Results indicated that regular all-concentrate diets increase fecal shedding of the pathogen. Increasing the ADF content of the concentrate diet between 10 and 20 percent minimized shedding of the pathogen without adversely affecting meat production efficiency.

Key Theme: Food Safety – Fruits and Vegetables

Statement: Sweetpotatoes and tomatoes are economically important crops in the state of Alabama and the southeastern United States. In an effort to improve the sustainability, production and health of these crops, researchers at Tuskegee University are using biological methods to control post-harvest diseases of these crops. The research is focused on using microbial antagonists such as Rhodotorula minuta to prevent post harvest decay of tomatoes and sweetpotatoes. This is important because this can reduce the chemical application to prolong shelf-life and reduce post-harvest losses.

Statement: Annually, damage sustained to cultivated tropical and subtropical commodities as a result of chilling injury translates into millions of dollars in lost revenues. A study at Auburn University is evaluating the physiological responses of various fruits to postharvest treatments for reducing losses. Ultraviolet treatments in combination with temperature preconditioning and film-coating materials are being tested.

Key Theme: Genetic and Biochemical Modification of Foods

Statement: Wholesome and safe muscle foods are an excellent, highly available source of critical nutrients, including essential amino acids and B complex vitamins and folic acid among others, for humankind. A negative aspect to muscle foods is that these food products may contain too much fat. Auburn University researchers are looking at the fundamental molecular factors that regulate total fat synthesis as well as the partition of fat deposition among tissues. This work represents a start in delineating regulatory pathways of overall lipid metabolism in pigs. In the future, this information will enable us to develop specific strategies to not only lower overall carcass fattening, but also to enhance the potential for intramuscular fat (marbling) deposition. Taken together this will enhance overall efficiency of pork production and improve consumer acceptance and sensory characteristics of muscle foods from pigs.

Key Theme - Food Safety and Risk Analysis

Statement: Consumers are receiving conflicting information on the consumption of fish. On the one hand, the medical community encourages consumption of cold water marine fish because of its content of omega-3 fatty acids which are known to have beneficial effects with respect to infant neural development. Yet, environmental contaminants in fish may be detrimental, particularly to high risk populations such as pregnant women. Research at Auburn University is showing that omega-3 fatty acids in the fetal brain would be enhanced by maternal consumption

of fish yet would not be inhibited by maternal exposure to the environmental contaminant methylmercury.

Goal 3: A Healthy, Well-Nourished Population

State Program 3: Improve Human Nutrition and Health

Overview

The socioeconomic status of some Alabama residents restricts their ability to practice healthy dietary habits, including choosing healthy foods and handling food safely. The nutritional quality of diets can assist in the prevention of serious health problems. Our research efforts aim at protecting and enhancing the health of Alabama citizens. Through understanding both societal issues affecting consumers' overall diet-related health and the relationship between diet and specific body function, better quality diets, including increased utilization of food crops and the development of dietary guidelines based on ethnicity, age, and consumption preferences, can be developed.

At Alabama A&M University, scientists are studying the nutrient composition of the shiitake mushroom and its role in nutritional diets. They also are evaluating the diets of the elderly population residing in assisted living long-term care facilities and congregate feeding programs.

At Tuskegee University, scientists have initiated a research program that focuses on improving human nutrition and health of the African-American population in the Black Belt region of Alabama through diet modification and nutrition education.

Scientists at Auburn University are conducting research that evaluates the nutrition composition of foods, obesity factors, and exogenous factors that affect shelf-life.

The accomplishments thus far have resulted in development of recipes utilizing novel vegetable sources of high omega-3 fatty acids, i.e., sweetpotatoes and purslane. There is also a greater understanding of food quality and product shelf-life of foods. The results are helping the elderly select appropriate foods and portion sizes while preventing the potential of confusing foodstuffs and other substances in the lives of older citizens. The research remains on target with stated objectives.

