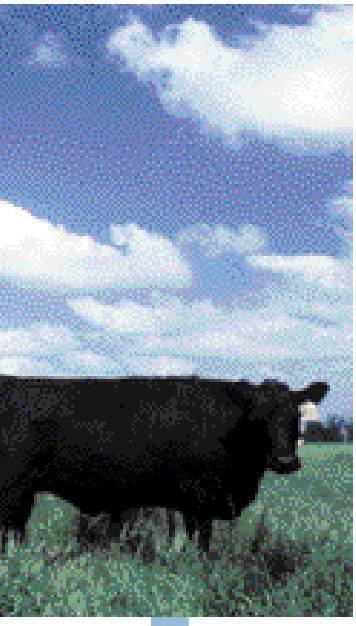


environmental report

The University of Georgia
College of Agricultural and Environmental Sciences








director's statement

WE BELIEVE SCIENCE-BASED information is essential to decisions involving the environment and sustainable public policy in Georgia. The Office of Environmental Sciences was created in 2000 by the University of Georgia College of Agricultural and Environmental Sciences to coordinate research, extension and teaching programs addressing environmental issues as well as opportunities for collaborations. We serve as a contact point for the highly diverse and well-qualified faculty of the college. Currently, our scientists are involved in more than 450 environmental projects relating to **water, air, land and environmental health.**

The Office of Environmental Sciences' mission is accomplished through a variety of means. We maintain a Web site that contains a database of research and extension projects and collaborations. We seek and nurture partnerships with other academic institutions, government entities, industry and nonprofits to combine expertise and outreach capabilities. When working to improve Georgia's environment, football rivalries are sidelined. UGA and Georgia Tech team up on a variety of projects to prevent pollution and even bioterrorism.

Study of ecosystems, which involves the interaction between human systems and natural systems, requires expertise in many scientific fields. College faculty work in interdisciplinary teams to study natural systems and ways to protect and maintain them while using them to foster economic and social well-being. The National Environmentally Sound Production Agriculture Laboratory in Tifton is an example of this team approach. It consists of faculty with expertise in agronomy, ecology, hydraulic engineering, soil science and biotechnology. As a group, they work on water quality and quantity issues and promote economic growth through development of technology.

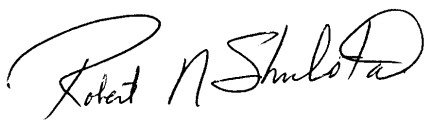
Society's ability to handle environmental problems depends on continuous research and teaching. But it also requires that scientific knowledge and research results reach public officials and concerned citizens. Our faculty serve on state task forces and boards, assist citizen-led groups, and provide expertise to decision-makers. Faculty sit on the Governor's Advisory Committee to the ACT/ACF Compacts, the Advisory Committee to the Joint Legislative Study Committee on Water, and water conservation and drought planning task forces.

Environmental education is an integral part of undergraduate and graduate studies offered in the College of Agricultural and Environmental Sciences. Programs range from environmental economics and management to biological engineering; from environmental health science to plant protection and pest management; and from agriscience and environmental systems to environmental soil science.

The College of Agricultural and Environmental Sciences has unique and effective mechanisms for transferring research results quickly to the general public through its educational and extension programs. The Cooperative Extension Service and the 4-H program, which extend throughout Georgia, provide farmers, industry, homeowners and students with environmental education. This educational dissemination mechanism has been honed for 100 years and reaches both rural and urban residents.

At the University of Georgia College of Agricultural and Environmental Sciences, we will continue to transform scientific knowledge into useful information that supports decision making to safeguard our environment. This report highlights some of the recent environmental efforts of our scientists who specialize in making research, extension and teaching applications beneficial to society.

For more information, visit http://unit.caes.uga.edu/oes/.



CONTENTS

Vol.1 No.1 Winter 2003

WATER ISSUES

Agricultural Water Use 2

Water Conservation and Farming 3
Irrigation Technology and Management
Precision Irrigation
C.M. Stripling Irrigation Research Park

Seashore Paspalum — The Environmental Grass 4

Protocol for Establishing Sediment Standards 5

UGA's Watershed Team 5
Source Water Asssessment

Garden to Protect Water Quality 6

Pollution Prevention Training for Farmers 7

Wakefield Farm — An Environmental Award Winner 8

LAND PROTECTION

Cost of Urban Sprawl 9

Bioconversion Center Recycles Waste 10

Recycling Waste at Construction Sites 11

Manure Matters 12

Bugwood Network 13

AIR ISSUES

Alternative Fuels — A National Security Need 14

Ford Partnership Tests Alternative Fuel Vehicles 15

Georgia Weather Web site 16

ENVIRONMENTAL HEALTH

Food Mircrobiologists Honored by CDC 18

***E. Coli* Eliminator** 19

Marinades Kill Microorganisms 19

Integrated Pest Management 20

Digital Diagnostics — A Tool for Biosecurity 21

EDUCATION

Undergraduate 22

Graduate 23

International Study 23

4-H Environmental Education 24

Gardening in Georgia 24

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water issues

GEORGIA'S POPULATION EXPLOSION coupled with a five-year drought places water issues high on the state's environmental priorities. Historically, the University of Georgia College of Agricultural and Environmental Sciences (CAES) has been a strong leader in water resources programs. Currently, more than 80 scientists conduct research and educational and extension projects emphasizing water quantity and quality. We especially need to find ways to reduce water use in traditional agriculture and to minimize the impact of rural and urban agriculture on surface water and groundwater quality.

