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 2006

October 1, 2005 – September 30, 2006

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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 the 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 the opportunities and the 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 annually since FY 2002.

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 2006 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

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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

I. PLANNED PROGRAMS

Following is the Annual Report of Accomplishment and Results for FY 2006 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: A*ttain 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 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 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.

In support of this ultimate goal, 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, improved profitability of small farms, alternative animal feed from agricultural by-products, new sweetpotato varieties and the development of transgenic sweetpotato plants with high protein content, and biosafety tests for transgenic products.

At Auburn University, scientists have been involved in various areas of plant and animal research that contribute to increasing the economic status of producers. For example, these programs have demonstrated that animal rearing procedures can affect the quality of the end product and include developing higher yielding cotton cultivars that can be produced at lower costs than current cultivars.

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 medicinal and alternative specialty crops.

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

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

Inst.	FY 2001		FY 2002		FY 2003		FY 2004		FY 2005		FY 2006	
	Approx. Expenditures ($)	SY	Approx. Expendi-tures ($)	SY	Approx. Expendi-tures ($)	SY	Approx. Expendi-tures ($)	SY	Approx. Expendi-tures ($)	SY	Approx. Expendi-tures ($)	SY
1862 (ALA)	13,957,013	42	14,654,863	42	15,378,606	42	15,378,606	42	15,378,606	42	13,670,727	52
1890 (ALAX)	1,408,995	8	1,479,444	8	1,553,416	8	1,631,086	8	1,712,640	8	1,800,000	8
1890 (ALX)	820,938	6	861,984	6	793,524	6	809,394	6	825,582	6	1,651,163	8
Totals	14,918846	56	16,220,501	56	17,837,105	56	17,819,086	56	17,916,828	56	17,121,890	68

Key Theme: Value-added Foods:

Statement: Phytochemicals and antioxidants are known to reduce blood cholesterol levels and decrease coronary heart disease risks. Research at Tuskegee University continues to focus on the development of novel functional foods using food crops such as purslane, sweet potato greens, and muscadine grapes. These crops were evaluated for their phytosterol and antioxidant phytochemical content and as functional food sources. Muscadine grapes were found to contain high levels of anthocyanins (dellphinindin-3,5-diglucosisde, cyaniding-3,5diglocoside, and malvidin-3,5-diglucoside) and high antioxidant capacity. Several isoflavones were identified in the purslane and sweet potato greens. Sensory research analyses have shown that these novel vegetables are generally accepted in the diet. This information is being used in the implementation of community nutrition education programs.

Statement: Tagatose is a sugar that is not metabolized directly by the body, rather it is fermented in the intestinal tract and, therefore, behaves as a prebiotic, improving intestinal health. Despite apparent benefits of ingestion of this sugar, it is not widely used. Researchers at Auburn University are examining ways to increase use of tagatose in food, particularly as part of cookie recipes.

Key Theme: Economics

Statement: Research at Auburn University has shown that family farms in Alabama rely to a larger extent on non-farm income than farm-generated funds to maintain production efforts. Therefore, in rural areas, lending institutions need to be encouraged to make loans that are not solely based on farm income in order to alleviate financial constraints of family farms and allow consistent and future farm production.

Key Theme: Improved Crop Systems

Statement: State-of-the-art technology and rapid assessment breeding techniques, have allowed Tuskegee University scientists to broaden their sweetpotato germplasm selection criteria for the selection and evaluation of germplasm for potential use for the production of ethanol. Several germplasm with high dry matter have been identified and are being grown as potential biofuel source. This is in addition to selection of several high yielding sweet potato cultivars with improved versatility and productivity suitable for 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: Understanding the role of genes and endogenous hormones as well as the physiological response of the sweetpotato storage root initiation and development can assist breeders in the development of sweetpotato cultivars for higher productivity and quality. Studies at Tuskegee University are in progress on the relationship between endogenous cytokinins and possible genes responsible for root initiation and enlargement. Results so far of t-Zeatin riboside (ZR) extraction and quantification in developing storage roots of four sweetpotato cultivars indicated that the gene expression level is rigidly regulated during sweetpotato storage root development.