Allocated Resources ($) and Scientists Years (SY) for State Program 3

Inst.	FY 2000		FY 2001		FY 2002		FY 2003		FY 2004	
	Approximate Expenditures	SY	Approximate Expenditures	SY	Projected Expenditures	SY	Projected Expenditures	SY	Projected Expenditures	SY
1862 (AL)	2,227,188	4	1,977,742	10	2,222,355	10	2,333,769	10	2,187,410	10
1890 (ALAX)	134,150	1.2	140,017	1	147,017	1	425,898	3	420,700	3
1890 (ALX)	164,785	1	174,439	2	183,160	2	326,941	2	328,900	2
Totals	2,526,123	6.2	2,292,198	13	2,579,532	13	3,086,608	15	2,937,010	15

Key Themes: Nutrient Composition of Foods and Nutrition Education

Statement: Non-traditional green leafy vegetables contribute to the larger group of functional

foods in the American diet. With proper nutrition education and diet modification, these functional foods can be incorporated in the diets of the African-American population in the Black Belt region where risk of cardiovascular (CVD) diseases are quite high. Tuskegee University scientists have continued to employ clinical as well as food and nutrition education strategies, in efforts to reduce the risk of CVD in these communities. Food and nutrition educational materials that focus on how to lower CVD through proper diets were developed through focus groups and are being distributed in the target communities.

Statement: Comparative studies utilizing a variety of fresh minimally processed fruits and vegetables under various postharvest treatments (i.e. temperature preconditioning, chitosan coating, and low dose gamma irradiation) have been initiated at Auburn University. This project will assist in the development of technology for increasing shelf-life while maintaining the nutritional and sensory quality of Alabama-grown fruits and vegetables.

Key Theme - Diet Modification for Targeted Populations

Statement: Auburn University researchers are examining the relationship between the effects of leptin in the brain and the development of insulin resistance. Leptin, acting in the brain, appears to affect both the regulation of body fat (obesity) and the regulation of insulin sensitivity. Therefore, by improving our understanding of the actions of brain leptin, we will gain greater insight into the connection between obesity and type 2 diabetes.

Goal 4: Greater Harmony Between Agriculture and Environment

State Program 4: Develop and Enhance Sustainable Ecosystems to Protect Natural Resources and Biodiversity

Overview

Society demands that our quality of air, water, and soil be protected. Contamination of these resources and food threatens the continued existence of many plant and animal species. Sustained productivity of Alabama's agricultural, silvicultural, and other natural resource-dependent industries will require immediate and long-term efforts to maintain quality. Considerable agricultural waste and residues are generated through the animal, poultry, and crop production systems in Alabama. In a sustainable agriculture system, these residues and wastes could be incorporated into the soil to enhance soil productivity, to improve water infiltration and plant root environment, and to improve soil quality by improving aggregate formation and stability. Excessive application, however, can result in groundwater contamination with nitrate, phosphates, and trace metals. Chemical composition of organic wastes and plant-residues affect transformation reactions mediated by soil microorganisms. Understanding the controlling factors in relation to microbial population and enzyme activities and mineralization is highly desirable for designing better management strategies.

Research at Tuskegee University is looking at the long-term effects of the application of broiler litter to agricultural lands and its effect on ground water contamination. Studies are also being conducted on soil conservation using grass hedges, on integrated pest management of sweetpotato weevil, and on the use of plasticulture technique in an integrated pest management system.

Scientists at Auburn University are conducting research that focuses on water quality and waste

management issues, ozone studies, improved farm management through precision agriculture and remote sensing, and the productivity of soils and the systems that affect them.

Alabama A&M University researchers continue to evaluate the utilization of composted poultry litter on the production of alternative crops such as shiitake mushrooms and in agronomic crops such as cotton to improve productivity and find ways of disposal of poultry waste. Additional research evaluates the mechanism of remediation of heavy metals in soils.

