Georgia
Annual Report of Accomplishments
FY 2006

The University of Georgia
College of Agricultural and Environmental Sciences
Cooperative Extension Service
Agricultural Experiment Stations

Fort Valley State University
College of Agriculture, Home Economics and Allied Programs
Cooperative Extension Program
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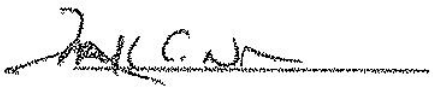

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The Georgia Annual Report of Accomplishments
FY 2006

Table of Contents:

Signatures required on the cover page and the expenditure reports are not included in the electronic versions of this report. Signatures are on record with original report.

Introduction

The Georgia Annual Report of Accomplishments and Results for 2005-2006 represents a coordinated effort between Georgia's 1890 and 1862 institutions – Fort Valley State University and the University of Georgia, and includes singular and combined results of research and Extension units at both universities.

Within Extension, UGA and FVSU state faculty with Extension appointments coordinate efforts with UGA county faculty housed in 158 of Georgia's 159 counties. FVSU has seven county agents housed with UGA Extension faculty. Extension programming is delivered as individual county efforts, multi-county programming, and state-wide programming efforts.

FVSU and UGA research programs are conducted through the agricultural experiment stations system. The Georgia agricultural experiment stations consist of four major campuses located in Athens, Tifton, Griffin and Fort Valley. These four campuses are supported by research and education centers located strategically throughout the state.

Research and Extension faculty have made major accomplishments toward goals identified in the current plan of work. While reduced state funding has greatly impacted the efforts of the faculty, the organizations have been effective and productive during the past year. Many of the documented outcomes within this report demonstrated immediate and prolonged impact on the citizens of Georgia.

This report represents the Extension and research programs of both the University of Georgia and Fort Valley State University as represented in the AREERA plan of work submitted in 1999 and revised in 2003. The accomplishments are recorded according to key themes and state performance goals.

In addition to this report, hundreds of impact statements may be accessed at http://www.caes.uga.edu/Applications/ImpactStatements. This impact database Web site contains advanced search capabilities that allow the user to sort by key words and program goals. The impact statement database contains a great deal more information than the limited summaries included in this report.

Goal 1

Georgia consistently remains highly competitive in the agricultural economy. Georgia's wide array of strong points includes broilers, cotton, timber, beef, eggs, horses, peanuts, dairy, greenhouses, and turfgrass. To remain competitive, Georgia has made improvements in each of these areas; even the smallest improvements to these areas would have a large impact in Georgia's competitive advantage. The University of Georgia has executed research or dissemination of information to:

- Increase the quantity and quality of value-added products
- Increase the efficiency of GA agricultural production, agribusiness, and natural resource management.
- Enhance competitiveness of Georgia's agricultural products.
- Improve management practices of small and part-time farmers.
- Help Georgia poultry producers remain competitive.
- Enhance the competitiveness of Georgia's agricultural and forestry products in domestic and international markets.
- Meet the growing consumer demand for wood-based products.
- Enhance specific genetic traits and germplasm to improve crop resistance to pests, increase plant performance, provide public and private breeding programs a greater array of germplasm, and ensure increased profitability for Georgia growers.
- Develop plant management strategies to improve crop production, minimize production risks, and ensure the sustainability of natural resources.
- Improve animal performance and production using molecular genetics and biotechnology.
- Develop comprehensive production management systems to increase value.
- Enhance animal production by improving health and production environment.
- Develop enhanced pest management systems that are efficacious, environmentally compatible, and economically rewarding for Georgia producers.
- Enhance production, value, and profitability with improved machines, processes, diagnostic devices, and decision support tools.
- Enhance the efficiency, profitability and competitiveness of agricultural enterprises by reducing risks, selecting profitable investment, improving production and management techniques, selecting appropriate marketing strategies and identifying economic development opportunities for rural communities.

Prompt summary of agricultural production systems that is highly competitive in the global economy:

Turfgrass' competitive advantage and examination of turfgrass genomics in increasing agricultural profitability

- The use of Drive for seashore paspalum turfgrass is safe to use as a weed preventive for turfgrass. This discovery influenced Drive to change their label reflecting the safe use on turfgrass.
- Plant genomics for seashore paspalum through the identification of paspalum reproduction vegetative weaknesses created the world's first seeded seashore paspalum cultivar, Seaspray. This allows paspalum to pollinate each other regardless of inherent problems with self-incompatibility.
- Research for using poorer water quality for turfgrass led to the creation of mobile salt monitor technology, better management of salt-affected sites and efficient use of water for salt leaching on a site-specific basis.
- The use of Tifton 85 Bermuda grass instead of alfalfa hay maintains performance of cows, reduces feed cost, and improves net income.
- Fungi usage to control Rhizoctonia large patch in zoysiagrass (turfgrass throughout Georgia on golf courses) limits the severity of Rhizoctonia disease and also enhances the quality of zyosiagrass.

Livestock competitive advantages

- Scientist increased access to the latest trends, research activities, production practices and new systems, regarding integrated livestock systems into formats farmers could easily understand by creating a newsletter, web-based presentations and certification programs. In addition, a one-day short course about beef cattle nutrition, planning budgets, health and marketing increased Georgia's competitive edge in the livestock market as evidenced through success rates in new meat goat and commercial lamb enterprises.
- Success in the competitive Herd Health Management studies has cited Georgia specialists as experts in several handbooks, USDA Veterinary Services, American Association of Small Ruminant Practitioners, U.S.

Animal Health Association, American Dairy Goat Association, Georgia Veterinary Medical Association, and on the SCSRPC website.
- Discovered providing financial and production data to dairy managers increases their net farm income.
- Faculty found that Paylean® is equally effective at reducing fat, increasing muscle, and increasing carcass fat free lean in pigs sorted into lean and fat phenotype groups.
- The Tifton Bull Test program, one of the most respected test stations in the U.S., created the second in the highest daily average weights and second in the highest sale average thus enabling cow producers to improve the herd's genetics and ultimately profitability.

Animal genomics through cloning
- Faculty developed a cloning procedure for cattle through collection of cells from beef carcasses. The procedure proved to be effective, resulting in the birth of a normal calf derived from kidney cells.
- Projects conducted helped unraveled the basis of goats' seasonal limitation to reproduce. This improved productivity in goats, techniques of goat in vitro fertilization, embryo transfer, and cryopreservation of goat embryos.

Agricultural profitability, animal health, animal production efficiency
- Faculty proved by deworming calves and deworming them earlier, their weight would increase on average 5.73 lbs. This gain in weight causes a higher profit to cattle producers since the benefit outweighs the cost.

Improving poultry competitiveness
- Research and educational programs related to energy efficient use of ventilation and heating systems for poultry operations helped producers meet or exceed industry standards for fuel and energy usage in production houses.
- Research on pearl millet identified ways to decrease Georgia's demand for imported corn as feed for poultry.

Peanut's Germplasm, health, profitability and competitive advantages
- Peanut is more tolerant to glyphosate in the early season, but 90 to 100 days after planting the plants' tolerance declined and ended in injury to peanut.
- Transgenic peanut lines are being developed from cultivars with superior agronomic traits, which provide resistance to tomato spotted wilt virus. Peanut lines with increased resistance to tomato spotted wilt virus will significantly increase yield and will have a positive economic impact on peanut growers financial well being and competitiveness. Planting date is another major factor in managing spotted wilt with moderately resistant cultivars. New cultivars have much better field resistance and should allow growers to plant peanuts earlier.
- 'GEORGIA-05E' is a new high-yielding, high-oleic, multiple-pest-resistant, Virginia-type peanut variety discovered by the Georgia Agricultural Experiment Stations and was found to have significantly less disease, higher resistance to tomato spotted wilt virus and higher yield, grade, and dollar value return per acre than other Virginia-type varieties.

Education topics such as diverse/alternative agriculture, plant health, and managing change
- A comprehensive training program was developed addressing the need for conservation tillage education thus improving pre and post test knowledge.
- Due to more educated growers, blueberries continue to increase every year - $59.4 million equating into a 122% increase in value over the past two years.
- The Southeaster Climate Consortium (SECC) held various agent trainings, county meetings and in-service conferences that increased the farmers' visibility of the climate extension program. In addition the SECC is responding to farmers' request to inform them of tool development and outreach offerings.
- Rising property values, which has increased popularity among housing, gardening, turf and ornamental species, have created a need to educate consumers, homeowners, producers, managers, and landscape companies' personnel on Integrated Pest Management strategies for control of plant pests and plant diseases. Educational activities were held resulting in agents initiating regional IPM and water quality programs in their own counties; students receiving a Junior Master Gardener certificate of completion; contacting industry professionals, landowners, and agro industry associations during the "Agroforestry Wildlife Field Day" in Griffin, GA; and faculty developing fact sheets in English and Spanish.

Plant genomics
- Fusarium wilt was observed to be the leading cause of disease for seedless watermelons. Scientists discovered race typing is essential in developing a profile for Fusarium wilt races so breeders will know the levels of resistance needed for developing resistant seedless watermelon lines.

- The UGA Small Grain Breeding Team discovered new high-yielding wheat releases with excellent test weights and a resistance to disease and insects. These wheat cultivars will provide excellent resistance to stripe rust and wheat soil-borne mosaic virus, two new pests in the Southeast.
- Root-knot nematodes are among the world's most damaging agricultural pests. To prevent these pests from attacking new targets, RNA testing identified the molecular tools used to infect plants. The silencing of the root-knot nematode parasitism gene by RNA interference made the plant resistant to the four common root-knot nematode species.

Adding value to new and old ag products by identifying high risk areas

- Diseased onions were removed from an inspection machine using a trial process simulation model (ARENA) and had a consistent removal rate that was accurate at the 90%+ level.
- Researchers identified high risk drought areas susceptible to aflatoxin contamination through the use of multispectral images. Now the technique serves as a tool for farmers to identify and segregate areas of high risk which can save the producer money as well as improve the safety the food supply.

Improving plant health through the use of precision agriculture

- Variations of rainfalls each year, caused by El Nino-Southern Oscillation, affect crops throughout the Southeast. Irrigation methods respond to such variations. The CSM-CROPGRO-Peanut system was developed to provide growers the same level of profitability with or without irrigation under different climate conditions. The Cropping System Model successfully simulated the growth, development, and yield of peanuts and cotton’s accumulation of leaves, stems, and boils. Use of this system with geostatistical techniques could benefit policy makers, planners, county agents, and farmers to identify regional irrigation demand.
- Weather-related conditions of dew point temperature are useful in estimating frost, fog, rain, snow, dew, and evapotranspiration. Back propaganda ARMs were developed that predicted hourly temperatures by identifying other factors contributing to dew point.

Progressing in agricultural competition and profitability through increasing the health of plants

- Regardless of the lack of disease and insect resistance, corn has proven to be the most economically sound for summer crop production compared to other options such as pearl millet and grain sorghum.
- Nematodes are estimated to be responsible for $51 million in damage annually and can be managed with Nemacur. Nemacur is currently pending and might be lost as a nematode control strategy. Scientist testing has shown an application of Telone II can reduce the amount of scrap, therefore increasing the amount of harvested grass which could lead to a potential net increase in revenue of $731 per square acre.
- Tebuconazole has been labeled for use on peanuts in the U.S. since 1994 and is the predominant fungicide used on peanut in Georgia, Alabama and Florida. Plant pathologists conducted field experiments from 1992-2006 examining rates of tebuconazole on early and late leaf spot of peanut and to examine the relative efficacy of tebuconazole and chlorothalonil over time. Decline in fungicide performance in research plots over time and the associated reduction in tebuconazole sensitivity provides early warnings of impending control losses in time to make appropriate modifications for disease management recommendations and prevent significant economic losses to peanut growers.
- Thrips are sources of primary inocula for center onion rot epidemics. Testing further identified dry weather conditions correlated with increased thrips populations that increased center rot severity by season.
- In effort to better understand the effect of exogenous nutrients on phylloplane yeast populations with the greater long-term goal of increasing leaf carrying capacity for use in biocontrol, a study was conducted to see if yeast populations on turfgrass could provide additional disease control. These results suggest that organic nitrogen stimulate yeast community growth and development on the phylloplane of tall fescue while carbohydrates, inorganic nitrogen and non-nitrogenous nutrients have little positive effect.
- The Homeowner IPM Plant Disease Clinic offers diagnostic support for plant disease related problems in home and urban landscapes across the Georgia and processes approximately 1,000 homeowner samples a year. Through Distance Diagnostics through Digital Imaging (DDDI) education can be provided to home owners thus increasing awareness of integrated pest management options.
- Georgia's vegetable industry is threatened each year by the increasing trend of using greenhouse-grown transplants to improve production efficiency. Green-house grown plants are conducive to bacterial multiplication and spread of bacteria such as bacterial fruit blotch of cucurbits (BFB). The threat posed by seedborne inoculum is significantly increased. To address this issue, scientists developed a way to detect phytopathogenic bacteria in seeds.
- A great deal of effort over the last ten years or so has been focused on the understanding of how fungi cause diseases of both plants and animals. Scientists identified a number of pathogen genes that are required for the completion of disease cycles enabling prevention methods.

- With research-driven registration, we now have a resistance-management tool for rotation with respiration inhibitors, extending the useful life of both fungicide categories. Modified fungicide programs are now available and recommended to address fungicide resistance management and brown rot control.
- Results from the study of Asian soybean rust in Georgia in 2006 have confirmed where Asian soybean rust can over-winter and provided a better understanding of the efficacy of fungicides.
- The use of a mustard fall cover crop significantly reduced disease and increased yield on a black shank susceptible tobacco cultivars. This may reduce the dependence on expensive fungicides and potentially save growers hundreds of dollars in losses and cost of disease control.

Plant germplasm
- The Statewide Variety Testing (SWVT) program identified numerous public and commercial row crop and small grain cultivars of corn, soybean, grain sorghum, peanut, wheat, barley, oat, rye, triticale, canola, summer annual forages, and winter annual forages during 2006 as adapted to being successfully grown in Georgia.

Agricultural competitiveness
- Studies of the ENSO have shown correlation to predicting the potential of wild forest fires. Due to success in testing the relation, the SECC implemented an ENSO based KDBI (KDBI is the test usually used to predict forest fires) forecast on their web site. Most districts and counties found this to be very useful, informative, and easy to interpret.

Agricultural profitability - vegetables
- Vegetables produced on plasticulture in Georgia account for a farm gate value of over $200 million with the assistance of methyl bromide to manage pests. Research has revealed three alternative methods to methyl bromide. If these alternatives continue to be as effective as methyl bromide over the next two years, a large scale grower adoption between 2009 and 2010 can be expected.
- In response to Georgia's cotton being declared as the least preferred in 2004 faculty have researched the cotton fiber ginning process. Since the research began, a line of cotton with high fiber quality that can be readily used has been discovered. In addition, spotlight on fiber quality has caused gin managers to scrutinize and improve their handling/processing systems and to encourage growers to do likewise.

Studies on use Palmer amaranth to increase agricultural profitability
- Studies were initiated to examine how Palmer amaranth weeds are resistant to Roundup with the objective of finding ways to control them while still using Roundup for weed management in Roundup Ready cotton in Georgia. Data indicates that glyphosate-resistance for this Palmer amaranth biotype is based on a difference in the site of action rather than limited translocation.
- Searching for alternative methods to manage glyphosate-resistant Palmer amaranth, scientist's research noted that Reflex (fomesafen) could be applied in cotton with minimal cotton injury and control Palmer amaranth. Reflex use was estimated to stop a loss of $38.1 million in cotton value for Georgia growers.
- Preliminary surveys indicated the resistance of Palmer amaranth will cause peanut growers to spend more money on herbicides and increase peanut production costs by $10 to $25 per acre.

Small farm viability
- In effort to determine if targeted social sectors of land owners would take advantage of small farm opportunities, five African-American farmers were provided a new small herd, shelters, holding pens, feed troughs, and small supplies needed for husbandry and health care.

Description of Activity; Impact of Activity; Source of Funding; Scope of Impact

Key Theme: Adding Value to New and Old Ag Products

- Goal 1-1

Improving Vidalia onion quality

a. Sweet onions are susceptible to bacterial and fungal pathogens. Chemical pest control strategies do not currently ensure adequate control. X-ray imaging techniques have been identified that enable identification of diseased onions in the packinghouse. This past year scientists continued our evaluation of x-ray technology with onions grown in the Vidalia region. Cost effectiveness is the major issue with technology adaptation in the packing house.

During the test, some 400 onions were passed through an inspection machine and then manually evaluated for disease presence. A simulation using an industrial process simulation model (ARENA) was developed that compared the dynamics of product movement through packinghouses with and without internal inspection capability.

b. The machine continued to be accurate at the 90%+ level and had a false positive rate of 9%, consistent with previous results. The x-ray machine removed a number of diseased onions that would have likely spoiled before making it to the retail outlet. The simulation model showed the impact of technology on product valuation through the post harvest handling system. The addition of technology at the packinghouse level was shown to be cost effective for the packinghouse only when a well-defined niche market was served or when a vertical integration of the distribution system was possible. The model suggested a net benefit for consumers with the internal inspection technology.

c. Hatch Act, State matching funds
d. State Specific

- Goal 1-37

Enhance and increase the cultivation of daylilies

Sub-keys: Agricultural Competitiveness, Agricultural Profitability, Plant Genomics, Plant Germplasm

a The daylily is a popular perennial used extensively in home and commercial landscapes because of its form, its ability to provide seasonal color and ease of culture. Nearly 60,000 varieties have been registered and many are available commercially. Although easily propagated, the process is very slow. The time between producing and introducing a new variety to the public is lengthy because vegetative propagation by division of the crown gives a net gain of one or two additional plants a year. With this in mind, we employed tissue culture techniques to rapidly propagate daylilies and to speed up the commercial release of new varieties by several years.

During the period between 2000 and 2006, daylily plantlets have been produced from tissue culture protocols developed in the Fort Valley State University Agricultural Research Station Laboratory. During spring and summer 2000, preliminary field studies were initiated to determine true-to-type tissue culture daylily plantlets. Results from this study suggested that explants sources could influence the plantlets ability to be true-to-type. With this in mind, studies were conducted to determine the effect of different explants' sources for maximum flower production in daylily tissue culture plantlets. During spring and summer of 2004 and 2005, field studies were initiated to determine the effect of different explants' sources on flower production in daylily tissue culture plantlets. Explants from immature seeds, immature and mature embryos, young inflorescences, ovary sections, and filament of the daylily flower buds (0.5-4.0mm) were investigated as the explants' sources. Tissue culture plantlets of the immature and mature embryos and filaments from young buds treatments were tested in field studies. True-to-type was measured by determining survivability, growth rate, multiplication of crowns and the numbers of flowers produced by tissue culture produced plantlets. Results from these studies showed that 100% of the plantlets survived for each treatment. For both years, the plantlets grew at a reasonable rate, producing two to four crown division/plantlets. Flower production was limited on all plantlets the first years, while there was a considerable improvement in flower production for all the plantlets the second years (2005). In 2006, further evaluations and observations were conducted in the field to confirm trueness-to-type for maximum flower production.

b It's anticipated that results of this nature will greatly enhance our goal of making varieties of daylily more readily available to the public. Research results from these evaluations will be made available to daylily growers and producers on local, national and international levels. Information from this study has been disseminated at agricultural showcases, Sunbelt Expos, field days, national and international conferences and meetings.

c NARETPA, State Matching Funds
d State Specific

- Goal 1-28

Increase chevon consumption

a Goat carcasses are lean with low intramuscular fat. However, goat meat (chevon) is considered inferior in palatability to other traditional meat animal species. Appropriate postmortem methodologies and

value-added products are expected to widen the existing market mostly confined to ethnic populations and increase the number of consumers benefiting from this low-fat red meat.

An experiment was conducted to better understand the quality differences between chevon and lamb. The objective of this study was to determine whether the quality characteristics of chevon differ from those of lamb. Sheep and goats were slaughtered using standard procedures. After 24 hours of cooler storage (4 ºC), the carcasses were fabricated into primal cuts. Loin chops were used for color, Warner-Bratzler shear force values, cooking loss, percent metmyoglobin, and thiobarbituric acid reactive substances (TBARS) determination at 24 hour postmortem. The chops were placed on aluminum pans and covered with aluminum foil, cooked in a convection oven to an internal temperature on 71 ºC, cooled at 2 ºC for 24 hours, and then 1 cm cores were removed for shear value determinations. Analysis of data as a completely randomized design showed that Warner-Bratzler shear force values were significantly lower in lamb chops compared with chevon chops. The mean (± SEM) shear values were 2.12 ± 0.21 and 1.3 ± 0.21 kg in chevon and lamb chops, respectively. The L* values (lightness) were not different between chevon and lamb chops, however, the a* values (redness) of lamb chops were higher compared with chevon chops. The mean (± SEM) a* values were 12.2 ± 0.37 and 14.2 ± 0.37, respectively, in chevon and lamb chops. Percent metmyoglobin and TBARS were not different among the chops, indicating that levels of pigment and lipid oxidation were not different between lamb and chevon at 24 hours postmortem. Cooking loss was also not influenced by species. The results indicated that lamb may have better tenderness properties compared with chevon, although the other quality characteristics studied were not different.

b Several papers were published on chevon quality characteristics during the past year. The study helped us better understand how chevon differs in quality compared with lamb. It is clear that the quality characteristics of chevon may be comparable to those of lamb, except for tenderness. Development of any methodology that results in an improvement in tenderness is likely to increase chevon consumption. The strategies we have examined recently to improve chevon tenderness include electrical stimulation of goat carcasses, hydrodynamic pressure processing, injection of calcium chloride in meat chunks, and development of comminuted meat products. Consumer panel testing on chevon products and surveys conducted on chevon consumption showed that the consumer base for chevon has expanded.

With continuing research on chevon technology, chevon consumption is expected to further increase in the near future.

c NARETPA, State Matching Funds

d State specific

- **Goal 1-1**

Georgia beef challenge

Sub-keys: Agricultural Competitiveness, Agricultural Profitability, Animal Production Efficiency

a Georgia calves are primarily sold at weaning and traditionally discounted because of their reputation of having inferior quality and health status. As a result, cattle from the Southeast sell at a discount to cattle from other areas of the country. In addition, since most cattle producers in Georgia sell at weaning, these producers do not know how their cattle perform in feedlots nor do they know the type of carcasses these cattle produce.

The Georgia Beef Challenge was organized by the UGA Department of Animal and Dairy Science to inform cattle producers about the health, performance and carcass merit of their cattle. Georgia producers bring weaned calves to central locations where they are tagged, weighed, graded, and assigned a market value by graders. These cattle are grouped into truck-load lots and are shipped to cooperating feedlots in Iowa where Iowa State Extension Specialists assist with collection and reporting of performance and carcass data.

b During the 2005 - 2006 season (March 6, 2005 - June 5, 2006) 42 producers shipped cattle in the Georgia Beef Challenge. A total of 1,584 head of cattle were processed from this group. After paying all expenses, the average profit per head was $76.56 for a total added value to Georgia producers of $121,271.04. In addition to immediate profits, producers also receive performance and carcass data on every individual animal. These data are being used by producers to make selection and

management decisions with their herds.

c Smith Lever; state matching funds
d Multi-state: IA

- Goal 1-23

Genetic transformation used to improve cattle productivity and improve quality of high yielding products

Sub-kes: Animal Genomics, Animal Production Efficiency

a Recent advances in genetic transfer in livestock have improved productivity. Gene transfer is a potential technique to speed up classical genetic breeding methods for animal improvement. It is also useful in the preservation of high yielding quality productivity traits. These advances affect products such as cashmere, mohair, lean meat and less allergenic dairy products from goats. Biotechnology can make goat products a competitive and lucrative economic system.

Projects were funded for the development of in vitro techniques to establish cell lines for genetic transformation. Techniques for establishing caprine cell lines using granulosa and oviductal cells were successfully refined. The cryopreservations of these were also done in collaboration with scientists and laboratories of reputable universities and research agencies. We sent students to some of these labs for internships. We exchanged visits to participate in seminars. Scientific papers were published in journals including the Small Ruminant Research Journal.

b The FVSU faculty can now train graduate students in reproductive biology due to the establishment of technology in cell biology. Graduates from the program have gone onto professional schools in medicine and dentistry. Stakeholders can now use our facilities for learning artificial insemination, estrous synchronization, and embryo transfer technology in their goat breeding programs. We are planning to routinely produce goat somatic cell lines for incorporation of genes of economic value in order to add value to the goat product.

c NARETPA, State Matching Funds
d State Specific

Key Theme: Agricultural Competitiveness

- Goal 1-2

Agricultural Energy Conservation Impact

a Recent increases in energy prices, especially for liquid fuels, have drawn attention to the need to for more efficient energy use. Much attention has been given to alternative energy sources including biodiesel and ethanol which can be produced from farm crops. These alternative sources need to be developed, but efforts to reduce energy consumption through efficiency will provide more immediate results. Many times energy conservation practices can save producers money while using less of our natural resources. An example is the more efficient use of agricultural and residential irrigation. If water can be applied in a more efficient way, less water will need to be pumped, which not only conserves water but energy for pumping as well. Another example is enclosing a poultry house by applying foam insulation to the inside of the curtains. Energy savings from this procedure have been demonstrated at approximately 25% on winter flocks thus paying for the cost of the installation in less than two years.

Extension specialists in the Department of Biological and Agricultural Engineering and in the College of Family and Consumer Sciences have combined efforts to educate agricultural producers and rural residential consumers concerning ways they can reduce water and energy usage while maintaining production levels. Programs have been developed and implemented in the areas of agricultural and residential irrigation efficiency, efficient application of fertilizers and pesticides, efficient heating and ventilation of poultry and other livestock facilities, energy conservation on dairies, energy conservation in peanut curing, energy conservation in row-crop production including precision agriculture, and energy conservation in rural housing.

b Approximately 7,000 people attended 78 meetings, and 800 one-on-one contacts (phone or personal visit) were made in 2006 where energy conservation was the purpose of the meeting or contact. As a result, savings have occurred in electrical usage, diesel, gasoline, and LP gas. If all these forms of

energy are converted to an equivalent amount of diesel fuel, the equivalent estimated savings would be 1.7 million gallons of diesel or approximately $3.5 million.

c Smith Lever; state matching funds
d State Specific

- Goal 1-1

Aquaculture industry development and technology transfer

Sub-keys: Adding Value to New and Old Ag Products, Agricultural Profitability

a Georgians are looking for alternative income activities and are interested in aquaculture enterprises. Most of the interest involves channel catfish, tilapia, and freshwater prawn production or processing. Training in all aspects of the aquaculture industry is needed as potential producers evaluate the industry and as established producers apply new technology. The catfish market has increased for the past two years, and prices have increased due to a need for additional supply of farm-raised catfish.

Technical assistance was provided to catfish processors, land owners, and fish farm owners through county agents and individual contacts. Marketing information was provided for catfish processors including Southeastern Pride in Louisville, Decatur Fish Farm in Bainbridge, R&D Fish Farm in Molena, and Georgia Sweetwater Catfish in Willacoochee. Marketing efforts included catfish fillet sample distribution at the Sunbelt Exposition. Workshops were held to train producers in technology related to freshwater prawn production and catfish production.

b Catfish processing and distribution increased to over $3,562,500 in 2006, most from Louisville and Bainbridge. Careful management of small processing plants was a more successful approach than the large processing efforts in the state, as reflected by the failure of a $3,000,000 plant. Individual catfish marketing contacts numbered over 10,500 through cooperative efforts of Auburn University and FVSU.

c Smith Lever, NARETPA, State Matching Funds
d Multi-state Extension: AL

- Goal 1-2

Weed control in seashore paspalum

a Seashore paspalum is an environmentally-friendly warm-season turfgrass grown primarily in coastal regions of the southern United States. This grass is highly adapted to saline sites. Similar to all turfgrasses, weeds can be a problem in seashore paspalum. As this turfgrass is new to the industry, very few herbicides are registered for weed control in this species.

Research conducted over the past five years at the UGA-Griffin Campus has identified herbicides that could be used for weed control in seashore paspalum. In experiments conducted in 2005 and 2006, Drive (quinclorac) at 0.5 and 1X (0.375 and 0.75 lbs. ai/acre, respectively) rates were applied to newly-seeded and sprigged 'Sea Spray' seashore paspalum. In 2005, Drive at 1X applied at the time of seeding was the only treatment that temporarily decreased the density of seashore paspalum during establishment (up to 35 days after application). Drive did not affect seashore paspalum establishment in 2006. This research showed that Drive, an effective herbicide for crabgrass and certain other annual weeds, could be applied at the time of seeding or sprigging, as well as during “grow-in” of seashore paspalum. This information was forwarded to BASF, the registrant of Drive, who has added this use and turfgrass species to this herbicide label.

Mesotrione (no trade name) applied at the time of sprigging or seeding seashore paspalum slightly injured and decreased density on both newly-seeded and -sprigged seashore paspalum at 14 days after application. However, by 30 days after application seashore paspalum density and quality were equal to the untreated check. This was the first experiment conducted with this herbicide on seashore paspalum. Future research on the tolerance of seashore paspalum is needed as this turfgrass species exhibits acceptable tolerance to mesotrione. In additional studies established seashore paspalum exhibited excellent tolerance to carfentrazone (QuickSilver), F6011 (an experimental from FMC), sulfentrazone (Dismiss), and halosulfuron (SedgeHammer).

b Information generated from this research is being supplied to agri-chemical companies who have proprietary rights for these herbicides. Companies will be able to use this information to register these herbicides with EPA for use on seashore paspalum. The net impact will be that turfgrass managers and

homeowners will have effective herbicides used to control objectionable weeds in seashore paspalum. As weed control programs continue to be developed for seashore paspalum, the use of this grass will continue to increase in geographical areas where other turfgrasses are poorly adapted.

c Hatch Act, state matching funds
d State Specific

- **Goal 1-3**

Aquaculture production

a Aquaculture is the world's fastest growing form of food production. Average fish consumption has doubled in less than half a century and is predicted to continue to increase. Thirty percent of U.S. fish populations are over fished and are being unsustainably utilized, and globally 75% of fish stocks are depleted in some way. It is predicted that 40% of the fish eaten in 2020 will have to come from aquaculture. Production will need to double in the next two decades from 28.6 million metric tons in 1997 to 53.6 million in 2020.

Aquaculture continues to grow and contribute to the economies throughout the South. In both Mississippi and Arkansas aquaculture alone contributes over $2 billion dollars a year to the economies of each state. Georgia, with its abundant natural resources, location, infrastructure, educated workforce, aquatic resources and location to airports, has the potential to develop aquaculture as an alternative agricultural crop. Even with the abundance of resources, producers in Georgia have been slow to embark on aquaculture as an alternative crop. The 2005 USDA NASS Census of Aquaculture showed only a modest increase in sales of aquaculture products in Georgia with total aquaculture sales of $2,943,000 in 1998 to $ 7,502,000 in 2005. In states where aquaculture makes a great contribution to the economy, there has been an increased effort by universities and extension to conduct applied research and carry out technology transfer and extension activities which has impacted the state by increasing aquaculture production and number of enterprises.

The goals of the present work are to develop demonstration aquaculture facilities to provide potential producers and students exposure with various aquaculture species in different rearing systems. It is also important that aquaculture species and systems be available for elementary and high school students to view the variety of culture options available in aquaculture. Aquaculture demonstration facilities are an important component of on site training, aquaculture workshops and agricultural field days.

Unlike traditional aquaculture, recirculation aquaculture systems (RAS) take only a small portion of the land, space and water used in traditional aquaculture production systems. This allows both rural and urban producers to now become involved in aquaculture. At the Georgia Center for Aquaculture Development (GCAD), the demonstration of and research on RAS with different aquaculture species is an important part of the multifaceted aquaculture program.

Further development of the aquaculture industry relies on support in the areas of diagnostic services with regard to water quality, fish disease and aquatic weed management. Fish diseases each year cause the loss of millions of dollars throughout the entire catfish industry. Poor water quality in many cases leads to disease problems if not corrected. Proper pond management is required to prevent aquatic weed problems both in aquaculture and recreational ponds. Providing diagnostic services for fish diseases, water quality and aquatic weeds management by the aquaculture program at FVSU fills important needs for producers to ensure their success in producing aquaculture crops. In addition to performing diagnostic services on a case-by-case basis, presentations and workshops on proper pond management techniques are given at various locations to educate farmers on best management practices to avoid problems and increase production and profitability.

Direction was given previously for the design plans for the new aquaculture facilities based on aquaculture research, education and extension goals. Five connected 35 by 120 foot greenhouses were erected along with the installation of fans and evaporative walls. Electrical wiring of the greenhouses has been recently initiated. Bids have been announced for plumbing and finishing the greenhouses along with building the ponds in the new aquaculture center. In the three aquaculture greenhouses located on campus, further modifications and improvements were made to existing systems. Six different types of aquaponic units have been set up to demonstrate the principles of aquaponics. Five types of recirculation aquaculture system (RAS) are available in three different

greenhouses with both monoculture and polyculture for visitors to examine.

Eight articles were written about various aquaculture topics for the FVSU Aquaculture News newsletter and over 1,400 newsletters were distributed. Four news releases about aquaculture workshops were prepared and distributed plus an announcement of the organic aquaculture workshop was displayed on the Georgia Department of Agriculture Banner webpage in August. Two different television interviews about the aquaculture program appeared on state Fox and NBC affiliates during 2006. An article on the aquaculture program at FVSU was published in the Macon Telegraph in conjunction with interviews and photos taken following the workshop on water quality and fish health maintenance. An article on the aquaculture program and organic aquaculture meeting was published in the Georgia Organic newsletter. An article on RAS and the FVSU aquaculture program written by AP reporter Elliott Minor has been carried to date in over 40 newspapers throughout the country, the UK and Australia. Articles on the FVSU aquaculture program also appeared in papers in Panama, Vietnam and the Virgin Islands. An article on global aquaculture was included in the Georgia Aquaculture Association newsletter. An abstract reporting on the culture of marine shrimp in low salinity waters in RAS was accepted for presentation at the upcoming annual World Aquaculture Society meeting. An article on aquaculture using limited resources has been submitted to Minority Landowner magazine. Two concept papers were written on means to enhance aquaculture education, extension and research at FVSU.

In 2006 six aquaculture workshops were held at the GCAD at FVSU. A workshop on water quality and fish health maintenance was held in March. In July “Introduction to Small Scale Recirculation Aquaculture Systems” was held, plus a visit to the greenhouses where a number of different RAS were in operation. Over 82 participants gathered at FVSU for a workshop on organic aquaculture and vermicomposting held from Aug. 24-25 which was sponsored by the FVSU GCAD and Georgia Organics. Participants learned about organic aquaculture regulations, vermiculture, community farming systems, marketing and toured the aquaculture RAS and aquaponic facilities. In September, “Fish Nutrition, Feeds and Health Management” was scheduled plus in November “Opportunities in Aquaculture” was held. This workshop presented a variety of different speakers on important topics including financial aid information, RAS management, and commercial catfish culture.

A work in progress is the creation of an international online university, Enoch Olinga College of Intercultural Studies, in which aquaculture studies will play an important role. Informational talks and demonstrations about various aquaculture topics were given at 16 field days, seminars and conferences in Georgia and outside the state involving over 1,847 clients. Presentations were given at two Team Agriculture Georgia meetings, Plains Field Day, UGA agent training and Winter School, the annual Farm Bureau commodity and Georgia Aquaculture Association meetings in addition to others. Assistance was given to the Tri-State Aquaculture Committee at the Sunbelt Agricultural Expo where a great deal of information on catfish, prawn and other aquaculture inquiries was transmitted during the week to over 10,000 individuals. Personal responses were provided to over 340 individual requests for technical information about aquaculture production, including disease, water quality and system production issues. Tours of the aquaculture facilities were given to over 1,020 visitors to FVSU from kindergartners to elementary and high school students to producers and senior citizens from various areas in Georgia. Over 2,746 Georgians received aquaculture information or training on aquaculture through personal contact, visits to the center, center workshops, or presentations.

Breeding populations of three species and hybrids of tilapia were developed and increased in three greenhouses. All male Tilapia honorum populations were maintained and increased to provide demonstration and experimental stock for crossing with T. mossambica to produce all male progeny. A growing population of hybrid red tilapia was maintained to demonstrate growth in different RAS and increased marketability and profitability. Spawning and rearing of all species of tilapia from egg to adult were demonstrated in aquaria, tanks, and RAS and were made available for producers and tours during visits and workshops.

Koi carp broodstock continued to grow well in different RAS in 2006 and will be large and old enough for successful breeding in 2007. Koi fry and fingerlings should be available in 2007. Emphasis on aquaponics continued. Aquaponics presentations were given as part of numerous talks and demonstrations on campus and throughout the state. A variety of herbs were grown in six different aquaponic systems representing four different types of aquaponic systems. Aquaponic systems included floating bed, ebb and flow, NFT gully and a vertical aeroponic system. Different herb species were evaluated with the use of tilapia RAS wastes as the sole nutrient sources in the aquaponic units.

Of the herbs demonstrated in aquaponic units, positive results were obtained with lemon grass, Spanish oregano, sweet basil, oregano, rosemary, mint, spearmint, peppermint, catnip, chives, marjoram, and tarragon. Vermiculture work was begun using the excess aquatic macrophytes grown throughout the greenhouses as food for the worms. Worms are then fed to the tilapia, catfish and koi. Selected channel catfish and tilapia reared to harvest size in RAS which have demonstrated optimum growth, improved survival to low dissolved oxygen, and disease resistance were chosen as broodstock to begin development for RAS, raceway and cage culture of select channel catfish and tilapia strains. Additional channel catfish egg masses were hatched and reared this season to add to the stocks of catfish available at GCAD. These catfish continue to be reared and selected for optimum growth.

Work began with rearing freshwater prawns, Macro brachium rosenbergi in RAS and with aquatic macrophytes. Post-larval freshwater prawns were stocked in RAS for grow out in different types of substrates. The different types of substrates were evaluated to prevent predation and improve survival. Trials are ongoing. A shrimp pathology and disease short course at the University of Arizona was attended during December. Information gained from this course will increase center capacities for disease diagnostics for marine shrimp farmers. Information and collaborative relationships were also set up for future research planned with shrimp disease challenges necessary for immunostimulant research.

Research proposals and ongoing collaboration for research with Bioagra and the Georgia Agriculture Center for Innovation have been conducted over the past year. Research plans are underway for feeding studies with Bioagra's Agrastim®, a ß-glucan product which has potential to enhance disease resistance in fish and shrimp. Methods of feeding immunostimulants will be demonstrated for producers as a means to eliminate the use of antibiotics and chemicals to make their aquaculture products marketable for a more premium price.

b The impact of the aquaculture program at FVSU continues to increase over time. GCAD provides information to citizens throughout the state. The base of clients now routinely served by the aquaculture program by workshops, newsletters, and other mailings has more than tripled in number since the initiation of the center.

The impact of the GCAD greenhouses with the different RAS fish species, shrimp, and prawns on Georgia citizens has been great. The ability to youth to have hands-on experience with fish, prawns, and to see the RAS production systems as an alternate enterprise is an eye-opening experience. Since many of our youth tours are members of minority groups it has been an important impact for students to get hands-on exposure to what shrimp look like before they appear on the plate in addition to alternative job opportunities to consider. For those considering aquaculture businesses, exposure to the different types of RAS allows them good learning opportunities along with the ability to make wise choices about their future enterprises. To date over 2,370 Georgians have toured the GCAD facilities.

Our workshops and extension assistance is making an impact on start up aquaculture enterprises. One local aquaponics producer is producing plants and fish after attending our workshops and receiving assistance and initial tilapia broodstock from us. Three other RAS producers receiving assistance are very near initiation of their businesses. Three vermiculture operations have gone online after attending our organic aquaculture and vermiculture workshop. Four other different aquaculture producers have made great progress in initializing their aquaculture enterprises with the assistance of the GCAD.

An area youth is in the process of starting an aquaculture youth loan program with the USDA FSA with our assistance. One undergraduate student has worked with the aquaculture program for over two years and has now graduated with a degree in agriculture education where he will be using his aquaculture training he received with the program. We assisted with the Women's League of Marshallville obtaining a free greenhouse from the Forestry Department for community development of an aquaponics program.

c NARETPA, State Matching Funds, Smith Lever, Hatch Act, state matching funds

d Multi-state Integrated Extension and Research: VA, DE, NC, WV, KT, AK, FL

- Goal 1-9

Aflatoxin contamination impact

Sub-keys: Adding Value to New and Old Ag Products, Agricultural Profitability

a Aflatoxin is a potent carcinogen and toxin that occasionally finds its way into our food supply. Aflatoxin contamination of peanut occurs when the fungi infect peanut kernels under drought stress prior to harvest. It is well known aflatoxin contamination is not uniformly distributed within peanut fields. It is also well known areas within a field prone to drought stress are at higher risk for aflatoxin contamination. Despite this knowledge, there is no suitable method for identifying and delineating high risk areas. Identifying high-risk areas would allow producers to harvest these areas separately and eliminate the potential of mixing aflatoxin-contaminated peanuts with the remainder of the crop.