Statement: Sodium azide is one pesticide currently being developed to replace methyl bromide. At Auburn University, in trials with bell peppers, sodium azide in combination with short-term solarization provided better control of nematodes and improved fruit size than longer periods of solarization alone. These findings could allow longer production duration following treatment for soilborne pests and pathogens.

Statement: Scientists at Alabama A & M University continue their work of Prospecting health- protecting phytonutrients in peanuts. This research established protocols for more accurately determining the phytochemical contents of peanuts. Since phytochemicals are becoming a more prominent feature in the establishment of nutritional benefits in foods, this information may be vital to consumers seeking to enhance their nutritional planning. Other researchers are using novel protocols to optimize fertility rate and mass propagation of transgenic hypoallergenic peanuts. They have reported the elimination or major reduction of the allergen Ara h 2 gene from peanuts, which could enhance the safety of peanuts as a food product. Additionally, they are evaluating a propagation system for the peanut using nodal cuttings which bears the potential for large scale propagation system for homogenous peanut plants.

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 continue to construct a cDNA library and screened it with probes to identify genes conferring high fiber quality in cotton. Identification of these genes may provide useful tools for understanding the mechanisms of fiber development. Cotton mutants have been used to examine fiber gene expression and regulation. Genetic analysis of one of these mutants, Li-I, utilized in this study revealed that it is a simply inherited, monogenic dominant trait characterized by short lint fiber.

Statement: Genetic engineering offers hope for understanding reniform nematode activity in cultivated cotton. The most consistent and economical means for evaluating reniform resistance without resorting to field tests are root cultures. Alabama A&M University scientists are using an integrated approach to understand this problem by studying the functional and evolutionary aspect of the plant-reniform nematode interactions through the use of genomics and bioinformatics. Populations of reniform nematodes have been established in the greenhouse; several primer pairs have been subjected to nematode DNA amplification; and preliminary procedures for developing quantitative assays using real-time PCR apparatus have been developed. Successful achievement of the above and subsequent preparation of the samples for whole genome sequencing may be useful in developing assays for the detection of reniform nematoes in field infestations. In related studies, scientists are using bioinformatics to establish a knowledge base containing information on reniform nematode population structure and characteristics.

Key Theme: Improved Poultry Systems

Statement: At Auburn University, in-house amendments to poultry litter are being evaluated for their effectiveness in reducing ammonia emissions. Such emissions contribute to disease problems in poultry. Effective treatments have been identified that reduce litter pH and ammonia, reduce bacterial levels in pens,

extend the useful life of litter, and can contribute to improved economic viability of poultry production facilities.

Statement: Tuskegee University scientists continue their studies on decoding the turkey genome for genes that are implicated in cardiomyopathy with the ultimate goal of developing a genetic model for human heart disease in African Americans. An apolipoprotein (apo) A gene as well as a cycloxygenase (cox) gene have been successfully isolated from the turkey cardiopathic heart. These genes are associated with cholesterol transport and inflammation, respectively. Studies are in progress to isolate and analyze the h-C-reactive protein gene, since the protein produced in blood serum is currently a marker for a preemptive heart attack. Studies also are in progress to isolate the the apo B (associated with LDL) and the cox 2 genes from the cardiomyopathic turkeys.

Key Theme: Improved Animal Systems

Statement: Auburn researchers have found that varying levels of dietary protein in lactating cows, between 13% and current recommendations of 17%, does not detrimentally affect milk quality or quantity, but could contribute to lower production costs.

Statement: Researchers at Tuskegee University have found that alternative or less traditional feeds such as kudzu (*Pueraria lobata*) eastern gamagrass, mimosa (*Albizia julibrissin*) leucaena (*Leucaena leucocephala*) and feeds supplemented with copper may have the potential to increase the profitability of limited resource farmers by providing a less expensive but nutritionally sound feed for goats, particularly when traditional feeds are either limited or not cost effective.

Key Theme: Development of Alternative Specialty Crops

Statement: The demand for canola oil is increasing and the U.S. is importing over 80% of its oil for domestic use. Researchers at Alabama A&M University have established cooperative linkages with several canola researchers/breeders in the U.S. and have developed 70 advanced breeding lines. They have also selected a range of varieties suitable for production in the SE in general and Alabama in particular. Agronomic practices such as optimum date of planting and seeding rate, and fertility levels have been established. Field research on sustainability of canola as a double crop and in rotation with major summer crops (i.e., cotton, corn, sorghum, and soybeans) has been completed. Results indicate that canola after soybean and corn gave significantly higher yield than after cotton and grain sorghum.