A comprehensive white paper, compiled by Dan Thomas, provides a "snapshot" of current water-related programs and personnel associated with them. Reduction of nitrate and phosphate leaching from golf greens, watershed assessments for local government, evaluating methods to reduce the toxicity of wastewater treatment effluents, and development of a mobile laboratory to audit landscape irrigation are just a few projects focused on preserving the integrity of Georgia's water resources.

The paper can be downloaded at http://admin.caes.uga.edu/workgroup/wtf/.

Agricultural Water Use

by Jim Hook

Dry summers and unpredictable rain patterns, seemingly inexhaustible water supplies, and efficient center pivot irrigation technology encouraged Georgia farmers to irrigate. With irrigation, they could not only increase productivity and reliability of conventional crops like peanut, cotton, and grain but they could diversify into vegetables, orchard crops and green industry staples like sod and container plants that require more water.

In 1970, very few Georgia farmers irrigated their land. By 2000, state farmers irrigated nearly 1.5 million acres **(Figure 1)** and became the largest water consumers in the state. Crops like peanut and cotton required only modest amounts of water, but their irrigated area is measured in hundreds of thousands of acres. Vegetables require more water than those crops, but each acre is planted twice during the year. Other high-value crops like turfgrass sod and container plants used to beautify our homes and businesses require long irrigation seasons. Fortunately few acres are used in these intensively managed crops. **Figure 2** shows crop water use for 2000.

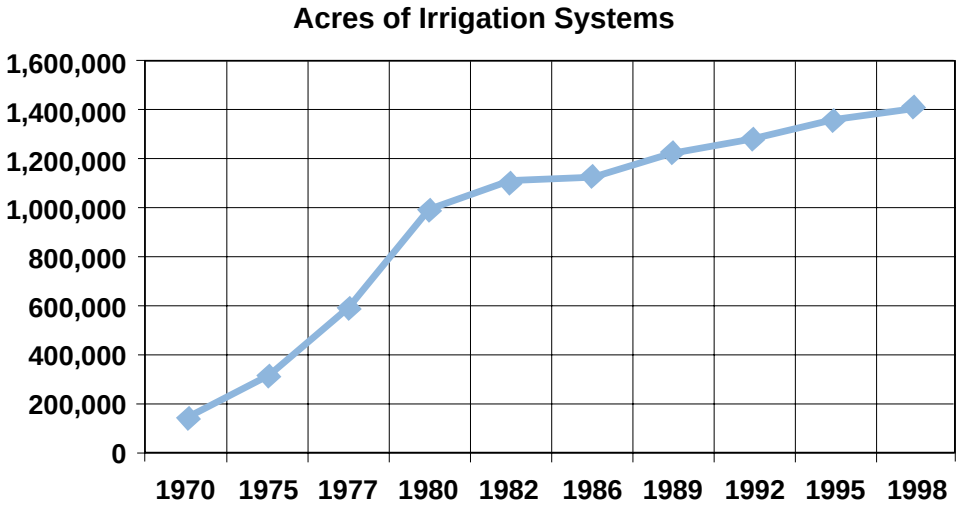


Figure 1. Irrigation development and water use permitting in Georgia are recent phenomena.

When Georgia became embroiled in the tri-state water negotiations with Florida and Alabama, Georgia Environmental Protection Division officials realized they lacked accurate data on agricultural water use. Farmers are currently not required to meter their water use; however, knowing those figures was important in determining Georgia's water needs now and for the future.

Models used by tri-state negotiators predicted that during severe drought, the Flint River could dry up. As a precaution, EPD officials approached scientists associated with the

water

National Environmentally Sound Production Agriculture Laboratory and UGA's biological and agricultural engineering department to develop methods for determining farmers' irrigation use. This voluntary project now monitors 638 permitted withdrawal sites for irrigation or 3 percent of the total permitted by EPD. Forty-five percent of the monitoring sites are for surface water withdrawals, 55 percent for groundwater.

There was also a need for reliable information on how many irrigated acres are associated with each water permit. NESPAL scientists teamed with the J.W. Jones Ecological Research Center and EPD to develop a geographic information systems-based permit management system for surface and groundwater withdrawals and irrigated fields. Then, with farmers' cooperation, they mapped individual permitted sources and fields and produced permit maps for farmers' records. Seventeen counties encompassing the permit freeze area were mapped.

For more information, visit http://nespal.cpes.peachnet.edu/agwateruse/.