We initiated a project to evaluate remote sensing as a technique for easily identifying drought-stressed areas in a peanut field. To do this we used tractor-mounted and airborne multispectral cameras in a 30-acre rain-fed peanut field to create multispectral images of the crop at critical times during the growing season. Multispectral images capture the crop's reflectance at specific wavelengths. Measured reflectance was analyzed mathematically to identify areas of drought stress. To verify these findings, we also instrumented the field with soil and temperature sensors. During harvest, we collected peanut samples at regular intervals throughout the field and analyzed them for aflatoxin concentrations.

b The multispectral images were successfully used to identify areas of drought stress in the field. Drought stress was verified by the moisture and temperature sensors. Because the 2006 growing season was very dry, aflatoxin concentrations in peanut kernels were high in drought-stressed areas. Our techniques show great promise as a tool for producers to identify and segregate areas at high risk for aflatoxin contamination. Segregation of high-risk areas can save the producer money as well as improve the safety of our food supply. The technique will be evaluated over several fields during 2007.

c Hatch Act, state matching funds

d State Specific

- Goal 1-2

Peanut response to late-season glyphosate applications

a While these herbicides are effective, Classic can increase the incidence of peanut injury from the spotted wilt virus, Basagran provides only topical control of weeds with no residual activity, and 2, 4-DB drift can severely damage cotton. These concerns often force growers to choose between how much of crop loss they are willing to accept with respect to investment in weed control verses other major cropping issues. Additionally there continues to be an increase in the number of miss-application of glyphosate to peanut by either tank contamination or glyphosate accidentally put into a spray tank when it is confused for crop oil. Growers are then left with the dilemma as to how much yield loss can occur and if they should continue to apply other inputs such as fungicides to injured peanut. Peanut tolerance to glyphosate (Roundup) varies with the stage of growth and development. Previous research indicates that when applied in low doses, peanut recovered rapidly and yield was not affected by glyphosate. Glyphosate as a late season post emergence herbicide could offer growers weed control options for Florida beggarweed and sickle pod as these two species are very sensitive. Additionally, by using glyphosate, growers could eliminate some of the disease and management issues currently encountered with chlorimuron and 2, 4-DB. Additionally, glyphosate provides broad-spectrum control of many weeds. However, peanut research data, with respect to tolerance, yield, and quality, does not exist for mid to late season applications of glyphosate.

Field studies were used to determine peanut response to glyphosate applied at 75, 90, and 105 days after planting at Plains and Tifton, GA. Rates evaluated included 2, 4, 6, 8, and 12 oz. of Roundup Original-max. Data indicated that peanut was tolerant to glyphosate at low doses early in the season and actually had increased yields at 2 oz. per acre. At 75 days after planting, peanut was very susceptible to glyphosate at rates of 6 oz. and greater. At 90 and 105 days after planting peanut was tolerant to glyphosate to rates of 6 oz. or less per acre. Injury to peanut included leaf drop, chlorosis, and some stand loss at rates of 8 and 12 oz. per acre. Peanut seed weights were reduced linearly.

b Farmers now have a better understanding if there is an accidental application of Roundup Weather-max to their peanut field via tank contamination. As a control option for Florida beggarweed, this treatment could potentially be used 105 days after planting. But this needs to be further evaluated.

c Smith Lever, Hatch Act, state matching funds

d Integrated Extension and Research

- Goal 1-3 and Goal 1-2

  Integrated livestock crop systems

  Sub-keys: Agricultural Profitability, Animal Health, Animal Production Efficiency, Grazing

  a Integrated livestock-crop systems are essential to sustainable production systems. Assisting landowners to have access to the latest trends, research activities, production practices, and new systems is a key in their success.

  For small ruminants, an updated newsletter was issued. A chapter was written for web-based training and certification program for goat farmers. PowerPoint presentations were developed on small ruminant enterprise planning and foundations for success. An in-service training day was held with a focus on live and carcass evaluation of lambs and market goats. Take-home messages were prepared for field day audiences.

  To address the need for cattle production information, a one-day short course was held at the Southwest Research and Education Center in Plains. The program included a variety of seminars related to nutrition, planning budgets, health, and marketing of beef cattle. Speakers consisted of faculty from UGA, Clemson University, and the State Department of Agriculture. In addition, representatives from pharmaceutical, livestock equipment, animal breeding, and feed companies provided a trade show and sponsored the program to reduce costs for program participants. A proceedings book was developed by the speakers that included each speaker's presentation, and various extension publications related to the program topics.

  b Success rate in new meat goat and commercial lamb enterprises has been improved because of better planning and resource assessment. Clients who are already engaged in livestock enterprises are able to easily access information to assist in problem solving.

  Many participants who attended the Beef Cattle Short Course indicated they learned of a new management strategy that can be implemented on their farms to increase profitability.

  c NARETPA, Smith Lever, state matching funds

  d Multi-State Extension: UT, SC

- Goal 1-6

  Poultry competitiveness

  Sub-keys: Agricultural Profitability

  a Georgia currently has over 12,000 poultry houses in operation. To be competitive, poultry producers must use the best available technologies and management programs to achieve energy efficiency. The proper operation of ventilation and cooling systems is particularly critical in Georgia due to the severe summer climates. Extension poultry science faculty and agricultural engineering faculty are providing research and educational programs related to energy-efficient use of ventilation and heating systems for poultry operations. Ventilation workshops are conducted on a regular basis for poultry company personnel. Research projects have resulted in numerous scientific and industry publications on this subject.

  b As a result of this program, poultry producers are able to meet or exceed industry standards for fuel and energy usage in production houses. In addition, production complexes in Georgia rank high in bird performances during summer and winter production seasons.

  c Smith Lever, state matching funds

  d State Specific

- Goal 1-2

  Calhoun heifer evaluation and reproductive development program

  Sub-keys: Agricultural Profitability, Animal Production Efficiency

  a Selecting a good bull is a critical component of a profitable cow/calf business. The majority of cow/calf producers use replacement heifers raised on their own farms to replenish their herd. Therefore, bulls are the only source of new genetics entering the herd. Producers need a reliable scientific basis for selecting genetically superior bulls. In addition, carcass traits are becoming increasingly important in determining the value of cattle at slaughter. Producers need a means of selecting bulls that not only

have excellent growth performance but will produce offspring that will excel in carcass traits.

A total of 184 bulls were evaluated in the 48th year of the Tifton Bull Test. Bulls were evaluated for growth performance in a 112-day gain test. Additionally, researchers used ultrasound to test for carcass traits. Bulls were framed scored, had scrotal circumference measurements taken, semen tested, and were screened for structural and disposition problems. Bulls were eligible for the sale if their weight per day of age plus test average daily gain index was in the top two-thirds within each breed on test.

b The Tifton Bull Test has long been recognized as one of the most respected test stations in the U.S. This year's program resulted in both the second highest daily gain (4.57 lb/day) and the second highest sale average ($2,400) on record. The program has given both buyers and breeders the ability to record differences in the ability of bulls to gain in a uniform environment. The value of performance records and of a complete health program has been demonstrated to many producers. Cow/calf producers in Georgia as well as surrounding states have been able to improve their herd's genetics and profitability by buying genetically superior bulls at the test station sales.

c Smith Lever, state matching funds
d State Specific

- Goal 1-4

Increasing conservation tillage knowledge benefits Georgia

a Producer interest in conservation tillage has increased in the last few years due to the desire for more production efficiency and a general awareness to improve stewardship of land and resources. Unfortunately, no faculty is directly responsible for educational programs or training in conservation tillage systems for UGA. County extension faculty has lacked consistent and intensive educational opportunities to prepare them to serve this growing need.

A multi-discipline educational task force was created to develop a comprehensive training program which included in-field and class room training sessions. Faculty members developed a training plan, timetable and funding request to cover cost of materials. The task force chose an 18-month timeline with four phases: investigative - identifying key individuals to help train, identify gaps or inconsistencies in the knowledge base, and conduct county agent needs assessment survey; development - create the training materials; training - conduct fall and spring two-day sessions both in the field and classroom; and implementation - evaluate and demonstrate the impact of the training.

b A comparison of pre- and post-test knowledge test data confirmed participants significantly improved their knowledge related to conservation tillage. As a result, 77% of the agents and participants improved their overall knowledge of conservation tillage; 54% overall increased their confidence in delivering information to growers on conservation tillage; 75% who had never held an educational program in conservation tillage increased their confidence to conduct new programs; 36% said they intend to hold an informational program on conservation tillage systems for their clients, help at least three farmers adopt new practices in the next 12 months; 95% of participants said that the overall program was good or excellent; and 98% indicated the program was an excellent learning experience and recommended the training to other agents.

c Smith Lever, state matching funds
d State Specific

- Goal 1-16

Developing best management practices for organic blueberries

Sub-keys: Agricultural Profitability, Plant Health

a Non-indigenous fruit crops such as peaches, apples, and strawberries have limited potential for commercial organic production in the southern U.S. due to the substantial pest pressures associated with the long growing season and the warm, humid climate. In contrast, rabbiteye blueberries, which comprise a large majority of the blueberry acreage in the South, are native to the region and are well-adapted to its challenging climate, poor soils, and extensive pest complexes. In the last few years, about 100 acres of organic or organic transition blueberries have been established in Georgia, and several factors indicate considerable near-term potential for expansion throughout the region:

increased consumer demand associated with the widely publicized health benefits of blueberry fruit; the need for alternative sources of income for small and medium-sized farms in a region where traditional cash crops have become unprofitable; higher wholesale prices (30-100%) for organic produce; and interest in organic blueberries by three major marketing organizations in Georgia and Florida. If some key production limitations can be solved and important knowledge gaps filled, organic blueberry production will become a significant part of the Georgia industry and an expanding segment of the Florida industry.

In collaboration with colleagues from the University of Florida, an interdisciplinary proposal was prepared and submitted to the USDA's Integrated Organic Program. The overall goal of this project is to develop best management practices and economic cost analyses for organic blueberry production in the southeastern U.S. Specific objectives are to: 1) evaluate establishment methods for organic blueberry plantings using locally available organic mulches or plasticulture for weed control under varied weed populations; 2) develop fertilizer regimes utilizing materials approved by the Organic Materials Review Institute (OMRI) and pose no microbiological food safety hazard; 3) formulate strategies for organic management of key pests in bearing blueberry plantings; and 4) conduct economic analyses and develop risk-rated enterprise budgets for organic blueberries. Diverse outreach mechanisms associated with the objectives will achieve efficient technology transfer to producers and other stakeholders.

b The proposal was fully funded in the spring of 2006 at a level of $357,351, with UGA receiving $114,763. We have begun to work closely with blueberry producers, county agents, and Georgia Organics (a non-profit educational organization) to assist growers via on-farm research projects, meetings, field days, and publications. The first results on management of mummy berry disease and flea beetles with OMRI-approved biopesticides have been obtained in field trials during the 2006 season. A long-term mulching, weed control and nutritional experiment has been initiated at the Bacon County blueberry research farm in late fall of 2006. Results from these trials will enable us to develop a comprehensive package of best management practices and enterprise cost analyses aimed at determining the financial viability of organic blueberries in the Southeast.

c Smith Lever, Hatch Act, state matching funds

d Multi-State Integrated Extension and Research: FL

- Goal 1-12

Evaluation of computer models for simulating crop growth, development and yield and irrigation water use

Sub-keys: Agricultural Profitability, Plant Health, Precision Agriculture

a Computer simulation models provide a more advanced approach to the integration of research results and application in decision support systems for alternate management options development. The key to the success of these models is evaluation with experimental and on-farm data to establish credibility, especially for local users such as county agents, farmers and others in agribusiness. Once the models have been tested, they can be applied towards developing responses to various management scenarios, ultimately resulting in an increase in net returns for the farmer and a reduction in natural resource use.

During the 2004 and 2005 growing seasons, experiments for cotton and new peanut varieties including Georgia Green were conducted at the Stripling Irrigation Research Park in Camilla, GA. At the same time, six farmers' fields in southwest Georgia were monitored. Crop growth and development variables were collected every two weeks. Yield and yield components were collected at final harvest. Farmers' monthly irrigation applications for cotton during the 2002 and 2003 growing seasons were obtained from selected sites of the agricultural water pumping program. These data were used to evaluate the performance of the Cropping System Model (CSM) CROPGRO-Peanut and a new cotton model that are part of the Decision Support System for Agrotechnology Transfer (DSSAT).

b The CSM-CROPGRO-Peanut model simulated growth, development, and yield of Georgia Green very well for farmers' fields and an experimental station in southwest Georgia. Simulated values for all plant components at different developmental stages agreed reasonably well with the observed values. Similarly, the new cotton model simulated biomass accumulation for leaves, stems and bolls in good agreement with observed data. The model simulated cotton yields very well. During a dry year, individual differences among farmers on how much water they applied contributed to the deviation between the simulated and observed irrigation. The on-farm evaluation demonstrated the potential of

using a crop model combined with geostatistical techniques for estimating regional water use for any given year and, ultimately, to forecast regional irrigation water demand. Potential users of this decision support system include policy makers, planners, county agents, and farmers.

c Hatch Act, state matching funds
d State Specific

- Goal 1-12

Irrigation decision support tool

Sub-keys: Agricultural Profitability, Plant Health, Precision Agriculture

a Crop yields in the southeastern U.S. are impacted by El Niño-Southern Oscillation (ENSO) events, and the magnitude of yield response varies depending on the ENSO phase. Peanut is a major crop grown under rain fed and irrigated conditions in the Southeast. From 1997 to 2002, the total peanut farm acreage under irrigation in the region increased from 159,495 to 201,575 acres. Available climate information can be used by growers to assess different scenarios and alternative management strategies. Irrigation systems provide farmers with an option to provide supplemental water to crops during dry conditions and to minimize some of the effects of temporal rainfall variability in the region. The goal of this study was to develop a climate-based irrigation decision support tool that will provide information to growers on the levels of profitability of peanut production with and without irrigation under different climate forecasts.

The CSM-CROPGRO-Peanut model was used to simulate peanut yields under irrigated and non-irrigated conditions from 1900-2004 for several peanut-producing counties in Alabama (22), Florida (12) and Georgia (18). The soil profile data of three representative soils for each county were obtained and used in the simulation. Eight plantings were considered in the simulation. The decision support system provides the probabilities of achieving net returns for different planting dates and soil types for main peanut-producing counties in the Southeast under different climate scenarios and also provides probability distributions of the seasonal cost to irrigate peanuts and the amount of water required.

b An example case study for Miller County, one of 18 Georgia peanut-producing counties, showed under irrigated conditions, average net returns increased when peanuts were planted between April 16 and June 5 in El Niño years. In La Niña years, the net returns followed a decreasing trend as planting was delayed. Non-irrigated peanuts were not profitable in El Niño years for most planting dates because of low yields. In La Niña years, dry land peanut production was only profitable when peanuts were planted between April 16 and May 8. The tool will be demonstrated to stakeholders consisting mainly of county Extension agents and growers. After further testing and evaluation, the irrigation decision support tool will be deployed as a web-based decision aid on the AgClimate website (www.AgClimate.org).

c Hatch Act, state matching funds
d State Specific

- Goal 1-12

Dew point temperature prediction using artificial neural networks

Sub-keys: Agricultural Profitability, Plant Health, Precision Agriculture

a Dew point temperature is the temperature at which water vapor in the air will condense into liquid. This temperature can be useful in estimating frost, fog, rain, snow, dew, evapotranspiration, and other meteorological variables. Dew point temperature is useful in the estimation of near-surface humidity which can affect the stomatal closure in plants and contributes to human and animal comfort levels.

Back propagation ANNs were developed to predict hourly dew point temperatures using real-time data from the AEMN system. Specific objectives included selection of the important weather related inputs, setting of ANN parameters, and selection of the duration of prior data. An iterative search found that in addition to dew point temperature, important weather related ANN inputs included relative humidity, solar radiation, air temperature, wind speed, and vapor pressure. The evaluation of the final models with weather data from 20 separate locations and a different year showed that the one-hour prediction had a mean absolute error (MAE) of 0.550 °C, the four-hour prediction model had a MAE of 1.234 °C, the eight-hour prediction had a MAE of 1.799 °C, and the 12-hour had a MAE of 2.280 °C. These final models adequately predicted on previously unseen weather data including difficult freeze and heat stress extremes.

b Dew point temperature models and air temperature models have been incorporated into the AEMN website. Users may select from over 70 locations to get a real-time prediction for the subsequent 12-hour period. These predictions can assist the decision-maker in determining when to protect a horticultural crop from frost damage or when to expect the possibility of heat stress in animals.

c Hatch Act, state matching funds

d State Specific

- Goal 1-11

Bioengineering root-knot nematode resistance in crops

Sub-keys Agricultural Profitability, Plant Germplasm, Plant Health

a Root-knot nematodes are among the world's most damaging agricultural pests, attacking nearly every food and fiber crop grown. The nematode invades plant roots, and by feeding on the roots' cells, they cause the roots to form large galls, damaging the crop and reducing yields. The most cost-effective and sustainable management tactic for preventing root-knot nematode damage to food and fiber crops and reducing growers losses is to develop resistant plants that prevent the nematode from feeding on the roots. However, only a limited number of crops are resistant to root-knot nematodes. Molecular breeding or the generation of genetically modified crops that show enhanced resistance to nematode infection will become an important strategy for managing plant-parasitic nematodes in the future.

The best prospect for identifying new targets for genetic engineering of nematode resistance in crops is identifying the molecular tools nematodes use to infect plants. We have discovered the parasitism genes that produce the secretions nematodes inject into plant cells during the infection process and enable the nematode to attack and feed on crops, ultimately reducing yields. We have genetically modified plants using a technique, called RNA interference, to silence a specific parasitism gene in the root-knot nematode when it feeds on the plant roots.

b We determined the parasitism gene studied was essential for root-knot nematode infection of crops. When root-knot nematodes attacked the genetically modified plants the parasitism gene was silenced, preventing the nematode from feeding on the roots. The silencing of the root-knot nematode parasitism gene by RNA interference made the plant resistant to the four common root-knot nematode species. These four species account for 95 percent of all root-knot nematode infestations in agricultural land. No natural root-knot resistance gene has this effective range of root-knot nematode resistance. Therefore, our results of in-plant RNA interference silencing of a parasitism gene in root-knot nematodes provides a way to develop crops with unprecedented universal resistance to this destructive pathogen. Equally important, our approach makes available a strategy for developing root-knot nematode-resistant crops for which natural resistance genes do not exist.

c Hatch Act, state matching funds

d State Specific

- Goal 1-4

Towards increased use of climate information and applications

a El Niño-Southern Oscillation is one of the most important determinants of inter-annual climate variability in different parts of the world. In Georgia and the Southeast, ENSO phases affect precipitation and temperatures in the fall, winter, and spring months and the frequency of hurricane landfalls and spin-off storms. Climate forecasts can be used to reduce risks faced by an agricultural enterprise, but simply providing better climate forecasts to potential users in not enough. Climate information only has value when there is a clearly defined benefit, once the content of the information is applied in the decision-making process. In an effort to integrate all aspects of applying seasonal climate forecasts to agriculture, the Southeast Climate Consortium (SECC) was formed as a research and extension partnership of six universities in Georgia, Alabama, and Florida. The overall goal of SECC is to apply ENSO-based forecasts to the development of decision support tools for agriculture, forestry, and water resource management. The land grant universities have the responsibility of developing a climate extension program in their respective state.

The SECC developed a web-based information system called AgClimate for timely delivery of climate and weather information to farmers and producers. Information available in AgClimate includes climate forecasts combined with risk management tools and information for selected crops, forestry, pasture, and livestock. The system was developed to allow easy expansion of the topic areas, number of commodities, and risk management tools available for users. In addition, extension agents, growers,

forest managers, crop consultants, and policy makers may use this decision support system to develop appropriate management strategies in response to climate forecasts. Adaptations include those that might mitigate potential losses as well as maximize yields. The responsibilities of the climate extension program are to disseminate climate-based information and develop decision support tools based on input from various stakeholders.

b We conducted a workshop on AgClimate decision support tools for county agents as part of a program to increase awareness on the use of climate information and climate-based tools available. We will continue to conduct AgClimate trainings to agents in different county districts. We have also been involved in various agent trainings and county meetings and working with commodity specialists in emphasizing the importance of climate forecasts. Climate and commodity outlooks were developed in close collaboration with different SECC members and UGA research and extension faculty. These outlooks were disseminated in various media forms and outlets to stakeholders including county agents and growers. A significant outcome is the increased visibility of the climate extension program as a result of extension specialists and county agents developing their recommendations (e.g. peanut, cotton, turfgrass management) based on the impacts of climate forecasts.

c Smith Lever, Hatch Act, state matching funds
d Multi-State Integrated Research and Extension: FL, AL

- Goal 1-10

Evaluation of wildfire forecasts for forest management

a Georgia and Florida combined have 40 million acres of forests worth approximately $20 billion and employing nearly 200,000. Most forest holdings are private ownerships. In a typical year some 100,000 acres are burned. During the first half of 2006, more than 200,000 acres burned in Florida and Georgia. Forest managers estimated the number of wildfires in Georgia to be about three times greater than normal during La Niña. Studies have shown a connection between the El Niño Southern Oscillation and the potential for wildfire activity in the southern coastal plain of Georgia. This connection lends a degree of predictability to wildfire threat based on current climate conditions, although other factors, such as fuel load and human intervention, can also play a role.

Forest managers normally use the Keech-Byram Drought Index (KDBI) to determine the risk of wildfires. An ENSO-based KBDI wildfire forecast was developed by UGA and others partners of the Southeast Climate Consortium and was implemented on www.agclimate.org. In May and June 2006, an assessment was conducted to obtain stakeholders' feedback on the product and to understand current and potential uses of the forecast. The assessment was based on phone interviews with representatives of federal and state agencies, producer and industry organization, environmental organizations, and forest managers at the local level. In most cases respondents were asked to access the AgClimate website during the interviews and comment on the presentation of the KBDI tool.

b Although few district and county levels were aware of the KBDI forecast, most judged it to be very useful, informative, and easy to interpret. Among the features stakeholders appreciated most are: its map format, its greater spatial variation compared to other tools; the provision of ranges of values and of trends overtime. Stakeholders' recommendations for improvement included: conducting an outreach campaign targeted to key stakeholders to create product awareness and its potential applications; producing and disseminating a monthly outlook to relevant stakeholders; refining the tool's visual presentation; adding tutorials, help functions, and a method section; monitoring and periodically reporting on forecast accuracy; and increasing spatial resolution. SECC scientists and extension specialists are actively working to address these recommendations. The assessment also suggested that economic estimates of the forecast based on timber values alone fail to account for the wealth of material resources and environmental services produced by healthy forests and grasslands.

c Smith Lever, Hatch Act, state matching funds
d Integrated Extension and Research

- Goal 1-2

Homeowner IPM plant disease clinic

Sub-keys: Agricultural Profitability, Plant Health

a Homeowners spend an extensive amount of time and money on their home landscapes, gardens, and orchards. The hot, humid weather in Georgia makes the state an ideal environment for the

establishment and progression of plant diseases. Homeowners acknowledge the risks and issues associated with pesticide use but still want attractive, vigorous landscapes. Disease management utilizing an Integrated Pest Management (IPM) approach relies less on the application and use of fungicides and more on cultural practices and/or environmental manipulation.

The Homeowner IPM Plant Disease Clinic offers diagnostic support for plant disease related problems in home and urban landscapes across Georgia. The clinic is an integral part of the plant pathology Extension program at UGA. The diagnostic lab processes approximately 1,000 homeowner samples a year. Recommendations given to the homeowners are individualized based on the biology of the pathogen involved and the plant life cycle. We focus on a variety of cultural and environmental options that can be implemented to manage the disease and oftentimes can avoid fungicide recommendations altogether. With the increased use of the Distance Diagnostics through Digital Imaging (DDDI) system in each county throughout the state, we can provide a more timely response to the county agents and therefore the homeowner. Web-based materials, such as a monthly Homeowner Diagnostic Report and published articles on various plant pathology-related subjects, are also available on our departmental webpage to provide additional information, which we hope will increase awareness to plant disease problems in our state.

b The Homeowner Plant Disease Clinic provides educational and diagnostic services to county agents in Georgia. They then interact with homeowners one-to-one to help increase homeowner awareness of integrated pest management options that can be utilized in the home and urban landscape, focusing on a minimal reliance and use of pesticides. An annual report summarizing the types of samples received in the clinic serves as a diagnostic tool for future plant disease problems in the state.

c Smith Lever, state matching funds

d State Specific

- **Goal 1-16 Improved management of vegetable diseases through seed health testing**

Sub-keys: Agricultural Profitability, Plant Health

a Georgia's $500 million vegetable industry is threatened each year by bacterial diseases that have great yield loss potential. This threat is exacerbated by the increasing trend of using greenhouse-grown transplants to improve production efficiency. Because growth conditions in transplant houses, including high plant populations, high relative humidity and overhead irrigation, are conducive to bacterial multiplication and spread, the threat posed by seedborne inoculum is significantly increased. Over the past 10 years many bacterial disease outbreaks in vegetables were initiated by infested seed lots. In the latest example, the 2006 season was plagued by multiple outbreaks of bacterial fruit blotch (BFB) of cucurbits in watermelon fields in six counties. While accurate yield loss estimates from these outbreaks are not available, it is clear that the primary inoculum source was infested seeds. Because BFB is not endemic in Georgia, and outbreaks are difficult to control, the most effective strategy for BFB management is exclusion of seedborne inoculum. This can be done by seed testing; however, the assays currently used by seed producers are expensive and lack requisite levels of sensitivity and specificity. Improving the tools used to detect and exclude contaminated seed lots could significantly reduce vegetable yield losses in Georgia.

For several years we have been developing rapid molecular tools for the diagnosis and detection of vegetable diseases. In response to the 2006 outbreaks, we used real-time polymerase chain reaction (PCR) to rapidly confirm the pathogen as Acidovorax avenae subsp. citrulli (Aac) and used DNA fingerprinting to aid the process of tracking the source of the outbreaks. We also developed an immunomagnetic separation and real-time PCR (IMS-PCR) assay for the detection of phytopathogenic bacteria in seeds. This technique is faster and more sensitive than the current industry standard for BFB. To aid technology transfer, we trained representatives of seven major vegetable seed testing and seed producing companies to conduct IMS-PCR. Additionally, we worked closely with Envirologix Inc., a diagnostics supply company, to develop and evaluate a commercial source of antibody-coated immunomagnetic beads required for IMS-PCR. This goal of this collaboration was to expedite the widespread adoption of this new technology. In an experiment involving nine independent laboratories, we demonstrated that IMS-PCR was easy to adapt and outperformed the standard BFB seed assay.

b The ability to rapidly confirm BFB in the 2006 epidemics and to track the source of the outbreak to a single transplant house, significantly helped growers and transplant producers to understanding the outbreak. Unfortunately, because this disease manifests itself at the end of the season, there was little

that could be done to save infected fruits. Nevertheless, the information provided will help to improve crop production strategies in subsequent seasons. Additionally, in contrast to the conventional BFB seed assay that requires 18-21 days for completion, IMS-PCR is faster and cheaper. It is expected that IMS-PCR will allow seed producers to conduct a more thorough inspection of their lots prior to sale. This should significantly reduce BFB outbreaks in Georgia.

c Hatch Act, state matching funds

d State Specific

- Goal 1-2

Management of Asian soybean rust in Georgia through monitoring and fungicide studies

Sub-keys: Agricultural Profitability, Plant Health

a Asian soybean rust, caused by the fungal pathogen Phakopsora pachyrhizi, is one of the most important and devastating diseases of soybean in the world today. Currently, no soybean varieties are resistant to the disease, and yield losses can be devastating to growers. The disease can be effectively managed with fungicides; however, fungicides add to the cost of production. Prior to 2004, Asian soybean rust was unknown in the U.S.; however American growers had been repeatedly warned the arrival of the disease was imminent. In November 2004, Asian soybean rust (SBR) was found in Louisiana, and a week later in Georgia. The detection of SBR in the U.S. set off a cascade of alarms and concerns for the protection of the domestic soybean crop. Reports of greater than 50% yield losses in unprotected fields in Brazil added to the anxiety of American growers. Soybeans are produced on a limited basis in Georgia today (150,000 acres in 2006); however SBR could be very devastating if not properly managed. Also, because of our geographical location, detection and study of SBR in Georgia is likely of great value to the rest of the U.S. Results from fungicide trials conducted in Georgia in 2005 documented that Asian soybean rust can indeed cause significant yield losses in fields not protected with appropriate fungicides. However, much additional data is required to provide our growers with recommendations not only for the best fungicides to use to manage this disease, but also the optimum timing for these applications.

Researchers, Extension specialists, and county agents at UGA searched the state for patches of kudzu that survived winter freezes and potentially harbored pustules of P. pachyrhizi. Prior to the winter of 2005-2006, it was believed that Asian soybean rust would have to be reintroduced annually to the state as the fungal pathogen cannot survive without a living host. Kudzu typically dies back in the winter with the advent of freezing temperatures, thus depriving the pathogen of a suitable over-wintering host. Scouting throughout Georgia in early 2006 documented not only the survival of kudzu in isolated protected pockets in southern Georgia, but also that Asian soybean rust successfully over-wintered in Miller, Thomas, Grady, and Brooks counties. Such information has tremendous implications for the early spread of the disease into the state and beyond.

In 2006, 25 SBR sentinel plots were established throughout the state with a grant of $79,500 from the USDA to monitor the spread of this disease. Asian soybean rust was eventually identified in 15 counties in the state. The sentinel plots provided an early-warning alarm for the producers in the state and the nation as the disease began to spread.

Fungicide trials were established in Tift, Colquitt, and Decatur counties to assess the efficacy of fungicides either currently labeled for the control of SBR or for fungicides expected to receive registration from the EPA soon. Because SBR is so new, data pertaining to the management of this disease with fungicides is lacking and is of tremendous interest around the country. In the fungicide trials where rust did become established, proper use of fungicides increased yields by as much as 50% over the untreated control. Results from fungicide trials also documented that waiting to apply fungicides when the disease is apparent will not likely provide sufficient control of the disease and will not boost yields to levels much above the unsprayed control. However, early applications near full bloom may provide yield increases even though the disease may not affect the crop for weeks.

b Results from the study of Asian soybean rust in 2006 have provided many results not only of importance to growers in Georgia but also to soybean growers across the country. First, it is now known with certainty that Asian soybean rust can over winter successful as far north as Miller County, GA. Second, from the data collected from fungicide trials, our growers now have a much better understanding of the efficacy of fungicides available for use to manage SBR. Specifically, tetraconazole, tebuconazole, and triazole fungicides mixed with pyraclostrobin appear to provide the

best control of SBR in our state. More importantly, it is now very clear that SBR cannot be treated like other crop diseases where effective control can still be maintained if fungicides applications are initiated at first appearance of disease. In our studies, growers who would have waited to begin fungicide applications until low levels of disease were detected in the field would have missed the opportunity to adequately protect their yields. Finally, data collected from within Georgia in 2005 and 2006 has been incorporated into a new Extension publication, "Soybean rust management in the mid-Atlantic region."

c Smith Lever, Hatch Act, state matching funds

d Integrated Extension and Research

- Goal 1-12

Biofumigation using mustard to manage tobacco black shank

Sub-keys: Agricultural Profitability, Plant Health

a The causal agent of tobacco black shank (Phytophthora parasitica var. nicotianae) is a serious and persistent soil-borne disease of tobacco. The use of new resistant cultivars of tobacco having the Ph gene has resulted in a shift of race structure from race 0 to race 1 of the pathogen. No commercially acceptable resistance is available for race 1. Without cultivar resistance, growers are left with only expensive chemical treatments and inadequate agronomic techniques such as rotation, and sanitation.

Brassica Spp. has been documented to produce chemicals known as glucosinolates. Glucosinolates degrade to form methylisothiocyanate (MITC), which are lethal to many soil-borne pests. MITC is also the active ingredients produced by the degradation of metam sodium, a commercial agricultural fumigant. Over the past two years, we have investigated the impact of growing a fall cover crop of Florida Broadleaf mustard in a disease nursery heavily infested with both race 0 and race 1 of the pathogen P. parasitica var. nicotianae. A fall cover crop of mustard destroyed just prior to transplanting tobacco in the spring has significantly reduced tobacco black shank and increased yields. The most significant reductions in disease and increases in yield have occurred where a fall cover crop of mustard was incorporated and the fungicide mefenoxam was applied in a split application at planting and at lay-by when compared to the standard rye or wheat fall cover crop.

b The use of a mustard fall cover crop significantly reduced disease and increased yield on a black shank susceptible tobacco cultivars. Although the greatest decrease in disease and increase in yield occurred where the mustard cover crop was used with mefenoxam, significant reductions in disease and increases in yield occurred with just the incorporation of the mustard cover crop. This data would suggest that Brassica Spp. cover crops may be used to reduce disease pressure from P. parasitica var. nicotianae over time and may reduce the dependence on expensive fungicides and potentially save growers hundreds of dollars in losses and cost of disease control.

c Hatch Act, state matching funds

d State Specific

- Goal 1-16

Molecular genetics of fungus-plant interactions

Sub-keys: Agricultural Profitability, Plant Health

a Fungi are the most economically important group of plant pathogens and are responsible for huge annual losses of marketable food and fiber. The smut fungi as a group constitute an important agricultural problem and, in some crops, can be responsible for local yield losses exceeding 25%. Corn is the most economically important crop in the U.S., generating $30 billion annually with approximately 80 million acres planted. In Georgia the corn crop was worth $84 million in 2005, with over 10% of the crop lost to diseases primarily fungal in origin.

Peanuts are another major crop in Georgia valued at $420 million in 2005. White mold (Sclerotium rolfsii) is the single most damaging fungal disease costing, Georgia growers about $39 million dollars in 2005.

A great deal of effort over the last 10 years or so has been focused on the understanding of how fungi cause diseases of both plants and animals. Most of this work has been accomplished using a few model organisms. Ustilago maydis, the corn smut pathogen, is one of these models. Molecular experimentation has elucidated some of the molecules required for fungal pathogenesis. Leveraging

the model systems like U. maydis, we have embarked on an exploration of molecular control of sclerotium development in the peanut white mold pathogen. This is a key survival structure in this pathogen and serves as the primary inoculum in the field. It is anticipated that over the next five to 10 years a better understanding of the disease process will yield significant developments toward novel disease control methods.

b Our group has identified a number of pathogen genes required for the completion of the disease cycle of U. maydis on corn. Some of these genes appear to be universally important in disease development of all fungal diseases. We were involved in supporting a public effort to sequence the genome of this fungal pathogen. We are also involved in studying the plant's reaction to infection by U. maydis and have identified a number of genes expressed specifically in the interaction. Through collaboration with Syngenta we will analyze several maize mutants modified in genes differentially expressed in response to fungal infection. With regards to our peanut-white mold project we have identified a number of genes potentially differentially expressed in sclerotia. We are quite early in the analysis of these genes. Work on the genome of U. maydis has led to a 2006 publication in the prestigious journal Nature. Based on our results, new methods of disease control will likely be suggested in the long-term.

c Hatch Act, state matching funds
d Multi-State Research: KY, Mexico

▪ Goal 1-12

Overcoming DMI fungicide-insensitive Monilinia fructicola populations through use of increased rates of fenbuconazole (Indar) and a 24C state specific label for Georgia

Sub-keys: Agricultural Profitability, Plant Health

a Brown rot, caused by Monilinia fructicola, is a pre- and post-harvest problem of peaches in Georgia and the entire Southeast. Disease incidence and severity vary from year to year, based largely on environmental conditions that impact initial and secondary infections. In many years, the disease can have a devastating impact in the field or during post-harvest transit and storage. Currently, very few classes of fungicidal chemistries are available for control of brown rot. Demethylation inhibitors (DMIs) and respiration inhibitors compose the primary fungicidal classes that control brown rot. Over the past 3-4 years, a resistance shift has been documented for the DMI fungicides in populations of M. fructicola from Georgia. This shift could result in the widespread failure of current brown rot control programs that rely heavily on the DMIs for pre-harvest disease control.

DMI resistance can be overcome by simply increasing the rates of DMI fungicides to a level which will control the pathogen. Rate increases are not generally possible, since tolerances are based on environmental and human health concerns, and the field rate is often established at the tolerance level. However, based on interaction with industry contacts, it was determined that fenbuconazole (Indar) tolerances were actually much higher than current established rates, allowing for a possible rate increase. In 2006, testing was conducted to determine whether a cost-effective, efficacious rate of fenbuconazole could be achieved with increased rates. In the presence of DMI-insensitive M. fructicola, a 2X rate of Indar provided disease control which was equivalent to that of the respiration-inhibitor fungicide (Pristine). As a result of this research, a 24C label has been approved for Georgia which will allow for a 2X application rate of fenbuconazole – essentially alleviating current DMI resistance in areas where it occurs.

b DMI resistance is widespread throughout the major peach production region of middle Georgia. In a wet year, the use of increased rates of fenbuconazole will allow for resistance management and excellent control of brown rot. Failure of control would often result in significant losses to the industry (over $10 million/year based on research trials), and the industry would cease to exist if this occurred on a regular basis. With this research-driven registration, we now have a resistance-management tool for rotation with respiration inhibitors, extending the useful life of both fungicide categories. Modified fungicide programs are now available and recommended to address the critical issue of fungicide resistance management and brown rot control.

c Smith Lever, state matching funds
d State Specific

▪ Goal 1-12

Development of biorational nematicides

Sub-keys: Agricultural Profitability, Plant Health

a Plant-parasitic nematodes are found in most agricultural soils and often cause crop damage and economic losses to growers. Few effective nematicides are available to growers due to health and environmental concerns. There is a critical need for additional nematode management options that use safer and more targeted compounds.

Fungi commonly inhabit soils and are known to produce a wide range of antibiotic compounds. Compounds derived from fungi are biologically-based and should prove more biorational than existing pesticide formulations. We have systematically collected fungal isolates from grower fields in Georgia. An emphasis was placed on identifying fungi common to soils identified as suppressive to plant-parasitic nematodes.

b Additional fungal isolates were discovered that produce nematicidal compounds. A group of fungal products that have already undergone extensive laboratory evaluations were tested for the first time in agricultural field trials. The eventual release of a new nematicidal compound, especially a more biorational product, would have a positive economic and environmental impact on agricultural production in Georgia.

c Hatch Act, state matching funds

d State Specific

- Goal 1-12

Control of Rhizoctonia in zoysiagrass

Sub-keys: Agricultural Profitability, Plant Health

a Zoysiagrass is used throughout Georgia as a turfgrass on golf courses, home lawns, and commercial properties. The disease Rhizoctonia large patch is a significant limiting factor in the production and maintenance of zoysiagrass throughout the state. All varieties of zoysiagrass are susceptible to large patch; therefore, chemical and cultural control methods must be used to suppress the disease. Several fungicides are registered for control of large patch, but little is known about how the products rank in effectiveness and whether both fall and/or spring applications are required.

A field experiment was conducted at UGA's Griffin campus to assess the efficacy of fungicides for control of Rhizoctonia large patch in zoysiagrass cv. Zenith. On Oct. 7, 2005, fungicides were applied at label rates to plots (1 x 3 m) arranged in a randomized complete block design with four replications. Treatments were reapplied on Nov. 4. Visual estimates of disease severity were made at approximately 7-day intervals from Oct. 25 to Dec. 4. In addition, estimates were made of the time required for the treated turf to break dormancy in the spring of 2006.

b The large patch epidemic was moderate, reaching a peak of 21% disease severity during the last week of November. In the spring, turf treated the previous fall with azoxystrobin, flutolonil, myclobutonil or triadimefon broke dormancy and developed a full foliar canopy 3-8 weeks earlier than non-treated turf. Fall applications of these fungicides will limit the severity of Rhizoctonia large patch and enhance the quality of zoysiagrass in Georgia.

c Hatch Act, state matching funds

d State Specific

- Goal 1-2

Increasing consumer, industry and student knowledge of IPM

Sub-keys: Diversified/Alternative Agriculture, Plant Health

a Georgia's population grew from 6 million to 8 million from 1990 to 2000. On a percentage basis, Georgia was the fastest growing state east of the Rockies. The highest levels of growth continued to be in the Atlanta region. Contributing to the fast increase of Georgia's population is the high level of migration into the area. Domestic and foreign migration to Georgia has been substantial in the last 10 years. The Hispanic population is one of the fastest growing sectors of the population. Due to the increase of population, housing, gardening, and the rising value of property; the popularity of turf and ornamental species had increased significantly. Hispanics are the backbone of the workforce in

Georgia's Green Industry. Eighty percent of landscape companies, greenhouses, and nurseries employ Hispanics workers.

Due to Georgia's climate, diseases from pests on turfgrass and ornamentals are present continually. Disease losses and control costs are significant for homeowners and green industry professionals. Pesticides are commonly used as the main control strategy. However pesticides are cost-prohibiting and their over-use can be detrimental to the environment. Thus, there is a significant need to educate consumers, homeowners, producers, managers and landscape companies' personnel on Integrated Pest Management strategies for control of plant pests and plant diseases.

A joint effort between UGA and Clemson University Extension specialists was initiated to fulfill this goal. A $14,600 CSREES-Southern IPM grant was obtained to carry educational activities aiming to educate homeowners, green industry professionals and students about the judicious use of pesticides, increase knowledge and efficacy of IPM strategies and to instruct them on alternative ecologically friendly solutions. Additional topics included pollution control, strategies for water quality, storm water management and water quality, and avoiding storm drain pollution by avoiding fertilizer and pesticide deposition. Materials in Spanish specifically targeted to Hispanic audiences were also developed.

b Nine statewide and regional educational trainings were carried out. A total of 306 participants were contacted and trained within the scope of the grant. Participants included 58 county agents; 82 industry professionals; 145 homeowners and master gardeners and 21 K-12 students. Participants received science-based information on pollution control, environmental strategies for water quality, preserving a clean urban watershed, storm water management and water quality, and avoiding storm drain pollution by avoiding fertilizer and pesticide deposition. Emphasis was given on reducing pesticide input through scouting techniques, pest thresholds, host resistance, proper timing of pesticide application, cultural management and biological control. A total of 2,302 hours of direct participant contact was achieved. Several agricultural and natural resources county Extension agents had initiated regional IPM and water quality programs on their own county. K-12 students received a Junior Master Gardener certificate of completion and books at the end of the educational training. Industry professionals, landowners, and agro industry associations were also targeted with printed materials that depicted the advantages of implementing IPM techniques during the “Agroforestry Wildlife Field Day” in Griffin, GA. The back cover of the program had IPM strategies to prevent plant damage from insects, weeds and diseases. Four hundred participants received the information contained in the program booklet. Twenty fact sheets were developed in English and Spanish and made available through the Clemson Extension Home and Garden Information Center (hgic.clemson.edu). Additionally, three trainings in Spanish were conducted and tailored to the landscape Hispanic workforce. Evaluation of the effectiveness of the outreach programs was also implemented by using surveys at the educational trainings.

c Smith Lever, state matching funds

d Multi-State Extension: SC

▪ **Goal 1-16**

Characterization of extra cellular proteins

Sub-keys: Agricultural Profitability, Plant Health

a Ralstonia solanacearum is one of the world's most destructive phytopathogenic bacteria, because after invading roots, the pathogen spreads rapidly throughout the plant and causes lethal wilting. A better understanding of this pathogen's ability to systemically colonize plants is necessary to develop improved control methods. We determined previously that the type II protein secretion system is critical for this pathogen to colonize a susceptible host. We are using modern proteomic methods to help identify R. solanacearum proteins that transit this system and thereby promote colonization.