Statement: Auburn University researchers have been studying inland shrimp production made possible by the availability of well water with low salinity. Research has helped shrimp farmers sustain survival rates above 60%, which is comparable to that of commercial coastal farms. Dietary supplementation of a chelated source of potassium and magnesium appears to enhance the ability of the shrimp to adapt to low salinity waters. The results from this research are providing the industry with an alternative aquaculture crop.

Key Theme: Fisheries and Aquaculture

Statement: Discharge of nutrients, organic matter, and suspended solids from aquaculture facilities could lead to pollution of receiving waters and impact the environment. However, treatment of effluent through the use of sedimentation ponds would require more land space than available on most catfish farms. Research at Auburn University has contributed to the establishment of Best Management Practices (BMPs) to minimize these effluent problems without increasing acreage needs and land costs.

Key Theme: Water Availability and Quality

Statement: Researchers at Tuskegee University are using of both soil enzyme assays and microbial diversity measurements to evaluate effects of tillage and cropping practices on water quality, selected soil factors and enzyme activities in 8 watersheds in Alabama. These factors have been proposed as possible early indicators of ecosystem sustainability. Tillage practices resulted in lowering the organic matter content with concomitant decrease in soil pH. The activity of phosphatase enzyme in the soils was significantly affected by land use patterns. Soils under native grass which received minimum tillage generally had significantly lower phosphatase activity than soils that received conventional tillage. Tillage activities generally decreased organic carbon content however minimum tillage combined with maintaining soil under native grass increases soil organic matter content. The use of soil enzyme activity as an indicator of soil quality will allow early detection of adverse affects of poor soil managemet. These studies will also help to develop agricultural management systems that will contribute to protecting water quality while maintaining efficient production. Tuskegee University scientists continue to provide water quality tests of well water samples for Alabama citizens. Long term studies with well water showed that well depth was inversely correlated with nitrate detection.

Statement: Water quality impairments to Flint Creek Watershed due to both point and non-point sources were documented in 2002 (USGS 2002). Researchers at Alabama A & M University continue to collected bi-weekly water samples from the Flint Creek, Flint River, and the Huntsville Spring Branch Watersheds to determine their water quality parameters including: nutrients, heavy metals, feed coliform bacteria, chlorophyll, turbidity, dissolved oxygen, and biological oxygen demand. Statistical evaluation of data showed a significant difference between means for the years. Mean coliform bacterial (CF) counts and concentrations of turbidity, BOD, Cd, Cr, Ni, Pb, and Zn were significantly higher during the 2005 monitoring period. Methods for modeling key TMDL parameters (i.e., heavy metals, sediments, biological indicators, dissolved oxygen are being synthesized to aid decision-maker in improving TMDLs.

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

Statement: Alabama A&M University scientists continue to address the educational deficit of agricultural biotechnology in underserved communities of the south. Teachers and, through them, more than 1000 high school students located in underserved communities received training and/or teaching kits in biotechnology. Several vegetable and medicinal type crops were demonstrated (i.e., biotech-based and conventional crops) to limited resource farmers via activities/field days, workshops, and one-day symposia.

Statement: Research at Auburn University is looking into the problems associated with loss of family property when an individual dies without a will. Understanding the degree of this problem, and sharing information about this could contribute to maintaining family wealth.

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 sub Saharan African countries to assist them in their efforts to increase agricultural production and improve the quality of life of the rural poor in these countries. In Ghana, a nutritional enhancement program was developed and targeted at farm families in the Northern region through the use of sweetpotato green leaves and other green leafy vegetables. Tuskegee University continues to build partnerships with private companies including Monsanto Company in its efforts to train and build capacity of African scientists in the area of biotechnology. Several short term technical training programs were provided to scientists from several African countries. Tuskegee University in partnership with IFDC, Auburn University and others are providing technical assistance to four West African countries in the West African Cotton Improvement Project (WACIP) funded by USAID. Tuskegee also participated in a four week fact finding business venture tour of 5 West African countries funded by Dupont Company.