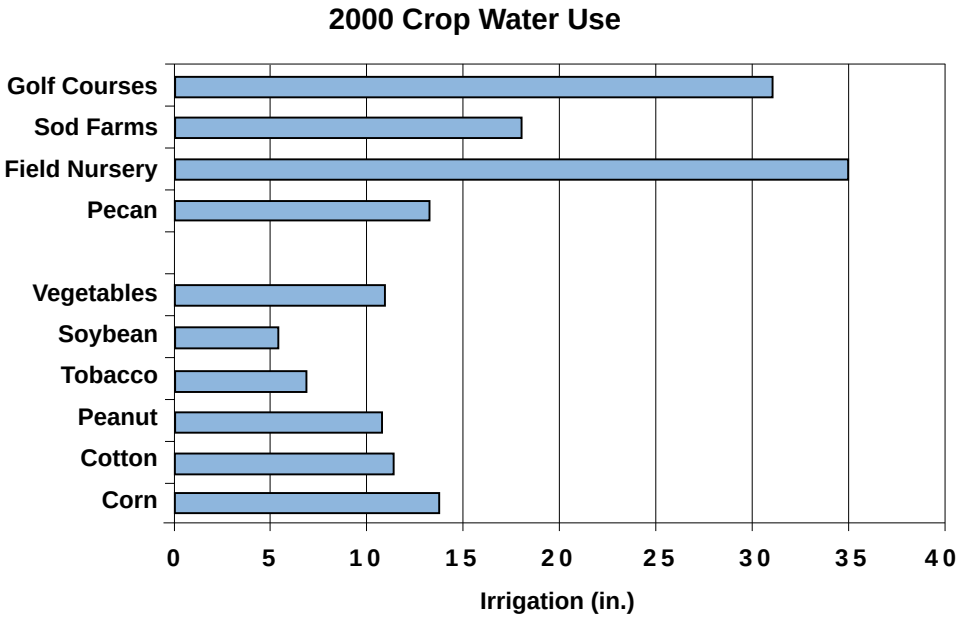


Figure 2. 2000 Extension Irrigation Survey.

Water Conservation and Farming

by Jim Hook

Irrigation Technology and Management

With the introduction of deep wells and center pivot irrigation in the 1970s, farmers could extract copious supplies of water from the abundant Floridan aquifer. However, during a drought, Georgia farmers realized that even these systems should be more efficient. Irregularly shaped fields required center pivots to be inefficiently small or to operate in a partial circle, or include fields with poor soils to make complete circles. Early systems were also equipped with energy-wasting high-pressure pumps and sprinklers that spread water widely, losing much to wind drift and evaporation.

In response to this need, scientists established field and laboratory experiments to improve application

technologies and to study crop responses to water. Several projects were funded by state and national commodity groups, state appropriations and federal grants to:

- Determine technologies to deliver water efficiently to plants and soil.
- Develop controls to minimize wasted water on noncrop areas within and around fields.
- Improve irrigation scheduling for major crops such as corn, peanut, cotton, soybean and wheat.
- Refine management of Georgia soils to take in rain, store water and supply it to crops.

Precision Irrigation

Technology from defense and other nonagriculture industries offers opportunities for precise timing and placement of water. With precision controls, correct amounts of water can be applied to various-shaped sites used for crop production. Once considered a system for the distant future, variable-rate irrigation proves to be a valuable tool to conserve water for center pivots that now cover 1 million acres in Georgia. VRI can minimize evaporation losses, improve sprinkler pattern, prevent water logging in low spots, apply more water in drier areas and avoid watering noncrop areas.

Model farms are operated by farmers willing to take risks in support of new technology and improved environment. They are used as research study sites. Aerial imagery, geographical information systems, global positioning sensors, program control logic and other technologies are combined with conventional irrigation technology to improve water use efficiency on these farms.

For more information, visit http://nespal.cpes.peachnet.edu/irrigation/.

C.M. Stripling Irrigation Research Park

Former Gov. Roy Barnes dedicated the state-of-the-art C.M Stripling Irrigation Park on May 11, 2002. The 130-acre tract in Mitchell County was donated to the University of Georgia by C.M. Stripling, a pioneer in modern irrigation farming in Georgia. This Irrigation Research Park centralizes the new research and outreach of the UGA Agricultural Water Initiative aimed at making every drop count for the farmers. Faculty collaborate using the irrigation park's land and equipment. Industry partners test equipment and water conservation strategies under the objective eye of the college's researchers. As the premier irrigation research facility in the East, the Stripling Irrigation Research Park will allow hands-on education for students in our technical colleges and universities as well as demonstration opportunities for farmers and irrigation companies.

For more information, visit nespal.cpes.peachnet.edu/agwateruse/initiative/park.asp.

Jim Hook is a professor of soil and water management at the UGA Tifton Campus. For the past 24 years, he has conducted research in the areas of irrigation, tillage and water resource management for a variety of crops. Hook advises Georgia state officials on agricultural water issues and is a member of many task forces, including the Joint Georgia Comprehensive Water Plan Study Committee.