Extra cellular proteins were recovered from culture supernatants of a wild type strain, a mutant incapable of producing eight known extra cellular proteins, and a mutant defective in its type II protein secretion system. These proteins were analyzed using both two-dimensional gel electrophoresis followed by peptide mass fingerprinting and liquid chromatography followed by tandem mass spectroscopy.

b A total of 103 extra cellular proteins were identified. The 36 proteins that appear to transit the type II protein secretion system included all eight proteins known to be secreted via this pathway (i.e., plant

cell wall degrading enzymes important for virulence), 13 proteins with putative functions (mostly enzymes), and 15 proteins with unknown functions. No other bacterium is known to secrete this many proteins via its type II system, and our results suggest that this system in R. solanacearum exhibits unusually low substrate specificity. In the remaining 67 extra cellular proteins, we identified eight that probably transit other protein secretion pathways and three that are part of common extra cellular protein appendages. The other extra cellular proteins, which are generally present in low concentrations, are probably accidentally secreted.

c Hatch Act, state matching funds
d State Specific

- Goal 1-12

Managing antagonistic yeast populations on turfgrass

Sub-keys: Agricultural Profitability, Plant Health

a Epiphytic yeasts colonizing turf grass leaves are presumed to provide a natural barrier to foliar diseases caused by Rhizoctonia solani and Sclerotinia homoeocarpa. Managing yeast populations on turfgrass could provide additional disease control as part of an integrated management plan. Our previous work has shown that a larger yeast population sizes provide increased biological control activity, however managing yeast populations on leaves in the field requires a greater understanding of the factors affecting these communities. The leaf surface has long been considered an extreme habitat for microbial colonists due to continuously fluctuating physical and nutritional factors. Most nutrients on the phylloplane are ephemeral, isolated or sporadic so microbes in this habitat often encounter nutrient-poor or oligotrophic environments. On the phylloplane, nutrients are made available to microbes either endogenously from plant exudates or exogenously from compounds found in materials that land on the plant surface. To date, no work has clearly established what nutrients limit the development, establishment, and growth of yeast on the phylloplane.

Our objective was to better understand the effect of exogenous nutrients on phylloplane yeast populations with the greater long-term goal of increasing leaf carrying capacity for use in biocontrol. In this study we test the hypothesis that the phylloplane yeast community of tall fescue is nutrient limited; and that nutrient availability, abundance, and content is a significant factor in determining population size. As a test of this hypothesis we investigated the effects of applying various solutions of sucrose and/or yeast extract, and different nitrogen-based solutions on the abundance of culturable yeasts colonizing the phylloplane of tall fescue.

b Significant positive linear relationships were observed between the number of yeast colony forming units and applications of yeast extract and sucrose plus yeast extract. Foliar applications of sucrose alone had no significant effect on yeast community abundance, indicating that phylloplane yeasts of turfgrass are not limited by the amount or availability of carbohydrates. Tryptone or yeast extract, both with considerable amino acid composition, significantly increased the yeast population while yeast nitrogen base (with or without amino acids) and ammonium sulfate had no affect on yeast abundance. These results suggest that organic nitrogen stimulate yeast community growth and development on the phylloplane of tall fescue while carbohydrates, inorganic nitrogen and non-nitrogenous nutrients have little positive effect.

c Hatch Act, state matching funds
d State Specific

- Goal 1-12

Reduced sensitivity to tebucanazole

Sub-keys: Agricultural Profitability, Plant Health

a Tebuconazole is a systemic sterol demethylation inhibitor (DMI) fungicide used widely for management of fungal diseases of peanut, including leaf spot, caused by Cercospora arachidicola and Cercosporidium personatum; stem rot, caused by Sclerotium rolfsii; and limb rot, caused by Rhizoctonia solani. Tebuconazole has been labeled for use on peanut in the U.S. since 1994 and is the predominant fungicide used on peanut in Georgia, Alabama, and Florida. Typically, a treatment consisting of a four-spray block of tebuconazole and a protectant fungicide, chlorothalonil, applied at sprays 1, 2, and 7 is included as a standard treatment in most experiments for evaluating fungicides for leaf spot control, as is a treatment consisting of 7 applications of 1.26 kg ai/ha of chlorothalonil. Examination of trends in the relative performance of those treatments indicated that the tebuconazole

treatment is not as consistent across experiments as it once was and in recent years has been less effective than chlorothalonil for leaf spot control. One possible explanation for this observed decline in performance is the development of resistance to the fungicide in populations of the leaf spot pathogens in response to repeated exposure to the fungicide over time.

UGA plant pathologists conducted field experiments at Tifton and Plains, GA, from 1992-2006 to examine the effect of tebuconazole rates on early and late leaf spot of peanut and to examine the relative efficacy of tebuconazole and chlorothalonil over time. In addition, more than 100 single-spore isolates of C. arachidicola and more than 90 isolates of C. personatum were obtained from infected peanut leaves collected in 2005 from research sites and commercial farms in Georgia, Alabama, and South Carolina with histories of DMI fungicide use and assayed in the laboratory for sensitivity to tebuconazole. Sensitivity of the 2005 isolates was compared to the baseline sensitivity profiles established for these pathogens in 1996.

b In 1992 and 1993, full-season applications of 0.102 kg a.i. /ha of tebuconazole provided control of late leaf spot similar to that of 1.26 kg a.i. /ha of chlorothalonil. During 1994-1998, application of 0.129 kg a.i. /ha of tebuconazole provided leaf spot control that was similar to or better than that of the chlorothalonil treatment in 5 of 6 experiments. In 2005 and 2006, much higher rates were required to achieve control similar to that of the chlorothalonil treatment, and application of 0.46 kg a.i./ha in 2005 and 0.58 kg a.i./ha in 2006 resulted in more severe leaf spot than in the plots treated with the chlorothalonil treatment in one location. When compared to the baseline tebuconazole sensitivities established for these pathogens in 1996, isolates collected in 2005 were significantly less sensitive to tebuconazole. Results of this research provide evidence of a significant shift in sensitivity of both leaf spot pathogens to tebuconazole between 1996 and 2005. Fortunately, there have not yet been widespread reports of leaf spot control failures with DMI fungicides. Detection of this decline in fungicide performance in research plots over time and the associated reduction in tebuconazole sensitivity provides an early warning of impending control losses in time to make appropriate modifications to disease management recommendations and prevent significant economic losses to peanut growers.

c Hatch Act, state matching funds
d State Specific

- Goal 1-4

Fusarium wilt threatens Georgia watermelons

Sub-keys: Agricultural Profitability, Plant Germplasm, Plant Health

a In 2005, watermelons were worth $119 million, roughly 17% of Georgia's vegetable farm gate income. Watermelons were planted to approximately 30,000 acres. The vast majority of this acreage is planted to seedless watermelons, which have been increasing in demand over the past several years. With such a high value per acre, growers must ensure they do everything they can to protect against weeds, diseases, and insect pests. Of these pests, diseases usually account for the greatest losses in yield and quality. Fusarium wilt (caused by the fungus Fusarium oxysporum f.sp. niveum) was observed in many fields in 2006 and was predominately on seedless watermelon. Seedless are more susceptible to all races of Fusarium wilt because resistance to this pathogen has been difficult to breed into seedless watermelon to date. Fusarium wilt presents a significant problem to Georgia growers because 1) watermelon buyers are demanding more seedless watermelons; 2) seedless have no resistance to Fusarium wilt; 3) inoculum from Fusarium wilt stays in the soil for up to seven years, making crop rotation a challenge. Therefore, Georgia watermelon growers have been basically planting themselves into a corner and may soon be unable to avoid planting susceptible seedless watermelons into Fusarium wilt infested fields.

The extension plant pathologist contacted the county faculty to collect Fusarium wilt isolates across the state. These isolates were then sent to the National Watermelon Lab in Lane, OK for race determination. Race typing is essential in developing a profile for Fusarium wilt races so breeders will know the levels of resistance needed for developing resistant seedless watermelon lines. The extension pathologist also provided information via e-mail alerts and on television news shows which described the problem and explained what growers could do to slow the spread of disease and especially highlighted disease management tools that would not work. An educational session on Fusarium wilt was also developed for the upcoming Southeast Regional Fruit and Vegetable Conference so growers can learn from and interact with some of the nation's leading experts on

Fusarium wilt of watermelon.

b Potential results would be that growers would reduce the number of acres of watermelons they plant so as to give greater flexibility for rotating to avoid Fusarium wilt. By identifying ineffective disease management tools for Fusarium wilt, growers can save time and money. Also, by exposing growers to new Fusarium wilt management tools at regional meetings, they are more likely to support research that evaluates these new tools. The end result would be the sustained production of seedless watermelons in Georgia through new Fusarium wilt management tools.

c Smith Lever, state matching funds

d State Specific

- Goal 1-11

Resistance to tomato spotted wilt virus

Sub-keys: Agricultural Profitability, Plant Germplasm, Plant Health

a Tomato spotted wilt virus is now the most important viral pathogen of peanut in the U.S. and can result in losses of up to $40 million yearly. Limited field resistance is available but only in cultivars that do not have the best agronomic traits. The use of pesticides against insect vectors of the virus is not effective.

Transgenic peanut lines are being developed from cultivars with superior agronomic traits by placing viral genes in peanut plants. The information carried in the viral genes provides resistance to tomato spotted wilt virus. AgraTech line AT 120 (no natural tomato spotted wilt virus resistance) and UGA line Georgia Green (some natural resistance to tomato spotted) are being used for transformation. In the case of Georgia Green, transgenic resistance will be pyramided onto the natural resistance.

b Transgenic lines from each cultivar have been generated and are being tested for resistance to tomato spotted wilt virus. Peanut lines with increased resistance to tomato spotted wilt virus will significantly increase yield and will have a positive economic impact on peanut growers financial well being and competitiveness.

c Hatch Act, state matching funds

d State specific

- Goal 1-12

Flexibility in planting with peanut cultivars with high levels of field resistance to tomato spotted wilt virus

Sub-keys: Agricultural Profitability, Plant Germplasm, Plant Health

a Tomato spotted wilt virus has cost Georgia peanut growers millions of dollars in either direct yield losses or costs associated with control. An integrated approach utilizing natural resistance to the virus as well as several cultural and chemical factors has greatly reduced losses to spotted wilt. Planting date is a major factor in managing spotted wilt with moderately resistant cultivars such as Georgia Green. Typically, spotted wilt epidemics are less severe in peanuts planted in mid to late May than in peanuts planted in April or early May. In the past ten years, there has been a major shift in time of planting for the majority of acres in Georgia, primarily to help manage spotted wilt. Although planting in mid-late May is effective suppressing spotted wilt epidemics, it is not always feasible to plant during this period. Growers with large acreage often cannot plant all their peanuts in this period, and planting earlier would be advantageous in many cases with growers planting other crops in the spring. New cultivars such as AP-3, Tifrunner, and Georgia-03L have field resistance that is much better than that in Georgia Green. They have performed well in tests in which cultural factors were used that enhance spotted wilt epidemics, including early planting date. Availability of cultivars with enough resistance to TSWV to allow earlier planting would be of greater convenience for growers and should greatly help reduce losses to spotted wilt for growers who must plant earlier.

In 2005 and 2006 field tests were established to address the effects of planting date on spotted wilt epidemics in the highly resistant cultivar AP-3 compared to the moderately resistant cultivar Georgia Green. Replicated plots were established to compare spotted wilt epidemics and yield in AP-3 and Georgia Green with planting dates that ranged from April through late May with planting dates at 7 day intervals.

b Planting date had a huge effect on final incidence of spotted wilt and pod yield in Georgia Green. As had been observed previously, epidemics of spotted wilt were much less severe in that cultivar for planting dates in mid to late May than in April or early May. However, planting date had a much smaller effect on spotted wilt incidence and yield in AP-3. In 2006, incidence of spotted wilt in AP-3 in even in the earliest planting date (April 24) was less than 12%, compared to 42% in Georgia Green at that planting date. There was a significant reduction in spotted wilt in AP-3 with later planting dates, but the levels of incidence across all the planting dates were very low compared to Georgia Green. The use of a cultivar such as AP-3 with high levels of field resistance to TSWV should help to minimize losses to spotted wilt and also should allow growers to plant peanuts earlier without greatly increasing the chances of losses to spotted wilt. Use of a highly resistant cultivar could allow growers to choose planting dates for convenience or for other production factors instead of for managing spotted wilt.

c Hatch Act, state matching funds

d Multi-state: FL

- Goal 1-12

Epidemiology and management of center rot of onion

Sub-keys: Agricultural Profitability, Plant Health

a Center rot of onion, caused by the bacterium Pantoea ananatis, continues to be a problem in the production of Vidalia onions. The disease reduces both yield and quality of onion bulbs. Under certain conditions center rot infections will promote a soft rot of the bulb prior to harvest. Incidence and severity of center rot in Georgia in 2006 were the highest observed in the past 5 years. In some instances entire fields were abandoned. The disease was responsible for hundreds of thousands if not millions of dollars in lost revenue, in spite of the fact conditions during the 2006 onion-growing season, when center rot was the most devastating, were some of the driest experienced in the past five years. Center rot is a very unusual bacterial disease, as the vast majority of plant diseases caused by bacteria are favored by wet conditions. Also, about the only labeled pesticide for plant bacterial diseases, namely fixed coppers, are relatively useless for managing center rot as most strains are resistant.

The Department of Plant Pathology at the Coastal Plain Experiment Station in Tifton, GA, has had a research program on center rot since 1999. During that time at least four research faculty members, two extension faculty members, two post-doc scientists, several county agents, technicians, and part-time student laborers have spent a portion of their time conducting research on center rot of onion. Experiments in the lab, greenhouse and field were conducted to investigate the ecology of Pantoea ananatis and the epidemiology of center rot. In addition to conducting research, personnel of the phytobacteriology lab once again served as a resource for the state by providing detailed identification of bacterial species submitted by growers, extension specialists, county agents, Georgia Department of Agriculture inspectors, and private industry.

b Previously, infested onion seed, weed hosts and thrips have been shown as potential sources of primary inocula for center rot epidemics. Currently, it was found that dry weather conditions correlated with increased thrips populations and center rot severity by season. Different strains of P. ananatis recovered from tobacco thrips, asymptomatic weeds, onion seed, or diseased onions were compared. Only 54% of all strains were pathogenic when inoculated on greenhouse-grown onion seedlings, but of those that were pathogenic, 93% were positive for ice nucleation activity (INA). Likewise, 91% of nonpathogenic strains were negative for INA. Only 4% of all strains identified as P. ananatis were pathogenic to onion but negative for INA. Interestingly, 100% of the strains recovered from diseased onions were both pathogenic and positive for INA. Similarly, 100% of INA-positive and INA-negative strains recovered from thrips were pathogenic and nonpathogenic, respectively.

The correlation of thrips populations with increased center rot incidence and severity along with previously observed disease gradients in field plots implicate thrips as the most important source of inoculum for center rot epidemics. Therefore, the primary focus for managing center rot should be on controlling thrips populations. INA could be developed as a means of rapidly screening for pathogenic strains of P. ananatis in the lab. These findings have stimulated new research on the interaction of INA with the development of center rot, survival of P. ananatis and the cold hardiness of thrips, which harbor internal populations of INA-positive strains in their gut. There is the potential to develop a biocontrol for thrips using an INA-positive, nonpathogenic bacterium. In addition, there is the potential of developing a disease forecast model based on the percentage of INA-positive thrips prior to the time

one would normally first expect center rot symptoms, total thrips populations and amount of rain.

Previously in a survey conducted to evaluate differences in fatty acid methyl ester (FAME) profiles, differences were found among P. ananatis strains recovered from different onion cultivars from three different sites in Georgia. Principal components (PC) calculated for those strains capable of growing on media amended with copper sulfate pentahydrate indicated copper-tolerant strains grouped into clusters separate from those of wild-type, copper-sensitive strains. Likewise, when PC1 was plotted against PC2 for generated, copper-tolerant clones and their wild-type parents, copper-tolerant clones again formed separate clusters distinct from copper-sensitive parents. Current research was conducted to determine what was responsible for the differences between copper-tolerant and copper-sensitive strains. Eigenvalues indicated that PC1 and PC2 accounted for 96 - 98% of the standardized variance. Furthermore, either the fatty acids cis-9-hexadecenoic acid / 2-hydroxy-13-methyltetradecanoic acid or cis-9/ trans-12/ cis-7-octadecenoic acid produced the highest or second highest absolute values for PC1 in all three strains of the parents versus copper-tolerant clones and hexadecanoic acid was the highest absolute value for PC2 in all cases.

The identification of the fatty acids cis-9-hexadecenoic acid / 2-hydroxy-13-methyltetradecanoic acid, cis-9/ trans-12/ cis-7-octadecenoic acid and hexadecanoic acid as being involved in changes in copper-tolerant P. ananatis strains may help in identifying the mode of action of copper tolerance in this bacterial species. One possibility is changes in these fatty acids may reflect changes in cell membrane structure. Such findings could lead to a better formulation for one of the only pesticides labeled for control of bacterial diseases.

c Hatch Act, Smith Lever, state matching funds
d Integrated Extension and Research

- Goal 1-2

Participation in the Southern Region Small Fruit Consortium

Sub-keys: Agricultural Profitability, Small Farm Viability

a Small fruit crops are knowledge- and technology-intensive enterprises, and all the land grant universities in this region have their strengths and weaknesses with regard to expertise and information dissemination with these crops. It is far more cost effective to meet the demands for small fruit crop information and research with a regional approach that capitalizes on the individual strengths of each cooperating land grant university. This is the basic premise on which the consortium is founded. It originally involved Clemson University, UGA, and North Carolina State University, and was initially established as the Southeastern Small Fruit Center in January 1999. In March 2000, the name was changed to the Southern Region Small Fruit Consortium to include all Southern universities. In 2002 the University of Tennessee joined consortium, followed by Virginia Tech in 2005. The long term mission of the consortium is envisioned to involve collaborative efforts at various sites across the region between small fruit growers and grower organizations, industries and service organizations allied with and/or serving small fruit growers, agricultural extension programs and research stations working together to enhance the development of the small fruit industries in the region.

Two multi-state agent training sessions (a planting and pruning workshop; and a muscadine training workshop) were sponsored by the SRSFC. Each state received five full agent scholarships for the each training. Additionally, 10 extension travel grants totaling $5,000 were awarded in 2006 to faculty in the five member states to support in-state training programs. We continue to update and refine the website (http//www.smallfruits.org/) and its use continues to expand. For example, we added on-line small fruits IPM and production guides in 2005. In 2006, the site received 1,497,789 hits, a 32% increase over the 1,137,698 hits received in 2005.

b The value of Georgia blueberries continues to increase ($59.4 million equating into a 122% increase in value over the past two years), and this increase is due to better educated growers who take advantage of the SRSFC products.

c Smith Lever, Hatch Act, state matching funds
d Multi-State Integrated Extension and Research: SC, NC, TN, VA

Key Theme: Agricultural Profitability

- Goal 1-2

  Alternatives to methyl bromide being adopted slowly

  a Vegetables produced on plasticulture in Georgia account for a farm gate value of over $200 million. Methyl bromide has been the primary means of managing many pests including weeds, nematodes, soil-borne pathogens, and insects. Georgia's most troublesome weed infesting vegetables, nutsedge species (Cyperus sp.), are the most difficult pests to manage in the absence of methyl bromide. The economic availability of methyl bromide is nearing its end and growers will be forced to use alternatives in the next three years.

  Small plot research efforts have been ongoing for five years by faculty. From this research, three potential alternatives developed with one of those alternatives being currently labeled. Thus during 2006, over 100 acres of large acreage replicated field trails were conducted with four growers across Georgia to determine if these methyl bromide alternatives were effective.

  b Although this is the initial year of our replicated on-farm, large-acreage research, our labeled alternative was as effective as methyl bromide in six trials. Results from these efforts were extremely promising and large acreage research trials will be conducted for several additional seasons in an attempt to verify results noted in 2006. If these alternatives continue to be as effective as methyl bromide over the next two years, we would expect large scale grower adoption between 2009 and 2010.

  c Smith Lever, Hatch Act, state matching funds

  d Integrated Extension and Research

- Goal 1-2

  Reflex section 18 granted

  a Since commercialization of Roundup Ready technology, some Georgia growers have used this technology in a monoculture system and have relied exclusively on glyphosate (Roundup) applied multiple times each season to manage Palmer amaranth and other weeds. From commercialization until 2004, these glyphosate programs in Roundup Ready technology effectively and economically controlled Palmer amaranth. Unfortunately, a cotton grower in Georgia was unable to control Palmer amaranth with glyphosate in 2004. Glyphosate-resistant Palmer amaranth was confirmed in three Georgia counties during the fall of 2005. Glyphosate was the most effective and economical tool to control this pest in cotton. Without glyphosate, controlling this weed is nearly impossible with currently labeled herbicides or tillage practices.

  Searching for alternative methods to manage glyphosate-resistant Palmer amaranth, our research noted that Reflex (fomesafen) could be applied in cotton with minimal cotton injury and control Palmer amaranth for 20 to 40 days after application. Utilizing our research results in 2005, we submitted a section 18 request for the use of ReflexTM in cotton to the Georgia Department of Agriculture and the Environmental Protection Agency.

  b The section 18 request was granted for the 2006 cotton crop. The use of Reflex was estimated to prohibit a loss of $38.1 million in cotton value for Georgia growers. These results were possible through cooperative efforts of UGA, the Department of Agriculture, Syngenta, and the EPA.

  c Smith Lever, Hatch Act, state matching funds

  d Integrated Extension and Research

- Goal 1-12

  Addressing fiber quality concerns of Georgia cotton

  a In the late 1980s and early 1990s, the fiber quality of Georgia cotton as compared to the overall U.S. Cotton Belt was second only to that grown in arid western states of Arizona and California. Cotton acreage in Georgia in the 1980s and early 1990s ranged from 110,000 to 400,000 acres each year. In the mid-1990s, because of the success of the boll weevil eradication program, favorable market prices over and above U.S. farm commodity programs, and the general suitability of the crop in the state after successful eradication of the boll weevil, cotton acreage in Georgia exploded to a modern-era high of 1.5 million acres. It has since fluctuated between 1.2 and 1.45 million acres. Over the past 9 years, the

adoption of genetically engineered varieties with genes conferring pest management traits has revolutionized cotton production in Georgia. Transgenic varieties have been planted on over 90 percent of the acreage each year since 2000. Unfortunately, during these same years, Georgia has experienced a significant decline in reputation of cotton fiber quality produced in here.

Initial concerns were raised in 1998-99 by one major U.S. textile mill regarding the spinning efficiency (yarn output per hour) of cotton from Georgia. In 2003 several mills reported similar problems, and in 2004, at least four major U.S. mills publicly declared a bias against Georgia cotton. While the problem was not specifically identified, buyers ranked Georgia cotton as the least preferred in the U.S. Cotton Belt in 2003-04.

UGA scientists have invested considerable resources towards the issue of cotton fiber quality. Some efforts are long term, others are more immediate. Several cotton team members have interacted with the Georgia Cotton Commission, Southeastern Ginners, Southern Cotton Growers, the USDA Cotton Quality Research Station at Clemson, Cotton Incorporated, and the National Cotton Council to consider the nature and scope of the problem and possible solutions.

Several years ago, UGA scientists recognized the disparity between commercial ginning and that employed in the process of handling research and demonstration samples. The commercial process is much more aggressive than small gins. Quality factors such as lint turnout, length uniformity, and staple (length) tend to be significantly over-estimated in miniature table top ginning as compared to commercial processing. Scientists conceived the idea of a scaled down but fully equipped micro gin to employ commercial-like effects to small plot samples. This gin could more accurately measure the effects of experimental treatments such as cultivar, production management, pest control, fertility, etc., on fiber quality. Federal and state funds for the project were secured with considerable help from the Georgia Cotton Commission and others. The first cotton samples were run in the UGA Cotton Micro-Gin in the summer of 2004 and multiple experiments from the 2005 crop will be ginned at the facility. It is anticipated that this world class facility will be a valuable research tool for addressing current and future fiber quality issues across the Southeast.

In 2005, emphasis shifted from the development of commercial cultivars towards that of releasing high yielding germplasm and nematode tolerant lines with superior fiber quality. He is working on the molecular side to determine markers specifically associated with nematode tolerance. The current standard for the transformation process is a variety that dates back to the 1970s, and while it is ready source for gene insertion and plant regeneration, it has inherent negative agronomic and fiber properties. The lack of desirable fiber characteristics of the current system saddles transgenic offerings with significant challenges to overcome in the pursuit of fiber improvement, and thus there is great opportunity to improve quality with transgenic cultivars. On another front, exploration of the cotton genome expands the possibilities for future advancements of cotton genetics as it relates to both yield and quality.

We have investigated the potential effects of aggressive or rescue applications of glyphosate in Roundup Ready cotton. Research shows no influence on fiber quality even when yields were reduced by glyphosate. We have extensively explored the management of stink bugs and demonstrated a strong correlation between not only stink bug control and yield but also bug damage and fiber quality. This research provides strong evidence that some of the problems associated with the quality of the 2003 crop are directly linked to stink bug problems. Field experiments also link nematode damage with reduced fiber quality and point to the need to develop nematode tolerant lines and better nematode management tools.

Because of high technology and seed costs associated with transgenic varieties, growers have incentive to plant reduced seeding rates. Physiologists at UGA have explored the relationship of low stand density and fiber quality, and while there was a slight effect on micronaire (fiber density), overall minimal stands had little to no impact on overall fiber parameters. The work has also demonstrated the importance of timely defoliation and harvest. In studies that have been widely sited, delaying defoliation past the appropriate time of 60 to 80 percent open boll reduced yields about 10 percent and income up to $30 per acre per week. Much of the reduction in income results from losses in quality. We are also actively investigating the effects of irrigation on fiber quality. The cotton team has identified additional researchable topics that might influence fiber properties. We conducted detailed

studies in 2005 and 2006 exploring the effects of fertility programs on lint quality. For these and other such experiments, the UGA Micro-Gin will be a valuable tool in such investigations.

Quality issues have been gaining momentum in recent years. In winter production meetings in 2005 and 2006, the UGA Cotton Team discussed the quality issue from numerous angles. Team members provided comments on the issue in field days, radio and television interviews, farm publication articles, and farm press interviews.

The team has developed specific strategies for improving quality. These include variety selection, stink bug management, timely defoliation and harvest, and proper ginning. The team has also suggested an early management system to address the challenge of conflicts between peanut and cotton harvest.

The Georgia Cotton Newsletter, a monthly publication posted on the UGA Cotton Web Page, included several articles pertinent to quality. The UGA Cotton Web Page continues to be a source of information delivery; as of November 2006, the site had received almost 41,000 “hits.”

We were invited to Cotton Incorporated's Engineered Fiber Systems Conference in Memphis, TN, June 5-7, 2005, to address fiber quality, and two researchers reported experimental data on crop and pest management pertinent to the quality issue. The conference included an international audience of several hundred persons.

Team members have worked with Bayer Crop Science, the Georgia Cotton Commission, and others regarding the establishment of the Georgia Quality Award. The program, which received a $50,000 grant for support, recognizes growers and their respective ginners for producing outstanding quality. The initial program honored 12 growers and their respective ginners and county agents in Atlanta in March 2006 and will be continued through 2007.

Through a special internal grant, the team developed a survey which assessed the knowledge of growers, ginners, and county agents on the issue of fiber quality. The survey served not only as an evaluative tool but also as another vehicle for educating clientele about fiber quality.

The collective effort of partners such as the Georgia Cotton Commission, its professional textile consultant, the USDA Cotton Quality Research Station in Clemson, Cotton Incorporated, and the UGA Cotton Team determined increased short fiber content is the probable source of reduced spinning efficiency associated with Georgia cotton. As defined by the industry, short fibers are those below 0.5 inches in length. Typically, cotton samples from the mid-South contain 6 to 10% short fibers, while cotton bales from Georgia may be 8 to 18% short fiber. Short fiber content is not directly measured by current USDA Fiber Quality Classing system but is indirectly reflected in the parameter termed Length Uniformity Index. Georgia cotton typically averages a full point below cotton produced in the Mid-South. Georgia producers and ginners are now well aware quality is an issue of intense importance.

Research and demonstration efforts have identified the effects of stink bug injury on almost every measure of fiber quality. Growers in 2004 and 2005 were much more aggressive in controlling stinkbugs than in previous years, and field assessments indicate considerably less damage than in 2003. Overall quality of the 2004 crop and 2005 crop is superior to that of the 2003 crop. The 2006 has been overwhelmed by drought and heat and there are the concurrent problems with high micronaire and short staple.

b As the harvest seasons of 2004 and 2005 approached, a change of attitude was evident among growers. Many prepared to get the crop out as early and quickly as possible. In spite of the onslaught of four tropical storms in 2004, some successfully did so. The quality of the crop harvested early was quite good. A shift in grower mentality is evident across the state -- there is beginning to be a greater sense of urgency about cotton harvest.

Publicity regarding fiber quality problems has focused not only on producers but also on ginners. Ginning plays a key role in the system because it is the end point of production and the contact point with quality measurements. Many gins also have advisory relationships with growers in terms of crop management. The spotlight on fiber quality has caused gin managers to scrutinize and improve their handling/processing systems and to encourage growers to do likewise. In the gin community, the

quality message has been heard.

c Smith Lever, Hatch Act, state matching funds
d Integrated Extension and Research

- Goal 1-12

Nematode management in turfgrass systems

a Approximately 85% (42,500 acres) of the turfgrass sod produced in Georgia is grown on soils susceptible to nematode infestations and across all areas of turfgrass management, nematodes are estimated to be responsible for $51 million in damage annually. Nematodes can be marginally controlled by cultural turfgrass management techniques; however, there are limitations and chemical control is necessary. With the pending loss of Nemacur as a nematode control strategy, turf managers have limited options for controlling plant parasitic nematodes.

Trials were conducted with Telone II (1, 3-dichloropropene) and an experimental biological nematicide to refine the effective rates for optimal nematode control in sod production and general turfgrass management.

b These trials have shown that when nematode populations in soils exceed damaging threshold levels, an application of Telone II can reduce the amount of scrap; therefore, increasing the amount of harvested grass. These results indicate that if nematode infested soils were treated, there could be a potential increase of 5,700 ft2 of harvestable sod per acre, translating to a net revenue increase of $731 per acre. The results of this work have contributed to the annual Georgia Turfgrass Pest Control Recommendations. Unfortunately, the results of our trials on a biological nematicide have not been encouraging. Further work will continue to look at an integrated approach to turfgrass nematode management.

c Smith Lever, Hatch Act, state matching funds
d Integrated Extension and Research

- Goal 1-12

New herbicides for pearl millet

a Pearl millet has been examined as a grain crop that can be grown in Georgia for Georgia's poultry industry. If pearl millet could be successfully grown in Georgia, demand for corn to be imported into the state for poultry feed would be reduced. This would have two positive impacts: 1) having a crop grown in Georgia that has a ready market would be economically beneficial to Georgia growers and 2) would have positive environmental benefits because of reduced nitrogen imports from the Midwest in the form of grain corn would be needed. Pearl millet also is more drought-tolerant than field corn and could reduce water demands in Georgia. However, one of the limiting factors to adopting pearl millet on a wider basis in Georgia is the lack of herbicides for annual grass control, particularly large crabgrass and Texas panicum.

Field studies have been conducted since 2003 to screen newer herbicide chemistries that could potentially control annual grass weeds while not injuring the pearl millet. Over 30 herbicides and herbicide-safener combinations have been examined. Of the herbicides examined, only mesotrione was found to provide annual grass weed control while not injuring pearl millet. Mesotrione applied post emergence to pearl millet germination caused excessive injury. Twenty-three pearl millet varieties were examined for their tolerance to mesotrione. Most varieties expressed less than ten percent foliar injury at application rates of 100 g ai/ha (0.1 lb ai/A). Field studies in Athens and Tifton, GA indicated that large crabgrass and Texas panicum control were greater than 90% 21 days after application.

b These data indicate mesotrione appears to be an excellent candidate to provide annual grass control in pearl millet in Georgia.

c Hatch Act, state matching funds
d State Specific

- Goal 1-12

Physiology of Roundup-resistant Palmer amaranth

a Roundup resistance has been confirmed in a population of Palmer amaranth in central Georgia. These pigweeds seem to be able to tolerate seven times more Roundup than susceptible pigweeds. The appearance of such a common and troublesome weed to the most widely used herbicide in cotton has the potential to be very devastating to Georgia cotton producers.

Studies were initiated to study how these pigweeds are resistant to Roundup with the objective of finding ways to control them while still using Roundup for weed management in Roundup Ready cotton in Georgia. Differences in glyphosate uptake and translocation between resistant and susceptible biotypes were not observed. This is different from other Roundup resistant weeds such as the Roundup resistant horseweed in Tennessee. Differences in calcium content were not observed as well. A laboratory bioassay was conducted to determine if there were differences in the target site to glyphosate in resistant and susceptible Palmer amaranth differed. Studies are being conducted to examine the competitiveness of glyphosate-resistant Palmer amaranth.

b These data indicate glyphosate-resistance for this Palmer amaranth biotype is based on a difference in the site of action rather than limited translocation.

c Hatch Act, state matching funds
d State Specific

- Goal 1-12

Salinity monitoring on turfgrass sites

a In response to water conservation pressures, turfgrass sites are increasingly using alternative irrigation water of poorer quality---saline ground waters, storm water runoff, some reclaimed waters, seawater blends, etc. Many of these sources contain soluble salts and various nutrients/elements. This trend has been greatly stimulated with the recent development of seashore paspalum cultivars exhibiting superior salinity tolerances by UGA scientists in the Crop and Soil Science Department. Thus, on many sites there is a need to monitor salinity by depth and over time.

Salinity monitoring methods/approaches/protocols have not been developed for turfgrass sites and the electromagnetic procedure used for many agronomic crops determines total soluble salts in a 12 inch zone rather than the 2-4 inch zone required for turfgrasses. In 2004, a project was initiated to investigate various in-situ and mobile means of monitoring salinity status. Part of the research is being conducted in a real-world situation on a golf course with irrigation water quality that varies from 500 to 5700 ppm soluble salts. In 2006 the second phase was initiated to move to cart-mobile units that can obtain more detailed information over a much larger area in a short-time frame based on information obtained from the studies using hand-held instruments in the first phase. We have initiated construction of a mobile soil salinity monitoring unit that could allow rapid, detailed (10 x 10 foot grid) salinity monitoring by four soil depths coupled with a GPS unit. Our target is to bring this unit online in early 2007 for testing.

b This research will result in development of mobile salt monitor technology and methods that are specific to turfgrass situations, better management of salt-affected sites, and efficient use of water for salt leaching on a site-specific basis.

c Hatch Act, state matching funds
d State Specific

- Goal 1-12

Managing ALS-resistant Palmer amaranth in peanut

a Palmer amaranth (Amaranthus palmeri) has become one of the most troublesome weed species in Georgia. Populations of this weed have developed resistance to various herbicides including glyphosate and ALS-inhibiting herbicides. Since Georgia peanut growers rely heavily on the use of ALS-inhibiting herbicides, Palmer amaranth management programs are in jeopardy.

A master's level graduate student was recruited to conduct research on the distribution and control of ALS-resistant Palmer amaranth in Georgia. Numerous field trials were established to identify alternative Palmer amaranth control programs. An herbicide resistance slide set and control program publications that were developed and are available on the UGA Weed Science website (www.gaweed.com).

Information about herbicide resistance was delivered to more than 1500 clients at 40 statewide and local meetings. Approximately $20,000 in external grant funds was obtained to support these research and extension efforts.

b Results from preliminary surveys indicate that more than 80% of the Palmer amaranth plants screened are resistant to ALS-herbicides. The presence of ALS-resistant Palmer amaranth will cause growers to spend more money on herbicides and increase peanut production costs by $10-25/A. However, inadequate control programs can result in peanut yield losses ranging from 15 to 72%. Thus, improved ALS-resistant Palmer amaranth control programs will result in an increase of $77 to $367/A which will pay for the increased cost of production and improve overall profits.

c Smith Lever, Hatch Act, state matching funds

d Integrated Extension and Research

- Goal 1-12

Measurements of CO2 nocturnal respiration as an indicator of stress response in peanut

a Peanut crops are susceptible to water stress of different duration and intensities during the growing season. Although the peanut plant is drought tolerant to some extent, plant water stress is one of the most critical abiotic factors limiting peanut yield and quality. In response to the rapid urban development during the last couple of decades in Georgia, demand for water has dramatically soared while competition for water availability between the rural and urban sectors has been on the rise. Furthermore, the water stress has become a main concern of farmers because of numerous years of drought associated with climate variability and climatic changes. Thus, the optimization of irrigation based on available and required water resources and plant physiological thresholds is necessary to maximize water use efficiency. Scientists' research focuses on the nighttime CO2 respiration measurements for early detection of soil water stress on peanut crops.

Nocturnal CO2 respiration measurements at the farm scale are carried out using a micrometeorological approach known as eddy-covariance (EC) technique, which allows continuous and long-term monitoring of water and CO2 fluxes between the soil-plant system and the atmosphere. This EC technique can provide valuable information on the functional responses of the soil-plant system to environmental factors such as water stress. Partitioning of soil-plant system respiration into soil respiration and plant respiration is necessary to improve our understanding of plant's responses to environmental stress. In order to achieve this, detailed soil respiration measurements are also conducted along with EC measurements.

In 2006, the experiment was conducted over two contrasting large areas of peanut crop, one a non-irrigated peanut field and the second an irrigated peanut field in Plains, GA. Continuous measurements of latent heat, CO2 and sensible heat fluxes were carried out using the EC technique throughout the growing season. The system consisted of a sonic anemometer for measuring the three components of wind velocity and sonic temperature, and an open-path infrared gas analyzer for measuring water vapor and CO2 densities. The sensors were setup 1.5 m above the ground.

The soil respiration separated into rhizosphere respiration (combined root respiration and the respiration of soil microorganisms residing in the rhizosphere) and heterotrophic respiration (respiration of soil microorganisms and microorganisms not directly under the influence of the live root system) was monitored using soil CO2 gradient method combined with the root-exclusion method. Two sets of solid-state infrared gas analyzers were buried between peanut rows and an adjacent root-excluded plot for soil respiration measurements. Other supporting measurements conducted include soil temperature, soil water content, soil heat flux, air and canopy temperatures, net radiation, and wind velocity and temperature profiles. An in situ weather station monitored weather parameters such as air temperature and humidity, wind speed and direction, solar radiation, and rainfall. These supporting data sets are used to help interpret CO2 respiration measurements.

b Extensive data sets collected continuously throughout the growing season are being analyzed to study the relationship between plant respiration and water stress. It is expected that measurements of nocturnal CO2 flux, soil respiration, and a combination of other supporting measurements in the peanut field will improve our understanding of plant's responses to environmental stress. The study's final goal is to provide early indication of water stress on peanut crops for better irrigation

management.

c Smith Lever, Hatch Act, state matching funds
d Integrated Extension and Research

- Goal 1-2

Soil and residual herbicide affect on peanut seedling development

a In 2004 Georgia and Texas led the U.S. in peanut production with 600,000 and 235,000 acres, respectively. Delays in peanut growth and development can significantly reduce peanut yield and affect quality. Explanations for peanut injury had not been fully investigated with respect to diclosulam, flumioxazin, and sulfentrazone rates and soil type. Therefore, research was conducted to evaluate peanut seedling development in the presence of Strongarm (diclosulam), Valor(flumioxazin), and Spartan (sulfentrazone) at different rates in three soils with different pHs and mineral fractions from Georgia and three from Texas. Greenhouse experiments were conducted to determine the effect of soil-residual herbicide on peanut seedling development. Total peanut biomass in nontreated soil types were Faceville sandy clay loam > Duval sand > Pelham sandy loam > Brownfield loamy sand > Tremona sand > Tifton loamy sand. Averaged across all soils, total untreated dry weight biomass was 722 mg/ plant. For the nontreated soil types, there were no observable trends for root and shoot mass or length with respect to sand, loamy sand, sandy loam, or sandy clay loam. Herbicide rate did not affect peanut development. Averaged across soils by herbicide, shoot and root dry weight orders were nontreated > diclosulam > flumioxazin > sulfentrazone while shoot length order was nontreated = flumioxazin = sulfentrazone > diclosulam. High pH soils (pH 7.8 for Tremona and Brownfield) significantly reduced peanut root dry weight to less than 74% of the nontreated checks for sulfentrazone, diclosulam, and flumioxazin. For sulfentrazone and diclosulam, this reduced root dry weight was attributed to an increase in solubility with increasing soil pH that increased the specific herbicides availability for uptake.

b When selecting which residual herbicide to apply to peanut, growers should make sure and test soil for pH and chose the herbicide which will best fit their weed spectrum needs. Spartan is no longer registered for use in Georgia peanut production.

c Hatch Act, state matching funds
d State Specific

- Goal 1-2

Double-cropped corn benefits from tropical background and transgenic technology

a Georgia growers looking for alternatives for summer crop production behind onions, winter grains, vegetables, and watermelons have had trouble finding profitable crops to grow that would fit into yearly rotations. Corn has been a poor alternative in years past due to the lack of disease and insect resistance in temperate hybrids. Studies were conducted to compare current temperate corn hybrids with adapted tropical hybrids and new transgenic hybrids and other grains including pearl millet and grain sorghum to find out if any grain crop would be suitable for production under late season conditions.

b A five-year study revealed disease resistant temperate Bt hybrids planted up to late May outperformed the tropical hybrids by 25 bushels per acre. However, if the temperate hybrids were susceptible to southern leaf blight and/or southern leaf rust, then the tropical hybrids were significantly better. In all cases, the Bt versions (insect resistant) of each hybrid out-yielded the non-Bt type by 12 bushels per acre. In very late planted conditions (late June and early July), tropical hybrids out-performed the disease resistant temperate by nearly 50 bushels per acre. Three times more grain was harvested in tropical hybrids than grain sorghum or pearl millet. Today, depending on when the corn is double-cropped, corn can successfully be used as an alternative to other crops in late planted conditions.

c Smith Lever, state matching funds
d State Specific

- Goal 1-12

Autumn vegetable response to residual herbicides applied previously under low density polyethylene mulch

a Spring vegetables grown after LDPE mulch fumigation include pepper, tomato, squash, and eggplant. A second autumn crop often includes cabbage, eggplant, cucumber, or squash. This second crop is either seeded or transplanted directly into the existing LDPE covered beds formed from the spring fumigation in order to grow two crops in one year and minimize expenses associated with polyethylene mulch and drip tape irrigation by spreading their costs over multiple crops. With the loss of methyl bromide as a fumigant, farmers will be dependent on herbicides for weed control in LDPE vegetable production. However, carryover issues from residual herbicides used for weed control could negatively impact second and third crop production.