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 continue with efforts to rapidly and precisely detect those microorganisms in food that have the potential to cause illness, as well as ways in which to reduce populations of these organisms. 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. Researchers at Alabama A&M University remain 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 2001		FY 2002		FY 2003		FY 2004		FY 2005		FY 2006	
	Approx. Expend-itures	SY	Approx. Expend-itures	SY	Approx. Expend-itures	SY	Approx. Expend-itures	SY	Approx. Expend-itures	SY	Approx. Expend-itures	SY
1862 (AL)	3,928,689	13	4,112,123	13	4,331,380	13	4,331,380	13	4,331,380	13	2,490,057	14
1890 (ALAX)	116,865	1	122,708	1	128,843	1	130,285	1	131,718	1	250,000	1
1890 (ALX)	239,971	3	251,969	3	275,359	3	283,619	3	292,128	3	584,256	4
Totals	4,285,525	17	4,486,800	17	4,724,790	17	4,745,284	17	4,755,226	17	3,324,313	19

Key Theme: Food Safety – Animal Products

Statement: Alabama A&M University scientists evaluated 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. Several dyes (i.e., Sudan 4 and Tryptophane blue) were tested for their proficiency in differentiating the individual leaves of liposomes and the presence of encapsulated BHA. These tests were unsuccessful, dyes did not fluoresce. However, Glycine and Acridine orange both fluoresced and were able to highlight the liposomal vesicles. Additionally, the encapsulated BHA remained as effective in preserving ground meat quality as was previously reported. Rancidity (TBARS) was significantly reduced over the storage period compared to unencapsulated BHA treated and untreated (control) samples.

Statement: At Auburn University, researchers are looking at ways to consistently and accurately monitor *Campylobacter* species populations in poultry flocks and poultry processing plants. Since these bacteria are the most common cause of human gastroenteritis, efficient monitoring can be important for implementation of rapid and appropriate interventions.

Key Theme: Food Safety – Fruits and Vegetables

Statement: Researchers at Tuskegee University continue to focus on biological methods in controlling post-harvest storage pests. The research is focused on using microbial antagonists such as *Rhodotorula minuta* as well as the use of low dose Ultraviolet light-C to prevent post harvest decay of tomatoes and sweetpotatoes. Results thus far indicate that *R. minuta* was very effective in controlling Rhizopus soft rot in tomatoes. The orientation of irradiated fruits and vegetables following low dose ultraviolet light –C treatment induced resistance to decay of selected fruits and vegetables. This is important because this can reduce the chemical application to prolong shelf-life and reduce post-harvest losses.

Statement: Research is continuing on microbial inactivation by combining ultrasonication with chlorine dioxide solution treatment of fruits and vegetables. Such treatment preserves the nutrition and flavor of fresh produce while efficiently reducing bacterial populations. Salmonella species and E. coli are among the bacteria that are inactivated with this treatment, which could be used in throughout the food industry to increase food safety and reduce the incidence of product recalls.

Key Theme: Food Safety and Risk Analysis

Statement: Pregnant women are faced with conflicting advice about fish consumption. Omega-3 fatty acids found in fish are needed for optimal neural development of the unborn child; however, fish may also be contaminated with mercury which has adverse effects on the developing fetus. The degree of risk to pregnant woman consuming fish is being clarified by Auburn University researchers.

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. At Tuskegee University, scientists continue to focus their research program 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 and how varying foods or supplements can affect human health.

The accomplishments thus far have resulted in development of recipes utilizing novel vegetable sources of high omega-3 fatty acids, i.e., sweet potatoes 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 2001		FY 2002		FY 2003		FY 2004		FY 2005		FY 2006	
	Approx. Expend-itures	SY	Approx. Expend-itures	SY	Approx. Expend-itures	SY	Approx Expend-ituress	SY	Approx. Expend-itures	SY	Approx. Expend-itures	SY
1862 (AL)	1,977,742	10	2,222,355	10	2,333,769	10	2,333,769	10	2,333,769	10	543,454	4
1890 (ALAX)	140,017	1	147,017	1	154,367	1	162,085	1	170,189	1	190,500	1
1890 (ALX)	174,439	2	183,160	2	192,318	2	201,933	2	205,972	2	311,944	2
Totals	2,292,198	13	2,579,532	13	2,680,454	13	2,697,787	13	2,709,930	13	1,045,898	7