The ultimate goal is to use the data to design effective broiler litter management strategies for the different soil types in Alabama. Further, these studies have resulted in new and innovative strategies in waste management, including new approaches to combining poultry waste and cotton gin waste into pellets for field application. In the remote sensing/precision agriculture area, improved management of row crop operations through understanding the sensed data in zones can reduce overall applications of treatments by concentrating on the less productive zones instead of overall field treatments. Understanding the biogeochemistry of soils and their systems has revealed how ecosystems process nutrients and the importance of moisture in wetland productivity as well as the role of soils and its mineralogy to the remediation process.

Allocated Resources ($) and Scientists Years (SY) for State Program 4

Inst.	FY 2000		FY 2001		FY 2002		FY 2003		FY 2004	
	Approximate Expenditures	SY	Approximate Expenditures	SY	Projected Expenditures	SY	Projected Expenditures	SY	Projected Expenditures	SY
1862 (AL)	12,538,179	36	11,825,926	38	12,417,222	38	13,038,083	38	13,689,988	38
1890 (ALAX)	188,200	1.5	92,610	1	97,240	1	466,269	4	450,250	4
1890 (ALX)	324,802	2	268,414	2	281,834	2	366,552	3	368,490	3
Totals	13,051,181	39.5	12,186,950	41	12,796,296	41	13,870,904	45	14,508,728	45

Key Theme: Water Quality and Waste Management

Statement: Agricultural lands have been used as an inexpensive solution to the disposal of broiler litter in Alabama. Tuskegee University scientists have focused their research on addressing the environmental concerns of ground water pollution and long-term effects on the agricultural ecosystems of broiler litter applications to agricultural lands. Results of earlier studies indicated that the trace elements on nitrogen transformation varied from soil to soil. Several farms with different soil types in Alabama that have received broiler litter application for over 20 years were sampled and analyzed. As a consequence of results of this and other research programs, farmers are now more aware of the possible impact of broiler litter on their soils and surface ground quality. More farmers are now reducing or adjusting broiler litter application rates on farmlands throughout the state. This will also assist the state government in developing new tools to monitor and guide organic litter application.

Statement: Auburn University research is continuing on a number of projects designed to impact poultry waste management and safeguard water quality through improved land stewardship. One project is looking at the efficacy of alternative litter for poultry houses. Use of sand litter permits longer intervals between cleanout, but requires a lot of land for spreading. Litter consisting of windrowed pine shavings compost more fully than the sand litter, but the cost of pine shavings may be prohibitive.

Statement: Scientists at Alabama A&M University continue to evaluate the environmental impact of animal waste applied to land, especially that of swine (sus scrofa domesticus) and poultry. Defining optimal levels of nutrient concentrations, as well as enteric pathogens for safe disposal and the improvement of soil and water quality is the ultimate goal of this research.

Statement: Little is known about how thinning and burning practices affect stream biological water quality within watersheds of Alabama. Auburn University research is indicating that stream water chemistries are not affected by these practices. Results also suggest that thinning and burning and associated environmental changes (increases in light levels reaching streams, short-term but biologically significant nutrient releases) may have positive effects on the abundance of stream periphyton, yet minor or no deleterious effects on stream animals.

Key Theme: Soil Conservation

Statement: Scientists at Tuskegee University continue to focus on methods of controlling soil erosion to ensure sustainable agricultural production on small limited resource farms. Previous studies have shown that Eastern gamagrass (Tripsacum dactyloides) grown as grass hedge to control erosion can be incorporated in a farming system of a small-scale farm. Current studies are focused on adaptability of several Eastern gamagrass to several acid soil types in the southeastern US and as a phytoremediation agent. Preliminary results indicate that eastern gamagrass performed favorably across the soil types and the pH levels that were studied. The use of Eastern gamagrass for phytoremediation, in addition to its ability to tolerate acid soils, control soil erosion, and its potential as a forage crop can play an important role in a small farm system.