For herbicides spring applied followed by autumn plantings, experiments indicated that in terms of tolerance to residual activity, cabbage, eggplant, squash, and cucumber were tolerant to Sandea (halosulfuron). Cabbage and eggplant were tolerant to Dual magnum (S-metolachlor). Squash and cucumber exhibited injury from Spartan (sulfentrazone).

b Growers should use caution when considering autumn plantings of seeded cucumber as data indicated that this species was not tolerant to spring applied Spartan to avoid costly crop failure. Growers have herbicide options for weed control when they are doing multiple crops such as eggplant, cabbage and squash.

c Hatch Act, state matching funds

d State Specific

- Goal 1-2

Improving reproductive efficiency and dairy management

a Currently, herd owners in Georgia continue to strive for ideas to improve reproductive management as well as milk production. Our ability to evaluate and assist producers in these efforts is essential. Techniques have been developed to inseminate cows on a timed breeding schedule rather than having to detect animals in standing heat prior to insemination. Current heat detection levels in Georgia are very low, and eliminating some of the need for heat detection could be extremely beneficial to producers and improve overall reproductive efficiency. Heifers do not respond the same as cows to typical ovulation synchronization treatments. More research is needed to evaluate a productive and cost effective synchronization program that is effective for heifers.

b Served as liaison between the Animal and Dairy Science Department and several groups, especially Georgia Milk Producers, Southeast United Dairy Industry Association, Georgia Department of Agriculture and Georgia Farm Bureau. Workshops were held for producers in Morgan, Putnam, Greene, and Macon counties. Topics covered included anatomy and physiology, heat detection, semen handling and placement, estrous synchronization, and setting achievable and attainable goals.

A study was conducted to determine if incorporation of gonadotropin releasing hormone (GnRH) and estradiol cypionate (ECP) into the controlled internal drug release (CIDR)-prostaglandin (PGF2a) protocol would increase pregnancy rates of dairy heifers using timed artificial insemination (TAI). Forty Holstein heifers with an average age of 16 months were randomly allocated to 1 of 2 treatment groups. In treatment 1, 20 heifers were synchronized by: 50 µg GnRH (-9 day), CIDR (1.38 g progesterone, -9 day), 25 mg PGF2a (-3 day), 1 mg ECP (-2 d), CIDR removal (-2 day), 50 µg GnRH (day 0), and TAI (0 day), (GnRH-CIDR-PGF-ECP). A second group of 20 heifers (CIDR-PGF) were synchronized by: CIDR (1.38 g progesterone) (-9 day), 25 mg PGF2a (-3 day), CIDR removal (-2 day), and TAI (0 day). Upon CIDR removal, retention rates and discharges were recorded. Estrus activity was monitored using Estrus$ Alerts (Universal Cooperatives, Eagan, MN) applied at day -3. Timed AI occurred 48 hours after CIDR removal. Pregnancy was determined by ultrasonography at 35 days post AI. For both treatments, CIDR retention rate was 100% and discharge was minimal with no significant effect on pregnancy rate. Pregnancy rates of heifers synchronized by GnRH-CIDR-PGF-ECP (9/20) were similar to those in the heifers synchronized with the CIDR-PGF protocol (11/20). In the GnRH-CIDR-PGF-ECP protocol, 16 of 20 heifers had Estrus$ Alerts that were all or partially rubbed while only 11 of 20 were observed in the control group. Additionally, 11/20 of the Estrus$ Alerts on heifers in GnRH-CIDR-PGF-ECP were completely rubbed compared with 3/20 in the control. Signs of estrus synchronization through visual appraisal of Estrus$ Alerts were significantly higher in the GnRH-CIDR-PGF-ECP heifers. Although the GnRH-CIDR-PGF-ECP protocol did significantly increase estrus activity, it did not increase pregnancy rates with a TAI. Additional experiments were conducted to test the efficacy of using progesterone treatment post AI to decrease embryonic mortality in dairy animals and to resynchronize estrus in dairy

and beef heifers. All animals were synchronized utilizing a single injection of 25 mg PGF2a and were inseminated 12 hours after animals were observed in standing estrus. Cows and heifers were randomly assigned to 1) receive post AI progesterone therapy from day 14 to 21 after AI using the CIDR insert (1.38g progesterone) (treatment) or 2) receive no further treatment post AI (control). This trial was split and run in the summer and winter seasons to determine progesterone variability. Supplementation of progesterone after AI had no effect on pregnancy rates in heifers or cows, regardless of season. Progesterone concentrations on day 21 in heifers, regardless of treatment, tended to be higher than those observed in cows. During both seasons, use of the CIDR maintained progesterone concentrations from day 14 to 21; however, there were significantly higher progesterone values throughout the winter season when compared with summer.

In another experiment, beef and dairy heifers were initially synchronized utilizing a new CIDR insert (1.38 g progesterone) (day -10) with a 5 cc injection of PGF2a at the time of CIDR removal (day -3). Animals were then artificially inseminated at 12 hours after detected estrus (day 0). At 14 day post insemination, all animals received the same previously inserted CIDR for a second 7- day period until removal on day 21, followed by reinsemination occurring 12 hours after detected estrus. Pregnancy rate response to initial synchronization was higher in both dairy (12/23) and beef (3/4) heifers compared with resynchronization, which yielded 51 pregnancy rates of 40% (4/10) and 50% (3/6), respectively. Use of the new CIDR insert significantly increased progesterone concentrations from day -10 to day -3 in heifers, whereas the used CIDR did not increase progesterone concentrations from day 14 to day 21. A mean increase in progesterone concentrations from day 14 to day 21 was a significant positive predictor of pregnancy. Furthermore, on day 21, progesterone concentrations were positively correlated with incidence of pregnancy at day 35. The use of exogenous progesterone maintains circulating blood progesterone concentrations in heat stressed heifers and non heat stressed heifers and cows. Although a used CIDR does not appear to maintain progesterone concentrations similar to those with a new CIDR, it did successfully suppress and resynchronize return to estrus. These studies provide our producers a better insight to how these techniques work and best fit management procedures.

Finally, assisted with the commercial and purebred dairy projects as well as other 4-H and FFA activities, including dairy evaluation and dairy quiz bowl. Training students on the relationship between type and production, as well as the life skills learned by raising an animal will continue to be beneficial. Over 200 animals participated at the UGA Commercial Dairy Heifer Show. Over 50 youth attended Animal Science in Action, a recruiting activity held annually in the department. Over $26,000 was distributed to worthy recipients through the departmental scholarship program. Fifteen students were advised. Four classes taught. Two undergraduate research projects were conducted. Additional assistance has been given using swine embryos to develop a system to improve freezing procedures for equine embryos. The Dairy Challenge is being developed to create an intercollegiate dairy management competition based on the examination of all aspects of a dairy business. In addition to the national contest, there are four regional contests held each year. The first Southern Regional was Nov. 19-21, 2006, in Roanoke, VA. Assistance was given to developing this regional activity and training a team to participate from UGA.

c Smith Lever, Hatch Act, state matching funds

d Integrated Extension and Research

- Goal 1-27

Hair sheep genetics

Sub-keys: Animal Genomics, Animal Production Efficiency

a Much of the expansion of sheep numbers in Georgia and the Southeastern states has been due to the availability of hair sheep grown exclusively for meat rather than meat and wool. Several breed options exist and there has been no clear information regarding comparative breed merits or their general combining ability. A need continues for research data which will add clarity to the choices that sheep owners will make within this production environment.

From an original base of 30 foundation ewes, the breeding flock has grown to approximately 100 ewes by retaining replacement female produced internally. A single 5.5 week breeding season in the fall results in lambs during March and April. The flock is maintained primarily on forage with modest amount of supplementation a few weeks prior to lambing. Research data are recorded on reproduction, growth, internal parasite tolerance, carcass characteristics, and composite economic factors.

Update information is contained in the Small Ruminant Center newsletter. Abstracts and presentations have been given at ASAS scientific meetings. A number of sheep owners have been counseled based on the information coming from the program. Lambs and ewes have been used in vegetation-management studies and market-assisted selection research. Update information has been informally provided at the annual meetings of the North Central regional sheep efficiency project.

b FVSU has become known as an active site in Georgia for the latest in sheep production system information. The flock has played a significant role in validating new approaches to internal parasite management. Flock production records provide field data for support of economic enterprise models.

c NARETPA, State Matching Funds

d State Specific

- Goal 1-24

Photoperiodic effects

Sub-keys: Animal Genomics, Animal Production Efficiency

a Success in production systems for goat is limited by reproductive inefficiency. The major reproductive constraint in goats is their breeding seasonality limiting transmission of desirable genetic traits. Photoperiodism influences the seasonality of breeding in both male and female goats. In dairy goat does, photoperiod causes anovulation while in bucks it results in inactive period of sperm production, and hence, minimal fertility. Unlike large ruminants and sheep, there is limited information on the goat as a research model for reproduction at the cellular level. Overcoming these constraints is critical for optimizing production and enhancing the competitiveness of the goat industry.

Projects were conducted to help unravel the endocrine basis of seasonal limitation in reproduction to improve productivity in goats; and improve techniques in goat in vitro fertilization, embryo transfer and cryopreservation of goat embryos.

We established contacts with reputable scientists due to the research and this provided exposure to good research laboratories for our scientists, students and staff. Papers were published in refereed journal, as well as in abstracts after presentation at scientific meetings. Visiting faculty and students participated in seminars and workshops.

b We participated in ag showcases, Sunbelt Expos and project directors' workshop where posters on project were displayed. Workshops on AI and embryo transfer trained producers to improve productivity. Further work is being done to refine techniques in goat cell manipulation and cryopreservation.

c Hatch Act, state matching funds.

d State Specific

- Goal 1-24

Improving calf weaning weights by deworming nursing calves

Sub-keys: Animal Health, Animal Production Efficiency

a A favorable climate for beef cattle parasites exists in Georgia. Parasites are particularly detrimental to performance of younger cattle. Nursing calves become infected as soon as they begin to graze, but most spring-born calves are never dewormed or only dewormed at weaning. This will not benefit the cow/calf producer that sells calves at weaning, which is a common practice. Deworming prior to weaning should improve the producer’s profits through the sale of heavier calves. Producers typically work cattle in the early summer to remove bulls, apply fly treatment, dehorn, vaccinate, etc. This would be an excellent time to deworm their cattle. A midsummer deworming demonstration would show cattle producers the benefits of deworming their cattle to improve calf weaning weights.

The study utilized 395 cow/calf pairs from three UGA research and education centers. Cattle were located at the Northwest Research and Education Center in Calhoun (209 pairs), the Central Branch Experiment Station in Eatonton (117 pairs), and the Southwest Research and Education Center in Plains (69 pairs). Calves were born from early-January to mid-March and were approximately 4.5 months old at initiation of the study. Treatments consisted of nursing calves dewormed 91 days prior to weaning at Calhoun, 97 days prior to weaning at Eatonton, 77 days prior to weaning at Plains, and a

non-dewormed (control) group of calves within each pasture group. One-half of the calves were dewormed and one-half were not dewormed. In addition, all cows were dewormed at the initiation of the study. All calves were weighed at the time of treatment, and approximately 30, 60 and 90 days (weaning time) following treatment at Calhoun and Eatonton.

b Deworming nursing calves about 90 days prior to weaning increased weaning weights at all locations. When combining both steer and heifer performance, weaning weights were increased by 2.8 lbs per calf at Calhoun, 5.9 lbs at Eatonton, and 8.5 lbs at Plains. Treatment costs on these calves would be approximately $1.50 per calf. With the high calf prices of recent years, expected returns would 2:1 (dollars returned per dollar invested) at Calhoun, 4:1 at Eatonton, and 9:1 at Plains. Calves can be dewormed when cattle are typically gathered to complete other procedures such as vaccinating, which greatly decreases labor requirements of deworming. This study showed that a mid-summer deworming of nursing calves can improve weaning weights, which will increase the profits of cow/calf producers.

c Hatch Act, state matching funds
d State Specific

- **Goal 1-14**

Feeding Tifton 85 bermudagrass to lactating dairy cows

Sub-keys: Animal Health, Animal Production Efficiency

a Feed costs represent the greatest proportion of the total cost of producing milk. Forage quality determines how much concentrate must be purchased to maintain milk production as well as potential milk yield. Higher energy prices have increased the cost of both producing forage and importing higher quality forage such as alfalfa hay. Tifton 85 bermudagrass. It is more digestible and produces greater yields than other bermudagrass cultivars. Previous research has shown a decline in intake and milk yield as the proportion of Tifton 85 in the diet increased compared with comparable diets containing alfalfa hay; however, milk fat percentage, dairy efficiency, and income over feed cost improved. Tifton 85 is more economical to produce locally compared with purchasing alfalfa hay, so its use in dairy rations could potentially reduce production costs. Tifton 85 also reduces soil erosion compared to planting annuals and can effectively use nutrients from dairy waste in support of growth. There are commercial enzyme products currently available that could improve fiber digestibility even more which could improve milk yield and net income and reduce the amount of waste produced by dairy cows. Limited data are available for dairy producers to use in determining the economics for using Tifton 85 for lactating dairy cows or the potential return for use of enzymes.

Forty-four Holstein cows were used in an 8-week trial to determine the effect of feeding diets based on corn silage plus either Tifton 85 bermudagrass or alfalfa hay (12.2% of ration DM) and treatment with a commercial enzyme on performance and income over feed cost. Total intake and milk yield were measured daily and composition of milk was determined weekly.

b Cows fed diets containing Tifton 85 bermudagrass consumed similar amounts of dry matter and produced equal amounts of milk as those fed diets containing alfalfa hay. There were no differences in milk composition. Based on feed ingredient cost at the time of the trial, income over feed cost was lower for cows fed the diets containing Tifton 85 bermudagrass.

Application of the commercial enzyme did not enhance milk yield or composition or alter intake. These results suggest that dairy producers should consider Tifton 85 bermudagrass as a forage source to maintain performance of their cows, reduce feed cost, and improve net income.

c Hatch Act, state matching funds
d State Specific

- **Goal 1-14**

How much free-choice cottonseed will mature beef cows consume when fed with hay?

Sub-keys: Animal Health, Animal Production Efficiency

a Cattle production in Georgia has become more efficient in recent years with utilization of improved production practices, including feeding of by-product feeds like whole cottonseed (WCS) with hay to beef cows. Both energy and protein are provided by WCS. It has a value similar to a 20% protein mixture of corn and soybean meal, making it worth around $150/ton. Prices of WCS vary with location and proximity to gins, annual production of cotton as affected by total acres planted, weather, and

demand. Cottonseed is high in energy and protein, but also relatively high in fiber. It can be effectively used by mature cows with well-developed rumen capacity, and it is often fed at recommended rates of 0.5% of cow body weight (5 lb. cottonseed/cow daily for 1,000-lb. cows; 6/cow daily for 1,200-lb. cows, etc.). This level of supplementation provides adequate protein and extra energy for cows fed medium quality hay during winter. The WCS contains about 20% crude fat; therefore, cows fed 5 lb. of WCS daily will be consuming fat or oil at about 1 lb/day. This level of fat is apparently not detrimental to cows; however, feeding higher levels of WCS may cause depressed hay intake and decreased digestibility of the total diet because of ruminal bacteria population shifts away from fiber digestion. Some producers wish to save labor and time by feeding WCS free-choice or self-feeding to cows. Experiments were conducted to determine how much WCS mature cows and 1,000-lb. steers would consume if it was fed free-choice.

Supplemental WCS and free-choice bermudagrass hay were fed for 63 days in hay rings on dormant pastures to determine maximum WCS intake by beef cows. Non-pregnant cows were ranked by weight, assigned to six groups randomly assigned to dietary treatments: Low WCS (LCS; 0.25% initial BW); Medium WCS, (MCS; 0.5% initial BW), and WCS fed free-choice (FCS). On day 1 and 63, body condition scores (BCS; scale 1 to 9; 5 = avg. condition), and ultrasound fat depth at the 13th rib (UR, in) were determined (initial BCS = 4.5; initial UR = 0.26 in). Beef steers (n=21, 1000 lb initial wt) were assigned to LCS, MCS and FCS treatments with bermudagrass hay, and individually-fed diets for 17 days to determine WCS intake.

b Daily intake of WCS and hay by cows on LCS, MCS, and FCS, respectively, were: 2.6, 23.2; 4.63, 29.1; and 9.5, 26.0; resulting in higher total dietary intake for MCS and FCS. Steers had similar hay intake for LCS and MCS, but lower hay intake for FCS (5.6 and 5.3 vs. 3.7), and increasing WCS intake for LCS, MCS and FCS (2.3, 4.6 and 7.7 lb/d). Cow ADG was affected by a cow breed X treatment interaction, with higher ADG on MCS and FCS than LCS (1.46 and 1.41 vs. 0.81 lb) for British cows, and more variable, but higher ADG for FCS than LCS and MCS (1.72 vs. 1.28 and 0.86 lb) for Brahman crossbred cows. Both BCS and UR (in) were higher ($P < 0.01$) for MCS and FCS than LCS (4.9, 0.34 and 4.9, 0.44 vs. 4.4, 0.26). Gains and body fat increased in cows on FCS, but cows ate more WCS (9.5 lb/d) than producers might expect. Current WCS costs, increased potential for digestion problems and gossypol poisoning make free-choice WCS feeding to cows a highly questionable practice.

c Hatch Act, state matching funds

d Multi-State Research: NC

- **Goal 1-14**

Regulation of gonadotropin secretion in pre-pubertal swine

Sub-keys: Animal Health, Animal Production Efficiency

a Reproduction is one of the major factors limiting the efficiency of livestock production. Although much progress has been made, infertility remains one of the major causes of economic loss in the livestock industry. The main reason for infertility is the various anestrous states (e.g. pre-pubertal, postpartum, seasonal, nutritional) that domestic livestock experience during their productive lifecycle. All anestrous states typically share one fundamental characteristic, inadequate gonadotropin-releasing hormone (GnRH) secretion from the hypothalamus, which in turn causes a lack of gonadotropin release from the anterior pituitary gland. Many factors such as suckling, inadequate nutrition, or photoperiod are known to have negative effects on the hypothalamic-pituitary axis, but the mechanisms whereby they act to regulate GnRH secretion have largely remained a mystery. It's widely held that stimulation of GnRH secretion reflects a decrease in inhibitory inputs and/or an increase in stimulatory inputs to GnRH neurons in the central nervous system. Yet the neurosecretory pathways that provide these inputs to the GnRH neuronal system have yet to be fully elucidated. The end result then is that our efforts to manipulate the hypothalamic-pituitary axis (such that animals start cycling earlier in the breeding season, attain puberty at optimal time points for efficient production cycles, or have shorter postpartum intervals) continue to be limited; a situation likely to persist if we don't continue seeking to elucidate the basic neuroendocrine mechanisms that regulate the gonadotropic-axis.

Recently, the newly identified peptide hormone kisspeptin has been implicated in regulating the hypothalamic-pituitary axis in laboratory animals. To determine if this novel hormone has a role in regulating reproductive function in domestic livestock, faculty conducted a study in which we administered kisspeptin (KISS1) into the lateral ventricles of the brain of prepubertal pigs. We collected serial blood samples and compared secretion of the major gonadotropin, luteinizing hormone (LH),

before and after infusion of KISS1.

b Intracerebralventricular infusion of KISS1 caused a rapid increase in LH secretion in prepubertal gilts. Of particular interest is the striking potency of this hormone in inducing LH secretion. It is the most potent stimulant of gonadotropin secretion since the discovery of GnRH over 30 years ago. Our current hypothesis is that deficiencies in kisspeptin secretion may underlie the various anestrous conditions of domestic livestock. Additional studies to understand its role in regulating reproduction will improve our ability to manipulate the hypothalamic-pituitary axis for increased reproductive efficiency in farm animals.

c Hatch Act, state matching funds
d State Specific

- Goal 1-18

Dairy business analysis project

Sub-keys: Animal Health, Animal Production Efficiency

a The U.S. dairy industry has shifted towards highly intensive, specialized and localized production systems driven by competitive economic, social and political forces. For dairy managers to make critical decisions, they need financial as well as production data.

The cooperative Dairy Business Analysis Project between University of Florida and UGA is continuing. Data collection is ongoing for 2005. In 2004, 22 dairies submitted financial data and were included in the summary results. Of these, 15 were located in Florida and seven in Georgia. The average herd size of the participating dairies was 1,170 cows and 585 heifers with 18,207 lbs. milk sold per cow. The average culling rate was 31%. The milk price received by DBAP participants averaged $18.98, 19% more than in 2003. Average total revenues were $20.89 per cwt. sold. Total expenses averaged $19.39 per cwt., an increase of $1.12 compared to 2003. The largest items were purchased feed ($8.13) and personnel costs ($3.17). Net farm income from operations averaged $1.50 per cwt., an increase of $2.01 compared to 2003.

b The project's database was used to update dairy budgets and for class resources. The budgets have been used by farm services and commercial banks to evaluate loans and work with current customers. Comments from bankers say the budgets allow them to make realistic evaluations for producers.

c Smith Lever, Hatch Act, state matching funds,
d Multi-State Integrated Extension and Research: NH, FL

- Goal 1-22

Neuroendocrine systems

Sub-keys: Animal Health, Animal Production Efficiency

a Photoperiod and hormone manipulation can induce off-season breeding in goats. However, such techniques are not very efficient. Faculty's studies of the neuroendocrine pathways of the goat physiology will provides insight into understanding and better manipulate the breeding cycles of goats to improve productivity. Projects were funded to investigate the role of certain neurotransmitters in maintaining anestrus in goats.

b An excellent facility on neuroendocrine investigation resulted. This has enhanced scientists' research capability, and improved the leadership role in reproductive research. The Animal Science Unit can train graduate students in neuroendocrine research. Our labs can assay protein and steroid hormones. Our results indicate that neurotransmitters are involved in the regulation of hormonal secretion which determine the breeding and non-breeding seasons in goats. Manipulation of these neurotransmitters may help regulate efficiently the seasonality and improve the breeding patterns in goats. We participated in poster and presentation of data at ag showcases, conferences and workshops.

c Hatch Act, state matching funds
d Multi-State: IA, ID

Key Theme: Plant Genomics

- Goal 1-11

Understanding the organization and evolution of the wheat genome

a Wheat is an important staple crop world-wide and would benefit from having its genome sequenced. However, the bread wheat genome is some 130 and 40 times larger than the arabidopsis and rice genomes, respectively, the only plant genomes that have been fully sequenced to date. The development of new sequencing strategies for bread wheat will require more detailed insight into the organization of the wheat genome.

220 randomly selected BAC clones are in the process of being sequenced, annotated for gene content and mapped to sets of overlapping terminal deletion lines. To ensure that all BAC clones, including those that lack genes, can be mapped, a new technique was developed whereby repeat junctions are used as single or low copy markers.

b The obtained data allow us to project the total number of genes present in hexaploid bread wheat, the organization of genes and repeats, and consequently, the minimum number of BAC clones that would need to be sequenced in a whole-genome-sequencing project to identify 95% or more of all wheat genes.

c Hatch Act, state matching funds

d Multi-State Research: IA

- Goal 1-11

Isolation and functional analyses of genes affecting plant height in cereals

a Reducing plant height in wheat and rice has led to a doubling of grain yields and to a phenomenon called the Green Revolution. However, a need of alternative dwarfing genes might be useful in different environments. In pearl millet, an important fodder and grain crop in Georgia, the U.S., West Africa and India, the major height reducing gene used in commercial hybrids is d2. The d4 dwarfing gene yields a too extreme phenotype to have economic value in pearl millet. However, our lab has shown that d4 interacts with a second gene, designated Br1, to give plants of intermediate height. Our objective is to isolate d2, d4 and Br1, and to study their effects across cereals.

The d2, d4 and Br1 genes have been mapped in pearl millet. Neither d2 nor d4 correspond to the rice or wheat Green Revolution dwarfing genes. Work is underway to isolate d2 by map-based cloning. For d4 and Br1, candidate genes have been identified using pearl millet – rice comparative information.

b It has been demonstrated that d4 might have commercial value in certain varietals backgrounds. Mapping of the d2 gene and the lack of known orthologous dwarf mutants in other cereals suggests that this might be an as yet unidentified gene. This is also true for Br1. This research will provide new knowledge on mechanisms of height reduction in cereals.

c Hatch Act, state matching funds

d State Specific

- Goal 1-11

New wheat releases

a The UGA Small Grain Breeding Team is working to develop improved cultivars to the stripe rust and wheat soil-borne mosaic virus. Increasing yields and improving disease and insect resistance, and improving milling and the baking quality of small grains will help to insure their economic viability. New resistant genes for leaf rust, powdery mildew and Hessian fly are also being crossed to adapted cultivars and selected for resistance to combat the new races of pathogens and insects.

The UGA Small Grain Breeding Team is part of a regional program with five other universities and has been involved in release of broadly adapted cultivars. In 2006, three new high yielding wheat cultivar, GA 951079-2E31 and GA 951216-2E26, were exclusively released to private companies. A wheat line, LA95135, and an oat line, LA966-270, were co-release as part of the regional program.

b These new wheat releases are high yielding cultivars with excellent test weight and disease and insect resistance and will offer new source of resistance to both pathogens and insects. These wheat cultivars

will provide excellent resistance to two new pests in Georgia and the Southeast, stripe rust and wheat soil-borne mosaic virus.

c Hatch Act, state matching funds
d Multi-State Research:

- Goal 1-11

Genetic markers for root-knot nematode resistance in cotton

a Southern root-knot nematodes (RKN) reduces profits from Georgia cotton producers through yield loss due directly to RKN or indirectly to other diseases associated with it such as seedling diseases and fusarium wilt and increased production costs by nematicide applications. Although nematicides are effective in controlling RKN, they do not provide season-long protection and their future availability is uncertain due to environmental concerns. Further, in fields below threshold levels of RKN, small yield losses that do not justify the cost of nematicide application can occur. At times when the costs input of cotton production are increasing and prices of fiber are at historical lows, any loss of yield can be considered economically significant.

The development and use of cultivars with resistance to RKN offers the best management tool for RKN. Cotton germplasm with RKN resistance has been extant since the development of Auburn 623 germplasm lines in 1974 and the resistance in this line has been transferred to lines with acceptable agronomic qualities. Yet, none of the currently grown commercial cotton cultivars expresses a high level of resistant to root-knot nematodes. The slow breeding progress for developing RKN resistant cultivars is partly due to the current screening process that is tedious, time consuming and destructive for identifying resistance genotypes. Molecular marker offers an alternative screening process for identifying resistance genotypes in breeding programs. The development of diagnostic markers for genes conditioning RKN resistance will accelerate the transfer of these genes to genotypes or germplasm for new cultivar development.

b Faculty's genetic mapping analysis has determined that the SSR marker CIR316 on chromosome 11 and the RFLP marker G1158b on chromosome 7 show significant association with the resistant phenotype. Therefore, we have accomplished our main objective in identifying the chromosome locations and linked DNA markers to the resistant genes. This result represents a major milestone in our understanding of the genetics of root-knot nematodes resistance in Upland cotton and will pave the way to the development of a more efficient selection strategy for breeding resistant cultivars.
c Hatch Act, state matching funds
d Multi-State Research: TN

- Goal 1-11

Improving finger millet

a Finger millet is an important staple crop of Southern India and East Africa. Very little crop improvement has been carried out and in some countries yields have actually declined. Classical breeding using a range of varieties combined with biotechnology approaches could yield varieties that have the characteristics required by the farmers but have a superior agronomic performance.

A finger millet rice comparative map, outlining the relationships between the genomes of finger millet and rice, has been completed. Further microsatellite markers are being developed and mapped and will be made available to the developing world as tools for marker-assisted selection in finger millet.

b The comparative maps allow the exploitation of the rice genomic sequence in the study of finger millet. Knowledge available in rice on blast resistance can be transferred to finger millet. Blast is the major yield decreasing factor in finger millet. The markers generated within this project will be available for distribution to interested parties.

c Hatch Act, state matching funds
d Multi-State (International): India, Kenya, WI,

- Goal 1-11

Georgia 05E

a Georgia leads the nation in total annual peanut production with nearly half, and average state peanut yields have more than tripled in the latter half of the 20th century. Publicly developed cultivars have played a major role in this overall process, and the quality of this vitally important commodity has likewise been enhanced. The Georgia Peanut Breeding Program is actively involved in the development of improved cultivars with desirable traits for increasing dollar value, yield, grade, disease resistance, insect resistance, virus resistance, nematode resistance, aflatoxin resistance, drought resistance, better shelling characteristics, longer shelf-life, and enhanced flavor and nutritional qualities. Possibly, no other single research effort can benefit the whole peanut industry as much as an improved cultivar.

b 'GEORGIA-05E' is a new high-yielding, high-oleic, multiple-pest-resistant, Virginia-type peanut variety that was released in 2005 by the Georgia Agricultural Experiment Stations. It was developed at UGA's Coastal Plain Experiment Station in Tifton, GA. Georgia-05E has the high-oleic (O) and low linoleic (L) fatty acid ratio for improved oil quality. In multilocation tests conducted in Georgia during 2001-05, Georgia-05E was found to have significantly less disease and higher yield, grade, and dollar value return per acre than Georgia Hi-O/L, Perry, Gregory, NC-V 11, and Wilson. These other Virginia-type varieties are all very susceptible to both early and late leafspots. However, Georgia-05E has shown leafspot resistance and tomato spotted wilt virus (TSWV) resistance comparable to some of the more disease resistant runner-types. It has also shown moderate insect resistance to potato leafhopper. Georgia-05E has a runner growth habit, medium-late maturity, tan seedcoat color, and a higher percentage of extra large kernels (ELK) compared to other Virginia-types.

c Hatch Act, state matching funds

d State Specific

- Goal 1-11

Growing the best adapted cultivars of agronomic crops in Georgia

a Farmers want and need to grow the best adapted crop cultivars to be successful but do not have the time or resources to plant several cultivars to determine which are best. That's where UGA agronomists step in to help. The college's variety testing team does the work and research for the farmers. They do variety research on public and private developed cultivars of corn, soybean, peanut, cotton, grain sorghum, wheat, barley, rye, oat, triticale, canola, summer annual forages, and winter annual forages each crop year. The research is conducted within each of the seven major geographic regions of Georgia to collect agronomic data such as yield, bloom date, maturity date, test weight, height, lodging, seed size and seed shattering, and tests for resistance/tolerance to pests and disease. The information is then published annually in five research reports made available to farmers, private industry, and other researchers in a timely manner. A website on the internet, electronic bulletin boards and a CD are also used to distribute the information.

The Georgia cultivar evaluation and crop management, Statewide Variety Testing, (SWVT) program during 2006 conducted numerous experiments within each of the seven geographic regions of the state, thus identified numerous public and commercial row crop and small grain cultivars of corn, soybean, grain sorghum, peanut, cotton, wheat, barley, oat, rye, triticale, canola, summer and winter annual forages adapted to Georgia growing conditions. Five Georgia Ag. Experiment Station reports on variety evaluation were published. The SWVT website (www.griffin.uga.edu/swvt) is used to make the data available electronically. There are 10 years of data on the web site (1997-2006). Data was obtained and disseminated on cultivar resistance or tolerance to the prevalent pests found in Georgia on soybean, wheat, corn, and grain sorghum. Also, data collected on tobacco varieties is published in the report on peanuts and cotton.

b Numerous public and commercial row crop and small grain cultivars of corn, soybean, grain sorghum, peanut, wheat, barley, oat, rye, triticale, canola, summer annual forages and winter annual forages were identified during 2006 as adapted to being successfully grown in Georgia. Two new Med-maturity runner type peanut variety(GA 011557, and GA 011568) from the Georgia breeding program and two new late-maturity runner type peanut variety from USDA-Georgia (Tifrunner and Attaboy) and two new peanut varieties from Florida (ANorden and Hull), one new peanut varieties from AgraTech (AT3085A), One new high yielding herbicide resistance soybean varieties (Ga 04G2261 named P97M50), two new high yielding disease resistant wheat variety (AGS 2010)(Vigoro-McIntosh), one new high yielding, disease resistant oat variety (Trophy), two new rye varieties (AGS 104, Boss) high yielding for both grain and forage, and one new high yielding, disease resistant triticale (Trical 342) were released during 2006 using SWVT data.

Peanut varieties identified by the SWVT program as adapted to Georgia growing conditions and having tolerance to tomato spotted wilt virus were used by the Georgia Cooperative Extension Service in production indexing that had an added value to the Georgia peanut producer in excess of $50 million during 2006 mainly due to less TSWV disease.

Wheat varieties that benefit from fungicide application were identified. Soybean varieties that are tolerant to several nematodes and soybean stem canker were identified.

c Hatch Act, Smith Lever, state matching funds
d Integrated Extension and Research

- Goal 1-11

Development of seeded seashore paspalum for coastal reclamation

a Seashore paspalum is a native coastal grass with tolerance to many of the environmental stresses commonly associated with coastal environments. Most importantly, this relatively unknown species tolerates soils with high salt concentration. UGA has thus far released three vegetatively propagated seashore paspalum cultivars for use on golf courses and other recreational uses in tropical and sub-tropical environments. Because of their tolerance to salt, these cultivars will grow where other grasses won't. Traditionally, seashore paspalum has been reproduced vegetatively using sod or sprigs because this plant produces very few seed and the seed that it does produce do not germinate due to an inherent dormancy. This species holds great promise for reclamation use on salt-affected sites, but establishing it vegetatively is too difficult and costly for most environmental reclamation projects. Seeded types of seashore paspalum are needed to make establishment easier and less costly.

University scientists collaborating with a private seed company in Oregon have now overcome inherent problems with self-incompatibility by inter-planting two different ecotypes of paspalum that can pollinate each other. The result is the world's first seeded seashore paspalum cultivar, Seaspray. Unfortunately, seed dormancy and related germination issues remain a problem in this new seeded cultivar. Although the seed produced are viable, the rate of germination can be as low. UGA scientists are now working to learn how to overcome the dormancy so the seed will germinate reliably. Recent breakthroughs in the research laboratory provide great hope that seeded seashore paspalum cultivars may soon be available for a host of uses including erosion control along salt water estuaries, reclamation of dredged sites, stabilization of coastal soils, plant cover for effluent application fields, and recreational uses on salt-affected sites.

b The development of seeded cultivars of seashore paspalum will provide an environmentally sound solution to many issues associated with urbanization of coastal areas. In the near future, seashore paspalum will be used to restore and maintain our fragile coastal environments by providing protection of water, soil, and other valuable natural resources.

c Hatch Act, state matching funds
d State Specific

Key Word: Small Farm Viability

- Goal 1-5

Small farm visibility

a New opportunities in small farm enterprises often become available to landowners generally but may not be taken up by some of our target social sectors immediately. Constraints such as shortage of information and in adequate time invested by specialists and Extension educators can be cited. Currently new opportunities in market goat production exist. Our goal is to provide tangible support for small farm owners in the Black Belt of the South.

Two years ago five African-American landowners in four counties were identified as having potential to benefit from meat goat production. Each farmer was provided a new small herd, shelters, holding pens, feed troughs and a variety of small supplies needed for husbandry and health care. Farmers were trained by county agents of specialists at group or individual training sessions. A total of 42 male

market goats was sold through the project and money returned to individual owners for profit. A total of 44 females went back into the herds for expansion. Some were sold as breeding stock to neighbors. A PowerPoint presentation on project progress was developed, and farmers were made aware of new informational resources as they became available.

b Both positive and negative impact was evident. Some of the new meat goat owners were not aware of the time investment and daily oversight that a viable enterprise required. However, in several cases the family children learned responsibility for feeding, observation and care of the goats. Positive financial returns were in evidence and pride in the product was shown.

c Smith Lever, state matching funds

d Multi-State: AL, FL, AR, TX

Key Word: Animal Genomics

- **Goal 1-13**
  Incorporating weights for animals measured at any age into beef genetic evaluation programs
  Sub-keys: Animal Production Efficiency

a Many areas of the United States have experienced severe drought conditions over the last several years. A management response to stress on cows and calves has been to early wean calves. Breed association genetic evaluation systems do not permit use of records for calves younger than 160 days because weight at 130-140 days is a different trait than weight at the standard age of 205 days. Also many producers weigh their calves past the maximum recommended yearling age of 410 days due to management or marketing considerations. Eliminating data from early weaned calves and late measured yearling animals results in a significant loss of data to evaluate the growth potential of calves and milking ability of their dams. Also for some herds, elimination of early weaned and older yearling records results in a significant loss of data for calves born over several years. This project addresses incorporating animals measured at any age into genetic evaluation, including records from early weaned and late measured yearling animals.

Scientists at UGA's Animal and Dairy Science Department have conducted research that has focused on the development of random regression models that can theoretically handle weights at any age and can also predict weight genetic values on an animal at any age. Models containing polynomial effects and models containing spline functions have been developed and investigated for their ability to model the continuous nature of growth in cattle to provide genetic values comparable to multi-trait models. Early results demonstrate that both polynomial and spline are function able. Random regression models yield genetic values that are highly correlated with the genetic values of the typical multi-trait model for the evaluation of birth, weaning, and yearling weight when data within normal age ranges were used. Rank correlations were lower between the genetic values produced from random regression models and a multi-trait model when data outside normal age ranges were included. The research thus far strongly indicates that both random regression models with polynomial effects and models with spline functions can be used to provide genetic values for growth traits on animals measured at any age. However, for the purposes of routine genetic evaluations, spline functions provide the most flexibility of implementation with the least computing cost.

b This research is paving the way for the inclusion of data for growth traits that have thus far been eliminated in U.S. beef breed association genetic evaluation programs. Including this new data will enhance the accuracy of evaluation and will enhance the ability of seed-stock producers to make selection decisions and market their cattle.

c Hatch Act, state matching funds

d State Specific

- **Goal 1-13**
  Producing value added animal products through cloning procedures
  Sub-keys: Animal Production Efficiency

a It is estimated that approximately $250 is lost due to waste and lack of uniformity in every beef carcass processed. In the U.S., billions of dollars of waste can be eliminated through improved genetics and increasing uniformity. Cloning provides a partial solution to these problems.

The recent advances in cattle cloning technology are important but there are still major obstacles preventing widespread commercial use of this technology. The problems preventing commercial use in animal agriculture are the relatively low pregnancy rates, abortions and high neonatal mortality rates in cloned offspring. These problems require cloned animals have a high value added. We have developed a procedure to collect cells from animals so we can collect both performance data as well as carcass characteristics. This level of sophistication should allow us to produce more valuable offspring under certain environments such as grass fed beef in Georgia.

b We were able to take cells from a beef carcass and propagate cells in vitro and produce a cloned animal. The cells from the kidney and the intercostals regions were collected and propagated using previously developed cell and tissue culture techniques. Using nuclear transfer techniques the cloned embryos were produced. Ten resulting blastocyst stage embryos were transferred to the recipient cows and three pregnancies were produced. One live calf was produced derived from the kidney cells (named K.C.). K.C. has produced a calf and is pregnant again and we are monitoring her reproductive performance. In 2005 and 2006 K.C. has produced two normal offspring and the 2006 offspring is with calf now.

The Food and Drug Administration has not yet approved cloned animals for consumption, and this year we have taken steps to address concerns. We have participated with industry partners and provided the animal carcass data and reproductive performance data the FDA needs to make an informed decision. There have been policy debates, public forums and popular press articles through which we have helped provide information to the public. In the future, once FDA approves the cloning process for human consumption we plan to take cells from steers raised on grass, no hormones or antibiotic, and produce a high yield and quality carcass for future breeding herds. We will select animals based on marbling and tenderness. The value added here is providing producers a source of genetics that can be sold to consumers that desire organically grown animals and or better quality retail cuts. This technology will allow Georgia beef producers to lead the beef industry into a new era in cattle genetics. In addition, we are in the planning phase to collaborate with investigators in Chile to start cloning research there in cattle and horses in 2007.

c Hatch Act, state matching funds
d State Specific

- **Goal 1-13 Improving fertility of Holsteins**
  Sub-keys: Animal Production Efficiency

a There is a worldwide perception of decline in fertility in Holsteins. Many inseminations are usually required for a successful conception. The decline is especially acute in the hot season.