Seashore Paspalum — The Environmental Turfgrass

by Ron R. Duncan

As water quantity and water quality concerns become pressing issues in Georgia and worldwide, less water and chemicals will be available to maintain our landscapes, golf courses and sports fields. Seashore paspalum, developed at the Griffin Campus by crop and soil scientists Ron Duncan

and Bob Carrow, can tolerate environments ranging from drought conditions to saline soils.

Seashore paspalum is a warm season grass believed to have evolved on the South African sand dunes. It was transported to the port of Savannah via slave ships from West Africa. Ron Duncan found it growing in salt water along the coast and brought it back to his research lab for breeding and testing.

Attributes

1. Drought tolerant when properly managed. Can perform with 50 percent less water than hybrid bermudagrass.
2. Capable of rooting in pure sands as well as heavy clays and bogs.
3. Survives saline soils and brackish water with proper management. Tolerates sea water.
4. Tolerates a soil pH range of 3.6 to 10.2, but performs best at pH 5.5 to 8.0.
5. Provides an effective buffer zone in environmentally sensitive areas.
6. May effectively and efficiently take up heavy metals or other contaminants (phytoaccumulation).

Applications

Seashore paspalum has multiple uses in the turf industry. It has the leaf texture, quality and traffic tolerance suitable for golf courses, sports fields, home lawns, parks and commercial landscapes. It can even clean up polluted waters and soils by extracting the contaminants (e.g., heavy metals from factories) through a process called *bioremediation*. Finally, it can serve as a transition into wetlands or other environmentally sensitive areas to minimize point and nonpoint source pollution.

Currently, seashore paspalum carpets golf courses across the globe, especially those in coastal areas. Australia, Florida, China, Malaysia, Indonesia, United Arab Emirates, South Africa, Peru, Israel and Sea Island, Georgia, are a few of the many areas where the grass is in use (Find list at www.georgiaturf.com. Click on 'seashore paspalum' and 'golf courses.')

Seashore paspalum is truly a 21st century grass for the era of environmental stewardship.

For information, visit http://www.griffin.peachnet.edu/cssci/turf/paspalum/paspalum.htm.

Ron R. Duncan is a professor of crop and soil sciences and a member of the CAES Turf Team. He develops grass for stress environments, including salinity, drought, acid soils and low light intensity.

Protocol for Establishing Sediment Standards

Sedimentation is the largest nonpoint source pollutant in North Georgia's rivers. There is no standard level for sediment in Southeastern U.S. streams. Specialists with the Georgia Conservancy and scientists from the Institute of Ecology and the College of Agricultural and Environmental Sciences formed a technical advisory group to develop a protocol for establishing sediment total maximum daily loads. David Radcliff, crop and soil scientist, and Mark Risse, biological and agricultural engineer, lent their expertise to the process. The group released a white paper identifying the best way to establish sediment TMDLs in the state, particularly in the Piedmont and Blue Ridge regions. The paper not only provides technical guidance but serves as an example of a process in which committed participants maintained open dialogue and reached consensus. The group hopes state officials use the document to guide development of sediment TMDLs. Recommendations in the white paper include:

- Identifying all problems causing biologic impairment (may not be sediment).
- Inventorying potential sediment sources and pathways by which sediments enter the water body.
- Setting a priority system for clearly impaired water bodies with a high potential for recovery and direct immediate attention on them.

For information, visit www.georgiaconservancy.org/WaterQuality/WaterQuality.asp or e-mail Alice Miller Keyes at akeyes@gaconservancy.org or David Radcliff at dradckif@uga.edu.

UGA'S Watershed Team

by Hillary Smith

Cities and counties are required to conduct a watershed assessment before they obtain a permit to upgrade, renew or establish a waste water treatment facility. Because the state's population is growing rapidly, many local governments are expanding wastewater treatment facilities. Matt Smith and David Gattie, environmental engineers affiliated with UGA's biological and agricultural engineering department, have assembled a team of specialists within the College of Agricultural and Environmental Sciences to provide comprehensive watershed

Research technician Vicki Collins samples a stream.

assessment services to counties and cities in Georgia.

Watershed assessment is a process using chemical, biological and physical parameters to predict the effects of development (often nonpoint source pollution) on streams and suggests management measures to minimize those effects. An assessment involves three main parts: **watershed characterization, watershed and water quality modeling and watershed management.** Team members specialize in various aspects of the process.

Watershed characterization establishes the baseline criteria for a watershed assessment. It includes water quality collection and analysis, biological assessment such as visual habitat surveys, macroinvertibrate and fish collection and analysis, and watershed delineation.

Watershed computer models predict the effects of future developments on streams. They can also be used to run development scenarios with the corresponding management options. The Watershed Group chooses a water quality model based on the watershed characterization. For example, in the rural farm community of Millen, the Annualized Agricultural NonPoint Source Pollution Model worked. In contrast, for the City of Valdosta, the Stormwater Management Model was selected because it models predominately urban areas.

Watershed management takes the findings of the watershed characterization and water quality modeling to outline plans to manage the watershed. These plans are designed to help cities and counties preserve water resources for now and into the future. The plan is submitted to the Georgia Environmental Protection Division for review.