Statement: Long-term fertility/soil test calibration experiments provide a rich source of information on soil changes over time. Auburn University has maintained and monitored such long-term experiments at eight Alabama locations, and these experiments are providing the basis for a southern regional effort through SERA-IEG-6 on soil testing and plant analysis to document research-based soil test calibration and recommendations for cotton on coastal plain soils. Soil organic matter and soil quality data from these experiments have helped explain the limiting effects of low-organic matter soils on yield, and the importance of high-residue, conservation tillage.

Key Theme: Urban Issues and the Environment

Statement: Drought and temperature extremes cause significant loss of plant material in commercial and residential landscapes and in nurseries. A better understanding of plant adaptation to these stresses and expanding the pool of well-suited plant materials is needed to reduce economic loss and environmental strain. Studies at Auburn University include the impact of chilling on Ginkgo biloba, an important landscape tree. In addition, low temperature evaluations of ornamental plants (gardenia, azaleas, hydrangea) continue, as does evaluation of how timing and severity of pruning affect the cold hardiness of Buddleia and Lantana cultivars.

Statement: Auburn University researchers are developing an IPM program that will prevent, reduce, or eliminate losses caused by termites in urban settings. The work has concentrated on Formosan subterranean termite, an exotic species that is more aggressive and destructive than native termites. Formosan termites are spreading and establishing in more states. Research has

proved that two subterranean termite species habituate to vibrational disturbances, indicating that using the new technology of a baiting system is an effective tool for termite control. Bait technology uses less than 90 percent of the pesticide in traditional control methods, but provides effective control. This finding has special meaning for enhancing the urban environment.

Key Theme: Integrated Pest Management

Statement: Tuskegee University scientists have pioneered soil solarization research in Alabama for the past decade. Soil solarization, the trapping of solar radiation under clear plastic mulch, is used as a biological method to control diseases, weeds and other pests of vegetable crops. Research at Tuskegee University continues to investigate the efficacy of plastic culture in integrated pest management of vegetable crops in Alabama. Several weed species, soil- and foliar-borne diseases can be significantly managed by soil solarization. Soil solarization can have a tremendous impact on the reduction of the use of chemical pesticides in managing weeds and soil-borne diseases.

Statement: Insect pests continue to be important production constraints on vegetable crops grown by limited resource farmers in many parts of the southern US. Sweetpotatoes and southern peas are two vegetable crops that are commonly grown by most limited resource farmers in Alabama. Research at Tuskegee University seeks to improve the production and utilization of these crops by reducing loss caused by the insects and diseases of these crops through an integrated pest management approach. Sweetpotato farm surveys are being conducted in Alabama and the southern US to determine the inter-specific variation of the sweetpotato weevil. Also, southern peas are also being surveyed for pests and diseases. The information gathered from these studies will be used to design pest management strategies for these crops and to reduce pesticide use. These studies will also provide information on the movement of the sweetpotato weevil and the potential risks of spread to uninfested areas and how this would impact the management and quarantine regulation of sweetpotato movement in the state.

Statement: Research at Auburn University is evaluating the application of beneficial organisms to plants and crops for reducing pest problems while moving toward organic production. Selections of beneficial bacteria have been shown to increase yields as part of sustainable production practices for vegetables in Alabama. A more specific aim is to lower the input costs of vegetable growers by allowing the elimination of soil fumigation and plastic row covers.

Key Theme: Remote Sensing and Precision Agriculture

Statement: The use of non-destructive technologies (e.g. electrical conductivity mapping) to facilitate detailed mapping (intensive mapping) of soil properties can be beneficial in two ways: 1) the depiction of soil properties is improved so better interpretations and management systems of the soil can be developed, and 2) detailed soil mapping is relatively time-consuming and expensive, so these technologies may improve the efficiency of soil mapping. In particular, the electrical conductivity mapping may hold benefits for both agronomic and urban applications, where soil mapping can range from $5 per acre (agronomic soil mapping), to $500 for an acre parcel (urban applications). Where electrical conductivity mapping is feasible, improved surveys can be developed. Seasonal high water tables can occur in sandy, coastal plain soils above soil features that are considered diagnostic of seasonal high water table depths. These findings can lead to improved assessments of site conditions for OSDS placement in these sandy soils. This can result in substantial savings for a home builder, when one considers the initial costs of OSDS

installation range from $2,000 to $5,000, and repairs on malfunctioning systems (due to installation in poor soils) can be costly.