Analyses involved service records of Holsteins in the Southeast born from 1985 to 1999. Factors considered in analyses included the level of production, days in milk, AI status, month of calving, month of insemination, and year of birth. Because of large number of incomplete records, the data needed extensive editing, and results should be interpreted as trends rather than definite numbers.

b For AI services, the average conception rate (CR) decreased by 9% from 1985-89 to 1995-99. Considering the month of service, the smallest decrease was 5% in January and the steepest decrease was 15% in June. High performing cows had CR about 3% lower. For cows born during 1995-99, CR increased by 12% from 50 to 125 days-in-milk. Fertility of Holsteins declined over time, with most of the decline in the Southeast over the summer season. Considering improvements in cooling systems over time, the real decline of fertility during the summer season was even higher. Results from a separate study indicated increased loss of heat tolerance when selection was for fluid milk as opposed for a type-production index. The continued selection for production in Holsteins affects fertility in the Southeast more than other regions. To reverse this trend, bulls selected for the Southeast should be weighted stronger on fertility and productive life and less on fluid milk.

c Hatch Act, state matching funds
d State Specific

Key Word: Animal Health

- **Goal 1-13**

  Effect of phytase on phosphorous balance in growing pigs

  Sub-keys: Animal Production Efficiency

  a Phosphorous and nitrogen are of major concern as environmental pollutants. In particular, phosphorous is associated with algae growth in fresh water supplies, which can result in oxygen depletion and fish kills. The primary sources of phosphorous are wastewater treatment plants, urban and agricultural runoff, and animal waste. Phosphorous (P) is an essential nutrient in livestock diets and is necessary for bone growth and multiple other functions. The P in typical diets is from grain and other plant materials such as corn and soybean meal, as well as from inorganic sources such as dicalcium phosphate. Much of the P in plant material is biologically unavailable to nonruminant animals because it is in the form of phytic acid. In typical swine and poultry diets, one-third to one-half of the total P is in the form of phytic acid or phytin phosphorous. Thus, a portion of the P entering the environment could be reduced by making this plant form of the mineral available in the digestive tract. Currently, the most practical means to improve P availability is to add the enzyme phytase to the diet. However, concern has been that while phytase will improve P digestibility and reduce fecal levels, the additional P absorbed may simply be excreted in the urine and thus have a limited impact on the total net excretion by the animal.

    We have recently completed studies looking at the effect of phytase on phosphorous balance in growing pigs fed normal and reduced P diets. A standard diet fed to growing pigs will contain 0.6% total P in order to provide approximately 0.3% available P. We compared such a diet to one in which the amount of inorganic P was reduced and that contained total P of 0.4% P. Both diets were supplemented with various levels of phytase and fed to growing pigs for 2 weeks. Phosphorous excretion in feces and urine was determined.

  b Pigs fed normal or reduced phosphorous diets without phytase had fecal phosphorous concentrations of greater than 2.0% on a dry matter basis. Addition of phytase to the low phosphorous diet resulted in a reduction in fecal phosphorous content to approximately 1.0% with high levels of enzyme. Urinary excretion of P increased with phytase, but this was a minor contribution to the total excretion. It appears that the P that is made available in the digestive tract by phytase is absorbed and retained by the pig. We have evidence that this P is used to support greater bone growth and is not excreted from the pig. This could have a major impact on the livestock industry as states move toward phosphorous-based land application regulations. With the results in these studies it will be possible to use less land to apply nutrients from swine or poultry operations using phytase.

  c Hatch Act, state matching funds

  d State Specific

- **Goal 1-14**

  Using the heat increment of feed ingredients to formulate diets which create less heat stress in dairy cows

  Sub-keys: Animal Production Efficiency

  a Heat stress seriously limits milk production and reduces the economic returns of dairies. Dairy cows are subject to heat stress for several months each year in Georgia and the Southeast. Symptoms include reduced feed intake and milk yield, weight loss, reduced production efficiency (less milk per pound of feed), impaired reproductive performance, and numerous health-related issues, which seriously impact the profitability of Georgia dairy farms. Heat stress is caused by the cow's inability to maintain normal body temperature. Feeding cows to minimize metabolic heat production should help alleviate some of the effects of heat stress and make cows more efficient during hot weather.

    A research study was conducted at the UGA Tifton campus to evaluate diets with varying heat increments for their effect on lactating dairy cows during hot weather. Diets with high theoretical heat increments were formulated using high forage content, high levels of fibrous by-products, and moderate to low levels of fat and highly fermentable carbohydrates, while diets with low theoretical heat increments were formulated using higher levels of fats and fermentable carbohydrates, and lower amounts of fibrous ingredients. Cows were fed during the heat of the summer, from June 15 through August 24, 2005. During this time, the mean maximum and minimum temperature and relative humidity were 88.2 and 73.2°F, and 99 and 61%, respectively.

b Even though high heat increment fed cows consumed more feed than their low heat increment counterparts, both groups consumed a similar amount of energy and produced similar quantities of milk (average of 76 lb. per day). There was a minor trend for improved efficiency of energy use for cows fed the low heat increment diet. In addition, the low heat increment cattle had an improved energy balance over the high heat increment fed cattle. Additional research is needed to determine if feeding lower heat increment or "cooler" diets will lead to improved production due to lower heat stress and greater efficiency of production. However, results suggest there is potential to feed diets formulated for reduced metabolic heat production in dairy cattle during hot weather, which may help to alleviate heat stress and contribute to improved efficiency of production and greater economic returns.

c Hatch Act, state matching funds

d State Specific

- Goal 1-5 and 1-25

Small ruminant herd health management

Sub-keys: Animal Production Efficiency, Diversified/Alternative Agriculture, Niche Market, Small Farm Viability

a Due to increased growth in the small ruminant industry in the U.S., we have seen increased need for scientific information and recommendations for small ruminant herd health management practices for increased productivity. Researchers compiled data; developed herd health management, vaccination, disease prevention protocol, as well as parasite control measures for small ruminants; and disseminated this information through extension activities. Herd Health Management recommendations, including FAMACHA parasite control management system cards and workshop are used by over 6,000 producers and implemented nationally, resulting in reduction in herd production losses. Additional information was posted on our website at www.scsrpc.org.

b The researchers were invited to make expert presentations at professional meetings. Published The Goat Handbook by Barron's educational series; served as caprine section editor for a textbook "Current Therapy in Large Animal Theriogenology 2"; provided updates to veterinarians, Georgia Department of Agriculture, USDA Veterinary Services, American Association of Small Ruminant Practitioners, U.S. Animal Health Association, American Dairy Goat Association, Georgia Veterinary Medical Association and other regional, national and international entities; participated in four funded research projects; and served on several state and national committees and organizations. They also submitted three proposals for funding; received funding for a new SARE proposal; made six producer programs and eight invited presentations at regional, state and national meetings; published seven manuscripts; and responded to 1,106 veterinary consultation and problem-solving activities for small ruminant farmers, extension agents, and veterinarians throughout the state and the nation.

c Smith Lever, Hatch Act, NARETPA, State Matching Funds

d Multi-state Integrated Extension and Research: AL, LA, FL, OK

- Goal 1-14

Tri-state horse round table

Sub-keys: Grazing, Small Farm Viability

a The equine industry in Georgia continues to grow annually. The 2005 Georgia Farm Gate Value Report ranks horses seventh in economic impact. Much of this growth is due to the increasing number of small farms or mini-farms. These small farms are popping up throughout the state but especially in growing metropolitan counties, such as Walker County in northwest Georgia. The total number of farms in Walker County grew by 34% from the 1997 census to the 2002 census. During that period, the number of farms from 10 to 49 acres in size increase by 72 farms. Managing small acreage of pasture for horses requires special knowledge to maintain quality forages. Knowledge in maintaining pastures and supplemental feed are essential in keeping horses healthy and maintaining a pleasing environment.

Eight county agents from Georgia and Tennessee in the Chattanooga metropolitan area and equine specialist from both states joined forces to conduct the Tri-State Horse Round Table in East Ridge, TN. Following the talks the presenters formed a panel for a question/answer session. The program was promoted to the horse clientele in the northwest Georgia, southeast Tennessee, and northeast Alabama areas.

b Ninety-nine individuals attended the three-hour program. Three of the nine attendees from Walker County called the Extension office afterwards for additional information and/or help with their horse pastures, two of which included follow-up farm/site visits. Participants ranked the program very beneficial through an evaluation survey. Due to the interest they indicted at the Tri-State Horse Round Table, a Tri-State Horse Field Day was planned and conducted in Trenton, GA, on May 20, 2006.

c Smith Lever, state matching funds
d Multi-State: TN

Key Word: Animal Production Efficiency

- **Goal 1-14**

Do probiotics improve digestive tract health of grain-fed herbivores by stimulating microbial use of lactic acid?

a Probiotics, including mixed cultures of selected strains of lactic acid bacteria, yeast cultures and extracts of various microbial cultures are routinely included in cattle and horse concentrate feeds to improve animal health and productivity. The exact mechanism for their claimed effectiveness is still uncertain, but some believe probiotics competitively exclude pathogenic intestinal bacteria by competing for substrate. Another possibility is that the probiotics provide a source of micro-nutrients or bioactive nutrients that are positively influencing host animal nutrition. The most prevalent theory in herbivore nutrition is related to the probiotic stimulating utilization of lactic acid and improving gastrointestinal pH and alleviating related pathogenic effects of acidosis on intake, absorption of nutrients, gastrointestinal infections, and laminitis. Certain microbes use lactic acid as a substrate. It is thought that the probiotic stimulates the growth of lactic acid utilizing microbes by providing a more constant food source of lactate. Lactic acid causes gastrointestinal acidosis because it is approximately 10 times stronger than the volatile fatty acids also produced during rumen fermentation in cattle or hind-gut fermentation of the horse. The production of lactate in the GI tract appears to be highly variable depending on the time after feeding. A lactic acid utilization assay is needed to determine if mixed cultures of GI bacteria from different sites of herbivore GI tracts have an enhanced capability to utilize lactic acid due to probiotic feeding.

A gas chromatographic (GC) assay for measuring total lactic acid in silage fermentation was developed for rumen fluid. The GC methodology has advantages as compared enzymatic assay often used to measure lactic acid because it is not isomer specific and less subject to interfering substances found in digestive fluids. The GC method provides a measure of total lactic acid because it assays concentrations of both isomers (L and D) in fermentation fluid. Thus, it is more related to digestive fluid pH and its physiological impact on animal health. The procedure for measuring lactic acid in silage was modified by first removing volatile fatty acids from the fermentation fluid that interfere chromatographic analysis of the methylated ester of lactic acid. Approximately 100% recovery of lactic acid has been obtained in rumen fluid samples spiked with biological levels of lactic acid. In addition, a linear rate of lactic acid disappearance that corresponds with an increase in the less acidic volatile fatty acid propionate was observed using in-vitro cultures using with mixed rumen microorganisms charged with varying levels of lactic acid for a 3-hour time period. These findings are the basis for establishing a lactic acid utilization assay and that will be used to determine effectiveness of various probiotics to improve digestive health by controlling acidosis of grain-fed herbivores.

b Development of a method to measure total lactic acid in digestive fluids of grain fed herbivores is being used to measure the impact of lactic acid on pH control and sub-clinical acidosis. A lactic acid utilization assay is being used to substantiate the potential mechanism of action of probiotics that currently being used in concentrate feeds to promote digestive tract and animal health.

c Hatch Act, state matching funds
d State Specific

- **Goal 1-21**

Nutrition for goats

a Due to their moderate rate of weight gain, goats are usually fed for a longer period than other ruminant livestock before reaching marketable weight. Grazing will be the best way to raise goats. A limitation to pasture-based production systems is seasonal variation in nutrient content, which often means pasture

alone does not always provide adequate nutrition for either fast growing or lactating animals. As a result, supplements are typically added to forage diets to increase energy and protein content in order to improve performance. Feeding hay or concentrate alone, or providing hay and concentrate half of the time from weaning to slaughter may produce different types of marketable goats.

The effects of feeding concentrate or alfalfa hay alone or feeding alfalfa hay followed by concentrate was investigated in a 90 day-experiment using 36 non-castrated Boer x Spanish goats. For this experiment, two groups consumed either concentrate or alfalfa hay for 90 days. The third group (HC) was fed alfalfa hay for the first 45 days and concentrate for the remaining 45 days. At the end of the second period (day 90), all animals were transported to the meat processing facility for overnight holding (water available but without feed). At slaughter, digestive tract mass (reticulo-rumen and intestines with and without digesta), liver and hot carcass weight were recorded. Rumen fluid was collected for VFA and ammonia analysis. Ruminal and large intestinal digesta pH were recorded. Blood samples were analyzed for glucose. Liver and muscle samples were analyzed for glycogen. Data were analyzed as a completely randomized design using SAS. Treatment means, when significant, were separated using lsd. Proportions of propionate, butyrate, and isovalerate and blood glucose increased with concentrate finishing while proportion of acetate, and acetate: propionate ratio increased with hay finishing. Liver and muscle glycogen concentrations were not influenced by diet. Final weights were lower for kids fed hay (21.5 and 22.7 kg for HH and HC) compared to those fed concentrate (30.3 kg). Ruminal ammonia was lower, but intestinal and ruminal pH was higher in goats finished on hay. Liver mass, liver (% BW), rumen and small intestine weights increased with concentrate feeding. Hay feeding did not affect small intestinal mass (%BW) but increased rumen mass as a proportion of BW. Chilled and hot carcass weights were higher for concentrate only fed compared to hay fed goats. Heavier goats can be produced when started and finished on concentrate. Concentrate finishing increased weight (% BW) of liver and rumen except the small intestine. Starting weaned kids on alfalfa cube hay and finishing on concentrate for only 45 days may not add any benefit in terms of weight gain.

Three abstracts have been prepared and submitted for presentation at the 2007 Joint Annual ADSA, PSA, AMPA and ASAS National Meeting in San Antonio, TX.

b Heavier goats can be produced when started and finished on concentrate. Concentrate finishing increased weight (% BW) of liver and rumen except the small intestine. Starting weaned kids on alfalfa cube hay and finishing on concentrate for only 45 days may not add any benefit in terms of weight gain.

c NARETPA, State Matching Funds

d State Specific

- **Goal 1-14**

Improving pork composition

a According to the most recent U.S. Pork Quality Audit, the U.S. hog industry needs to focus on reducing the production of excess fat, improving quality (water-holding capacity and color), and increasing product consistency. Since that time, improved genetics in the swine industry have allowed for market hogs to be leaner and heavier at slaughter, producing a more health conscious product. Coupled with this reduction in external fat has been a reduction in the amount of “taste fat” or marbling found in pork cuts.

It has been estimated that the pork industry is losing about $3.38/carcass because of quality defects in leanness. Last year the U.S. pork industry slaughtered approximately 100 million heads. Thus, reducing the quality defects in leanness would result in a potential savings to the industry of over $325 million. This would also have a significant impact on the southeastern swine industry, since approximately 15% of the U.S. swine population is located there.

b This research has emphasized the measurement and modification of carcass cutability as well as the impact of these changes on pork meat quality. Several projects have been conducted with support from Elanco Animal Health to determine the impact of Paylean® (Ractopamine hydrochloride), a repartitioning agent, along with phenotypic selection for leanness, variable protein levels (including the use of crystalline amino acids), and gender on pork carcass composition and meat quality attributes. This work has documented the fact that Paylean is equally effective at reducing fat, increasing muscle, and increasing carcass fat free lean in pigs sorted into lean and fat phenotype groups. In addition, Paylean has been shown efficacious across varying dietary protein levels and in barrows and gilts,

although there appears to be some advantage to feeding higher protein levels in order to gain the full impact of Paylean. One of the concerns with feeding Paylean has been the potential for negative impacts on meat quality traits since it increases lean growth. This work has shown that Paylean does not negatively impact meat quality traits measured in the loin muscle, except for a slight increase in shear force. Another concern with Paylean feeding involved its impact on the pork belly, and subsequently on the bacon produced from it. Our work showed that the firmness of the belly (directly related to sliceability) was not impacted by Paylean. Paylean did alter the fatty acid composition of subcutaneous fat by reducing the level of saturation and increasing iodine values; however, the effects of Paylean were similar to those noted in the pigs selected into the lean group, based on phenotype. This suggests that Paylean is not having a direct effect on the fatty acid composition of pork fat but is affecting it due to the lower lipid content of fat from pigs fed Paylean prior to harvest. The improvements in carcass muscle associated with Paylean feeding, coupled with the fact that pork meat quality attributes are not greatly impacted, may provide swine producers another avenue to produce leaner, healthier products for today's health conscious consumer.

c Hatch Act, state matching funds

d State Specific

- **Goal 1-26**

Heritability values

a Heritability values are a measure of the additive genetic influence that exists on livestock production characteristics. Those values are derived from research with real animals under a variety of environmental conditions. Making a determination of additive genetic differences among breeds, strains and herds of meat goats provides important tools for long term genetic change and improved efficiency in human food production. Meat goat owners continue to ask for more data to guide them in their breed selection programs and crossbreeding systems.

Actions taken under this goal during this reporting period represented a modification in the original plan and resulted in higher quality data and more complete data analysis. A study was completed that allowed the comparison of nine breed and crossbred groups, including three purebred populations. Data include growth rate, internal parasite tolerance, ultrasound ribeye estimates, and a full range of carcass measurements and boneless edible product.

Early trends suggest there are significant differences among the several genetic groups. Those trends have allowed commercial producers of goat meat to choose breed combinations that will grow well, stay healthy, and yield high-dollar products for added profit.

Facilities used are valued at about $10,000 from both research and extension sources. Two faculty members are directly involved with about 15% of their time during the period of experiment implementation.

b Preliminary reports have been given at several field days, including the Sunbelt Agricultural Exposition Small Ruminant Educational program. Abstracts have been prepared and presentations given at regional American Society of Animal Science meetings.

c NARETPA, State Matching Funds

d Multi-State Integrated Extension and Research: TN, LA

Goal 2

Concerns about food safety and nutrition are on the rise. With the recent increase of food safety concerns on the public's health when eating out, food safety and nutrition have become a significant topic to consider. Below are some issues taken into consideration while accomplishing the performance measures:

- Minimize the risk of food-borne illness through adoption of recommended food handling and preservation practices.
- Enhance the safety and quality of foods through continued innovations in detecting and preventing microbiological and parasitological hazards and in adding value throughout the pre-harvest, post harvest, and processing segments of the food continuum.
- Develop, transfer, and promote the adoption of safe and efficient food processing technologies and systems that improve consumer access to affordable, convenient, and good-tasting foods while ensuring food safety and quality maintenance in processing systems.
- Develop value-added chevon products of superior palatability and shelf-life.
- Develop dairy product technology to overcome the seasonality of goat milk supply.
- Enhance profitability and sustainability of dairy goat industry in Georgia by developing year-round uniform quality goat milk cheeses.
- Educate and protect Georgia's agricultural industry from catastrophic agrosecurity or natural disaster events.

Prompt summary of a safe and secure food and fiber system:

Increasing the public's knowledge of foodborne illness and pathogen protection, food handling, quality and safety

- Campus and county-based employees reached a reported 2955 clients. Programs were implemented in schools, churches, homes and other sites on food safety, food preparation, hand washing, thawing foods and stopping bacterial growth in effort to reduce the high costs of foodborne illnesses.
- Addressed the increased potential for foodborne illnesses outside the home.

Increasing food safety by identifying the source of the threat

- Addressed Listeria to help prevent food disease outbreaks and recalls by identifying how it survives cleaning and sanitation efforts, in addition to how these efforts can be modified to be more effective.
- Identified the sources of human fecal contamination to Georgia water through an inexpensive means of combining fluorometry with targeted sampling thus allowing bacteria source tracking.

Increasing goat quality through examination of food handling and safety measures

- Research showed the possibilities of overcoming seasonal restrictions on goat using frozen-stored goat cheese products with respect to consumer acceptability showed goat milk cheeses can be frozen and stored up to six months without significant changes in sensory qualities or food quality.
- Discovered that microbial quality of goat carcasses and meat can be effectively controlled by pre-slaughter strategies using new technologies that can be used without a significant increase in production costs.

Description of Activity; Impact of Activity; Source of Funding; Scope of Impact

Key Theme: Food Handling

- **Goal 2-10**
  Dairy Production
  Sub-keys: Food Quality, Food Safety

  a Dairy goat farmers have never been able to establish a viable and profitable dairy goat industry in Georgia and the nation. One of the primary obstacles for growth of the dairy goat industry is the seasonality of goat milk production. In order to have a profitable and sustainable agricultural enterprise, it is essential that dairy goat farmers not only supply year-round consistent dairy goat products to consumers, but also provide goat products attractive to consumers. Another main reason for poor development of the dairy goat industry is the lack of supports by the government, industry, and academia where the limited resource dairy goat farmers traditionally have been underserved. In order to overcome this existing seasonal milk production problem, we have set a few research goals from food science and technology perspectives. Two definite goals at the beginning were to produce goat

milk cheeses during peak production season and frozen-store them for later marketing during off-season and to evaluate food quality of the frozen-stored goat cheese products with respect to consumer acceptability.

Goat milk soft cheeses and Monterey Jack semi-hard cheeses have been developed and many batches of the cheeses were produced from FVSU's Georgia Small Ruminant Research and Extension Center. Several studies have been conducted to investigate the feasibility of frozen storage of the produced goat cheeses and effect of the frozen-storage on microbiological, nutritional, physico-chemical, rheological, and sensory qualities of the frozen goat products.

After the frozen studies of goat milk cheeses, the food qualities of the frozen products were investigated. The results revealed that the goat cheeses up to 6 months of frozen-storage did not have significant impact on sensory and nutritional qualities, although there were some changes in microbiological, physico-chemical and rheological characteristics. The positive outcomes of these research investigations have generated many presentations and written reports to the scientific audience, dairy goat producers and consumers through regional, national, and international conferences, symposia and scientific journals.

b The results of the research showed that goat milk cheeses can be frozen and stored up to six months without significant changes in sensory qualities. This outcome is greatly important and has a significant positive impact on the economic sustainability of dairy goat farmers and their industry because the frozen-stored cheeses can extend storage life of the products and can provide later marketing opportunity during the off-season. This processing and storage methods of goat milk can provide the consumers with a year-round consistent supply of goat products, which will enhance the profitability and economic viability of goat farmers. This food technological approach is innovative to solve the inherent problem of the seasonality of goat milk production and marketing. The traditional belief was that goat milk cheeses may not be frozen to prolong the shelf-life of goat milk products since freezing was believed to cause significant deterioration on the goat milk products for later marketing.

c NARETPA, State Matching Funds

d State Specific

- Goal 2-1

Food Borne Illnesses

Sub-keys: Food Quality, Food Safety, Foodborne Illness, Foodborne Pathogen Protection

a The reported incidence of foodborne illness from pathogenic bacteria is increasing; these illnesses may be life threatening or trigger chronic disease. Changing patterns of consumption, an aging population, more persons with chronic illness and wide variation in food handling and preparation practices are some of the factors contributing to the population's increased vulnerability to foodborne disease. Food safety and quality concerns often put different groups within society in conflict over perceived and real concerns. Approximately 97% of documented cases of foodborne illness result from the mishandling of foods in foodservice establishments and in the home. The resulting percentage from foodservice establishments alone is about 77%. With an increasing number of meals being eaten away from home, there is the potential for an increased incidence of foodborne illness. Employee education and certification in the sanitary handling of food is viewed by food protection experts nationally as one strategy for reducing hazards to the consumer.

County Extension agents conducted group training programs to teach safe food handling for consumers, elementary and high school students, child care providers, personal care home providers, school food service employees, restaurant employees, food processors, and other foodservice or distribution professionals. County educators collaborated with relevant agencies, organizations, and individuals who deliver food handling information to the public and foodservice industry. Faculty provided technical expertise in food safety to Extension agents and individual or industry clientele. County Extension educators were trained and updated in food safety issues and recommended food handling practices yearly. Training was offered in use of specific curricula, such as the ServSafe® foodservice manager certification and employee training programs, Smart Kids Fight BAC! ®, and Hazard Analysis Critical Control Point (HACCP) systems training.

More than 17,200 educational contact hours in food handler education were provided to 3,309 foodservice personnel. This includes 681 food service managers who received the ServSafe®

employee training. ·Nearly 7,800 educational contact hours of food safety education were provided to 2,883 consumers, families, and youth. Fifty-five percent of them were at risk or low income Georgians. Nearly 320 educational contact hours in home food preservation were provided to 118 program participants. Nearly 485 contact hours of food safety education were provided to 143 child care providers. Almost 5,800 contact hours of food handler training were provided to 1,866 school foodservice employees. ·Food safety programs reached over 1,770 school children. In addition, over 9,000 interactive Smart Kids Fight Bac!® CD-ROMs were distributed to children throughout the country. Media was a major strategy for food safety and preservation education: five exhibits reached over 17,700 individuals; nine radio spots were broadcast to a listening audience of over 17,800 people; and 54 newspaper columns went to a circulation of over 0.9 million readers.

b Of the foodservice employees who completed the ServSafe® food safety education program, 94% improved their knowledge in five food safety areas: recognizing hazardous food situations, receiving and storing food safely, preparing and serving food safely, preventing contamination, and personal hygiene. After training, over 88% of the participants indicated they are more likely to thaw foods in the refrigerator, in cold running water, or in the microwave right before cooking; 98% are more likely to follow recommended hand washing procedures; 97% are more likely to sanitize their cutting boards; and 88% are more likely to use a food thermometer to decide if meat, poultry, egg dishes, or fish are done before serving. More than 95% of the foodservice managers who completed the ServSafe® manager training planned to implement recommended food handling practices in their food establishments. For example, 91% of the participants said that they will monitor that their employees check and record food temperatures regularly in cold and frozen storage; 96% plan to train and monitor employees on cleaning and sanitizing equipment and dishware; and 96% will train and monitor employees to recognize food spoilage and unsafe foods. At the end of the training, participants emphasized their preparedness to apply gained knowledge to train others. Comparison of pre and post test evaluations indicated that participants in the general foodservice food safety training programs significantly improved their knowledge. Over 78% of the participants learned important food safety practices. For example, 95% of the participants planned to wash their hands with hot running water and soap for at least 20 seconds after handling raw meats, poultry, and fish; and 88% planned to reheat leftovers to at least 165°F measured by a thermometer before serving them. Overall, 99% of the participants rated these programs as either helpful or very helpful. Ninety percent of the childcare providers who participated in the Smart Care Givers Fight BAC!® food safety education program significantly improved their knowledge and learned to follow recommended food handling practices. Of the approximately 1,200 school foodservice personnel who participated in the Hazard Analysis and Critical Control Point (HACCP) workshops in South Georgia, over 90% indicated that they would improve how they handle food. For example, 91% of the participants planned to slice down large cuts of meat and package them in shallow pans for cooling; 94% planned to reheat leftovers to at least 165°F; 95% planned to check the temperature of foods on hot and cold buffets and serving lines at least every 2 hours; and 94% planned to analyze the flow of food for potential hazards, identify critical control points, and write down standards for critical control points in recipes. Overall, 96% of the participants rated the workshops as helpful or very helpful in teaching them how to safely handle food. Ninety-one percent of the 178 elementary school students who completed the Smart Kids Fight BAC!® program improved their knowledge related to four basic food safety principles: cleaning, preventing cross contamination, cooking, and chilling. More than 95% of the children learned recommended food safety practices as a result of this program. For example, 99% learned the best way to save a ham and cheese sandwich that they want to eat later is to cover it and put it in the refrigerator.

c Smith Lever, state matching funds

d State Specific

▪ 2-1

Food borne illnesses

Sub-keys: Food Quality, Food Safety

a The Centers for Disease Control and Prevention (CDC) and the Food and Drug Administration (FDA) have estimated as many as 33 million reported cases of food borne illnesses each year in the United States. Estimates of the economic costs of food borne illness vary from a low of nearly $500 million to a high of $7 billion a year. In spite of the serious consequences associated with food borne illness, few consumers have had any food handling education. This lack of education in rural low-income communities has implications both for consumers handling their own food at home and for their ability to assess the safety of food obtained in eating establishments. The benefits of implementing a food

safety program for audiences with low-income and limited resources are that these families and individuals will improve their food handling practices and, in turn, reduce their risk for food borne illness and reduce the economic costs associated with food borne illness.

A food safety program for county-based employees to teach and educate their clients was continued. Major components of the program are food preparation, preservation, storage and handling practices; cooking and storage methods; proper hygiene practices; cooking times and temperatures; food selection techniques; and understanding risks and responsible practices. Curriculums, exhibits, and various resources were written, designed, purchased, and adopted. The Expanded Food and Nutrition Education Program (EFNEP) was introduced.

Through the Food Safety Program, two trainings for Extension county-based employees were implemented. One county agent and four program assistants reported that they attended 27 trainings, worked with 39 volunteers, worked with 594 families, worked with 559 adults/individuals, worked with 1,802 children, made 2,438 home visits, distributed 12,328 publications, and conducted 129 group programs and activities. The specialist distributed over 2,000 handouts and publications. Through the EFNEP Program, 38 children were reached and three volunteers supported the program.

b Campus- and county-based employees reached a reported 2,955 clients. Programs were implemented in schools, churches, homes and other sites on food safety, food preparation, hand washing, thawing foods and stopping bacterial growth. One county agent and four program assistants reported 15.5% or 457 clients increased their knowledge of food borne illness, 16.6% or 491 clients are cooking and storing foods correctly or better, 31.2% or 890 clients are using proper hand washing practices, 8.5% or 251 clients are using thermometers and 19.1% or 565 clients are better understanding the relationship of food safety to better health. There are 595 clients that the county-based employees are regularly working with and with their help have identified 11 food safety and health issues and concerns in their counties they are working to address. County-based employees indicated that they implemented five food safety programs and 73 activities in their counties this year. In addition, the 38 EFNEP children learned proper food preparation, food handling and hand washing practices.

c Smith Lever, state matching funds
d State Specific

Key Theme: Food Safety

- Goal 2-7 Food pathogens

a Food companies producing refrigerated ready-to-eat foods must control the presence of the pathogen, Listeria monocytogenes, in the food processing environment. This pathogen has, in the past, contaminated these foods resulting in disease outbreaks and product recalls.

A research program with the objective of developing and evaluating control measures for the growth of Listeria in the food processing environment was initiated. This program focuses on the ability of Listeria to survive cleaning and sanitation efforts and how these efforts can be modified to be more effective. Completed research has been published in journals commonly read by food industry professionals.

b Foodborne illness in the U.S. is undergoing a gradual decline. In 1998 listeriosis cases were at 5/million. In 2004 they were down to 2.7/million. However, in 2005 cases increased to 3.0/million. See CDC web site: http://www.foodhaccp.com/memberonly/newsletter206.html.

c Hatch Act, state matching funds
d State Specific

- Goal 2-7
  Combining fluorometry and targeted sampling as an inexpensive way to identify human fecal contamination

a High numbers of fecal bacteria have triggered advisories for a number of Georgia's waters. The economic consequences of these advisories are bad. Because we are experts in bacterial source tracking (BST), the state requested identification of the sources of human fecal contamination to Georgia waters inexpensively. Bacterial source tracking identifies the sources of fecal bacteria using a

variety of microbiological and chemical methods.

As an inexpensive way to identify sources of human fecal contamination, we combined targeted sampling with fluorometry. Targeted sampling works by identifying hotspots of fecal contamination through continued sampling and resampling over ever-decreasing distances. Fluorometry identifies human fecal contamination by detecting optical brighteners, primarily from laundry detergents. We confirmed this combination with two other BST methods, Enterococcus speciation, and the presence or absence of the esp (enterococcal surface protein) in Enterococcus faecium isolates. Enterococcus speciation determines the percentage of the bacterium, Enterococcus faecalis, among the fecal enterococci. High percentages of Enterococcus faecalis (>30%) are associated with fecal contamination from humans and birds. The esp gene in the bacterium Enterococcus faecium is associated almost exclusively with humans.

b We combined targeted sampling with fluorometry in two Georgia waters, Potato Creek, a freshwater creek between Griffin and Thomaston, and the beach on St. Simons Island. Potato Creek had three reaches identified as containing high numbers of fecal bacteria. Targeted sampling quickly and inexpensively identified humans, cattle, and dogs as the major sources of fecal contamination in the first, second, and third reaches, respectively. Fluorometric values were consistent with these identifications, but high fluorometric values were sometimes observed in areas with no fecal contamination. Meanwhile, on St. Simons Island, targeted sampling and fluorometry identified two hotspots of potential human fecal contamination. Detection of the esp gene confirmed the human origin of one site but not the other. The problems with fluorometry were caused by background organic matter fluorescence. We solved this interference two ways. First, an experiment showed that adding a 436-nm emission filter to the fluorometer reduced background organic matter fluorescence by >50%. Second, because optical brighteners photodecay relatively quickly when exposed to sunlight, we determined if exposing water samples to ultraviolet (UV) light could help distinguish between optical brighteners and organic matter. When exposed to UV light, optical brighteners photodecayed significantly faster than organic matter. Assuming a) the fluorometer was equipped with a 436-nm emission filter, b) a spike in fluorometric value was observed in environmental waters, and c) the total organic carbon was <20 mg L-1, optical brighteners were reliably present when the percentage difference in fluorometric value of the water before and after UV light exposure was >30%. If the water contained high numbers of fecal indicator bacteria as well, then the water was likely positive for human fecal contamination. With these changes, combining fluorometry with targeted sampling was a relatively inexpensive method for identifying human fecal contamination in water.

c Hatch Act, state matching funds

d State Specific

- Goal 2-9

Develop chevon products

a Suitable pre- and post-slaughter methodologies are essential to obtain meat products of superior shelf life and palatability. Since the meat goat industry is still in its infancy in the U.S., ante- and post-mortem methodologies suitable for meat goats and goat carcasses are not fully understood. Currently, researchers are focusing more on preslaughter intervention strategies to prevent pathogen contamination of carcasses and meat. For example, dietary manipulation in ruminants has been reported to influence gut bacterial counts. Diets high in condensed tannins (CT), such as sericea lespedeza hay, have also been reported to reduce gut microbial loads in ruminants. Reduction of gut bacterial numbers has been reported to reduce skin and carcass contaminations in meat animals.

During the past year, two experiments were conducted in relation to food safety. In experiment 1, 36 Boer x Spanish goats (BW = 17.7 kg) were used to determine the effects of dietary treatment on volatile fatty acids (VFA) in rumen and microbial loads of gastrointestinal tract (GIT) contents. Animals were randomly allotted to nine pens, and each pen was assigned to one of three dietary treatments for 90 days: (1) a hay diet, consisting of alfalfa hay alone (H); (2) a 18% CP concentrate diet, consisting predominantly alfalfa meal and yellow corn (C); or (3) a combined diet, consisting of the hay diet for the first 45 days, followed by the concentrate diet (HC). At the end of the feeding trial, goats were slaughtered using standard procedures. Immediately after evisceration, rumen fluid and rectal samples were aseptically collected from each animal to determine the microbial loads. Rumen fluid was also collected and prepared for determination of volatile fatty acid concentrations (VFA). No significant differences were found in rumen fluid VFA concentrations among treatments, although the acetic acid

concentration was high in the H group (66.27 mM), low in HC group (34.61 mM), and intermediate in C group (44.18 mM) The total plate counts were not different among treatments for rumen fluid and fecal (rectal) samples. The E. coli counts in the rectal samples were lower in the H group (6.43 log10 CFU/g), compared with C (8.21 log10 CFU/g) or HC (8.40 log10 CFU/g) groups. However, no significant differences were found in the E. coli counts of rumen fluid samples among the dietary treatments. The mean (± SEM) rumen E. coli counts were 1.38, 1.65, and 2.51 ± 0.560 log10 CFU/g in H, C, and HC groups, respectively. The results indicated that either concentrate diet or a diet change from hay to concentrate may increase fecal shedding of E. coli in meat goats. Experiment 2 was conducted to determine the effects of feeding higher levels of CT on gut, skin, and carcass microbial counts in goats. In a Completely Randomized Design, 20 Boer x Spanish kids (6 months of age) were fed ground sericea (SER) or Bermuda grass hay (BER), 75% of daily intake for 14 weeks with a corn-based supplement (25% of intake). At the end of the feeding trial, the animals were slaughtered using standard procedures. Skin swab samples were made on the hind legs (5 x 5 cm area) prior to slaughter. Immediately after evisceration, rumen and rectal samples, as well as carcass swab samples were collected to assess bacterial loads. Concentrations of rumen volatile fatty acids were significantly different between dietary treatments. Goats fed sericea hay had higher contents of butyric (8.66 vs. 7.16 mM), isobutyric (1.94 vs. 1.44 mM), isovaleric (3.03 vs. 2.13 mM), and valeric (1.43 vs. 1.07 mM) acids than those fed Bermuda hay; however, the content of acetic acid (78.6 vs. 64.4 mM) was higher in the BER group than in SER group. Generic E. coli (2.24 vs. 0.93 log10 CFU/g) counts of rumen contents were higher in the SER group compared with BER group. However, microbial counts in feces were not different between dietary treatments. The aerobic plate counts on skin in the SER and BER groups were 4.58 and 4.46 log10 CFU/cm2, respectively. Carcass aerobic plate counts were 3.12 and 2.65 log10 CFU/cm2 in SER and BER groups, respectively. Total coliform and E. coli counts on skin and carcass were estimated to be <1.00 log10 CFU/cm2. The results indicated that CT in the diet may influence rumen volatile fatty acid composition, but may not reduce the gut bacterial loads.

Several papers were published last year on preharvest food safety.

b The above studies show that microbial quality of goat carcasses and meat can be effectively controlled by pre-slaughter intervention strategies. These technologies can be implemented in even very small operations without significant increase in production costs. The information gathered from these experiments will be further disseminated to the producers and processors via workshops and training programs conducted in collaboration with FVSU extension personnel. The full impact of these studies will be realized in the near future.

c NARETPA, State Matching Funds

d State Specific

- **Goal 2-11**

Poultry

Sub-keys: Food Security

a Georgia has more than 4,000 poultry farms that are vulnerable to the introduction of bio-contaminants. The introduction of a bio-contaminant either intentionally or via natural occurrence would have devastating economic implications for this very important agricultural business.

Extension faculties of the Department of Poultry Science have taken steps to develop and implement an agro-security/bio-security educational training program for poultry producers in Georgia.

Training materials and slide presentations have been developed for use in educational sessions with poultry producers. To date, 10 training sessions involving approximately 500 participants have been conducted.

b As a result of the training sessions, poultry producers have been provided comprehensive information on bio-security procedures and are implementing steps on their farms to provide maximum security for their flocks.

c Smith Lever, state matching funds

d State Specific

Goal 3

Hypertension, heart disease, cancer, stroke, diabetes, osteoporosis and obesity are all leading causes of diet-related mortality and morbidity in the United States. Nutrition programs are vital in Georgia. Research has shown strong and consistent patterns between a diet rich in fruits and vegetables and a lowered risk of a number of chronic disease. The main performance goals outlined below focused on the following topics:

- Educate the public about chronic disease risk factors to change eating habits to decrease those risks.
- Inform people with diabetes how to create a healthier menu to improve glucose levels.
- Reduce the risk of chronic diseases (hypertension, cancer, diabetes, and obesity).
- Maintain optimum health by integrating a healthy diet and physical activity into daily active life.
- Increase the research and knowledge base available in human nutrition.

Prompt summary of a healthy, better nourished population:

Promoting human health and human nutrition through education

- A diabetes nutrition program was offered to inform the public about diabetes**.** Programs were implemented at schools, churches, homes and other sites on basic nutrition, diet, exercise and chronic diseases.
- Provided programs to address chronic diseases. Major components of the program are the 2005 Dietary Guidelines for Americans as well as hypertension, heart disease, cancer, diabetes, obesity, exercise, and various nutrition, diet and health resources.
- Studied the risks of obesity with focus on DNA promoter structure and related factors that controls genes involved in the development and growth of fat cells. In addition, studied the regulation of genes involved in appetite control.
- Identified there aren't any significant differences in goat meat besides ash content and it's leaner than lamb. Thus, chevon consumption is expected to increase dependent upon improving its palatability traits.

Description of Activity; Impact of Activity; Source of Funding; Scope of Impact

Key Theme: Human Health

- **Goal 3-1**

Human nutrition and health

Sub-keys: Human Nutrition

a The leading causes of diet-related morbidity and mortality in the United States and in Georgia today include heart disease, cancer, stroke, and diabetes, ranked respectively from most prevalent to least prevalent. Other significant diet related public health concerns include osteoporosis and obesity. Statistics show that a disproportionate burden of diet-related disease is borne by minority, low income, and educationally disadvantaged persons. These groups have higher rates of hypertension, stroke, diabetes, and other diseases than the general population. Most of these diseases also occur more frequently with advancing age.

Diabetes is a major public health problem. Approximately, 486,000 adults in Georgia were diagnosed with diabetes in 2004. For every two persons diagnosed with diabetes, another has not yet been diagnosed. If all medical costs, costs attributed to premature death, and lost job productivity in Georgia were added together, the actual economic impact of diabetes would be close to $4 billion per year.

UGA Cooperative Extension offered a comprehensive diabetes education program. This includes intensive training for county Extension agents in nutrition issues related to diabetes, a quarterly newsletter focusing on diabetes, the Rite Bite Cooking School written by Extension specialists and conducted by county Extension agents, and a diabetes management program conducted locally by county agents and cooperating hospitals, health departments, or physicians. Agents provided the "Focus on Diabetes" CD to teach the basics of diabetes self-management. "Walk a Weigh" is a comprehensive social learning based weight management curriculum written by UGA Extension specialists and conducted by county agents. Fitness was emphasized, and walking was an integral part of the program. Recipes which teach lesson concepts were demonstrated and sampled.