The watershed management plan consists of three parts: social management measures, physical management measures and ongoing monitoring. The UGA Watershed Group facilitates public meetings to explain the project and its progress. County and city officials, utilities, environmental groups and others who may have an interest in the project provide input. Their comments are incorporated into the final report. Recommendations to install stream buffers, detention ponds, and erosion and sedimentation controls may be part of the physical management measures. To maintain integrity of the streams, ongoing water quality studies and biological assessments must be conducted.

The UGA watershed group works in Millen, Lowndes County, Valdosta, Thomasville, Fort Valley and Statham. A Web site is posted for each site (e.g.,http://watershed.engr.uga. edu/valdosta) to allow all interested people and groups to watch the progress and see test results.

Source Water Assessment

Source water protection is another set of projects undertaken by the UGA Watershed Group. Before source water can be protected, the potential sources of pollution must be identified. A source water assessment is conducted to identify potential pollutants of concern, analyze the risk to public health, and provide data and analyses for creation of a source water protection plan. A source water assessment couples cartography with hydrologic analysis to locate the pollutants present and discern the likelihood of human exposure. Source water protection is a proactive effort to protect drinking water sources before they become contaminated. Work is being done in Dublin, Hatwell, Sparta and Warrenton.

A Web site is also posted for source water assessments at http://watershed.engr.uga.edu/swapmain.

For more information, e-mail Hillary Smith at hsmith@engr.uga.edu.

Hillary Smith is an agricultural research engineer who conducts watershed assessments for various cities and counties in Georgia.

Garden to Protect Water Quality

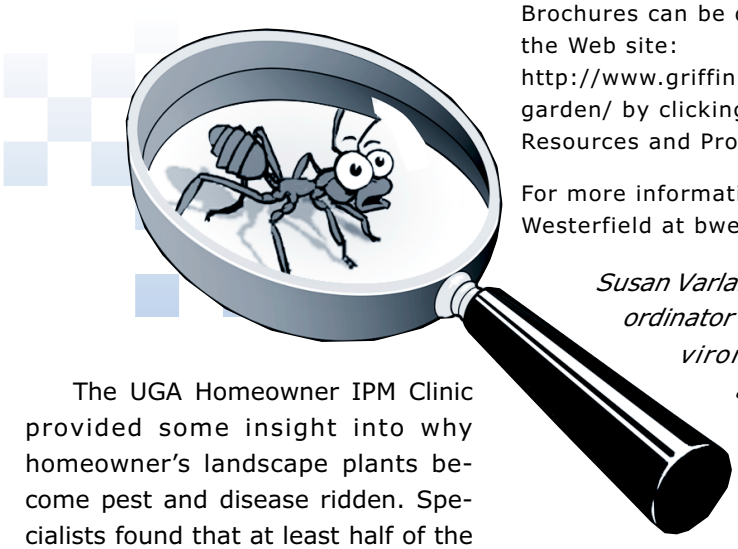
by Susan M. Varlamoff

The National Academy of Sciences reported homeowners use as much as 10 times more chemicals per acre on their lawns than farmers use on their land. Farmers know from experience and education that excessive use of fertilizer and pesticides will decrease their profits and eventually their production. Landscape professionals who treat urban landscapes are trained in pesticide application. However, homeowners have little financial or regulatory incentive to apply gardening chemicals correctly.

The result is that our urban streams contain more pesticides, and at generally higher concentrations, than rural ones. Improperly applied gardening chemicals may run off landscapes. In some cases, they have become nonpoint source pollutants that have killed fish.

According to a 1999 Georgia gardening survey funded by the Georgia Pollution Prevention Assistance Division, the majority of home gardeners want to protect the environment. Sixty-seven percent choose products they believe are environmentally friendly, 69 percent want to learn more about alternative ways to control pests, and 72 percent are willing to plant pest-resistant plants.

With public sentiment in favor of environmentally friendly gardening, scientists and Extension agents developed best management practices for Georgia homeowners with a grant from EPA's Section 319 (h) program through the Georgia Center for Urban Agriculture.



The UGA Homeowner IPM Clinic provided some insight into why homeowner's landscape plants become pest and disease ridden. Specialists found that at least half of the disease and pest problems they see come from things like improper watering, over fertilizing and placing plants improperly.

Best management practices for Georgia gardeners includes information on proper planting and maintenance of ornamentals and turf, vegetable gardening and pest management, including alternatives to pesticides such as biological control and water conservation.

All Georgia county Extension offices and new Master Gardeners use best management practices to answer homeowner questions about landscape management. The information is further disseminated through the Clean Water Campaign, the Georgia Pollution Prevention Assistance Division, Department of Community Affairs and various environmental groups such as the Upper Chattahoochee Riverkeeper and Southface Energy Institute. Walter Reeves, horticultural educator and former Extension agent, promotes natural gardening through the mass media (see "Gardening in Georgia," page 24).