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 diet were developed by Tuskegee University through focus groups and are being distributed in the target communities. Workshops have been conducted to educate local health leaders and the general public in "Fighting Heart Disease with Nutrifoods"

Statement: Work is progressing at Auburn University toward understanding how plants accumulate Vitamin B6 glucoside through the identification of genes involved in particular biosynthetic pathways. Clarification of these pathways will contribute to engineer improved vitamin B6 content of food commodities in the future.

Key Theme - Diet Modification for Targeted Populations

Statement: Auburn University researchers have determined that men and women who regularly consume snacks have significantly higher energy, protein, carbohydrate and total fat intake. The same research group has determined that decrease in food and caloric intakes is associated with the aging process. Taken together, results suggest that while snacking can promote energy imbalance resulting in obesity among other age groups, it may offset malnutrition in elderly individuals.

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 the quality of our air, water, and soil be protected. Contamination of these resources threatens the continued existence of many plant and animal species. Productivity of Alabama's agricultural, silvicultural, and other natural resource-dependent industries will be sustainable only with immediate and long-term efforts to maintain quality. In a sustainable agricultural system, animal, poultry and crop production residues and wastes might be incorporated into the soil to enhance soil productivity, to improve water infiltration and the 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 continue to focus on the long-term effects of the application of broiler litter with high levels of trace elements 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. Analysis of variance showed no significant difference in the protein content of Shiitake grown on sweet gum logs based on type of nitrogen solutions, rate (i.e., 0, 3, and 6g N/L water) or soaking period. At Alabama A&M University research 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 continues.. Additional research evaluates the mechanism of remediation of heavy metals in soils.

A number of projects are being conducted at Auburn University that fit this program. Issues that are being addressed range from observations on wildlife to minimizing pesticide use. Alabama has a diversity of ecosystems (e.g. plant hardiness zones from 7a through the warmer 8a) as well as soil types, so the research addressing ecosystem protection is frequently complex and long-term.

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

Inst.	FY 2001		FY 2002		FY 2003		FY 2004		FY 2005		FY 2006	
	Approx. Expend.	SY	Approx. Expend.	SY	Approx. Expend.	SY	Approx. Expend.	SY	Approxi. Expend.	SY	Approx. Expend.	SY
1862 (AL)	11,825,926	38	12,417,222	38	13,038,083	38	13,038,083	38	13,038,083	38	8,054,517	29
1890 (ALAX)	92,610	1	97,240	1	102,101	1	107,207	1	112,567	1	325,000	2
1890 (ALX)	268,414	2	281,834	2	215,619	2	222,087	**2**	226,529	2	353,058	2
Totals	12,186,950	41	12,796,296	41	13,436,109	41	13,367,377	41	13,377,179	41	8,732,575	33

Key Theme: Water Quality and Waste Management

Statement: The metal loading in selected streams in the lower Tallapoosa basin is being evaluated by researchers at Tuskegee University to determine total trace and heavy metal levels in the water, sediments and fish in the four streams (Choctafaula, Uphapee, Calebee and Cubahatchee) of the Tallapoosa river basin. This is to determine if these levels are associated with land use. Preliminary results show moderate to low levels of Fe, Al, Ba and Zn in the streams. Other metals such as As, Cr, Cd, and Pb were below detectable limits.

Statement: DNA fingerprints of fecal bacteria are being obtained by researchers at Auburn University for bacterial source tracking. Sources include wildlife as well as livestock and farm animals. Fecal bacterial that may then be found in watersheds can be identified to source. This information can be used to develop effective pollution control strategies and ensure pollution control efforts are directed at the correct source(s).

Statement: Scientists at Alabama A&M University have evaluated the impact of poultry waste applied to land. The ultimate goal of this research is to define optimal levels of nutrient concentrations, as well as enteric pathogens for safe disposal and the improvement of soil and water quality. Results indicate that the various P forms decreased with soil depth and were significantly (P,0.01) affected by season with the lowest phosphatase activity occurring in the fall. The data suggest that high yielding forage crops remove significant amounts of soil phosphorus from heavy manure applications on land.