Diabetes education programs provided nearly 3,000 hours of diabetes control and prevention

instruction to 1,650 Georgians in 2006. Nearly 39% of the participants were low income or at risk. Walk A Weigh reached 960 Georgians and provided 1,120 hours of nutrition and exercise education in 2006. Extension provided over 46,500 hours of general nutrition and chronic disease educational programs to 25,727 individuals in 2006. Nearly 67% of the participants were low income Georgians. Media was a major strategy for educating Georgians on controlling and prevention diabetes. For example, 48 diabetes articles in newsletters reached over 15,300 readers; five radio spots were broadcast to a listening audience of over 36,400 people; six newspaper columns went to a circulation of over 183,700 readers; and five exhibits reached over 1,185 people.

b Of the participants who completed diabetes education programs, 94% said those sessions were very helpful for them in learning how to control diabetes by practicing healthy habits. Most of the participants improved their diabetes management knowledge and planned to follow healthy practices. For example, 100% of the participants intend to use artificial sweeteners to control their sugar intake; 79% intend to have their A1c tested at least twice a year; and 88% intend to use carbohydrate counting to plan meals. All of the participants who completed the weight control education programs said the classes helped them improve their knowledge and practices about weight control. Most of the participants planned to adopt recommended practices: 92% planned to walk regularly to help manage their weight; 95% planned to use liquid vegetable oils instead of solid fats in food preparation; and 100% planned to drink water before, during and after physical activity. The comparison of pre- and post-program data confirmed 88% of participants who completed the Walk A Weigh program improved their overall dietary and exercise behaviors and adopted a healthier lifestyle. Comparison of the pre- and post-evaluations of participants who completed nutrition education programs show that 58% of participants improved their knowledge of nutrition. Eighty-three percent said the workshops helped them to make healthy food choices. For example, 89% planned to use the nutrition facts on the food label to make food choices; 86% planned to trim the fat from meat; and 99% planned to choose the regular size foods instead of the deluxe and super sizes. Of the participants who completed Walk A Weigh, 88% significantly improved their dietary and exercise habits, helping them to reach their weight loss goals and reduce risk factors. For example, 66% of the participants began using low-fat condiments; 68% began modifying recipes to lower fat; 69% began reading nutrition labels to help make food choices; and 57% began exercising three time a week for 30 minutes at a time. Participants in Walk A Weigh typically report an average weight loss of 4 pounds during the six-week course. Children who completed the “Power of Choice” nutrition program significantly improved their health and nutrition knowledge. Most of the children planned to adopt healthy nutrition and dietary habits. For example, 68% of the children planned to drink milk or water when they eat out; 82% planned to add more variety to their fast food meal by choosing at least one serving of fruit, vegetable, or a low fat food made from milk; 76% planned to eat slowly; and 71% planned to try at least one new or unfamiliar food when they have the opportunity. Participants in the nutrition education program, What is that Yellow Bar Doing on MyPyramid?, planned to follow the new recommendations for consuming oils. After the program, 82% of the participants planned to use liquid oils instead of solid fats in food preparation; 75% planned to use the nutrition facts on the food label to make food choices; and 82% planned to bake, broil or grill rather than fry their food.

c Smith Lever, state matching funds

d State Specific

▪ Goal 3-2

Human nutrition and health

Sub-keys: Human Nutrition

a Leading causes of diet-related morbidity and mortality in the U.S. today include hypertension, heart disease, cancer, stroke, diabetes, osteoporosis, and obesity. Research has shown strong and consistent patterns of relationships between diet quality such as rich in fruits and vegetables and lowered risk of a number of chronic diseases. Based on the latest scientific evidence, the 2005 Dietary Guidelines provide information and advice for choosing a nutritious diet, maintaining a healthy weight and achieving adequate exercise. In addition to the positive reports on fruits and vegetables, many clinical and experimental studies support a role for dietary fiber, trace elements, vitamins, and other components of whole grains in reducing risk for chronic diseases such as cancer and coronary heart disease. As a result of the increased number of chronic diseases, nutrition education programs are needed. The primary benefit of implementing a nutrition program for clients with chronic diseases is that the information and resources help to improve their quality of life while reducing the economic costs associated with chronic diseases.

A nutrition program to address the chronic diseases was continued. Major components of the program are the 2005 Dietary Guidelines for Americans as well as hypertension, heart disease, cancer, diabetes, obesity, exercise, and various nutrition, diet and health resources. Various curriculums and exhibits were used; resources purchased; and publications written and distributed. The Expanded Food and Nutrition Education Program (EFNEP) were introduced to expand the nutrition program.

Through the nutrition program, two trainings for Extension county-based employees were implemented. One county agent and four program assistants reported they attended 25 trainings, worked with 64 volunteers, worked with 1,073 families, worked with 647 adults/individuals, worked with 2,545 children, made 2,957 home visits, distributed 22,057 publications and handouts, and conducted 1,344 group programs and activities. The specialist reached over 150 individuals in group meetings and distributed over 25,000 publications and handouts. Through the EFNEP Program, three Extension professionals and paraprofessionals volunteered to support the program and 38 children were reached during two residential summer camps.

b Campus and county-based employees reached a reported 4,265 clients. Programs were implemented at schools, churches, homes and other sites on basic nutrition, diet, exercise and chronic diseases. All of the programs focused on improving nutrition and health. One county agent and four program assistants reported that 9.4% or 401 clients improved their nutrition behavior, 10.9% or 466 clients changed their eating and exercising habits, and 13.1% or 559 clients are practicing healthy lifestyles. From 2169 clients that county-based employees regularly work with, they identified nine current nutrition and health related issues and concerns in their counties they are working to address. They implemented 12 nutrition programs and 165 activities in their counties this year. In addition, the 38 EFNEP children received 11 education hours devoted to nutrition information, resources, and snack demonstrations. All of the children stated that they wish their parents could learn EFNEP education in their communities and experience how good healthy foods can taste so that they will eat a variety of healthy foods as a result of learning that some healthy foods taste good. Children said they acquired new knowledge as a result of the EFNEP presentation/experience, and will try to get their parents to select healthier snacks and practice the implementation of healthier choices of food as a new lifestyle to live by daily.

c Smith Lever, state matching funds

d State Specific

- Goal 3-3

  The genetics and molecular biology of nutritional health

  Sub-keys: Human Nutrition

  a In spite of education, drugs, dieting, and surgery, obesity continues as the most important heath problem in the U.S today. Most alarmingly, it claims a greater percentage of our adults and children every year. The cost in health care and lost work time indirectly and directly due to obesity and its complications are the single biggest health expense our society has to bear. Our work seeks to understand the mechanisms of obesity at a molecular and cellular level, especially in gene mechanisms of appetite control. Both fat cell development and appetite regulation are driven by sequences of DNA called promoters that regulate gene expression. Understanding the way in which these promoters work is key to our ability to intervene in the condition of obesity.

  Laboratory methods used to study promoters are very labor intensive, slow, and very limited in scope. Computer methods of promoter identification, while more broadly applied, suffer from too many possibilities. Thus better methods of computational analysis are needed to identify promoters and their mechanisms of action. Finding and understanding promoter sequences important in fat development and appetite could be used to develop treatments for obesity. In the case of animal meat production, understanding the mechanisms of fat cell development could lead to improved meat quality with greater partitioning of energy into muscle.

  The work focuses on the promoter structure and related transcription factors that control genes involved in the development and growth of fat cells and to understand the regulation of genes involved in appetite control. Public domain software is used together with supplemented sequences to analyze sequences for response elements. These elements are then analyzed in the context of species and functional conservation, for coupled response elements, and then a parameter is set for gene

divergence between species to determine the functional conservation of a gene. Test of these computational methods are done using known regulatory sequences and their conservation as a standard.

b A SMAD binding site in the PPAR- gamma2 gene promoter acts as a repressor of fat cell development and is highly conserved across species. SMAD transcription factors are activated by TGF beta which causes pre-adipocytes to proliferate. This has led to a hypothesis that SMAD factors act as mitogens in fat tissue proliferation, and that SMAD may have a repressive affect on other fat related development genes. This repressive effect may include genes such as leptin which is involved with appetite control. We have found SMAD binding sites in the leptin promoter which are conserved. This is very exciting and will require further work to determine how these sites may be related to a more general description of appetite control.
In extending our search for SMAD and related binding sites to other gene promoters, we have found core sites in CEBP alpha and beta genes as well as the wnt gene. Further study shows the sites in CEBP beta are not conserved as well in mice as the response elements in CEB/P alpha and wnt genes. The analysis is leading to a more comprehensive understanding of the role of SMAD in fat cell development. In addition, we have begun an analysis of the fatty acid binding protein (FAB4) for conserved fat development related sites. This gene can be used as a model for conserved promoter sequences. The goal is to develop a model to analyze promoter regions for functional responses and integrate the information into functional models for tissues such as fat.

c Hatch Act, state matching funds

d State Specific

- Goal 3-3

Flavonoid compounds for the prevention of osteoporosis

Sub-keys: Human Nutrition

a Approximately 10 million people in the U.S. are estimated to have osteoporosis, a disease that results in over 1.5 million bone fractures a year. The direct expenditures for osteoporosis in 2001 totaled $17 billion, which equals a cost of $47 million per day. One of the greatest obstacles in treating osteoporosis is the limited capacity for bone formation observed in older adults. Bone marrow adipocytes can inhibit osteoblast proliferation, and adipocytes secrete osteoclastogenic cytokines. Moreover, accumulation of adipocytes in bone marrow is known to decrease blood supply to bone, impeding nutrient delivery to bone forming cells. Induction of adipocyte apoptosis is a treatment strategy that could have beneficial effects on bone by decreasing marrow adiposity and improving blood flow to bone tissue and decreasing levels of osteoclastogenic cytokines in marrow produced by adipocytes.

Women with osteoporosis have higher numbers of marrow adipocytes than those women with healthy bone, and bone formation rate is inversely correlated with adipocyte number in bone tissue biopsies from both men and women. Bone marrow adipogenesis is also known to increase with conditions that induce bone loss, such as estrogen depletion, disuse and hindlimb unloading, and exposure to microgravity. Recent in vivo and in vitro studies provide important insights into why marrow adipogenesis is associated with bone loss.

First, mesenchymal stem cells within bone marrow can differentiate to form adipocytes or osteoblasts. Conditions favoring adipocyte differentiation will therefore have adverse effects on bone formation because precursor cells are directed towards the adipocyte lineage rather than the osteoblast lineage. Second, adipocytes secrete osteoclastogenic cytokines such as IL-6, and adipocytes can inhibit osteoblast activity in culture. Thus, bone marrow adipogenesis is linked directly with decreased osteogenesis and increased osteoclastogenesis. Finally, marrow adipogenesis and fat cell hypertrophy are associated with the compression of intraosseous capillaries. This suggests that the normal pattern of blood flow and blood supply within bone is disrupted with increased marrow adiposity, which is further indicated by the fact that blood supply to fatty marrow is only 1/3 that to hematopoietic marrow. Together these studies indicate that bone marrow adipogenesis is a major factor contributing to age-related bone loss.

Using natural products to increase bone mass and inhibit bone marrow adipogenesis flavonoids are polyphenolic compounds that share the same basic structure, characterized by two benzene rings on either side of a 3-carbon ring. The various classes of flavonoids (e.g, flavonones, flavonols) differ

primarily in the placement of hydroxyl groups attached to the three-ring molecule.

They are perhaps best known as powerful antioxidants; however, there are now several flavonoid compounds that appear to exert a variety of effects related to bone metabolism. For example, the flavonoid genistein significantly inhibits peroxisome proliferator-activated receptor (PPAR gamma) expression and cellular proliferation in pre-adipocytes. Genistein, like the statins referred to above, also increases expression of the osteogenic factor Cbfa1/Runx2 and inhibits PPAR gamma expression in mesenchymal stem cells. Furthermore, genistein increases protein synthesis and increases the expression of bone markers in cultured osteoblasts.

b Pluripotent mesenchymal stem cells within bone marrow can differentiate to form a variety of cell types including osteoblasts, myoblasts, and adipocytes. Conditions that predispose individuals to bone loss, such as aging, estrogen depletion, and disuse are all associated with an accumulation of adipocytes in the bone marrow compartment. Women with osteoporosis tend to have a greater number of bone marrow adipocytes than women with higher bone mass, and bone formation rate is inversely correlated with adipocyte number in bone biopsies of adult men and women. Several flavonoids are known to affect lipid metabolism—for example, genistein is known to inhibit adipogenesis and silibinin and quercetin are lipoxygenase inhibitors. We are screening a large number of flavonoid compounds in vitro to identify those products most effective at inhibiting adipogenesis. Our criteria for selecting these compounds are 1) that the compound itself or a structurally related compound is known to inhibit adipogenesis and/or lipoxygenase activity in vitro or 2) that the compound itself or a structurally related compound is known to stimulate osteogenesis in vitro. The ultimate goal of this screen is to determine which compounds are most effective at inhibiting marrow adipogenesis so that these natural products may be further developed as novel therapeutic agents for preventing age-related bone loss and osteoporosis.

It is now known that adipocytes and pre-adipocytes can not only express osteogenic markers but they can also trans-differentiate to bone forming cells in the presence of certain factors. It is also known that certain flavonoid compounds can inhibit the differentiation of stromal cell precursors toward the adipocyte lineage and instead induce their differentiation to the osteoblast lineage. One of our goals is to identify flavonoid compounds that not only stimulate the expression of osteogenic factors in pre-osteoblasts (MC3T3 cells) but also stimulate the release of osteogenic factors by pre-adipocytes (3T3-L1 cells). Our approaches will enable us to identify compounds that inhibit adipogenic differentiation and to identify those factors that stimulate osteogenesis. The two approaches will in turn facilitate the discovery of 1) single compounds that can inhibit adipogenesis and stimulate osteogenesis and/or 2) combinations of compounds that together will produce the desired effect of inhibiting adipogenesis and increasing osteogenesis.

c Hatch Act, state matching funds
d State Specific

Key Word: Human Nutrition

- **Goal 3-4**

Chevon products

a Goat meat (chevon) is attractive to health-conscious consumers due to its lower fat content compared to other types of red meat. Goat carcasses are highly lean with lower intramuscular and subcutaneous fat. Chevon have been reported to contain healthier fatty acid profile compared with lamb, beef or pork. Chevon is an ideal source for developing low-fat meat products.

The objective of the study conducted last year was to determine variations in the distribution of fatty acids, including conjugated linoleic acids (CLA) and trans-fatty acids, in fresh lamb and chevon loin chops. Goats and sheep raised on pasture with a concentrate supplement were slaughtered. Proximate composition of longissimus dorsi (LD) muscles from loin chops was analyzed by the AOAC methods. Total lipid from the LD muscles was extracted by the chloroform (0.013% BHT)-methanol method. Extracted lipids were prepared for the fatty acid methyl esters (FAME), and were analyzed by gas chromatography. No significant differences were found in moisture, protein, and total lipid percentages between LD muscles of sheep and goats. The LD muscles from sheep and goats contained 69.0 and 68.3% moisture, 23.4 and 23.4% protein, 4.56 and 4.97% fat, and 1.17 and 1.73% ash, respectively.

The ash content in goat LD muscles was higher than that in lamb LD muscles. Four major fatty acids, palmitic (16:0), stearic (18:0), oleic (18:1n9), and linoleic (18:2n6) acids, made about 90% of the total lipids in the LD muscles of either species. Compared to sheep, goats had a higher level of 18:1n9 and lower levels of 16:0 and 18:0 in the loin chops. Loin chops from sheep and goats contained 4.6% and 5.5% polyunsaturated fatty acids (PUFA), respectively. Compared to sheep, goats had a higher level of cis-9, trans-11 CLA in the loin chops. No significant differences were found in the levels of other CLA isomers and trans-fatty acids (18:1t) in the loin chops. The results indicate that chevon may have healthier fatty acid profiles compared with lamb.

Several publications were generated last year from our chevon products research.

b Based on this experiment, there were no significant differences on chemical composition of fresh chevon and lambs, except for the ash content. The fatty acid profile of loin chop of goats might provide healthier lipid profiles than that from crossbred lamb. Saturated fatty acids with 12 to 16 carbons have plasma LDL-cholesterol raising characteristics, whereas unsaturated fatty acids reduce the plasma LDL either with or without any effect on plasma HDL cholesterol. Meat from ruminants is generally considered to be high in saturated fatty acid content, which is associated with incidence of coronary heart disease. Conjugated linoleic acids, which are naturally produced by ruminants, may provide anti-atherogenic effects in humans. With increasing incidences of obesity and heart diseases, chevon consumption, therefore, is expected to increase healthier population in the U.S. The impact of this project also depends on improving the palatability traits of chevon, which requires more research.

c NARETPA, State Matching Funds

d State Specific

Goal 4

UGA examined, researched and educated the public on:

- Protecting and enhancing soil, water, and air quality in the context of agricultural operations.
- Improving production and marketing of agricultural products through a greater understanding of weather and climate and their impacts on and interactions with agricultural production.
- Having an agricultural sector that manages its waste in an environmentally sound manner.
- Utilizing production by-products to the greatest extent possible and practical.
- Providing society with sustainable waste management options.
- Providing the research, instruction, and extension activities necessary to ensure that Georgia citizens protect, conserve, and utilize surface and groundwater resources in a sustainable manner.
- Having all poultry producers in Georgia implement nutrient management plans.

Prompt summary of greater harmony between agriculture and the environment:

Managing soils' resistance to wastewater through agricultural waste management studies

- Improved soils' resistance to excessive wastewater with simple low-cost technologies that have minimal maintenance requirements and can be used in onsite wastewater management systems.
- Reduce phosphorous export from poultry and beef cattle operations by implementing new best management practices such as low impact development.

Agricultural nutrient management aimed at sustainable agriculture and water quality

- Addressed public concerns of equine management through education. Course curriculums included production and environmental issues for producer (and agency) training, equine management for Farm*A*Syst assessment and production concerns.
- The Ag Partners program helped farmers identify and implement cost-effective practices for increased environmental protections, better neighbor relations, and enhanced farm sustainability. The program has increased access to technical and economic assistance.
- The new multi-state Livestock and Poultry Environmental Learning Center was formed for the public to provide public policy issues, animal production, and delivery of technical services for confined animal systems.

Increased nutrient management by improving agricultural waste management practices and water quality

- Implementation of trainings about nutrient management plans for poultry producers taught producers the requirements and procedures for implementing nutrient management practices on poultry farms.
- Educated agents about diagnosing aquaculture problems and recommending specific cures.
- Developed waste management program using soldier fly prepupae to digest pig manure solids thus reducing the amount of nutrients being returned to the environment.
- Used sweet potatoes to remove toxic waste materials from hazardous heavy metal waste sites more efficiently and economically than traditional methods using the engineered sweet potato alone or in combination with other remediation technologies.

Sustainable agriculture addressing profitability options

- Formal studies, demonstrations and field days were held to examine use of grazing animals, particularly sheep or goats, in controlling invasive vegetation and in utilizing vegetation that exists in the margins of forest or crop areas.
- Discovered alternative broil soil option for pasture fertilization using urea-ammonium nitrate solution and urea-polymer. Using this leads to better nitrogen recovery than urea-ammonium nitrate solution and would be preferable to these two fertilizers.
- In response to the EPA and economic management, a golf course is implementing new environmental management strategies using gap analysis, model development, educational plans, and a cooperative effort plan.
- Turfgrass irrigation methods were examined through greenhouse and field experiments. The hydroponics experiment using gypsum showed aluminum toxicity was clearly reduced with is the major source of rooting reduction in soils.
- Studied cereal cover crop and tillage on above ground biomass yields and leaf area index of six common dry bean cultivars to provide farmers with sustainable options to choose from, which are both profitable and productive.
- The observation of peanut yields in Georgia from 1934 to 2003 demonstrated simulation models are useful for predicting peanut yields.

Increased water quality and conservation through educational programs and improved irrigation methods

- Urban reduction of waste water is influenced through educational programs such as efficiency and safety, water conservation strategies, and seminars. An educational model was designed specifically for Home Depot to improve Master Gardener trainings.
- Impacts of irrigation on streams and groundwater resources were observed through development of numerical tools for the systematic, reproducible, statistical analysis of stream flow and climatic data. The most important result is that variation in climate cannot explain the decrease in stream flows.
- The UGA 'EASY' Pan Irrigation Scheduler has over 600 units in use across the southeast and as far away as North Dakota. In addition, a start-up business was initiated in South Georgia to manufacture and market the units.
- High expenses associated with fuel for irrigation were addressed through programs presented on using the EASY Pan Irrigation Scheduling method, Irrigator Pro computer software, checkbook method, and the use of tensiometers for irrigation scheduling. These trainings stressed the use of new technology to save money and water.

Water quality observed through weather climate factors

- Explored drought prevention options using seasonal rainfall forecasts. Ethnographic research indicated that farmers are willing and able to integrate scientific climate forecast; despite their resource limitations, farmers have several crop and livestock management options; and farmers have privileges to interactive approaches to learning and through farmer-to-farmer exchange and radio broadcasting.
- Developed a software program for weather pattern recognition.
- To better understand what kinds of information farmers need and how to communicate it to them, an exploratory study based on open-ended interviews was conducted. Most farmers are interested in the overall tendency for the season, rainfall fluctuations at particular times of crop growth, occurrence of hail or thunderstorms, soil temperature at planting time, and growing degree days.

Description of Activity; Impact of Activity; Source of Funding; Scope of Impact

Key Word: Agricultural Waste Management

- **Goal 4-1**

Evaluation of Phosphorous Removal Technologies for Onsite Wastewater Management Systems

a Onsite wastewater management systems are a cost effective and environmentally benign method to manage household wastewater if properly installed on suitable soils. Most soils have a large capacity to remove or immobilize bacteria, viruses, nitrate, phosphorus, and other potential ground and surface contaminants. There is concern, however, that high amounts of phosphorus added to the soil over the life of a typical onsite system may exceed the soil's capacity to assimilate the wastewater phosphorous. If the soil's assimilative capacity is exceeded, the wastewater phosphorous may move to lakes and streams and contribute to eutrophication. Thus, components are being developed to remove phosphorus from the household wastewater before it is introduced into the soil.

Two onsite systems that included passive anaerobic filters to reduce biological oxygen demand and total suspended solids and passive phosphorous removal technologies were installed in Hall County, GA, near Lake Sidney Lanier. The effectiveness of these technologies was evaluated by periodic sampling of the wastewater at various locations in the onsite system.

b Results of 14 months of sampling indicated that the anaerobic filters in both systems reduced wastewater biological oxygen demand and total suspended solids by 84 and 96%, respectively. In addition, these simple, low-cost components reduced total phosphorus in the wastewater by 58% and total coliform bacteria by 91%. The iron-based phosphorus removal component reduced total phosphorus in the wastewater by an additional 63% and dissolved reactive phosphorus by an additional 51%. The aluminum-based phosphorus removal technology was ineffective in phosphorus removal beyond that achieved by the anaerobic filters. These results demonstrate that simple low-cost technologies that have minimal maintenance requirements can be used in onsite wastewater management systems to reduce contaminant loading to the soil and prolong drainfield life.

c Smith Lever, Hatch Act, state matching funds

d Integrated Research and Extension

- Goal 4-1

Phosphorus loading to Lake Allatoona

a Lake Allatoona is a large reservoir located about 50 km northeast of metropolitan Atlanta. Rapid population growth has occurred in the southern part of the Lake Allatoona watershed. Poultry combined with beef cattle production is an important activity in the more rural northern part of the watershed. A study in the early 1990s classified the lake as being in transition between mesotrophic and eutrophic, with phosphorus (P) being the primary limiting nutrient for algal growth. Recent monitoring has shown excessive concentrations of chlorophyll-a and a lake-wide total maximum daily load (TMDL) for P is scheduled to be developed by 2008. Consequently, it is important to estimate the P loads to Lake Allatoona and to identify the sources of P within the drainage basin so that the most effective watershed management measures and nutrients control practices can be adopted to reduce excessive P loads into the lake.

The Soil and Water Assessment Tool (SWAT) is a computer model used to simulate watershed-scale transport of P. We used SWAT to develop models for the six major tributaries to Lake Allatoona. A number of model parameters related to P had to be quantified. Soil test P values for the watershed were obtained from a database of land owner samples submitted to the UGA soil testing laboratory. Phosphorus sorption coefficients were obtained from a national rainfall simulation study. Stream related parameters were obtained using the nutrient uptake length concept used by stream ecologists. Land use data were obtained from the Multi-Resolution Land Characteristics Consortium for 1992 and 2001. The models were calibrated using daily stream flow at Canton, GA and bi-weekly measurements of the instantaneous stream flow, suspended sediment, and total P concentrations in the eleven primary Lake Allatoona tributaries from May 1992 to May 1996.

b The primary land uses in this watershed in 1992 were forest (85%), pasture (10%), and urban (4%). During the next decade, urban land cover increased 227%; pasture grew by about 50%, while forest lost 20%. Our model results estimated that the P load to Lake Allatoona increased from 174 Mg to 239 Mg, which were 87% and 118% of the total P annual cap (201 Mg) set by the Georgia Environmental Protection Division for discharge into Lake Allatoona. In 1992, pasture was the largest source, contributing about 36% of the total P load to Lake Allatoona, followed by forest, point sources, and urban land uses, which contributed 26%, 23%, and 12%, respectively. A decade later, the largest P source was still pasture which contributed 47% of the total P loading to Lake Allatoona. Point source P dropped to 10% while the contribution from urban land use increased to 27%. Permit limits on poultry processing plants reduced the point source P loads but increasing urban land use increased non-point sources of P. Best management practices to reduce P export from poultry and beef cattle operations will need to be implemented in the watershed to reduce the nonpoint source P load to Lake Allatoona. New urban best management practices such as low impact development may also be important. Our work is described in two journal articles submitted to the Journal of Environmental Quality.

c Hatch Act, state matching funds

d State Specific

- Goal 4-9

Environmental fate of Arsenic in poultry litter upon land application

a Arsenic concentrations are regulated at very low levels. Regulators and the general public should be interested because arsenic contamination is of major concern and arsenic loading to soils through land application of poultry litter with subsequent contamination of surface and ground waters is a real threat. Research was initiated to determine the fate of the commonly employed feed additive Roxarsone, an organo-arsenic compound widely used as an antibiotic and growth promoter in the poultry industry.

b The use of the organic arsenic compound, roxarsone, as an antibiotic additive to poultry feed continues to raise concern over potential negative environmental impacts. Total arsenic concentration in poultry litter can reach > 40 mg kg-1 and both roxarsone and its mineralization product arsenic (V) have been identified in poultry litters (PL). To investigate the fate of these arsenic species upon land application of PL we conducted two studies. In the first, an Orangeburg soil (Ultisol from the Atlantic Coastal Plain) was spiked with either 20 mg kg-1 arsenic (V) or roxarsone and incubated at 10% moisture content for 4 months. Exchangeable arsenic was determined periodically by extraction with 0.1 M PO4. Both arsenic (V) and roxarsone displayed similar desorption; initially, approximately 70% of added arsenic was ligand exchangeable and this decreased to 35% after 4 months incubation, presumably due to

either slow sorption reactions or a change in solid phase speciation of arsenic to less exchangeable forms. In the second study, various manipulations of two PL samples were applied to the Orangeburg soil at realistic field application rates. The treatments were wet to 10% moisture content and water soluble arsenic, copper and organic carbo moisture content and water soluble arsenic, copper and organic carbon (DOC) was measured over 30 days. Arsenic and copper solubility were highest from the dried litter samples. Ashing of the PLs decreased soluble arsenic and copper, presumably because of the loss of organic matter from the ashed litter and subsequent decrease in DOC. Application of leachates from either PL resulted in higher concentrations of soluble arsenic and copper than when the soil was amended with equivalent concentrations of soluble arsenic and copper dissolved in DI H2O. We hypothesize that the increased levels of DOC from the PL treatments enhance arsenic and copper solubility through competitive sorption and complexation, respectively. In fact, arsenic and copper solubility was correlated to DOC levels in the amended soil extracts. Even though land application of PL introduced relatively low concentrations of arsenic and copper to soil, it appeared that other soluble constituents of PL significantly enhanced arsenic and copper solubility. The results suggest that management strategies for PL need to be developed to minimize negative environmental impacts in terms of surface and groundwater arsenic contamination.

c Hatch Act, state matching funds

d State Specific

- Goal 4-1

Master equine management training

Sub-keys: Nutrient Management, Sustainable Agriculture, Water Quality

a Educational activities focusing on production and environmental concerns associated with livestock have typically been directed to dairy, beef and poultry production. Since a comprehensive and collaborative educational program specifically targeting equine management has not been offered to Georgia horse owners in the past, the need for educational assistance is significant. Many horse owners are interested in their livestock as companion animals and for recreational purposes, having no formal training and limited knowledge about supporting issues, such as forage management, prescribed grazing, nutrient management, alternative water supply, and treatment of critically eroding and heavy use areas. In many cases, equine managers have not been introduced to or participated in USDA or other offered cost-share assistance that would enable them to apply best management practices commonly adopted by dairy, beef and poultry producers

The following general approach to increase technical and financial assistance awareness among equine managers is recommended by the State Technical Committee subcommittee, with additional specifications outlined by Oconee River RCandD as administrators of the project:

1. Develop a “Master Equine Specialist” education program to be delivered in two counties within the Oconee River RCandD Council area. A curriculum, presentations and outreach publications to achieve participation were produced. Similar to other “Master Specialist” programs, the training will be offered during two to three hour sessions, one night per week, over a six week period. The proposed time frame for the training is September - October 2006 and March 2007.

The program will be in-depth and cover both production and environmental issues relevant to equine management. Attracting producers to the training with production and health management education will be a primary focus to insure good participation, while emphasizing environmental issues and best management practices available to address them will be a primary focus to meet the educational objectives of the program. Successful completion of the training will gain the participants a “Master Equine Specialist” training certification, which has the potential to benefit the reputations of their operations for boarding and breeding, and enhance their eligibility for financial assistance.

2. Develop an equine management environmental self assessment tool, Horse Farm*A*Syst, as a publication reviewed by pertinent agencies and producer groups and used by producers to evaluate their management practices.

3. Conduct an environmental assessment and develop a conservation plan for the equine operation. For producers receiving the Master Equine Specialist designation, on-farm outreach visits will be made available to training participants to assist with a whole farm inventory of resources since many equine owners have limited exposure to governmental agencies available to assist them.

Oconee River RC&D and local Extension agents will provide assistance to producers to complete the self assessment and explain those criteria that reveal themselves as environmental issues on the operation. Oconee River RC&D and local NRCS Conservationists will provide assistance to producers with the development of a resource management system conservation plan. The plan will include aerial photography of the operation, as well as soils information and recommended practices/changes to increase production and reduce environmental liability.

Multiple Farm*A*Syst Assessments will be offered to represent the needs of the entire farm, as is the case with resource management system planning to meet the owners objectives for animals, plants, soil, water, and/or other resources.

A summary of the findings will be prepared to document baseline conservation needs by practice and extent, estimating the need for cost-share assistance by equine managers participating in the educational project. The summary will also detail the existing environmental impact resulting from equine management, prior to promotion of cost-share opportunities.

While dependent on basic EQIP (Environmental Quality Incentives Program) eligibility criteria that establish the operation as a farming entity, producers participating in the Master Equine Specialist training, whole farm assessment and conservation planning process, at the discretion of Georgia NRCS program guidelines, could be afforded additional ranking points or prioritized opportunities to increase their opportunity to participate in USDA cost-share programs.

Priority practices for USDA funding might typically include those practices emphasized in the training, such as a composting facility, critical area planting, diversion, fencing, heavy use area protection, nutrient management, pasture and hay planting, prescribed grazing, stream crossing, trough or tank, use exclusion, waste storage facility, waste utilization, and watering ramp.

If implemented by NRCS, this cost-share pilot project approach would serve to limit available funding to those producers that have participated in the educational opportunities that help insure best management practices are used to their fullest potential.

b One program has already been conducted in Oglethorpe County with 31 people participating from five counties. Evaluations from this first training are still being compiled. The second training is being planned for March 2007.

c Smith Lever, state matching funds

d State Specific

- Goal 4-1

Ag partners program

Sub-keys: Nutrient Management, Sustainable Agriculture, Water Quality

a Many farmers pride themselves as being good stewards of the land. But they may simultaneously view environmental regulations and some best management practices as expenses that they are unable to afford. The Ag Partners program is designed to overcome the conflicting attitude farmers have towards environmental management by providing recognition to good environmental stewards. The program then encourages these good stewards to work with their neighbors to help them to also improve their environmental management. This farmer-to-farmer training approach can help farmers identify and implement cost-effective practices for increased environmental protections, better neighbor relations, and enhance farm sustainability.

As initially developed, the Ag Partners Program provided farmers with limited incentives while asking them to provide, to a government agency, information that many viewed as confidential. The complexity of the program structure also limited involvement in the program to larger-scale farms. These factors initially limited farmer interest in, and the willingness of farmer organizations and producer groups to support the Ag Partners program. However, members of the Ag Partners Advisory Group, consisting of farmer and producer organization leaders, did support greater farmer awareness and implementation of environmental practices. To enhance farmers' ability to address environmental management, the Ag Partners Advisory group recommended revising the program to focus on two producer groups and then developing grants that would provide participating farmers with technical and economic incentives.

In response to the recommendations of the Ag Partners advisory committee, Ag Partners program has been restructured to work primarily with dairy, grass-fed beef, and conservation tillage farmers. Several grant proposals were developed to provide potential Ag Partners with technical information, environmental monitoring assistance, and financial support to implement environmental practices. All submitted proposals include outreach components designed to facilitate on-farm meetings and demonstrations of environmental monitoring and management practices. One project, funded through the NRCS, is already being implemented. This project is designed to assist three dairy farmers and three conservation tillage farmers implement environmental management systems. These projects will help participating farmers address one or two critical environmental concerns on their farms while helping them to monitor and document environmental impacts from their farming practices. Initial work on these projects has focused on developing technical information and identifying critical resources the farmer participants. As the farmers start using these resources to address their priority environmental concerns, we will initiate monitoring studies. Project cooperators will then work with the farmers to develop user-friendly record keeping tools to document farm production and environmental management practices.

Other proposed projects will work with vegetable farmers, peanut farmers, and dairy farmers to identify and test innovative environmental practices that they can implement on farm. Two projects are designed to work with vegetable farmers; one will help farmers monitor nitrogen availability from organic matter additions to the field as cover crops, mulches, or manure. The other project will help a farmer test mulches that could serve as an alternative to agricultural plastics. Two projects are designed to help peanut farmers reduce farm inputs and protect soil quality. One project will monitor nutrient availability to peanuts from cover crops in conservation tillage practices. The other project will help identify effective weed, soil, and crop management practices for farmers interested in transitioning to organic peanut-small grain production. Another potential project will work with three farmers as they implement and revise environmental management system tools to fit the needs of mid-scale farmers.

Proposal development afforded the opportunity to establish collaborative relationships with farmers, researchers, Extension agents, educators, and other technical support personnel. These interactions will help obtain assistance and access resources as work with farmers to develop integrated environmental management plans continues.

b While the structure of the Ag Partners Program is still evolving, the increased access of participants to technical and economic assistance through current, and hopefully, future grant-funded projects will encourage their involvement in this program. The farmer participatory approach used to develop this program will also help the program evolve into a format that is cost-effective while enhancing farm management skills and environmental stewardship. This format will start with existing management tools or practices, such as comprehensive nutrient management, management intensive grazing, organic production, or conservation tillage. Then, farmers will use simple monitoring tools to make management decisions to enhance both the economic and environmental sustainability of their farms.

c Smith Lever, Hatch Act, state matching funds

d Integrated Extension and Research

- Goal 4-1

Livestock and poultry environmental learning center

Sub-keys: Nutrient Management, Sustainable Agriculture, Water Quality

a The U.S. EPA has identified agriculture and livestock and poultry production in particular as the leading contributor of pollutants to the nation's rivers and streams. Water quality issues associated with animal agriculture are the current focus of significant public policy. Animal producers must be in compliance with new federal regulations and many states are modifying existing regulations to continue to serve as the permitting authority for these regulations. High-quality, science-based information must be rapidly collected and widely disseminated to assist animal agriculture with implementation of management practices and technologies identified by these public policy initiatives.

USDA estimates that there are 257,000 livestock and poultry operations that will need to have comprehensive nutrient management plans (CNMP). Critical to this CNMP will be a plan addressing crop requirements and nutrient credits from manure, fertilizer, legumes, irrigation water, and soil

residual nutrients for just short of 15 million acres of cropland and 780 million tons of manure. Costs associated with manure collection and storage facilities, alternative technologies, changes in feed management, and land treatment practices would all be additional costs associated with a CNMP.

The quality of and timely accessibility to science-based information is a significant weakness of many of our current research and outreach infrastructure. A primary reason for the inadequate use of research by programs and policies is the lack of well-established cross-agency communication channels. There is no formal or continuous means for agencies such as NRCS, Extension, or EPA to receive and utilize information from research entitles such as ARS and land grant universities. A second challenge is language and outreach. Instead of documenting their research and findings in papers targeted solely to others in the research community, the findings of researchers should be translated into layperson terms for policy makers and the general public. The third challenge is the overwhelming volume of sites and papers distributed around the Internet. Faced with the number and variety of information sources on the Internet -- and little if any verification of quality or validity of the documents -- even those sources available become significantly less valuable and hard to find. As a result, our customers often find a range of answers of varying quality. In this information environment, customer access to reliable science-based knowledge from our LGU system and partnering organizations is questionable.

By working with a national team, the Livestock and Poultry Environmental Learning Center has been established (www.lpe.unl.edu). A team of investigators from the universities of Washington, Nebraska, and Georgia have worked with a customer advisory team that includes more than 15 agricultural, environmental, state, and federal organizations, and a team of expert outreach specialists from more than eight land grant universities, five federal organization, and representatives from the private sector. These teams have guided the project to establishment of the learning center. The vision of the center is that individuals involved in public policy issues, animal production, and delivery of technical services for confined animal systems should have on-demand access to the nation's best science-based resources. Our team envisions that this center will be responsive to priority and emerging environmental issues associated with animal agriculture. To date, we have established the national website, initiated a monthly web cast and newsletter, and made numerous presentations.

b The learning center has reached a large audience in its first year. More than 900 individuals have subscribed to the monthly newsletter, 180 have attended live webcasts, 150 have downloaded archived webcasts, and more than 2,500 have accessed the website. Evaluation data has indicated that the average user of the information we are providing works with 50-100 farmers per month and 95% find our information to be very useful to their clients. The most cited uses are improving general knowledge on the issues and improving recommendations made to livestock and poultry producers. The Learning Center team is currently working with Extension to upgrade our information and website and interest in the learning center continues to grow.

c Smith Lever, Hatch Act, state matching funds

d Multi-State Integrated Extension and Research: NE, NC, WA

- **Goal 4-6**

  Value of poultry manure and used litter

  Sub-keys: Nutrient Management

  a Georgia currently ranks as the number one poultry producing state producing more than 1.4 million broilers, 9 million layers and 13 million breeder hens. Growth of Georgia's poultry industry has resulted in more than 2 million tons of poultry manure and used litter annually. When applied properly, this material has value as an organic fertilizer. Proper utilization of poultry litter is critical to the protection of the environment in Georgia. The implementation of nutrient management plans by poultry producers can reduce the potential for adverse environmental impacts.

  Educational materials including computerized software for NMP implementation for poultry producers have been developed. Approximately 1.5 EFT are utilized in the delivery of this program. Approximately $130,000 in formula funding is needed to support this program. Educational programs have been conducted to train poultry producers on the requirements and procedures for implementing NMP's on poultry farms.

b This educational program has reached more than 4,000 poultry producers in Georgia and as a result, producers across Georgia are implementing NMP's on their farms.

c Smith Lever, state matching funds
d State Specific

- **Goal 4-7**
  Development of an economical, environmentally friendly method of reducing the volume of pig manure returned to the environment
  Sub-keys: Sustainable Agriculture

a Environmental concerns over the amount of swine waste being returned to the environment have led to increased regulation and expenses for swine producers. Regulations and the cost of disposing of waste increase each year. Current waste management plans call for either storage of waste in the liquid form until land application or separating the solids from the liquids and composting the solids and spraying the liquids through irrigation systems. Legislative initiatives in several states have called for the elimination of waste lagoons on swine farms. Current methods of separating solids from the liquids lead to the loss of some nutrients, the generation of odors, and are labor intensive. Alternative methods of handling waste are needed to insure the protection of the environment and the profitability of swine producers.

Scientists from UGA's Animal and Dairy Science Department and the Department of Entomology have worked cooperatively with scientists from other universities to develop a waste management program using soldier fly prepupae to digest the manure solids and reduce the amount of nutrients being returned to the environment. Solids are collected on a belt, with the liquid running off. The solids are then moved to a secondary area where soldier flies lay their eggs. The prepupae hatch into the manure solids and feed on it. Mature prepupae develop and become mobile and are easily self collected. Soldier fly prepupae are then dried and processed into a meal and used as a high quality ingredient in nursery pig diets.

b Data indicate that soldier fly larvae digest approximately 50% of the dry matter and 60% of the nitrogen present in manure. Ten pounds of fresh manure will produce a pound of prepupae. The prepupae are high in crude protein (~30%) and fat and have an acceptable amino acid balance. Prepupae were frozen, dried and ground into meal and fed to nursery pigs. Nursery pigs fed diets containing 3% soldier fly prepupae substituted for plasma protein had performance similar to pigs fed the control diet. The diets containing the soldier fly prepupae were cheaper to feed. These data indicate that soldier fly prepupae can be used to digest manure solids and efficiently convert those solids into a high quality protein meal suitable for pigs and other animal species. The manure is converted into a useable byproduct, and the amount returned to the environment is reduced by ~50%.

c Hatch Act, state matching funds
d State Specific

Key Theme: Nutrient Management

- **Goal 4-1**
  Aquaculture diagnostics, pond, and aquatic environment management
  Sub-keys: Sustainable Agriculture, Water Quality

a The freshwater environment in Georgia includes lakes, ponds, streams, and swamps on private lands that utilize Cooperative Extension for technical assistance and problem solving. In addition, city and county governments and private corporations request aquatic environment management assistance. In 2006, drought and declining water volume of ponds caused an increase in requests for assistance from private pond owners. Fish kills, aquatic vegetation control, pollution abatement, and fish population management are the major issues brought to Extension for solutions. Heavy metal poisoning traced to imported seafood in the Atlanta area is an example of an aquaculture related issue brought to Extension. Georgia producers and the Extension agents who assist those producers need rapid response to aquaculture problems. Management of aquatic environments involves specialized knowledge that requires specialist support for the county delivery system. These clients do not receive technical assistance from the Georgia Department of Natural Resources since that agency has

concentrated on its regulatory responsibilities. New aquatic weed control methods have been recently approved and that technology needs to be delivered.