Brochures can be downloaded from the Web site: http://www.griffin.peachnet.edu/garden/ by clicking on 'Educational Resources and Programs.'

For more information, e-mail Bob Westerfield at bwesterf@uga.edu.

Susan Varlamoff is program coordinator for the Office of Environmental Sciences and a Georgia Master Gardener. She has degrees in biology and environmental pollution control and has worked in the environmental field for more than 20 years.

Pollution Prevention Training for Farmers

by Tina Pagan

Georgia farms are increasingly being recognized as potential sources of surface and groundwater contamination in rural areas. To encourage the use of farm practices that protect water quality, the Georgia Farm*A*Syst program works with farmers and rural residents to increase awareness of potential agricultural pollution. The program provides technical assistance, training, workshops, demonstrations, on-site assessments, and publications. Self assessments identify potential sources of contamination, supply information on corrective actions, and ultimately encourage the farmer to form an action plan to address concerns.

In 1996, the program was funded under U.S. Environmental Protection Agency's Section 319 (h) program to encourage a voluntary means for producers to manage their farms to protect their water resources. Since its inception, the program has gained support and cooperation from Georgia's farmers.

Much of the program's success is credited to the county Extension agents and Natural Resources Conservation Service (NRCS) representatives who use the program and conduct the self-assessments with their clientele. Lumpkin, Baldwin and Crawford county Extension agents, to name a few, have organized countywide programs to address specific pollution concerns such as protecting drinking water wells and developing comprehensive nutrient management plans.

Over the past two years, the Georgia Farm*A*Syst program has reached many Georgians. The self–assess-

ments were available at 52 state, regional or local/county meetings. More than 14,000 selfassessments have been distributed through the efforts of the Georgia Farm*A*Syst coordinators, UGA Cooperative Extension Service agents, NRCS agents and various training and field day events with an estimated 30 to 40 percent completion rate. Based on a 1999 survey, the distribution of these assessments would result in approximately $6 million provided by farmers toward pollution prevention practices.

The traditional audience of the Georgia Farm*A*Syst program has expanded to reach well and septic systems owners in Georgia's coastal areas and forest landowners through the development of new self assessments. In addition, the program is supported by the Georgia Environmental Health Association, the Georgia Department of Agriculture's voluntary pesticide screening program and various state EPA 319 grants. These partners distribute and conduct on-site self assessments with their various audiences or refer rural residents to the Georgia Farm*A*Syst coordinator.

NRCS representative Larry Coburn uses a Georgia Farm*A*Syst assessment to address a well owner's concerns.

Georgia Farm*A*Syst is supported by the Georgia Department of Natural Resources Pollution Prevention Assistance Division and the University of Georgia Cooperative Extension Service.

For more information about the program, contact Tina Pagan at tpagan@engr.uga.edu.

Tina Pagan is a program specialist in the department of biological and agricultural engineering.

Wakefield Farm — An Environmental Award Winner

"I try to foster nature as an ally rather than an adversary," said Dick Phillips, owner and operator of Wakefield Farm, a thriving cow/calf operation. With hard work, good business sense, an innovative spirit, teamwork and respect for the environment, Phillips converted a depleted cotton farm into an environmental award–winner. The National Cattlemen's Beef Association honored Wakefield Farm with its prestigious Environmental Stewardship Award for 2002.

Dick Phillips credits Charles McPeake, state program leader – agriculture and natural resources; Charles Rice, Hart County Extension agent; and Forrest W. Ferguson, district conservationist with the Natural Resources Conservation Service, with providing the environmental practices he implemented. These practices include:

- No-till planting on 75 percent of the crop land
- Leaving 50 percent of the farm for wildlife (700 acres)
- Fencing off streams
- Concrete watering tanks for cattle
- Establishing buffer zones on streams
- Extensive erosion control measures

"We want to let people know that it makes good business sense to do the environmentally sound thing," Phillips concluded.

For more information on Wakefield Farm, contact Dick Phillips at 706-376-6023.

Land protection

THE THRUST OF THE COLLEGE'S land protection research and extension programs involves recycling agricultural and industrial waste into usable products. Many of these industrial and agricultural products are used to enrich the land for farming. Nutrient management on livestock and poultry farms is an important area where scientists and extension personnel are working to minimize the impact of confined animal feeding operations. The Bugwood Network is a Web site that offers tools to government agencies, farmers and even homeowners to protect forests, farms and gardens from serious pest damage. In addition, economists are measuring the impact of urban sprawl.

Land

Cost of Urban Sprawl

Measuring Sprawl and Its Impact, a three year study conducted by Rutgers and Cornell universities, ranked metro Atlanta as fourth in the country for urban sprawl. Between 1990 and 2000, Georgia's population grew by nearly 40 percent. Local government officials usually believe they can increase the tax base of their communities by developing the land into residential subdivisions. Not necessarily so, says Jeff Dorfman, an agricultural and environmental economist. In fact, his studies show residential development may place a financial burden on communities.