Statement: Auburn University researchers have worked cooperatively with forest industry companies to develop a new ground-based precision herbicide spraying system, and a prototype sprayer is under development. In addition, a mobile data acquisition system has been built and used to measure geospatial variation in whole-body vibration of skidder operators. This system maps terrain influences on operators as the machines move through the forest, and will help equipment manufacturers improve the safety and comfort of the operator enclosures on forest machines.

Key Theme: Restoration and Best Management Practices (BMP)

Statement: Forest management practices contribute to decreased population densities of gopher tortoises. Current Auburn University research results indicate the density at which tortoise management should switch from one in which animals are managed where they reside naturally, to one in which animals are moved to reserves where they might participate in creating viable populations. This information should lead to addressing the divergent need to conserve sensitive species, while extracting economic benefits from public and private lands.

Key Theme - Soil Conservation, Quality and Bio-indicators

Statement: Auburn University research is generating exposure-response relationships that are necessary for the development of regional emission reduction strategies and recommendations for improving management and sustaining productivity of grassland ecosystems that support animal agriculture. Research done on Trifolium (clover) species show that ozone decreases aboveground and root biomass yield. However, while early-season ozone exposure decreased nutritive quality of T. subterraneum and T. cherleri, T. striatum was not affected. Early-season ozone exposure also appears to decrease the nutritive quality of some forage grasses (i.e., Briza maxima and Cynosurus echinatus), but not others (e.g., Bromus hordaceus). These results indicate that in areas that can be exposed to ozone the choice of pasture species is important.

Goal 5: Enhance Economic Opportunity and Quality of Life for Americans

State Program 5: Ensure Socioeconomic and Self-Empowerment of Families and Communities

Overview

One-fourth of the American population lives in rural areas. Alabama is 45 percent rural, based on 2000 census data. Further, the Black Belt Counties (BBCs) of south central Alabama, which extend from the Georgia border in the east, to the Mississippi border in the west, pose a unique challenge for the land-grant system due to the demographic, social, and economic distinction of the region. The well-being and societal contributions of this population hinges on having viable communities, businesses and economies. This viability becomes significantly important in rural communities where the majority of the residents are poor.

Forces of change continue to dramatically affect rural areas and communities including exposure to global economic trends, technological revolution, and diversification of community economic foundations formerly almost entirely dependent on agriculture and other extractive industries. In this changing context, there is a serious concern about the fate of the rural communities and the underserved, particularly in the Black Belt region of Alabama. Based on the historical nature of underdevelopment for this region, while at the same time acknowledging specific areas of potential for development, research at Tuskegee University focuses on the assessment of the current measures for economic growth, equity issues and quality of life indicators as elements of sustainable rural development in the Black Belt of Alabama.

At Auburn University, research is being conducted on natural resource and environmental issues that affect the rural population of Alabama. Another major research area is in the identification of issues that affect marriages and families in Alabama and to better understand the patterns of consistency and change in marriages.

At Alabama A&M University, programs are designed to ascertain the impact of technology and sustainable agriculture practices on the well-being of farmers, particularly small- and medium-sized farms in Alabama. The research results have provided information on areas of the small-scale and limited-resource farm that can be targeted for value-added programs and be assisted by access to and participation in specific USDA programs.

Outcomes of the research under this goal will enable the forestry industry in the state to support more effectively rural development in the state and assist farmers in developing sustainable farming practices and other enterprises.