Personal contacts with producers, county agents, and DNR agents were made to diagnose aquaculture problems and recommend specific cures. Case studies and sample submissions were received at Tifton in order to address aquatic problems. The Distance Diagnostic System was used, when possible, to increase the efficiency of case submission and response. Workshops were held to educate county Extension agents about fish diseases, culture methods for catfish, freshwater shrimp, sport fish pond management, and aquatic weed control.

b Over 1,400 requests for assistance and calls were answered during 2006. Aquatic herbicide applicator training was conducted for Extension agents, DNR officers, and commercial applicators at five locations around the state. Over 100 participants renewed their license training requirement. Value of the information requested varied from less than $100 to over $104,000 for single cases. Estimated total impact of this activity exceeded $3,000,000 in 2006.

c Smith Lever, state matching funds

d State Specific

Key Theme: Soil Quality

- Goal 4-16

Sweet potato production

a Soil contamination with heavy metals has increased drastically due to industrialization. Heavy toxic metal contamination in soils poses vital environmental and human health problems worldwide. Removal of heavy metals from contaminated soils is an urgent issue. Conventional remediation of the metal contaminated soils is prohibitively expensive. Plant-based phytoextraction from metal contaminated soils is emerging as cost-effective alternative. However, no natural hyperaccumulating plant is so far recognized as useful for commercial phytoextraxtion due to its slow-growth and small biomass. Sweet potato possesses the other desirable plant characters for phytoextraction such as its adaptability to a broad range of agro¬ecological conditions, highly productive even under adverse farming conditions, having few natural enemies and rare pesticides needed, and fitting in low-input agriculture. Certain environmental cleanup genes could be inserted into sweet potato genomes through genetic engineering. As a result, the value-added transgenic sweet potatoes have good potential to remove toxic heavy metals from contaminated soils.

b We screen the suitable sweet potato varieties for phytoextaction; refine high plant regeneration protocol(s) for sweet potato under in vitro culture condition; insert Metallothionein-I (MT-I) gene into sweet potato cells through gene gun and Agrobaterium-mediated methods; regenerate and identify the transformants; characterize the MT-I gene express; and test metal removing ability of the MT-I gene-added sweet potato under field conditions.

We then establish efficient plant regeneration protocols for sweet potato in vitro culture; develop efficient protocols for sweet potato gene transformation; develop protocols for efficient genetic transformation of sweet potato; produce transgenic sweet potato plants for phytoextraction of metal pollutants; add more information for comprehending the underlying of molecular mechanism of metal biology; and provide more experience and information for consolidating phytoextraction into a decision matrix or cost model.

We produced hyperaccumulating sweet potato genotypes with wide adaptability that remediate hazardous heavy metal waste sites more efficiently and economically than traditional methods using the engineered sweet potato alone or in combination other remediation technologies.

c Hatch Act, state matching funds

d Multi-State: FL, SC

Key Theme: Sustainable Agriculture

- Goal 4-5

Grazing and management

a Recent attention to financial opportunities as well as responsible nutrient recycling has encouraged the use of grazing animals, particularly sheep or goats, in controlling invasive vegetation, or in utilizing vegetation that exists in the margins of forest or crop areas.

Demonstrations have been established that provide visual information and evidence of the possibilities. Further, formal studies have been included to provide accurate data to verify the demonstrations. A field day was planned for information transfer; however climatic change prevented implementation. Portable fencing was utilized to illustrate options in animal control.

Several hundred people have observed the use of grazing sheep or goats in vegetation management in non-traditional land areas. Fact sheets were developed with a litany of the facts involved. Baseline information has been taken on existing vegetation in order to document species composition change. Photographic evidence has been obtained and update articles have been included in the Small Ruminant Newsletter.

b A measurable increase in inquiries has resulted from these demonstrations. Reference has been made to the new ASI targeted grazing guidebook, which includes experience similar to ours. Additional impact will exist after a field day in the new year and as more visitors are exposed to the work.

c Smith Lever, state matching funds

d State Specific

- Goal 4-7

Ammonia volatilization losses and nitrogen uptake from urea-based fertilizers applied to tall fescue pastures

a About 36% of the agricultural land in Georgia is used as grassland for grazing or hay production and requires nitrogen fertilization for adequate production. At the present time, 40% of these grasslands are fertilized with broiler litter, but application of urea-based fertilizers is likely to increase as restrictions on broiler litter applications are implemented because of environmental reasons. Surface application of urea-based fertilizers commonly leads to ammonia volatilization losses, which reduce nitrogen recovery by forages. Information on such losses is very limited in the Southeast.

We conducted a two-year study in which we evaluated ammonia volatilization losses from urea, urea-ammonium nitrate solution, and urea-polymer fertilizers. In a separate study we also evaluated nitrogen uptake from ammonium nitrate, urea-ammonium nitrate solution, and urea-polymer fertilizers.

b On average, ammonia volatilization losses from urea were about 30% greater than those from urea-ammonium nitrate solution or urea-polymer. Nitrogen recovery was similar for urea-ammonium nitrate and urea-polymer, with an average of 35 to 40% of the N applied. Nitrogen recovery from ammonium nitrate was about 50% of the applied nitrogen because ammonium nitrate does not undergo ammonia volatilization losses. In summary, urea-ammonium nitrate solution and urea-polymer lead to smaller losses of ammonia than urea and therefore would be preferable to urea for pasture fertilization. In addition, ammonium nitrate leads to better nitrogen recovery than urea-ammonium nitrate solution or urea polymer and would be preferable to these two fertilizers if its use can be justified economically.

c Hatch Act, state matching funds

d State Specific

- Goal 4-7

Environmental management system template for golf courses.

a The U.S. EPA and many state environmental agencies are increasingly encouraging businesses of all types to adopt an EMS approach to address environmental issues. The EMS approach is essentially the model for regulatory agencies to address environmental issues for all facilities in a comprehensive manner by bringing all environmental issues together in one management system approach. An EMS has been defined as a set of management processes and procedures that allow an organization to analyze, control, and reduce the environmental impacts of its activities and operate with greater

efficiency. EMS involves a loop process of plan, identify, manage, monitor, and review. The ultimate goal of any EMS is to integrate environmental considerations into everyday business operations, and ensure that environmental stewardship becomes part of the daily responsibilities for everyone across the entire organization, not just in the environmental department. To-date EMSs are very limited in agriculture (Georgia has one for the poultry industry), horticulture, and green industries. Currently, the golf course industry has not developed a model EMS as the first step toward implementing the EMS approach into golf course management.

In fall 2005, a process was initiated in the Crop and Soil Science Department to plan an EMS template for the golf course industry by coordinating interchange between various stakeholder groups --- United States Golf Association, Golf Course Superintendents Association of America, Audubon International, University of Georgia, and key industry personnel. Information on the EMS was reviewed and the 17 basic EMS concepts evaluated for adaptation to the golf course industry including the complete facility--- i.e., grounds, course area, clubhouse, maintenance buildings, etc. Of the 17 suggested elements, 15 focus on process or business management aspects, while two are the real core, namely: a) environmental assessment to identify environmental issues of concern on the facility, and b) development of a series of Best Management Practices (BMPs) to minimize potential adverse environmental aspects. While the 15 business organization/management and process elements are rather generic across industries, the 2 core elements are much more industry specific and these are essential elements for an environmentally sound and effective EMS program. The initial objectives arising from the first planning phase were:

• Gap analysis---Conduct a "gap" analysis to determine what environmental issues may be missing in currently available environmental assessment and management programs that have similarities to parts of the EMS approach, but would be essential for a holistic EMS approach.

• Model development---Develop a 20-40 page "detailed summary EMS template" for golf courses which would summarize all 17 basic elements with emphasis on the 2 core elements of assessment and BMPs for each environmental issue. At this stage, each of the elements would be presented in a "detailed summary" format --- i.e., presented in a manner to educate about the scope and depth of what an EMS involves but not to attempt to provide highly detailed information on BMPs to address each of a number of environmental issues (for example, water conservation).

• Education plan---Develop a plan to communicated the presence of the EMS template document.

• Cooperative effort plan---Since the initial discussions with potential stakeholder groups was expected to stimulate assessment of what their group should do about EMS in preparation for the future, we would be open to cooperative efforts as they arise as well as initiate ones that would be beneficial.

b To date, the gap analysis has been completed; the initial draft of the template has been developed with the final draft expected by the end of the year or January 2007; the template will be co-hosted on the Audubon International and UGA Turf websites followed by articles on the EMS concept and the template information in key industry trade publications, as well as conduct presentations; the GCSAA has initiated a process to investigate the role of GCSAA in education, communication, and research activities related to EMS for golf courses. Stakeholders we have spoken with believe that over the next few years the EMS approach will be the most significant environmental concept to impact the turf industry since the Clean Water Act; that it is essential to develop a holistic model EMS in summary form as an educational tool since very few in the industry have even heard of EMS to date; and to insure that more detailed EMS will truly be holistic in nature a good summary template is necessary. Thus, our activities are foundational for the future activities related to EMS and we expect that the EMP template will be used by state golf course groups and governmental agencies as well as a model for other non-golf green industries.

c Hatch Act, state matching funds

d State Specific

- Goal 4-7

Use of gypsum to enhance subsoil rooting of turfgrasses

a Turfgrass is a multi-million dollar industry in Georgia, ranging from maintenance of home lawns to sports fields, golf courses, and commercial landscaping. Water via irrigation is a major input needed to maintain turf vigor and aesthetics. Recurrent droughts in the state have led to water restrictions, which can lead to increased expense and/or degraded quality of turfgrass stands.

Acid subsoils inhibit deep rooting and water extraction of many plants in Georgia, especially in the Piedmont. Gypsum is an inexpensive byproduct material that readily leaches into subsoils, supplying calcium which helps to offset the negative effects of acidity on rooting. Greenhouse and field experiments have been established to evaluate the effect of gypsum applications on subsoil rooting and water extraction of common turfgrasses on representative soils of the Piedmont region.

b In hydroponic experiments with fescue, gypsum clearly reduces aluminum (Al) toxicity, the major source of rooting reduction in subsoils. This effect is largely related to complexation of soluble Al and reduction in Al activity in solution. In greenhouse soil column studies, fescue and bentgrass root significantly more deeply when acid soil is amended with field rates (5 t/a) gypsum, although no clear trend in water extraction was measured in the columns used. Field experiments are in progress at the Georgia Station, where subsoil moisture measurements show greater water extraction by fescue and zoysia grass with gypsum treatments, but not by bermudagrass. In addition, five field demonstration trials are installed in Georgia, Alabama, and Mississippi on golf course fairways, and are being visually evaluated for vigor.

c Hatch Act, state matching funds

d State Specific

Key Theme: Sustainable Agriculture, Weather and Climate

- Goal 4-12

Analysis of the inter-annual variation of peanut yield in Georgia using a dynamic crop simulation model

a Advanced information tools such as crop simulation models are used to study the impact of climate variability on agricultural production. However, the necessary long-term observed yield data that should be used to evaluate the performance of the crop simulation models are scarce or not available. If available, they cannot be readily used for evaluation of crop simulation models because of the lack of data that define the specific crop management conditions that dominate a particular technological period. However, long-term crop yield data from statistical estimates, such as the USDA National Agricultural Statistics Service (USDA-NASS), are a valuable source of information, as these include yield estimates at a county level that go back as far as 1917. This information can be used as a complement to crop model simulations for studying the impact of climate variability on yield. Yet, the evaluation of crop models is important for minimizing simulation errors and optimizing their performance to allow for further applications in different locations and at larger scales. Nevertheless, the variation in simulated yields mainly represents the inter-annual and intra-annual weather variability, while the adoption of new technologies is not reflected.

Since weather is one of the most important factors that affect agricultural activities, its characterization could help understand the inter-annual variation of crop yield. The El Niño Southern Oscillation (ENSO), which refers to changes in sea surface temperature (SST) in the eastern equatorial Pacific Ocean, influences the weather pattern in Georgia and other southeastern states and this impacts crop production. ENSO is categorized in three phases: El Niño (warm SST anomalies in the Pacific), La Niña (cool SST anomalies), or neutral based on an index derived from observed SST. If index values are 0.5°C or greater for six consecutive months (including October, November, and December), the ENSO year of October through the following September is categorized as El Niño, La Niña (index values equal or exceed -0.5°C), or neutral (all other values).

Observed peanut yields obtained from state variety trials as well as peanut yield estimates from the USDA-NASS for three counties in the Georgia peanut belt for the 70-year period from 1934 to 2003 were used for evaluating peanut yield estimated with a crop simulation model. We defined three technological periods: the period from 1934 to 1954, characterized by no impact of breeding on peanut production and by a rain-fed system; the period from 1955 to 1978, characterized by an increase in yield due to changes in technology, such as breeding for improved varieties and irrigation practices that started around the beginning of the 1970s; and the period from 1979 to 2003, characterized by important adoptions in peanut production technology by farmers, such as the use of high-productive varieties and irrigation. A weighted average based on the acreage of the soil type, the peanut type, and the irrigated land in each county was calculated to obtain a unique simulated yield. Then yields and weather data of the 70-year period were grouped with respect to ENSO phases and

technology periods and compared with yields from variety trials and yields from USDA-NASS.

b When compared with yields from variety trials, NASS yields failed to reflect the weather variability at the beginning of the study period, but the yield obtained with the crop simulation model clearly reflected the variability during the 70-year period. The yields obtained from NASS estimates seemed to be useful for evaluating simulated yields from the mid-1970s. The results showed that crop models can be useful for understanding the inter-annual variation of yield due to climate variability if appropriate adjustments are made to account for changes and improvements in agrotechnology.

c Hatch Act, state matching funds
d State Specific

- Goal 4-7

Comprehensive program on BMPs for turfgrass water conservation

a Turfgrass managers are increasingly confronted with implementation of site-specific water conservation practices---and water will be the number one problem confronting the turf industry in the future. For the turf industry to successfully address the water conservation issue, they must have a plan that: is environmentally sound; will work; and will be understood/accepted by the general public and environmental regulatory agencies. However, at of the initiation of this project in 2004, an in-depth, science-based, holistic-systems plan/model had not been well-defined for turfgrass water-use efficiency/conservation. Site-specific strategies and implementation for water conservation (precision turf management) requires in-depth science information to be integrated into a single package concerning: a) comprehensive inclusion of all possible water conservation strategies; b) information on various options within specific strategies, c) the specific information required to actually implement many strategies, and d) information or implications to the turf manager/owner of choosing certain options in terms of direct/indirect cost, altering management regimes, labor, etc. Development of a successful holistic, science-based approach/plan/model to turfgrass water conservation was deemed as the first step with additional steps to follow focused on adoption and strengthening this model.

The Best Management Practices (BMPs) concept and terminology evolved out of the Clean Water Quality Act over the past 25 years for water quality issues and is readily understood by regulatory agencies. The first comprehensive overall water conservation model or plan was developed in 2004-2005 by the UGA Crop and Soil Science Department by applying BMPS concepts and terminology to water conservation/use-efficiency. Up to this period, the national turf industry was hindered by water conservation plans that were very limited, confusing, and/or used terminology that was not easily understood. After creation of comprehensive water conservation plans, our 2006 focus has been to build upon this foundation.

b Activities directed toward promoting and enhancing the water conservation BMPs program in 2006 included an invitation to become a committee member and present this model in oral form via a Council for Agricultural Science and Technology (CAST) conference on turfgrass water issues in urban landscapes; adoption of this model and terminology by the CAST group as the model to promote so that all have a single model and terminology to apply to this issue; writing the closing/tie-up chapter in the CAST special publication arising out of the CAST conference; and research was conducted by a master's student during the summer of 2006 on an unique concept using cart-mobile sensor arrays to obtain rapid and detailed site-specific information on soil moisture and plant stress on complex sites. The concept involves how to use the information to make irrigation system design changes and then changes in irrigation scheduling on a frequent basis to insure efficient use of water.

c Hatch Act, state matching funds
d State Specific

- Goal 4-15

Sustainable vegetable production

a Georgia's farmers need more environmentally friendly sustainable options to choose from which are both profitable and productive. Use of a fall non-leguminous cover crop with a leguminous succeeding cash crop has not been thoroughly researched. Developing cultural practices that protect improve and sustain the environment now and for the future will save Georgia's farmers cost of nitrogen fertilizer. Established and emerging markets interested in environmentally friendly production systems that

produce value-added vegetables will sell these commodities at higher prices compared to conventionally produced vegetables. In turn, Georgia farmers would improve their income, better protect the environment, and insure farm land usage now and for the future.

In 2005, results indicate that hairy vetch supplemented with N at 101 kg/ha is most effective in supporting yield and plant growth of the BCsh2 sweetcorn variety. These findings terminated the GEOX-5320 research program and the new GEOX-5321 research program was initiated. During the 2005-2006 growing season a study was conducted to determine effect of cereal cover crop (abruzzi rye, AR) and tillage on above ground biomass (AGB) yields and leaf area index (LAI) of six common dry bean cultivars (C1-C6). The following cover crop, no/strip tillage(NT/ST) and six cultivar treatments were applied using randomized complete block design with three replications: 1)AR-NT-C1, 2)AR-NT-C2, 3)AR-NT-C3, 4)AR-NT-C4, 5)AR-NT-C5, 6)AR-NT-C6, 7)AR-ST-C1, 8)AR-ST-C2, 9)AR-ST-C3, 10)AR-ST-C4, 11)AR-ST-C5, 12)AR-ST-C6. In spring of 2006, seeds of six common dry bean cultivars were field planted. AGB was collected two weeks prior to harvest while LAI was recorded at flowering (7/17), podding (8/7) and harvest week (8/23). AR-NT-C3 produced highest LAI at flowering (2.14), podding (2.57), and harvest (1.70). Lowest LAI at flowering (1.01), podding (1.11) and harvest (0.49) were produced by AR-NT-C1, AR-ST-C4, and AR-ST-C6, respectively. Maximum AGB fresh (66.5 Mg/ha) and dry weight (11.4 Mg/ha) yields were produced by AR-NT-C3 while minimum AGB fresh (26.1 Mg/ha) and dry weight (5.2 Mg/ha) yields were produced by AR-ST-C4. Results showed that C3 (cv. Hooter, Cranberry type) under AR-NT treatment produced maximum LAI and AGB yields. An additional goal of this study is to evaluate same cover crop and tillage practices on water use(WU) and yield of three of the common dry bean cultivars(C2, C4, and C3). Dry beans were harvested 93 days after planting. Six bi-weekly (6/19=vegetative, 6/30=early flowering, 7/14=late flowering, 7/25=initial podding, 8/9=pod fill, and 8/24=harvest) volumetric soil water percentages were measured at a depth of 0-45 cm. Maximum bean yield (470.0 kg/ha) was produced by AR-ST-C4 while minimum yield (0.0 kg/ha) was produced by AR-ST-C2. Among the three dry bean cultivars over all dates, WU was highest for C4 grown in AR-ST and lowest for C2 AR-NT. Results indicate that C4 (cv. Dwarf Taylor Horticulture, Cranberry type) in abruzzi rye strip tilled had highest yield and water use while C2 (cv. Mayflower, Navy type) in AR-NT was lowest.

This is the first year of research and information from this program has been disseminated at the Fort Valley State University 30th annual Farm, Home, Ministers' Conference with additional accredited avenues forthcoming.

b The initial outcome of this study indicates that among the common bean cultivars abruzzi rye (non-leguminous cover crop) strip tilled was most effective in supporting seed yield and WU for common bean cultivar Dwarf Taylor Horticulture (Cranberry type). Cultivar Hooter (Cranberry type) LAI and AGB was affected the most by abruzzi rye no-till treatment. This first year results indicate that a Cranberry common bean type showed the best performance and potential for middle Georgia growth and possible production.

c Hatch Act, state matching funds

d State Specific

Key Theme: Water Quality

- Goal 4-2

Agricultural water use

a Water has become one of the most critical issues affecting agricultural crop production. Several areas of the state have been under a permit moratorium which essentially means no agricultural growth for those areas. A better understanding of agricultural water use was needed.

From 1999 through 2004, the college embarked on a comprehensive monitoring and modeling program to determine how much water is being used by agriculture in the state. This multi-disciplinary, multi-location project monitored over 410 permitted withdrawals (represents over 2% of all sites in a randomized, statistical based sample, and included over 670 individual field sites). Over 38,000 acres were monitored which also represents about 2% of the 2.2 million acre of irrigation listed in the permit

data base.

b Average agricultural irrigation use in 1999 ranged from 7.6 to 10.8 inches across the southern half of the state, with the coastal region using less water. In 2000, average irrigation water use ranged from 7.3 inches (central Coastal Plain) to 10.2 inches (Flint River basin). In 2001, average irrigation water use ranged from 5.8 inches (central Coastal Plain) to 7.5 inches (Flint River basin). In 2002, average irrigation water use ranged from 6.0 inches (central Coastal Plain) to 8.7 inches (Flint River basin). In 2000, 2001, and 2002, average water use in the coastal region has been between the values indicated.

Over 100 educational programs conducted by Extension have presented these facts to numerous commodity and other groups across the state pointing out that farmers are doing their part as good stewards of the resource and demonstrating agricultures commitment to water conservation.

c Hatch Act, Smith Lever, state matching funds

d Integrated Research and Extension

▪ Goal 4-2

Efficient landscape irrigation

a While Georgia had above average rainfall in 2003, there is still a need to reduce wasted water due to landscape irrigation in the urban setting. Georgia has only a limited supply of water and continues to experience dynamic growth in most urban areas. New initiatives for better water management in the state are being established by many different non-government agencies and state agencies. The State Department of Natural Resources Drought Management Plan and the Municipal North Georgia Water Planning District (MNGWPD) Water Supply and Conservation Plan are two examples. Each of these initiatives requires a better understanding of water conservation issues and solutions. Reduced outdoor water use is one of the key recommendations of the two plans named above. MNGWPD Water Supply and Conservation Plan research indicated that outdoor water use is a major component of total residential water use. They estimated that an average of 20% of residential water use is for outdoor watering. Landscape professionals need to be aware of the options available to reduce outdoor water use and eliminate wasteful watering practices.

Several educational programs were developed and implemented for landscape professionals to expand their knowledge and understanding of water conservation strategies in landscapes. A half-day seminar on landscape water use efficiency and safety was conducted in Augusta. In Hall and Chatham counties, a 45-minute seminar was presented to landscape professional audiences. More than 85 landscape professionals received training in landscape irrigation best management practices through these three seminars.

An educational module on landscape irrigation targeted to Home Depot employees was created. This module was one of several designed to assist Home Depot in providing good information to their customers through better-trained employees. The irrigation educational module should take approximately 20 minutes to complete and is one of several created by GCES specialists. The modules will be available to Home Depot employees around the U.S. through a Home Depot website dedicated to employee education.

A group of 24 county agents were trained on efficient landscape irrigation practices during Winter School in January, 2003. These agents will be able to take this updated information and use it in Master Gardener training as well as training for landscape professionals and homeowners in their counties.

b Evaluations from one of the above seminars allowed for feedback from participants. All of the landscape professionals who responded on the evaluations indicated the information they received enhanced their skill level and would result in improved management practices in their operations.

The response of the landscape professionals has been overwhelmingly positive. At each seminar, these professionals have indicated a real appreciation and need for better information on irrigation design, installation and management for the landscape. A quote from one landscape professional participant stated “…we use just about all the things you had talked about, and I really enjoyed the presentation and the knowledge you had to give to us.”

Workshops and seminars will continue to be carried out for county agents and landscape professionals to supply them with information and strategies to save water and prevent pollution through more efficient use of outdoor water.

c Smith Lever, state matching funds
d State Specific

- Goal 4-2

Erosion and sediment control certification

a Georgia House Bill 285 requires all individuals that disturb soil and conduct land disturbing activities to be certified by Dec. 31, 2006, in erosion and sediment control at the level appropriate to their work. Thousands of people who work in Georgia require this certification. Penalties for not being certified can include fines, permit revocation, forfeiture of bonding and stop work orders on sites where work is being conducted. There are 3 levels of certification: Level 1A for contractors and those who do most of the work on-site, Level 1B for inspectors and Level 2 for erosion, sediment and pollution control plan designers and reviewers.

We wrote articles for the Center for Urban Agriculture website to inform green industry professionals about the new regulation's requirements; wrote articles that were published in the Georgia Green Industry Association Journal, Georgia Irrigation Association Newsletter, and Georgia Turfgrass Association Newsletter to tell members in these professional associations about the new requirements and how they would affect their businesses; and trained county agents in the northeast district on the new regulations and who needs to be certified. Other county agents were informed about the new regulations through the Center for Urban Agriculture newsletter sent electronically to urban agriculture professionals and urban county agents. Several other county agents that did not become trainers partnered with their local county governments to offer training opportunities. The Extension training program was targeted to landscape industry and local government officials and staff.

b Four staff became certified Level 1 trainers, and one also became certified to instruct Level 2 professionals. These county agents and specialists were instructors for more than 30 Level 1 courses providing training for over 900 professionals. Four Level 1B courses were offered and over 30 local government staff and officials received training and were certified. The one Level 2 course trained nine professionals in design and review of erosion and sediment control plans. Approximately 85 % (about 774 professionals) of those receiving training from courses with Extension faculty trainers passed the exam and became certified in erosion and sediment control in Georgia. Many more urban agriculture professionals were made aware of the new law's requirements for certification through newsletter articles and web pages. The UGA courses were often offered at rates below those of most other groups offering training which resulted in estimated savings of more than $54,000 to certified individuals.

c Smith Lever, state matching funds
d State Specific

- Goal 4-2

Irrigation scheduling made EASY

a Irrigation scheduling remains as one of the most critical management factors in any agricultural operation. A system can be efficiently designed, but if water is not applied at the proper time and at the proper amount, water will be wasted or crop production will be poor. Irrigation scheduling technologies have been developed and improved upon for decades. Some advanced computer-based programs are available to help a farmer decide when to irrigate and when to stop for specific crops. Unfortunately, many of the advanced technologies and traditional approaches are not being used. Most farmers do not use irrigation scheduling because the techniques are too complicated, the instrumentation requires too much maintenance, is too time consuming, or expensive. An easy and reliable irrigation scheduling method has been needed that can be adapted to a variety of crops.

In 2001, the UGA "EASY" Pan Irrigation Scheduler was introduced. This scheduler uses a simple, but effective design, and is made from readily available parts (such as a wash tub, toilet bowl float, etc.). The EASY pan takes into account the water holding capacity of soil, the water used by the crop being grown, and water applied by sprinkler irrigation and rainfall. In addition, the indicator arm for the float system can be read at a distance (edge of the field) while the unit remains in the field that is being

irrigated.

b Although the system is simple, tests have indicated reliable irrigation recommendations as compared to more sophisticated approaches (like computer-based models). Over 600 units are now in use across the Southeast and as far away as North Dakota. A start-up business was initiated in south Georgia to manufacture and market the units (with at least 1.5 employees). Recent tests have improved the unit to allow a smaller 9 gallon tub to be used in place of the original 17 gallon tub. The pan can be seen at many county Extension offices in the row crop production areas. Additional tests are being conducted in a variety of crops including pecans.

c Smith Lever, state matching funds

d State Specific

- Goal 4-9

Impact of irrigation on stream water levels

a Recent droughts have illustrated the fragility of the water resources system in southwest Georgia. Reduced stream levels associated these droughts may have a negative impact on the survival of protected wildlife species. It has been suggested that increases in groundwater pumping for irrigation purposes were a factor on the low stream levels during dry months. The objective of our study is to qualify and quantify the actual impacts of irrigation on stream and groundwater resources in southwest Georgia.

We developed numerical tools for the systematic, reproducible, statistical analysis of stream flow and climatic data. In particular, we want to estimate the temporal trends in precipitation and evapotranspiration. We implemented several algorithms for the automatic detection of change points in a time series, and applied these algorithms to analyze average monthly precipitation and temperature data of climate division 7 in southwest Georgia, as well as on streamflows data recorded from 1957 to the present on the Flint River at Newton, GA. We also tested several methods that take the potential changes of trends at different time scales. At last, we contributed to the development of function libraries.

b The most important result is that variation in climate cannot explain the decrease in stream flows on the Flint River at Newton. This result indicates that groundwater pumping and/or landscape changes may be responsible for the decrease flows in the Flint. We didn't observe any significant change in trend rainfall anomalies. We detected a slight decrease of average temperatures from May to September. The analysis of monthly average streamflows indicates a decrease in recorded discharge, and shows a significant drop in spring flows (March to May) in the late seventies and early eighties. The more complex methods confirm the absence of significant trends for the rainfall anomalies. However, there is a significant increase of the squared deseasonalized anomalies (corresponding to a change of variance) in the last 30 years, compared to the earlier data.

c Hatch Act, state matching funds

d State Specific

- Goal 4-2

Variable rate irrigation technology

a Modern-day farming shares few technological similarities with farming from a bygone era. Lack of precipitation and the presence of pests are still common factors. However, agriculture in the new millennium is nothing short of big business. And along with big business come high expenses.

The 2006 growing season showed farmers exactly how high expenses could be. The highest of them was fuel for irrigation. Average irrigation costs to grow an acre of peanuts or cotton rose more than 20% in one season. Therefore, everyone involved with farming began trying to find ways to conserve water, fuel, and reduce expenses.

Worth County Extension responded to the issue with a multi-faceted approach aimed at educating farmers on becoming more water-wise. Meetings were held in late winter and again in mid-summer 2006 to teach growers how to use irrigation scheduling devices and techniques, and to introduce them to new variable rate irrigation systems to use water more wisely.

Engineers from UGA's Department of Biological and Agricultural Engineering visited Worth County to help with the education process. Programs were presented on using the EASY Pan Irrigation Scheduling method, Irrigator Pro computer software, the checkbook method, and the use of tensiometers for irrigation scheduling. Trainings were sponsored by Worth County Extension with seminars by engineers and representatives from Automated Irrigation Controls. Their expert knowledge of variable rate irrigation controls and remote sensing technology helped to reveal what the next frontier of irrigation devices will bring to the farm. Additionally, Automated Irrigation Controls retrofitted one center pivot using their variable rate irrigation technology to showcase the water saving capabilities available on the farm today.

b More than 75 Worth County farmers participated in the trainings, and their willingness to adopt new technology to save money and water was overwhelming. Sixteen of the participants indicated that they were going to use the new methods of irrigation scheduling immediately. Although the number of farmers to profess using new technology is small in number, the acreage impacted is huge. Irrigation scheduling was adopted on 20,000 acres.

According to one Worth County farmer, the results have been that water saved is money earned. "Using tensiometers has been a huge help to me, especially in peanuts. They have taught me to manage my crop in a different way. Now I have a good understanding of the soil on my farm and how it likes to be watered. I don't get nearly as much runoff anymore. In fact, I saved one inch per acre of water this season by using them. On top of that, I've made the best peanut crop ever!"

Almost all farmers using the techniques have indicated an average of one inch per acre savings in irrigation water over the course of a season. The economic impact of Worth County Extension programming on this single issue has been $320,000 in 2006 alone. UGA Cooperative Extension has an impact on all aspects of agriculture in Worth County, and the economics show it.

c Smith Lever, state matching funds

d State Specific

Key Theme: Water Quality, Weather and Climate

- Goal 4-10

Climate forecasting for agricultural resources

a The Sahel-Sudan region of West Africa is characterized by chronic food insecurity and severe environmental degradation. Rural households depend on rain-fed crop production and pasture availability for their livelihood and are therefore vulnerable to climate variability. This situation is exemplified by the recent famine that affected the Sahelian countries after drought and locus infestation destroyed crops and pastures. According to the Famine Early Warning System, northern Burkina Faso, where one of the project sites is located, faced a very serious food security crisis in July 2005 due to collapsing terms of trade between staple grains and livestock, the main source of cash income for rural families.

This project addresses this situation by exploring how recent advances in climate prediction (i.e. seasonal rainfall forecasts) can be used to increase households' adaptive capacity and the production potential of rain-fed agriculture in three agro-ecological zones of Burkina Faso. In particular, the project sought to determine how seasonal rainfall forecasts can be communicated to farmers in ways that are meaningful and useful to them; whether and how climate forecasts can be enhanced by their integration with other tools, such as crop modeling; and how intermediaries (radio broadcasting, agricultural extension, farmer-to-farmer networks etc.) can support farmers' use of forecasts. The project collaborates with the National Meteorological Service and the National Institute for Agricultural Research of Burkina Faso, with international NGOs that operate in agricultural development and food security (Plan International), and with regional forecasting institutions and early warning systems. It also provides technical advice on communication and capacity building relative to climate products to U.S. agencies (NOAA, USAID).

b Findings from fieldwork conducted during the first phase of the project (1998-2001) provided the basis for the design of this second phase (2002-2006), which tested specific applications. Ethnographic

research indicated that farmers are willing and able to integrate scientific climate forecast with their own predictions in making farming decisions; despite their resource limitations, farmers have several crop and livestock management options for responding to forecasts; farmers privilege experiential, interactive approaches to learning, but farmer-to-farmer exchange and radio broadcasting are also significant means of information exchange. During the second phase of the project, the team fine-tuned an innovative communication approach centered on participatory farmer workshops, and complemented by radio broadcasts, local language leaflets, and farmer-to-farmer information dissemination. Farmers were also trained and equipped to measure and record daily rainfall on their farms. They also maintained test plots that yielded data for crop modeling to assess the role of this decision support tool in enhancing the value of forecasts for farmers. To ensure the institutional sustainability of this effort, two Burkinabé scientists from partner institutions received training on crop model evaluation and application at UGA.

c Hatch Act, Smith Lever, state matching funds

d Integrated Extension and Research

- Goal 4-10

Climate prediction and crop yield forecasting

a Short- and long-term weather and climate forecasting provides invaluable information for various businesses, especially agriculture. A rough estimate of upcoming weather would allow growers and producers to act in time for different management practices, such as irrigation and fertilizer applications and pesticide applications for pests and diseases. The ultimate goal would be the forecast of final yield for various crops. Based on this yield forecast, the farmer could opt for a different regime of additional fertilizer supply; supplementary irrigation; a different intensity of pest, disease, and weed control; and different timing of harvest. In addition, an early warning for a poor yield in a variable environment can allow policy makers the time needed to take appropriate actions to ameliorate the effects of food shortage and to prevent hunger.

We are evaluating various approaches for future weather prediction. We have found that pattern similarity would be a suitable and reliable choice for weather prediction. This is based on the assumption that we can find similar weather pattern for coming days within a year based on similar pattern of weather in history. A good estimate of future weather data linked with a crop growth simulation model would enable an accurate forecast of crop yield.

b We developed a software program that included the required mathematical relationships for weather pattern recognition. The tool was evaluated for ten different locations in Georgia that represent different climatic conditions. The tool obtained the weather data from January 1 up to today as the current weather pattern and then evaluates the historical observed weather data for the same specified location. Based on this process, the tool was able to find the most similar pattern of the current year from the historical data and consider it as the most likely weather sequence for the remainder of the year. The results were very promising for the ten selected locations. During the next phase of the project the short- and long-term weather and climate predictions will be integrated with a crop simulation model for yield prediction.

c Hatch Act, state matching funds

d State Specific

- Goal 4-10

Potential uses of climate-based decision support tools among south Georgia farmers

a Climate variability has significant implications for crop production in the southeast U.S. For instance, El Niño-Southern Oscillation phases accounted for a shift of $212 million or 26% of the long-term average inflation-adjusted value of maize and $133 million or 18% for soybean in the Southeast. ENSO influences important Georgia crops such as peanut, cotton, corn, and soybean. Although losses due to climate variability cannot be entirely avoided, the influence of ENSO activity provides an opportunity for farmers to tailor agricultural decisions to anticipated weather conditions, either to mitigate the impacts of adverse conditions or to take advantage of favorable conditions.

UGA is a member of the Southeast Climate Consortium. SECC's goals are to develop a climate-based decision support system for agriculture, forestry and water resource management and to make such information and tools available in timely fashion. To better understand what information Georgia

farmers need and how to communicate it, an exploratory study based on in-depth open-ended interviews was conducted in January and February 2006. The area selected (Mitchell, Dooly, and Sumter counties) has production systems that can potentially benefit from SECC products. Their economy is dominated by row crops of cotton, peanut, and corn. Smaller acreages are planted with sorghum, wheat, and soybean. Sweet corn is emerging as a profitable crop, but it is risky and costly to grow. Vegetable production is also growing in importance. Some land is used for pine or pasture.

b Most farmers interviewed believe climate is changing and are, therefore, keen on receiving updated climate information. They listen to local TV and radio stations, seek advice from Extension agents and technical consultants, and older farmers use the Farmers' Almanac and their traditional knowledge. Internet is becoming common among younger farmers. Farmers most commonly seek short-term weather forecasts, which can aid day-to-day decisions, but they are also interested in the overall tendency for the season, rainfall fluctuations at particular times of crop growth, and occurrence of hail or thunderstorms. Soil temperature at planting time, growing degree days, and climate conditions in competing states are also of interest. Farmers' decisions are shaped by goals that go beyond maximizing profits, such as avoiding catastrophic losses and forced disinvestment, attaining consistent production levels and timely market delivery, meeting living expenses, and repaying debt. Government subsidies, insurance coverage, and credit availability for different crops also shape decisions. Among potential adaptive responses to climate forecasts, farmers mentioned: a) adjusting expenditures, insurance coverage, and chemical input application; b) modifying the timing of planting and harvesting; c) planting more or less in certain fields/soils; d) selecting crops and crop varieties; e) preparing irrigation equipment; and f) implementing soil and water conservation. The main obstacle to adaptive responses is the need to contain production costs and labor demands (especially for cotton and vegetables). The heavy financial investments for equipment and infrastructure also reduce farmers' flexibility to respond to changing conditions. The findings were fed back to SECC scientists and extension specialists to inform tool development and outreach efforts.

c Hatch Act, state matching funds

d Multi-State: FL

Goal 5

Whether it's buying a home or providing youth with scientific education, universities work to enhance the economic opportunities of citizens. We are working hard to provide consumers educational programs to help individuals maximize limited financial resources, set goals and plan spending-to-achieve goals. Through this, we've provided free tax assistance service and helped Georgians avoid refund anticipation loans.

The University of Georgia and Fort Valley State University are working to provide educational programs that are relevant to the needs of the various individuals they strive to serve through:

- Develop, provide and expand effective child care giving.
- Develop citizenship skills.
- Develop skills in communication, arts and leisure.
- Develop coping and life skills among children, youth and families at risk.
- Build leadership capacity to make decisions and take action for the public well-being.
- Improve quality of life for families.
- Provide the educational resources enabling individuals to make informed decisions about home ownership.
- Educate community and economic development practitioners of Georgia's rural housing needs and provide them with the informational resources needed to address these impediments.
- Provide youth a variety of self marketing skills.
- Enhance decision making skills, develop positive leadership characteristics, prevent teen pregnancies and encourage development of positive self esteem
- Provide youth with science educational resources thus enhancing their knowledge of science.
- Provide educational programming to strengthen the family unit by informing the public with the most up-to-date and research based concepts of positive development, family coping strategies and basic life skills.

Prompt summary of enhanced economic opportunities and quality of life for Americans:

Education programs with a positive impact on children, youth and families at risk

- Educational programs provided participants with information about up-to-date concepts of positive development and to increase knowledge of parenting through the annual Family Life Conference, childcare workshops, and presentations.
- Building Our Youths Skills (BOYS) provides educational enrichment opportunities and leadership development.
- 'Voice of the Family' project is a comprehensive family centered community outreach program especially designed to help migrant farm workers. There is evidence in positive impact from the 70 families. Results indicated 96% are more likely to read books to their children and 84% are more likely to teach children how to solve conflicts that arise during play.

Family resource management

- Provided over 2,700 consumers educational programs to help maximize limited financial resources and to set financial goals. Also, focused on program to provide financial literacy to non-violent, drug-dependent defendants.

Increased the quality of childcare/dependent care

- Increased quality of childcare by providing training to childcare providers, including child care safety, professional development, quality community based trainings and media efforts.

Impact of change in rural communities

- Program increased home buyer education in rural counties to approximately 200 clients and through several publications.

Leadership

- Georgia Officer Training provides training for 40 junior, 32 county and 9 state officers, and many others.
- 82% of 4-H youth participants learned entrepreneurship education, how to develop their own business, positively communicate with future clientele, market their own business, finance their own business, set and achieve business goals, and to successfully cooperate and collaborate with people.

Youth Development/4-H

- Offered a week-long horse school to 4-H members in Georgia with 20 teen leaders and 172 4-H members.
- Provided opportunities for young people to learn about animal products, animal production, economics of animal production, and environmental issues.
- 75% of 4-H youth participants increased their knowledge of science education and the importance of conserving earth's natural resources.

Description of Activity; Impact of Activity; Source of Funding; Scope of Impact

Key Theme: Child Care/Dependent Care

- Goal 5-4

Child care giving

a Childcare is the third highest household expense for most families of young children (after shelter and food). Childcare that is affordable, accessible, and of high quality is not available to many Georgia parents needing it. Most childcare in Georgia and nationwide is only of marginal or poor quality. High staff turnover, poor quality environments, and lack of training and experience in childcare staff contribute to low quality care. According to the Center for the Child Care Workforce, the national annual wage of a childcare worker is $17,495, compared to $24,560 for a preschool teacher, $44,940 for a kindergarten teacher, $19,200 for a home health aide, and $21,890 for a nursing aide. Childcare provider wages have increased only 3.2% nationally over the past five years, and Georgia's childcare provider wages have actually decreased 0.9% in that same time period. Georgia's average annual wage for childcare providers is nearly $2,000 lower than the national average. Many parents seek the least expensive source of care, not understanding the benefits of high quality early care and education.