Key Theme: Urban Issues

Statement: In the suburbs, nice green lawns are a status symbol to which an abundance of nitrogen fertility is applied. Research at Auburn University has pinpointed N rates needed for optimal establishment and maintenance of some of the newer cultivars (TifSport, TifEagle) of hybrid bermudagrass. These nitrogen rates help speed establishment of the sprigged turfgrasses, without overapplying N and contributing to pollution downstream.

Key Theme: Integrated Pest Management

Statement: Application of plasticulture technology shows promise as a non chemical alternative to pesticides for the control of storage rots and improving storage of sweetpotatoes. Growing sweetpotatoes under plastic mulch has the potentials of controlling weeds and increasing yields. Studies at Tuskegee University show that, plastic mulch may reduce skinning of sweetpotatoes and reduce surface rot in storage. Studies also show that thermoplastic polyurethane film improves the soil solarization process better than the low density polyethylene in Alabama and can be used effectively against soil borne pests of vegetable crop production.

Statement: Peanut is planted to about 160,000 acres in Alabama, and one of the most significant diseases affecting production of this crop is tomato spotted wilt (TSW), caused by a virus of the same name. Studies at Auburn University continue to evaluate insecticide use and cultivar selection on the intensity of TSW. Much of this work is in cooperation with researchers in Georgia since TSW tends to ignore state lines. Data collected in these studies contributes to fine-tuning of the TSW risk index, use of which has successfully led to declines in TSW occurrence.

Statement: Insect pests continue to be important production constraints on vegetable crops grown by limited resource farmers in many parts of the southern US. Research at Tuskegee University continues to seek improvement in the production and utilization of sweetpotatoes by reducing loss caused by the insects and diseases an integrated pest management approach. Information from these studies is being used to design pest management strategies to reduce pesticide use. A regional risk assessment of the weevil and a study of pest profiles on sweetpotatoes show that the overall risk of spread of weevil to non-infested areas is small (ca. 2%) as long as the recommended pre-post harvest mitigation procedures are observed. However, this risk could increase to 26% or greater if no mitigation is undertaken. These studies continue to provide information on the movement of the sweet potato weevil and the potential risks of spread to uninfested areas, and how this would impact the management and quarantine regulation of sweet potato movement in the state.

Key Theme: Remote Sensing and Precision Agriculture

Statement: Auburn University researchers continue to work with forest industries in developing technologies, arising from precision agricultural applications, to assist with seedling counts during planting season. One effort in particularly has shown that capitance sensing can assist with trees counts and in assuring quality in the planting process.

Key Theme: Restoration and Best Management Practices (BMP)

Statement: The Eurasian collared-dove is a recent exotic introduction to Alabama which may compete with the native mourning dove. This competition could negatively impact the recreational and economic value of native species. Work is on-going at Auburn University that is examining interactions among Eurasian collared-doves, mourning doves, and rock doves to begin to determine if the collared-dove is filling an unexploited niche or will detrimentally affect other species.

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, however, is 45% rural, based on 2000 census data. The rural 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 continue to focus 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 economic opportunities and quality of life in rural areas 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. Research Studies at Alabama A & M University have been 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. Research Studies at Alabama A & M University have been 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 2001		FY 2002		FY 2003		FY 2004		FY 2005		FY 2006	
	Approx. Expend.	SY	Approx. Expend.	SY	Approx. Expend.	SY	Approx. Expend.	SY	Approx. Expend.	SY	Approx. Expend.	SY
1862 (AL)	1,149,524	3	1,207,000	3	1,267,350	3	1,267,350	3	1,267,350	3	1,076,618	6
1890 (ALAX)	383,670	2	402,853	2	422,995	2	444,144	2	466,351	2	400,000	2
1890 (ALX)	268,819	3	301,159	3	316,216	3	332,026	3	348,627	3	897,258	5
Totals	1,802,013	8	1,911,012	8	2,006,561	8	2,043,520	8	2,082,328	8	2,373,876	13