While residential development brings new taxes, it creates a demand for costly local government services such as schools. The cost of providing these services exceeds the revenue generated by the new houses in every case studied (Amercian Farmland Trust).

Jeff Dorfman collected data for the fiscal year 1999 from four counties with a variety of growth conditions and determined the costs and benefits of three major land uses: residential, commercial/industrial, and farm and forest. Appling County represents a very rural community with significant large-scale private land holdings and considerable timber production. A nuclear plant makes up 65 percent of the tax base. Cherokee County is a rural/suburban county facing rapid growth and located in north metro Atlanta. It consists of small private landowners. Dooly County is rural and a major agricultural producer. It has small–scale land holdings. Jones County, a rural/suburban county on the east side of Macon, has forestry.

The numbers clearly show the misconception of establishing a growth policy based on residential development. In not a single instance did residential development generate sufficient revenue to cover associated expenditures. Bedroom communities are not sustainable at tax rates likely to be levied by local governments. When a rural community converts large tracts of farm and forest land into residential development, the government is nearly guaranteed to travel a path of deteriorating financial stability and increasing local property taxes.

Commercial/industrial development and leaving land in farms and forests will provide a tax base for the community but will not dramatically increase expenditures for services.

However, residential development will cause public expenditures for services to greatly exceed the tax revenues received. The results are tabulated in **Figure 3** and **Figure 4.** The figures are presented as dollars of public expenditure per dollar of revenue, so numbers greater than 1 signify land uses generating less in revenue, than they are incurring in service expenditures. For example, Appling County spends $2.26 providing services to residents for every $1 it receives in revenue from residential land uses, creating a shortfall of $1.26 in the residential category.

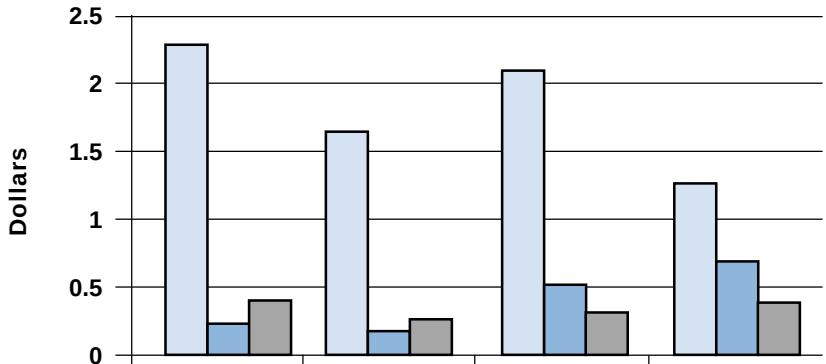
This study shows there must be a balance between commercial and industrial development to support residential development. In particular, rural communities do not generate enough revenue solely from residential development to cover expenditures of services.

Even if schools were totally state tax supported, local government expenditures for residential development currently exceed all sources of revenue generated by residential development. Farm and forest land may not generate an impressive looking tax base, but neither do they create a large demand for government services.

For more information, contact Jeff Dorfman at JDORFMAN@agecon.uga.edu.

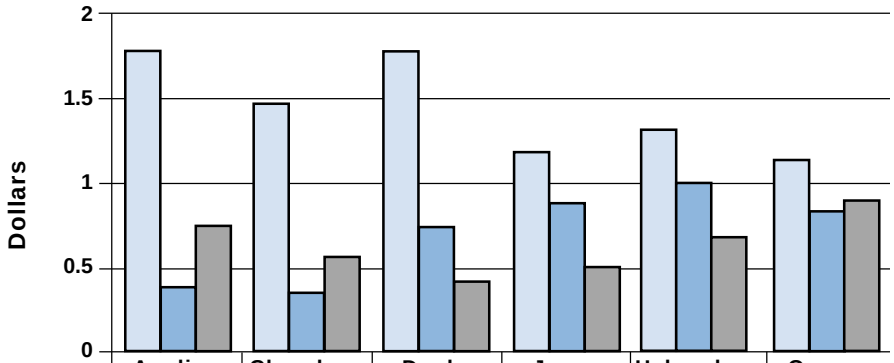
Jeffrey Dorfman is a professor in the department of agricultural and applied economics. He teaches classes in economic theory and the economics of the food industry. His research includes productivity measurement, the economics of growth and sprawl and the effect of e-commerce on agribusiness.

Figure 3. Dollars of Expenditure per $1 of Revenue by Land Use (including schools).



	Appling	Cherokee	Dooly	Jones
Residential	2.26	1.6	2.07	1.24
Comm/Ind	0.17	0.12	0.5	0.65
Farm/Forest	0.36	0.2	0.27	0.35

Figure 4. Dollars of Expenditure per $1 of Revenue by Land Use (excluding schools).



	Appling	Cherokee	Dooly	Jones	Habersham	Oconee
Residential	1.76	1.44	1.75	1.15	1.28	1.11
Comm/Ind	0.34	0.31	0.7	0.85	0.97	0.8
Farm/Forest	0.71	0.52	0.38	0.47	0.65	0.85

Bioconversion Center Recycles Waste

Biological and agricultural engineers give nature a helping hand by recycling waste into usable products. This process is called bioconversion. Bill Tollner and K.C. Das spend their days at the bioconversion center concocting recipes using yard, animal and industrial waste to make soil amendments, animal feeds and even fuel.