Allocated Resources ($) and Scientists Years (SY) for State Program 5

Inst.	FY 2000		FY 2001		FY 2002		FY 2003		FY 2004	
	Approximate Expenditures	SY	Approximate Expenditures	SY	Projected Expenditures	SY	Projected Expenditures	SY	Projected Expenditures	SY
1862 (AL)	1,218,759	5	1,149,524	3	1,207,000	3	1,267,350	3	1,330,719	3
1890 (ALAX)	135,110	1	383,670	2	402,853	2	170,000	2	173,250	2
1890 (ALX)	505,304	3	286,819	3	301,159	3	421,049	4	418,100	4
Totals	1,859,173	9	1,820,013	8	1,911,012	8	1,858,399	9	1,922,069	9

Key Theme: Economic Viability and Sustainable Communities

Statement: Tuskegee University continues to focus on the economic viability of the Black Belt counties of Alabama in efforts to enhance socioeconomic well-being and self-empowerment of families and communities, particularly underrepresented minorities (African-American, Native American, and Hispanic/Latino farm families). The research involves the assessment of current measures of economic growth, quality of life indicators and equity issues as elements of sustainable rural development in the Black Belt of Alabama. Current research is focused on socio-economic factors on sustainability of agriculture in these counties for limited resource farmers, the development and implementation of programs so that eligible farmers and their family members may apply for and acquire farm ownership, farm operating equipment, housing and youth loans, development and enhancement of business management skills for USDA

borrowers, development of the financial documentation of farm and other applicable rural enterprises where the owner graduates to a commercial lender, development of a long-range base for self-sustaining farm business analysis services through existing associations and institutions. Outreach programs are therefore targeted towards educating the clientele on available services and technical assistance programs. A holistic system for building collaboration and delivering management and technical assistance to small farm families and communities utilizing the resources of local staff and federal government programs, various segments of the private sector, and universities and colleges throughout the state is used to address the needs of the communities. These programs thus assist in improving the economic conditions of small farm families.

Statement: Studies at Auburn University assessed opportunities and constraints affecting citizens and citizen organizations which seek to play a role in natural resource policy formulation and implementation. Research was conducted on citizen involvement in market-based environmentalism, where citizen groups attempt to influence the purchasing decisions of major retailers toward socially desirable and ecologically sustainable alternatives, thereby creating markets for the production of such products. The case examined involved the office supply chain Staples, Inc., serving the office supply market, and focused on increasing recycled paper sales. Additional research was conducted on the influence of the pulp and paper industry in Alabama on environmental policy. This research influenced the decision by Staples, Inc. to work with environmental groups in promoting recycled paper products and has paved new ground for the development of similar campaigns in the future, mobilizing the power of informed consumers to shape industrial production processes. Increasing demand for recycled paper products should lead to lower prices for such products and will reduce demand for virgin fiber from forests.

Statement: Researchers at Alabama A&M University have evaluated the impact of sustainable agricultural practices and technologies on the well-being of small farmers in North Alabama. Personal contacts and telephone interviews with agricultural teachers, extension personnel, and primary change agents in technology transfer were used to solicit information about the knowledge and understanding of stakeholder groups regarding sustainable agricultural practices and the effectiveness of different information delivery systems. Results showed that small farmers have adequate knowledge and positive attitudes toward agriculture sustainability. However, there were significant differences between location within the state, age, years of experience, ethnicity, and prior association with the technology. This study provides environmental, economic, and educational information to small and limited-resource farmers about sustainable practices and marketing strategies for alternative enterprises.

Key Theme: Families and Children

Statement: Most preschool-age children are in some form of non-parental child care, and many spend most of their waking hours in such arrangements. Recent research at Auburn University suggests that many of these children show elevated levels of the stress hormone cortisol while at child care, particularly in the afternoon. A primary purpose of this research is to identify factors that predict which children will experience elevated cortisol, and whether elevated cortisol is associated with increased rates of illness, sleep problems, or problems regulating behavior. With this information, parents and childcare providers will be able to provide better arrangements that (perhaps) contribute to lower levels of stress in young children.