Key Theme: Economic Viability and Sustainable Communities

Statement: Research at Tuskegee University focuses 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). Investigations on critical factors necessary for sustainable rural community development included those that apply to resource development (e.g., land loss and retention), economic development (e.g., small business and micro enterprises), and socio-political development (e.g., access and equity issues). Sustainability of related farm and other small business operations depends on factors and program or policy initiatives that are undertaken by governments (federal, state and local), community-based organizations and engaged institutions such as Tuskegee University. Our programs have led to the development of the farmers markets in Tuskegee and Selma becoming more sustainable, with more produce being sold and receipts reported. There were 11 micro loans secured from out-of-state financial institutions through SBA Community

Express Program as well as 3 farm ownership loans, 17 operating loans, 7 equipment loans, 13 housing loans and 9 livestock loans.

Statement: Research at Auburn University is evaluating the unique needs and opportunities associated with timberland owners of 50 acres and less, a group numbering in the hundreds of thousands across the South. Over the past 20-30 years, such owners have lost access to traditional timber markets for pulpwood and saw logs because contemporary logging operations are designed to harvest large tracts and find small tracts economically unattractive. In addition to documenting the size of the need, researchers are working to identify scale appropriate harvesting and wood processing technologies that can be adapted to meet the needs of owners of small timberland tracts, and local farmers, in order that they might sell timber and enhance their economic status.

Key Theme: Families and Children

Statement: Dating relationships affect adolescent self-perceptions/self-knowledge and can be important contributors to social capital. Working with high schools through Alabama, Auburn researchers developed and implemented a curriculum ("Relationship Smarts") that addresses healthy relationship development. Data were then collected on varying aspects of identity development and identity processing styles. Results indicate that the adolescents who participated in the curriculum developed more accurate and realistic attitudes about dating relationships, and felt that they had gained skills in communicating and managing conflict in dating relationships.

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. 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.

V. Integrated Research and Extension Activities

Summaries of projects that address Integrated Research and Extension Activities follow. Form CSREES-REPT, along with these summaries, has been sent separately and via e-mail from L. Sauser, Alabama Agricultural Experiment Station.

PROJECT SUMMARIES, FY2006

Title: **A National Agricultural Program to Clear Pest Control Agents for Minor Uses**
A number of herbicides continue to be tested for use on ornamental plants. Results from one herbicide, Gentry®, have been submitted to EPA for label registration. This is the first herbicide that may be labeled for use on liverwort in container production.

Title: **Growth Regulation of Woody and Herbaceous Landscape Plants**
In nursery production of woody ornamentals, labor costs can be substantial, particularly when pruning must be done to produce a marketable plant. However, pruning costs can be reduced with the use of appropriate plant growth regulators. This project is evaluating these products and finding some substitutes for physical pruning.

Title: **Animal Manure and Waste Utilization, Treatment and Nuisance Avoidance for a Sustainable Agriculture.**
Studies are being done on densification of broiler litter by applied pressure for compaction. This treatment was demonstrated to decrease N and C concentrations of the litter, but also decreased transportation costs.

Title: **Cultural Practices and Cultivar Evaluations for Pecans**
In addition to continued evaluations of improved pecan cultivars, studies are also looking at herbicide and insecticide application with sprayers or with irrigation. Studies have also shown that wiper application of herbicide, on weeds taller than the clover groundcover, are effective and can reduce mowing.

Title: **Decision-making under Uncertainty and the Economics of Risk in Alabama Agriculture**
Increased predictability of climate changes associated with El Nino Southern Oscillation (ENSO) was shown to help reduce farm risk by timing the selection of crop insurance products to coincide with predictions of the severity of those events. The current state of the satsuma marketing effort in the Gulf States was summarized, and recommendations were made for development of a regional brand.

Title: **Epidemiology of Plant Diseases in Crop and Urban Landscape Ecosystems**
During research on crop rotation sequences and effects on diseases and yields, it was discovered that the cotton root knot nematode reproduces well on corn. Analyses are indicating that these nematodes do have detrimental effects on both corn and cotton, although a single year rotation to peanut will substantially reduce populations of this nematode.

Title: **Impacts of Trade and Domestic Policies on the Competitiveness and Performance of Southern Agriculture.**
Work as part of this project examined non-tariff trade barriers and has given policymakers a better tool to assess and improve agricultural trade policies for producers, consumers and the government. The quantitative analysis of trade barriers from this project provides researchers a new perspective to address these barriers in their research.