Extension contributed to ensure high quality childcare by providing state-accepted training hours for childcare providers by organizing and presenting local and regional training workshops and conferences for childcare professionals; providing self study courses for care givers who cannot attend in class training sessions; providing print information on child development for childcare professionals; providing consumer information to help parents identify quality childcare; and collaborating with employers and community leaders to ensure the availability of consistent, high quality childcare as a vital part of community infrastructure.

Extension provided 30,876 educational contact hours to 9,976 childcare providers in 2006. Extension provides this training at approximately one fourth the total cost of consultants or other agencies. Extension is one of the largest single sources of the required community-based education for childcare providers in many Georgia counties. Three child care self study courses were provided to almost 110 childcare providers. Extension collaborates with numerous other organizations, including childcare resource and referral agencies, technical colleges, and the Georgia Association on Young Children to ensure high quality community-based training is available for childcare providers. Extension is a partner in grant projects to support professional development for childcare providers. Media efforts have been undertaken to increase awareness and child care knowledge: 112 newsletters reached more than 31,000 readers; four radio spots have been broadcast to nearly 6,400 listeners; and 31 newspaper columns have gone to a circulation of over 544,000 potential readers.

b Ninety-six percent of the participants in the childcare and child development trainings offered by Extension said that those programs helped to improve their knowledge and practices. Over half of the participants intended to adopt practices that will improve the quality of childcare they provide. For example, 90% of the participants planned to set clear limits and enforce them every time they are broken: 99% planned to encourage children to explore and experiment; 100% planned to create a safe environment for infants and young children to explore; and 98% planned to read aloud to children every day. The childcare providers who participated in the Sun Safety for Kids training workshop in Colquitt County indicated that they intended to apply learned practices to their childcare settings. For example, 92% of participants planned to share the information they learned about sun safety with the parents of children in their care; 85% planned to wear a cap to protect their face, scalp, ears, and neck against UV rays; and 87% planned to use sunscreen with at least SPF 15 and UVA/UVB protection when going outside. Of the childcare providers in Bulloch County who completed Positive Guidance and the Spirited Child, 82% planned to expect the best of each child every day; 84% planned to rethink and use new

words instead of old labels; and 82% planned to work to prevent and eliminate “triggers” in the environment. Over 96% of participants in the Play is Children’s Work training program in Baker County indicated they are likely to include more activities in dramatic play, art and music; 82% are likely to assign small groups so that children can interact with others; and 91% are likely to get on the floor and play with the child. The comparison of pre and post test results indicates that childcare providers who participated in the self study courses significantly improved their childcare development knowledge. Of the participants, 71% scored higher on the post test than on the pre test. ·Targeted childcare educational efforts were continued in 2006 through a community collaborative in Muscogee County. Results from pre and post data indicates 81% of the participants significantly improved their child caring behaviors, and 75% improved their confidence levels in their child caring abilities.

c Smith Lever, state matching funds
d State Specific

Key Theme: Children, Youth, and Families at Risk

- Goal 5-21

Positive development of family unit

a Human development starts at conception and continues throughout the lifecycle. The Fort Valley State University Cooperative Extension Program's Family Life Area focuses on the concept of learning throughout the life cycle. Educating the children, parents/caregivers, and professionals of Georgia with the most up-to-date researched information is the focus of this program. The program provides economic and family stability by offering programs and information to the citizens of Georgia.

The Family Life Area has hosted several types of programs to meet the goals and objectives for the program. An annual family life conference and childcare workshops have been held for parents and caregivers to receive the most up-to-date and research based concepts of positive development and family coping strategies and basic life skills. There have been 23 presentations on family life/parenting held at various venues. Three senior programs were held on campus for the seniors to receive information to improve their knowledge of family, health, and computers. Thirty-five youth presentations were held at local schools and community centers.

b The educational programming provided participants with information usable to increase their knowledge of parenting skills which can be used within their own family. The youth activities have provided the participants with a new knowledge of how to approach various life situations and a heightened awareness of self.

c NARETPA, State Matching Funds
d State Specific

- Goal 5-5

Citizenship skills

Sub-keys: Impact of Change on Rural Communities, Leadership Training and Development, Youth Development/4-H

a Youth need opportunities to provide service and increase their understanding of issues relative to individuals who are at risk. Youth need projects that enable them to take a personal part in improving the quality of life for their peers who have limited resources or extraordinary challenges. Service learning is an integral part of youth development. 4-H junior-senior project achievement includes a component for inclusion of service activities in project work and other activities. These activities are reported in the portfolio as 50% of the final records score (with leadership). Junior Conference focuses on not only on workforce preparation skills but also on service to others with the opportunity to complete several service projects for statewide projects. Local 4-H programs include service programs coordinated by 4-H’ers as a part of the 4-H motto of making the best better for the community. Additionally, in response to the needs of military families, Operation Military Kids provides service projects related to the needs of youth in military families. An additional program was launched this year in Dekalb and Clarke counties in conjunction with youth in governance identifying and working with at risk youth. Finally, the Georgia Youth Summit addresses civic engagement statewide.

b More than 2,000 7th-12th grade students completed portfolios including service records. More than 800 youth participated in Junior Conference raising more than $6,000 for the Ronald McDonald House, 163 pet rocks for Children's Hospital, and 220 Hero Packs. As a part of Operation Military Kids, youth completed over 15 projects relative to the needs of military families. Through the grant program in Dekalb and Clarke counties, over 15 new 4-H clubs were started in at-risk communities and focusing on youth in governance. The Georgia Youth Summit reached over 30 Georgia youth. Every county in the state received funding for a group of four youth and one adult to attend. Each group was required to research their county and identify major issues, key resources and important contacts prior to the event. While attending the summit, participants heard experts speak about four key issues facing Georgia: health, safety, education, and community development. Summit participants had time to question these issue speakers on topics directly related to the issues facing their counties. County groups were split up into larger cluster groups comprised of youth and adults from all parts of the state. During these cluster sessions participants discussed the diverse challenges facing Georgia communities, learned how to work with a team comprised of both youth and adults and received guidance on formulating realistic solutions.

State issues have been identified and described these to state level decision makers around the topics of education, economic development, the environment, and safety. Local grants have been awarded to 10 communities to help put their plan into action. The Georgia Youth Summit will also result in over $10,000 invested in local communities

c Smith Lever, state matching funds

d State Specific

- Goal 5-7

  Life skills

  Sub-keys: Youth Development/4-H

a Increasing numbers of youth are growing up without the basic types of support necessary to become capable and responsible adults. This support takes many different forms, including nurturing parenting, positive school experiences, supportive communities, and opportunities to explore career and life options. Extension provides a unique approach to supporting youth and families at risk through an overall positive youth development focus in addition to targeting specific at risk groups and behaviors.

In Georgia, Family and Consumer Sciences Extension initiated two new community projects in Candler and Colquitt counties in 2003. These new community projects integrate the children, youth, and families at risk (CYFAR) programming philosophy into the University of Georgia Extension programs. The total cost of the USDA-funded project is $500,000 for the five-year period.

The Candler County CYFAR project, “Building Our Youths Skills” (BOYS), provides educational and enrichment opportunities to help increase academic success and leadership development, while supporting parents, teachers, and community leaders in creating a safe, healthy, and nurturing environment for 27 low income preadolescent males. The program provided 39 enrichment sessions during the 2005/2006 school year. The Colquitt County CYFAR project, “Voz de la Familia” or “Voice of the Family,” is a comprehensive family-centered community outreach program especially designed to help migrant farm workers build healthy, strong, and self-sufficient families for rural Georgia. There were over 70 families in the “Voz de la Familia” program in 2006. The Missouri Community Action Poverty Simulation workshop was presented to more than 830 community leaders and service providers to help them better serve the needs of the people living in poverty. Nearly 51% of the Georgians reached by Family and Consumer Sciences Extension programs in 2006 were audiences estimated to be at risk (low income, illegal activity, or lack of school success).

b The BOYS program in Candler County focused on building life skills and addressing problem behaviors. Evaluation data confirmed that 47% of the students in the BOYS program improved their life skills and 31% reduced their problem behaviors as reported by their teachers in 2006. The frequency of the students completing their homework on time significantly increased from the fall of 2005 to the spring of 2006.

Evaluation data indicated that 96% of the “Voice of the Family” program participants who completed the parenting workshops are more likely to read books to their children beginning in early infancy and 84% are more likely to teach their children how to solve conflicts that arise during play. The Parent

School Partnership Program, a 10-lesson series that focused on establishing a strong relationship between parents and schools, graduated 102 “Voice of the Family” participants. Evaluation results indicated that 97% of the participants are more likely to attend and participate in PTO meetings; 100% are more likely to provide a quiet environment for their child to do homework; and 100% are more likely to ask their child’s teacher for help if their child is having difficulties with schoolwork. Ninety three percent of the “Voice of the Family” participants who attended homebuyer education programs indicated they are more likely to evaluate the type of home they need. Nine Latino families initiated the application process for first time homebuyers including attending homebuyer education programs through UGA Cooperative Extension and USDA Rural Development. Three families have already closed on their new homes. The comparison of children’s academic data for 2004/2005 and 2005/2006 school years indicates that the children who participated in the “Voice of the Family” program considerably improved their academic averages in math, reading, social studies, and science. The children’s CRCT scores increased in both math and language arts. The school absentee rate for these students decreased from 16.125 annually in 2004/05 to 14.375 in 2005/06; an 11% improvement.

Just over 88% of the educators, services providers, and community leaders who participated in the Welcome to the State of Poverty simulation workshop said it was helpful in providing them with a better understanding of the problems faced by working poor families. For instance, a program participant said “It was a real experience that showed me how difficult it is for families living in poverty to hold things together.” Comparison of pre and post evaluations indicated that the poverty simulation participants who responded significantly reduced their negative attitudes toward people living in poverty. Over half were able to develop a more positive attitude toward working poor families and plan to help serve their needs. For example, 85% of the participants plan to work with other related community resources to assist people who live in poverty; 86% plan to seek out information that can be used to address poverty issues in their community; and 93% plan to share this information with others in their communities.

c Smith Lever, state matching funds

d State Specific

Key Theme Family: Resource Management

- Goal 5-1

  Family resource management

  a Georgia ranks 10th in the nation in personal bankruptcy filings with one of every 46.3 Georgia households having filed for bankruptcy in the 12 month period ending December 31, 2005 (American Bankruptcy Institute). The personal saving rate for the U.S. is at the lowest level in history, suggesting Georgians and other citizens are not saving adequately for future needs. Families need to know how to plan their finances, cope with lack of adequate income effectively, control cash flow, manage credit and debt wisely, insure adequately, contribute to savings/investments regularly, pay necessary taxes but no more, prepare to retire at current living level, avoid consumer fraud, and pass assets to heirs. Limited resource families, particularly, are faced with economic uncertainty, and it is often difficult for these families and individuals to make wise consumer choices and meet basic needs.

  Extension provided consumer education programs to help Georgians of all ages to maximize limited financial resources, set financial goals, and plan spending to achieve goals. Cooperative Extension was approved as a provider of personal financial management educational courses mandated by the Bankruptcy Abuse Prevention and Consumer Protection Act of 2005.

  Consumer financial educational programs reached over 2,700 Georgians to help them better manage their financial resources and protect themselves from consumer fraud in 2006. The use of media was a major strategy for public financial management education. For example, 25 newspaper columns went to a circulation of almost 630,000 and three radio spots reached 4,800 listeners.

  b Of the Georgians who completed the consumer education programs, 96% said that the training workshops were helpful to learn about consumer skills and debt reduction. Over half of the participants said they plan to follow learned financial practices. For example, 100% of the participants planned to request a copy of their credit report; 100% planned to contact a creditor about reducing their interest rate; and 98% of the participants planned to pay their bills on time every month. The Fulton County

Extension Office partnered with the Fulton County Drug Court to provide a 6-week financial literacy course for non-violent, drug-dependent defendants as part of their intensive treatment program. Participants completing the course indicated they made significant changes including opening a savings account, creating a home budget box, and utilizing public transportation to save money. Approximately 91% of the participants said that they were more likely to set a goal to get out of debt, organize their financial records, and develop written spending plans. Bankruptcy filers who participated in Extension's personal financial management education programs improved their knowledge of recommended financial practices. As a result of the program, 94% indicated that they are more likely to keep track of their spending; 98% are more likely to pay their bills on time every month; 96% are more likely to start an emergency saving fund; and 100% are more likely to get their financial records more organized. Georgia 4-H chose financial literacy as one of its top three issues to be addressed in various 4-H activities and events on the local and state level. There was a significant increase in the pre and post test scores for the 125 youth who completed the financial literacy curriculum at senior camp. Ninety-two percent of the 101 youth who participated in the Youth Financial Literacy Conference in southwest Georgia reported knowing more about money management after the conference and 75% noted that the most important things they learned were how to save and the importance of saving.

c Smith Lever, state matching funds
d State Specific

Key Word: Impact of Change on Rural Communities

- Goal 5-16

Homebuyer education

a Access to homebuyer education in rural counties is often unavailable and, if provided, may require travel to a location outside of the county. Basically, there exists no statewide monitoring or quality assessment process of any type specific to homebuyer education.

FVSU Cooperative Extension Housing Program created the HomeGrown Program, a homebuyer education series that educates Georgians on understanding the buying process, mortgages, financial management, and how to prevent foreclosure and default. The program also includes education in maintaining a safe, clean and healthy home environment; offers 10 hours of comprehensive training; and exposes to clients to field professionals.

Of the individuals that were educated in 2006, approximately 15 program graduates have been able to purchase their first home based upon the education that they received from the classes. Many of the program participants (approximately 50%) spend between 12 to 18 months after graduating from the program trying to repair their credit history. Poor credit history is the primary reason that keeps program graduates from being able to qualify for a mortgage.

The Georgia Department of Community Affairs provides financial reimbursement for all classes taught and facilitated by FVSU's Extension housing specialist. This contract is renewed annually. FVSU Extension Housing program does not charge a fee to their clients to participate in the program.

b In 2006, the program educated approximately 200 clients and provided numerous publications from various agencies and organizations that assist with the home buying process. FVSU Extension advertised their program on television and radio to attract clients to the program.

c NARETPA, State Matching Funds
d State Specific

Key Words: Leadership Training and Development

- Goal 5-8

Leadership as the cornerstone of 4-H program
Sub-Keys Youth Development/4-H

a Development of leadership skills continues to serve as a cornerstone of the 4-H educational program. Through the mission of assisting youth in acquiring knowledge, developing life skills and forming attitudes, 4-H program activities strive to not only teach but offer the opportunity to practice leadership skills.

Programs planned on the county, district, and state level have provided youth with skills necessary for developing leadership skills. Georgia Officers Training offers in-depth training for district and state officers at the junior and senior level. At the county level, leadership is a cornerstone of 4-H involvement. Youth are involved in planning and implementing programs, in project club leadership, as committee chairs and as officers. Georgia Officer Training provides training for junior, seniors, and state officers. Additionally, 4-H Ambassadors were trained on subject matter and empowered to lead educational sessions in their home counties. The Georgia 4-H counselor program provides over 75 hours of training in leadership and subject matter for camp counselors. Additionally 4-H'ers are recognized for their work in leadership through the teen leader recognition program.

4-H was named as the lead agency in the state to facilitate and deliver youth leadership opportunities to students.

b Georgia Officer Training provides training for 40 junior, 32 state and nine state officers. 91 counselor college-aged youth completed training. 42 4-H Ambassadors completed training and project. 2,100 youth participated in project achievement with leadership components. More than 550 youth were recognized for excellence in leadership through the teen leader recognition program. These projects represented a direct community impact with students completing at least three leadership projects.

c Smith Lever, state matching funds
d State Specific

Key Word: Consumer Management

- Goal 5-10

Niche markets

Sub-Keys Farm Safety

a Product marketers and/or food product marketers must always cater to the needs of consumers/customers. Usually, the marketer tends to establish his product with a unique image, even though close substitutes may be available. However, today's consumers are closely aligned to lifestyle preferences and have a strong quest for product safety and more information. The recent consequences of food-borne illnesses and the devastation that can be associated with food-borne illnesses have cost the U. S. Between $500 million and $7 billion a year. On the other hand, the Center for Disease Control launched a food safety program targeting food preparation preservation, storage and handling practices, proper hand washing and other hygiene practices, storage methods, cooking and temperature aspects and food selection techniques. This program was necessary to help ameliorate the reported problems of (1) estimated 75 million illness cases, (2) 32,000 hospitalizations, and (3) 5,000 deaths in the United States each year. The USDA/Economic Research Service (ERS) estimates that this cost society $6.9 billion from the five (5) bacterial pathogens.

Research scientists at FVSU/Agricultural Research Station (ARS) used survey data from eleven (11) states with an average number of respondents representing 247 households. The data were measured by contingent rankings using five (5) levels from (1.) – Not important to (5.) – Very important. Results showed that respondents preferred selected cuts of meat. The most prevalent cut selected by respondents was lion chops with a confidence level at 10 percent. The study also showed that frequency of consumption may have an impact on shopping decisions and consumption because respondents may not be able to describe their preference behavior. 2 Last but not least, the results suggest that differences among consumer preferences for attributes follow the intrinsic pattern such as freshness, color, and quality remained significant in influencing their purchase decisions. Another aspect of the study focused on the socio-economic aspects of food insecurity. The major aspect of food safety is the policies and management measures taken to protect the nation's food supply and food supply chain. Even more specific is the available agricultural and technical resources that are in place, designed to both protect the nation from (1) accidental contamination and (2) potential deliberate

attacks via “bioterrorism.” The challenge became crystal clear during the aftermath of 911 (2001) when Congress passed the Public Health Security and Response Act of 2002, generally known as the Bioterrorism Act or Public Law 107-188. This work was developed to lay out the new law in its four (4) parts and to discuss the reduction of food insecurity as a major consumer concern. Preliminary results show that the new law was needed especially to show the establishment of (1) new safety standards, (2) monitoring inspection strategies, (3) tracking food safety problems, and (4) the economic cost to consumers. The research team will also highlight the role of “Vulnerability Assessment:” programs with the multi-faceted aspects of food insecurity.

Outputs: Through the research efforts of FVSU Agricultural Economics Research Scientists, six (6) presentations and/or publications have been developed. They are listed below. Publications: Liu, Xankli and Mack C. Nelson, 2005. Demand Potential for Goat Meat in Southern States: Empirical Evidence from a Multi-State Goat Meat Consumer Survey. Paper presented at the American Agricultural Economics Annual Meeting, July 24-27, 12 pp. Liu Xanli, G. Y. Miller and P. E. McNamara, 2005. Do Antibiotics Reduce Production Risk for U. S. Pork Producers. Journal of Agricultural and Applied Economics, Vol. 37, No. 3, December, 11 pp. Liu Xanli, G. Y. Miller and P. E. McNamara, 2005. A Farm-to-Fork Stochastic Simulation Model of Pork-borne Salmonellosis in Humans: Lessons for Risk Ranking. Accepted in the Journal of Food Protection, May 12-15, forthcoming. 12 pp. Liu, Xanli, M. C. Nelson and Paul McNamara, 2006. Assessing the Critical Deficiencies of Information on Food Safety: Evidence in Building Farm-to-Table Simulation Models. A paper presented at the 64th Annual PAWC Meeting, Tuskegee University, Alabama, December 3-5, 12 pp. Liu, Xanli, M. C. Nelson and Mohammad Ibrahim, 2006. Analyzing Consumers’ Calculation Factors in the Purchase Decisions on Goat Meat. A paper presented at the Food Distribution Research Society Annual Conference, Quebec City, Canada, October 14-18, 17 pp. 3 Brown, Jr., N. B., Tiffany Campbell, Mohammed Ibrahim and Jael P. Jackson, 2006. A Case Study Analysis of Socio-Economic Aspects of Food Insecurity in the U. S.: Emphasis on PL 107-188. A paper presented at the 64th Annual PAWC Meeting, Tuskegee University, Alabama, December 3-5, 18 pp.

b During this reporting period, three (3) aspects of the project were developed. They are: (1) Consumer choices in purchase decision for goat meat, (2) Information deficiencies on food safety with respect to food-borne pathogens, and (3) The socio-economic aspects of food insecurity with emphasis on PL 107-188 (Bioterrorism).

c NARETPA, State Matching Funds

Key Word: Youth Development/4-H

- Goal 5-6

4-H horse school

a It is important that we educate our youth about horses as horse ownership continues to increase as the population becomes more urban. A need exists to train the youth in essential horsemanship skills, safety, and management, as well as to motivate them to seek future agricultural opportunities and careers.

UGA Animal and Dairy Science Department and 4-H staff in cooperation with State Department of Education Agricultural Education staff offer a week-long Horse School to 4-H members in Georgia. Horse School provides extensive instruction in horseback riding, tailored to the student's riding discipline and experience, as well as many seminars in horse educational topics delivered by UGA faculty and staff, veterinarians, and furriers. Horse School also provides older 4-H members the opportunity to develop their leadership and communication skills by inviting them to participate as teen leaders, through which they organize activities and demonstrations for the students.

b In 2006, 20 teen leaders and 172 4-H members participated in Horse School with their horses.

c Smith Lever, state matching funds

d State Specific

- Goal 5-8

Junior livestock show projects

a A need exists to provide opportunities for young people to learn about animal products, methods of animal production, economics of animal production and environmental issues related to animal agriculture. In addition, youth should be encouraged to develop important life skills including communication skills, leadership abilities, decision-making skills, and a sense of responsibility.

The University of Georgia Animal and Dairy Science Department staff and 4-H staff in cooperation with State Department of Education Agricultural Education staff offer livestock show projects to 4-H and FFA members in Georgia. In these programs, young people raise and care for cattle, sheep or swine. After the animals are trained youth compete in shows and use these experiences as the basis for other competitions including record keeping, public speaking and Quiz Bowl events.

b In 2006 there were 4,483 animals entered as state projects. These included 414 steers, 900 beef heifers, 311 dairy heifers, 1,955 market hogs, 464 market lambs, 118 breeding ewes and 321 market goats. There were 2,560 youth participating in these projects. There were 279 more animals and 128 more youth participating in 2006 as compared to 2007.

c Smith Lever, state matching funds

d State Specific

- Goal 5-19

Life skill development and science education

a Several studies have shown that poor choices made by youths and adults lead to inappropriate actions which result in negative consequences. Unemployment, poverty, child abuse, drug abuse, unsuccessful parenting, and lack of positive leadership in the home are some of the factors that keep youth from developing good decision-making skills. In Georgia, poor choices made by adolescents and teenagers have contributed to teen pregnancies, teen incarceration, incompletion of high school, and has produced a generation of young adults that lack basic employable skills. Georgia ranks 43rd among states in infant mortality. There are 395,200 poor children; and 131,349 adults and children receiving cash assistance from Temporary Assistance to Needy Families (TANF) in the state. Several studies have indicated that teenage mothers that have babies at an early age are more likely to drop out of school and rely on TANF. Their children are more likely to require care for health problems and disabilities. There are 41,206 children that are victims of abuse or neglect, 13,149 children in foster care, and 93,987 grandparents are raising their grandchildren in Georgia. Presently, 312,000 children do not have health insurance in Georgia. These alarming statistics indicate the need and importance to create family focus programs to address the problems of at-risk youth.

The 4-H and Youth Development Program is specifically designed to meet the needs and challenge the strengths of at-risk youths living in Georgia. The components of this program are 4-H Sprouts (6 to 10 years old), 4-H Sprouts Graduate (11 to 14 years old), and 4-H Sprouts Post-Graduate (15 to 18 years old). These program components focus on initiating success by empowering the minds of our youth to a higher level of thinking through leadership development, entrepreneurship education, life skills, and science-based educational activities and programs for adolescents and teenagers. These programs are designed for all participants to enhance their decision-making skills, develop their leadership capabilities, become empowered to achieve excellence by diversifying their knowledge, and by planting seeds of prosperity in their minds. This process will help them to create a prosperous future of financial independence for themselves by creating entrepreneurship opportunities in their communities. This process will also help them to become the best leaders of the future by acquiring knowledge and skills in the area of leadership develop. The 4-H Sprouts, 4-H Sprouts Graduates, 4-H Sprouts Post Graduates and Youth Development of Life Skills Programs focus on the national and international subjects and principles of 4-H programming.

Through the 4-H and Youth Development Program, the 4-H and Youth Development specialist worked with 1,372 youths which is made up of 119 white males, 159 white females, 436 black males, 482 black females, 20 American Indian males, five American Indian females, 85 Hispanic males, 66 Hispanic females, and 377 adults. We implemented a Youth Taking Responsibility Conference, two summer residential camps, facilitated 24 4-H science club meetings, 36 4-H leadership club meetings, 81 4-H entrepreneurship club meetings, attended 17 youth development meetings, did 24

presentations.

b Programs were implemented in elementary, middle and high schools, community centers, Camp John Hope, Boys and Girls Clubs of America, 4-H offices, and churches. All of the 4-H Sprouts, 4-H Sprouts Graduates, 4-H Sprouts Post Graduates, and Youth Development of Life Skills Leadership Program components are leadership framework, leadership styles, power and leadership, the nine steps of goal setting, the six steps of team problem solving, managing conflict skills, problem solving, positive communication skills, positive stress management techniques, prevention of teen pregnancy, positive decision-making skills, and characteristics of a positive leader. The 4-H and Youth Development Specialist reported that 85% of youth participants acquired strategies to enhance their ability to make good decisions, increase their knowledge of teen pregnancy prevention, increased their knowledge of the consequences of making negative decisions, and increased their knowledge of the benefits of abstinence based on pre and post testing results.

The 4-H Sprouts, 4-H Sprouts Graduates, 4-H Sprouts Post Graduates and Youth Development of Life Skills Science Program components focus on initiating success by empowering the minds of our youth to a higher level of thinking by teaching adolescents and teenagers science education and the importance of conserving earth's natural resources. The 4-H and Youth Development Specialist reported that 75% of youth participants increased their knowledge of science education and the importance of conserving earth's natural resources based on pre and post testing results.

c Smith Lever, NARETPA, State Matching Funds

d State Specific

Stakeholder Input Process

The University of Georgia College of Agricultural and Environmental Sciences (CAES) in cooperation with the College of Family and Consumer Sciences have many opportunities to collect stakeholder input.

CAES established a liaison program about nine years ago. There are approximately 200 organizations and industries to which a faculty member (tenured or non-tenured) is assigned as a liaison. The faculty member may serve as a resource person, board member, attend board meetings or meet individually with members, in order to learn what is happening in that organization and/or industry. The CAES dean meets with these liaisons once a year for a report. If there are important issues surfacing that need to be considered for action, he asks for input.

The county faculties in the field are very active gathering input for the college. They do this through advisory committees, being active with organizations and industries in their county, by one-on-one input with clientele, and by monitoring phone calls and office visit content for any trends. Every county is required to have an advisory committee in place and to meet with that committee at least twice a year. The membership of the committee must be reflective of the local population and knowledgeable of community issues appropriate for the university to address. County programs must develop county issues for the purpose of developing local Extension programs that have impact. This process offers a great deal of stakeholder input into the state program planning process. This is the best source of information from our end users.

Each CAES department also has individual methods for collecting input. Some departments have advisory committees, other are active in the industry's major organizations and other collect data from individual contact with industry representatives.

The College of Agricultural and Environment Sciences Advisory Council was created in 1996 by consolidating the State Extension Advisory Council and the Georgia Agricultural Experiment Stations Research Advisory Board. This was done to reflect changes in the college and to help our stakeholders understand the equal importance of all functions of the college (teaching, research, and extension). The council seeks stakeholder counsel and advice to ensure the college's programs are responsive to the needs of Georgia residents. Council members work closely with college faculty, staff, and administrators to review ongoing programs and identify and plan high-priority future programs.

Finally, the CAES dean meets quarterly with key leadership within the state, including Georgia's Secretary of Agriculture, the Georgia Farm Bureau president and other key agricultural leaders.

Stakeholder input processes for Fort Valley State University Research and Extension Programs employ diverse methodologies which allow for input from end users, including county advisory committees and individual clients, peers and other agricultural professionals, partners and cooperating agencies, including community-based organizations, and university administrators. The College of Agriculture, Home Economics and Allied Sciences has a college-wide advisory board for teaching, research and extension programs.

Annually, county-based professionals and paraprofessionals complete and submit survey instruments used to measure clientele needs for programs and services offered at the local level by the Extension program. Concurrently, 1,890 program clients are included on county-wide advisory boards which provide for development of individual county plans of work. Evaluations of programs conducted are also used to measure value of ongoing programs.

Agricultural researchers and extension specialists also use feedback gained from clients and others attending workshop and similar events to gather input on current and planned programs. At the same time, these agricultural professionals use peer-to-peer contacts, professional meetings, media reports and other data to gauge emerging issues and evaluate their relative value to identified needs of clientele. Active partnerships with community-based organizations also provide useful perspectives on issues and opportunities, which may be integrated into research and extension programs.

University administrators also provide valuable input for program development and implementation as both research and extension programs are evaluated in terms of their relationship to the overall university mission. A major current focus is engaging the total university in the land grant process.

The University of Georgia and Fort Valley State University Extension administrators, department heads, and district program leaders meet annually in a week-long planning conference to share needs assessment, program results, and programming ideas. The annual Extension Program Planning Week conference allows for the collaboration necessary to develop complementary and/or joint programming that meets the needs of the citizens of Georgia.

Program Review Process

Extension programs participate in a review process in which issues and programs are reviewed for continued support. Individual and departmental Plans of Work are reviewed by the program development team during annual and bi-annual programming cycles. Research projects continue to participate in a merit and/or scientific review process as required. Each project is peer reviewed by both internal and external reviewers.

There have been no significant changes in the review processes described in the Plans of Work submitted for research and Extension programs of the University of Georgia or Fort Valley State University.

Evaluation of the Success of Multi-State and Joint Research/Extension Activities

The University of Georgia continues to make progress on its integrated research and Extension programming. A very large percentage of the accomplishments documented in this report credit that integrated effort.

At UGA, all state level faculties are administratively housed within an academic department. A large percentage of these faculties hold a joint research and Extension appointment, a structure which encourages a high level of integrated work. County faculties have become increasingly involved in integrated activities in the last few years. Several integrated accomplishments in this report involve these faculties.

As stated in the last three reports, UGA has increased its participation in multi-state efforts during recent program cycles. Budget cuts continue to increase the need for multi-state collaboration. And in many activities, Georgia uses out-of-state expertise in subject areas not well supported by current Georgia faculty.

The many examples of multi-state accomplishments within this report are documented as such and identify the states involved. The following are examples of multi-state and research/Extension collaborations found in this report:

- The catfish market has increased over the past two years and education is needed to be competitive in this market. The multi-state integrated effort for an aquaculture product increased Georgia's catfish production by over $3,526,500.

- Organic blueberries are one of the only non-indigenous fruit crops that can flourish in the South. With the increased interest in blueberries due to their health benefits, a multi-state integrated collaborated effort with Florida was executed. This increased farmers' knowledge of overcoming blueberry diseases and implemented research on long-term mulching, weed control and nutritional experiment initiated at the Bacon County blueberry research farm in late fall of 2006.

- Multi-state and integrated efforts were combined to address some of the most critical issues affecting agricultural crops, livestock, and environmental pollutants -- water and wastewater management. The U.S. has identified livestock and poultry production as leaders the leading contributor in the rivers and streams.

  Extension and Research underwent an integrated effort to apply irrigation as a means to decrease water usage in Georgia. This information was spread to farmers which has had a direct positive impact in the annual decrease of water usage.

  Research has shown environmental wastewater concerns about phosphorus can be minimized by adding phytase in addition to a low phosphorous environment. In addition the phytase supports greater born growth, which can have a major impact on the livestock industry.

- Farmers are trying to find ideas to improve milk management in addition to livestock reproductive management.

  Florida and Georgia are collaborating on efforts in the dairy industry to determine the best ways to increase profitability in the dairy industry. The results in net income for dairy producers increased $2.01 per cwt. These budgets are used to inform bankers and farm services and thus to evaluate loans.

  Both Extension and research collaborated efforts to find better ways to manage reproductive efforts through heat detection and to increase the knowledge of Georgians of these benefits.

- The herbicide Classic can be very harmful to peanuts. In addition, water stress of different intensities and duration during is one of the most critical factors limiting peanut yield and quantity. Researchers discovered a way to determine if traces of the herbicide Classic are related to application of Roundup Max or if the contamination is coming from a contaminated tank. This information is estimated to farmers allowing them to decrease infection rates.

- To avoid risks of damaged crops dependent upon rainfall and therefore vulnerable to climate variability, the Southeast Climate Consortium was created. The SECC examines ENSO-based forecasts to better the development of decision support tools for agriculture, forestry, and water resource management.

  The SECC developed a web-based system to disseminate information on up-to-date weather information.

Several trainings and workshops have been conducted in addition to various media. In addition, farmers are willing to integrate scientific climate forecasts with their own and do have resources for options to respond to climate changes.

- In effort to eliminate the intense damage to Asian soybeans from Phakopsora pachyrhizi, scientist have been proactive in finding ways to prevent Phakopsora pachyrhizi from having a widespread effect in the U.S that could result in a 50% loss of crop. Researchers discovered proper use of fungicides, early in the crops life, would have significant yield increase. Extension specialists have incorporated these finding into a new publication “Soybean rust management in the mid-Atlantic region.”

- There is a need to find alternative methods, for the pending loss of Nemacur, to fight nematode infestations in turfgrass. Researchers found Telone II decreases the harm caused from nematode infestation in addition to increasing the square feet of the harvestable acre. This could result in a net revenue increase of $731 per acre.

- Center onion rot reduces the yield and production of onions and this rot was the highest observed in five prior years. Researchers have conducted studies that successfully identified the reason for the root rot and created ways to overcome such large outbreaks.

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

Select One: ☐ **Interim** **(X) Final**

Institution: University of Georgia College of Agricultural and Environmental Sciences

State: Georgia

	Integrated Activities (Hatch)		Multistate Extension Activities (Smith-Lever)		Integrated Activities (Smith-Lever)
Established Target %	25	**%**	0.25	**%**	0.25
This FY Allocation (from 1088)	$4,560,522		$7,477,156		$7,477,156
This FY Target Amount	$1,140,138		$1,869,289		$1,869,289
Title of Planned Program Activity					
Agricultural Production System	$815,199		$1,244,199		$1,336,542
Safe & Secure Food and Fiber System	$102,612		$337,033		$149,543
Healthy, Well-nourished Population	$5,701		$0		$9,346
Harmony between Ag & Environment	$182,422		$8,412		$271,047
Ec Opportunity & Quality of Life	$34,204		$279,645		$102,811
Total	$1,140,138		$1,869,289		$1,869,289
Carryover					

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

_____ 3/30/2007

Director **Date**

University of Georgia College of Agricultural & Environmental Sciences
FY06 Federal Funds and EFTs

	Hatch (1862) Funds	Hatch (1862) Federal EFTs	State Matching Funds*	Smith Lever (1862) Funds	Smith Lever (1862) Federal EFTs	State Matching Funds*
Goal 1: An agricultural system that is highly competitive in the global economy	$3,260,795.00	38.58	$3,260,795.00	5,308,781.00	64.71	$5,308,781.00
Goal 2: A safe and secure food and fiber system.	$410,450.00	4.17	$410,450.00	598,172.00	7.24	$598,172.00
Goal 3: A healthy, well-nourished population.	$22,803.00	0.26	$22,803.00	37,386.00	0.45	$37,386.00
Goal 4: Greater harmony between agriculture and the environment.	$729,687.00	8.08	$729,687.00	1,121,573.00	13.12	$1,121,573.00
Goal 5: Enhanced economic opportunity and quality of life f or Americans	$136,817.00	1.05	$136,817.00	411,244.00	4.98	$411,244.00
Total	$4,560,552.00	52.14	$4,560,552.00	7,477,156.00	90.50	$7,477,156.00
Note: The dollars reported include salary, benefits and operation cost. It is total dollars received.						
Note: The EFTs reflect Faculty and Staff						
* UGA received additional state funds. Only required matching funds are reported on this chart.						

Fort Valley State University

FY06 Federal Funds and EFTs

National Goals	1890 Extension FTE's	1890 Extension Expenditures	1890 Research FTE's	1890 Research Expenditures
1. An agricultural production system that is highly competitive in the global economy	2.45	203,840	5.51	487,084
2. A safe and secure food and fiber system	1.30	108,160	2.50	221,000
3. A healthy, more well nourished population	1.95	162,240	1.25	110,500
4. Greater harmony between agriculture and the environment	0.50	41,600	2.73	241,332
5. Enhanced economic opportunities and quality of life for Americans	5.00	416,000		
Total	11.20	931,840	11.99	1,059,916

Note:
This chart is based on *$83,200.00 expenditure per EFT* for section1444 (Extension)
and *$88,400.00 expenditure per EFT* for section 1445 (Research) at Fort Valley State University.
The annual allocation for section 1444 (year-2006) was $1,981,116.00 and
the annual allocation for section 1445 (year-2006) was $2,198,840.00.

Brief list of Multi-sate and Integrated Activities

- Root stock and interstem effects on pome and stone fruit trees
- Ecology and management of European corn borer and other lepidopteran pests of corn
- Genetic and functional genomic approaches to improve production and quality of pork
- Advanced technologies for the genetic improvement of poultry
- The economic and psychological determinants of household savings behavior
- Agricultural and rural finance markets in transition
- Economic assessment of changes in trade arrangements, bio-terrorism threats and renewable fuels requirements on the U.S. grain and oilseed sector
- Impact of climate and soils on crop selection and management
- The chemical and physical nature of particulate matter affecting air, water and soil quality
- Improvement of thermal and alternative processes for foods
- An integrated approach to control of bovine respiratory diseases
- Applied animal behavior and welfare
- Management systems to improve the economic and environmental sustainability of dairy enterprises
- Small fruit and viticulture research
- Committee on swine nutrition
- Regulation of adipose tissue accretion in meat-producing animals
- Biochemistry and genetics of plant-fungal interactions
- The interface of molecular and quantitative genetics in plant and animal breeding
- BioEnergy and BioProducts committee
- A regional effort to maintain the health and survival of the honey bee, the most important pollinator
- Controlled environment technology and use
- Agricultural safety and health research and extension
- Assuring fruit and vegetable product quality and safety through the handling and marketing chain
- Rural communities, rural labor markets and public policy
- Biological improvement, habitat restoration, and horticultural development of chestnut by management of populations, pathogens, and pests
- Developing and integrating components for commercial greenhouse production systems
- Alternative management systems for plant-parasitic nematodes in horticultural and field crops
- The National Atmospheric Deposition Program (NADP)
- Postharvest quality and safety in fresh-cut vegetables and fruits
- Animal manure and waste utilization, treatment and nuisance avoidance for a sustainable agriculture
- Development and evaluation of TMDL planning and assessment tools and processes
- Genetic selection and crossbreeding to enhance reproduction and survival of dairy cattle
- Dynamic soybean pest management for evolving agricultural technologies and cropping systems
- Genetic (co)variance of parasite resistance, temperament, and production traits of traditional and non-bosindicus tropically adapted breeds
- Mineral controls on potassium retention and release in soils and soil amendments
- Impacts of trade and domestic policies on the competitiveness and performance of southern agriculture
- Improved systems for management of economically-important arthropod pests attacking pecan
- Irrigation management for humid and sub-humid areas
- Fruit and vegetable marketing innovations and demand assessment
- Basic and applied aspects of bacterial source tracking
- Enhancing production and reproductive performance of heat-stressed dairy cattle
- Systems for controlling air pollutant emissions and indoor environments of poultry, swine, and dairy facilities
- Textile materials and technologies addressing energy, health and other national security issues
- The poultry food system: A farm to table model
- Ecological and genetic diversity of soil borne pathogens and indigenous microflora
- Economics and management of risk in agriculture and natural resources
- Plant breeding
- Control of food-borne pathogens in pre- and post-harvest environments
- Genetic improvement approaches to sustained, profitable cotton production in the United States
- Biological control of arthropod pests and weeds
- Nutritional and management abatement strategies for improvement of poultry air and water quality (from W195)
- Flies impacting livestock, poultry and food safety
- Modeling for TMDL development, and watershed based planning, management and assessment
- Improving the sustainability of livestock and poultry production in the United States
- Biology and management of peanut insects and other arthropods
- Aquatic food animals from warm water aquaculture

- Review and coordination of oilseed rape research programs in the southern region
- Development and evaluation of bunch and muscadine grapes for fresh market, juice, wine and other products
- Competitiveness and sustainability of the Southern dairy industry
- Southern conservation tillage systems conference
- Management of cotton insects
- Turf
- Nursery crop and landscape systems
- Southern natural resource economics committee
- Evaluating the physical and biological availability of pesticides and pharmaceuticals in agricultural contexts
- Benefits and costs of natural resources policies affecting public and private lands
- Germ cell and embryo development and manipulation for the improvement of livestock
- Aquaculture production
- Developing best management practices for organic blueberries
- Towards increased use of climate information and applications
- Participation in the Southern Region Small Fruit Consortium
- Dairy business analysis project -2005
- Small ruminant herd health management
- Livestock and poultry environmental learning center
- Heritability values
- Peanut response to late-season glyphosate applications
- Management of Asian soybean rust in Georgia through monitoring and fungicide studies
- Nematode management in turfgrass systems
- Addressing fiber quality concerns of Georgia cotton
- Evaluation of phosphorous removal technologies for onsite wastewater management systems
- Evaluation of wildfire forecasts for forest management
- Epidemiology and management of center rot of onion
- Alternatives to methyl bromide being adopted slowly
- Reflex section 18 granted
- Managing ALS-resistant Palmer amaranth in peanut
- Measurements of CO2 nocturnal respiration as an indicator of stress response in peanut
- Improving reproductive efficiency and dairy management
- Growing the best adapted cultivars of agronomic crops in Georgia
- Ag Partners program
- Agricultural water use
- Climate forecasting for agricultural resources