II. Stakeholder Input

Stakeholder input into the planning and priority setting of Alabama's Agricultural Research Programs (AARP) is continuous and includes formal and non-formal processes. The formal process includes conducting statewide surveys of citizens, commodity and advisory groups, farmers, urban and rural families, faculty and students, and policymakers. Additionally, input is sought through the Annual Farmers' Conference, the Professional Agricultural Workers Conference, the Annual Agriculture Week, Advisory Councils, and the six Research and Extension Centers throughout the state in conjunction with the Alabama Cooperative Extension System (ACES), including the Tuskegee University Extension Program. Farmers and other key constituent groups have input via their respective associations and commodity groups. The Associate Directors of the AAES (the Deans of the associated academic school and colleges at Auburn University), and the Research Directors at Alabama A&M University, and Tuskegee University, have their own Advisory Councils who provide counsel on research program directions. Stakeholder input aids in identifying and addressing the needs of the under-served and under-represented populations in the state. Stakeholder input is also from the Alabama Cooperative Extension System's very comprehensive stakeholder process that utilizes a network of 67 county extension advisory boards and county and state-level program advisory committees.

III. Program Review Process

The Research Directors ensure that the Merit Review Process for 1890 Evans-Allen Research Proposals remain consistent with guidelines published in the Administrative Manual for Evans-Allen Cooperative Agricultural Research (Sec C: Program Administration, Subsection 2b: Project Approval Procedures-Merit Review , p. 5).

The Director of the Alabama Agricultural Experiment Station and other administrators ensure that projects and programs are merit-reviewed and that they adhere to criteria listed in the Administrative Manual for the Hatch Act, as amended.

IV. Evaluation of the Successes of Multi- and Joint-Activities

The Alabama Agricultural Experiment Station and the Alabama Cooperative Extension Service have many joint activities and the research portions of the integrated activities are supported by Auburn University through formula funds; however, Extension programs are supported through Smith-Lever formula funds and are reported under a separate Plan of Work. The research components of these integrated projects are representative of the five state programs identified in the Alabama Agriculture Research Program's Five-Year Plan of Work and coordinated with the USDA REE goals. The amount of Hatch funds committed to each goal is listed as follows: Goal 1, $1,717,766; Goal 2, $147,697; Goal 3, $131,638; Goal 4, $707,738; and Goal 5, $212,858.

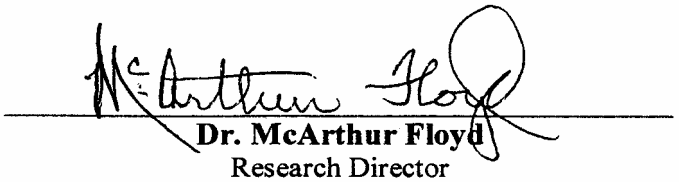
VI. Integrated Research and Extension Activities

The following forms are included to document integrated research and extension activities: Form CSREES-REPT, Computation for Meeting Research/Extension Integration for FY 2003 Goal, and FY 2003 Integrated Research and Extension Activities Project Summaries.

V. Multi-State Extension Activities

These activities are reported under the Five-Year Plan of Work from the Alabama Cooperative Extension System.

Certification of the *Annual Report of Accomplishments and Results for Alabama Agricultural Research Programs,* Federal Fiscal Year 2003:



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Dr. McArthur Floyd
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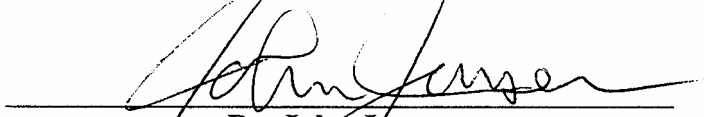

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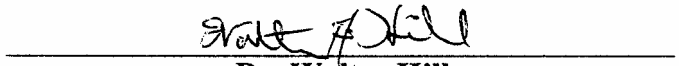

4/01/04

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