Title: **Developing Sustainable Production Practices for Cotton (*Gossypium hirsutum*)**
The common practice in cotton production in the southeastern U.S. is to allow weeds to grow along with seedling cotton until the four-leaf stage. This is the time when label restrictions would limit over-the-top applications of glyphosate. However, research indicates that negative yield impacts due to weed competition are irreversible at this point even if the crop is maintained weed-free for the remainder of the season. Adjusting the timing on glyphosate applications can result in cotton yield increases, and provides cost benefits for the producer.

Title: **Management of Arthropod Pests on Peanuts**
Studies continued that contribute to the peanut spotted wilt risk (TSW) index, a multi-state tool that extension and research scientists in Georgia, Florida, and Alabama utilize to assist peanut growers in managing this disease. In particular, the evaluation of new and developing cultivars for their reaction to TSW is significant. Acreage of newly available cultivars such as AP-3, Ga-02C, Ga03L should continue to increase. Because these cultivars have lower TSW and increased yield than previously predominant cultivars, grower revenue is expected to increase by about $2.5 million dollars in Alabama alone.

Title: **Management of insect pests of forage and grain crops in Alabama**
A long-term study on spatial and temporal distribution of soil insects in pastures continued in 2006. In particular, data on soil characteristics (P, K, OM, texture) will be compared to insect abundance to see if soil insect pest occurrence can be predicted. Such a predictive system will help cattle producers in targeting scouting efforts and control efforts to prevent losses of pasture acreage to soil insect pests.

Title: **The Poultry Food System: A Farm to Table Model**
Detrimental microbes are facilitated in their infestation of poultry products in warmer conditions. For this reason, cool water washing was tested in two shell egg operations in Alabama. Research results indicate that cool water washing could enhance the cooling of shell eggs and potentially reduce pathogen growth. Federal approval of a cool water wash process would not only reduce energy costs but improve egg quality and safety.

Title: **The ecology of the Mobile-Tensaw Delta: an ecotone between marine and freshwater ecosystems**
Largemouth bass is an important species to the Mobile-Tensaw Delta, both ecologically and economically. In order to better manage this species for sustainability, fish and water are being sampled and analyzed from the delta. Results show that salinity is one of the most important factors influencing the dynamics of the Delta. Salinity peaked relatively earlier in 2006, generally beginning in mid summer and continuing into the fall.

Title: **Metabolic Relationships in Supply of Nutrients for Lactating Cows**
Milk production from cows that were fed on cycling protein content (from 13% to 17% over three-days) was evaluated in this project. Quantity of milk produced did not differ with varying protein diet compared to

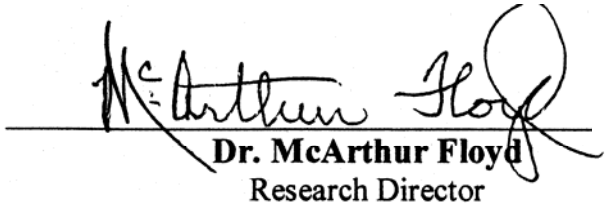
constant 17% protein diet. However, protein content of milk produced was decreased with lower protein intake.

Title: **Evaluation of Aquatic Species, Strains and Hybrids and their Production Methods to Improve Sustainability of Aquaculture in Alabama**
Research on this project has been evaluating differences in production of freshwater prawns when cultured in single sex or mixed populations. Data indicate that females, grown-out in mono-sex culture, are about 20% larger and have slightly improved survival than males only.

VI. 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 2006:



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Dr. McArthur Floyd
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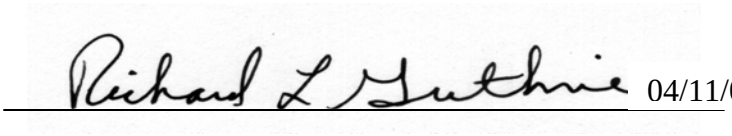

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Dr. Richard Guthrie
Dean and Director, College of Agriculture
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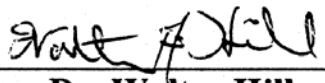
Auburn University



04/11/07

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