It began back in the late 1980s when Harold Reheis, Director of Environmental Protection Division, determined there was a solid waste problem in Georgia. Municipalities were mandated to reduce solid waste en-

tering landfills by 25 percent. In 1997, yard waste was prohibited from entering subtitle D landfills. Because yard waste constitutes approximately 30 percent of the solid waste stream and can be composted, this portion was considered for experiments.

The Georgia Research Alliance funded a bioconversion center at the University of Georgia Athens campus. The intent was to assist Georgia municipalities and industries find ways to convert waste destined for the landfill into worthwhile goods. The project began with UGA Athens campus yard and animal waste. Mixed in the right proportions and composted, it was returned back to the campus as a soil amendment and mulch for the landscape.

The process begins in the laboratory, where researchers assess the material for potential odors, find the carbon and nitrogen ratio, and perform a chemical analysis. Once scientists have balanced the nutrients required to sustain microbial life, they move the project to the bioconversion center for prototype evaluation. Haystack-sized piles are evaluated in a controlled environment and then transferred to windrow pads for further examination.

Mature compost is available in six to nine months. A low–tech method for determining whether the compost is mature relies on applying a small amount on watercress seeds, which are sensitive to organic acids. If the seeds grow, the compost is mature. With further water removal, compost can be made into fuel pellets.

Today, pulp and paper companies, poultry processors, a wool processor and municipalities employ the services of the bioconversion center. A compost using wool shows promise as a soil amendment for the sod industry. Wool reduces the weight of the sod. Another great potential for the composted waste is its use for soil and erosion control, said Bill Tollner (see **Table 1,** page 12).

In addition, research is being conducted into using byproducts to produce gas or a high-quality energy source. Alternative fuels are being explored through the Department of Energy as a means to reduce emissions and dependence on foreign oil.

To learn more about bioconversion, visit the biological and agricultural engineering Web site at http://www.engr.uga.edu/ or read *Natural Resources Engineering* by Ernest W. Tollner. The book examines the physics and engineering aspects of soil and water quality preservation.

Ernest W. Tollner is professor of biological and agricultural engineering. His teaching and research interests include management of runoff and nonpoint source pollution in agricultural and urban settings.

Recycling Waste at Construction Sites

by Mark Risse and Julia Gaskin

The U.S. Environmental Protection Division reported in 1997 that soil loss from construction sites is typically 10 to 20 times greater than from agricultural lands. Construction sites, especially in North Georgia, contribute significant amounts of sediment to urban streams. Amendments to the Erosion and Sedimentation Act (2000) focus on reducing runoff from construction sites to improve surface water quality. Biological and agricultural engineers seized the opportunity to test a variety of compost and mulch

materials under simulated rainfall for their effectiveness in reducing runoff and controlling erosion and sedimentation. The results are shown in **Table 1.**

The research revealed that composts and mulches performed better than bare soil in reducing eroded solids. Fine and medium mulches had the lowest runoff rate and volume. Results show that compost filter berms appear to be a good alternative to silt fences.

This study provides promise that wood waste can be ground and recycled at construction sites to reduce erosion. By using wood waste for erosion and sedimentation control, landfill costs are averted. Mulch cover can serve as good short-term protection and a base for vegetation.

A large component of construction waste is wallboard. As landfill tipping fees and environmental concerns increase, scientists looked for ways to use the wallboard as a soil amendment. If it is ground and incorporated into the soil, wallboard can improve infiltration. It also provides calcium and sulfur. This treatment applies only to unpainted and unwallpapered wallboard. Recommended application rates vary between 50 and 250 pounds per 1,000 square feet of soil. The rate is ultimately determined by the soil type and calcium content, which can be determined by the local Cooperative Extension office.

Additional information can be obtained about wood waste and compost from Mark Risse at mrisse@engr.uga.edu or about wallboard from Julia Gaskin, jgaskin@engr.uga.edu.

Mark Risse is an associate professor in the department of biological and agricultural engineering. He is extension water quality coordinator for the College of Agricultural and Environmental Sciences.

Julia Gaskin works in agricultural pollution prevention as a land application specialist for the Cooperative Extension Service. The program is sponsored by the Georgia Pollution Prevention Assistance Division.

Table 1. Runoff and Solids Loss Data for Selected Composts and Mulches.

Treatment	*Total Vol. Runoff (L)*	*Total Solids Loss (g)*
Cobb County compost	50	215
Food and ground wood waste	41	96
Yard waste, ground wood, manure	66	118
Fine ground wood	**37**	**71**
Medium ground wood	52	124
Coarse ground wood	26	114
Soil	76	766

Manure Matters

by Mark Risse and Thomas M. Bass

Animal agriculture has been under enhanced scrutiny in recent years by regulatory agencies as well as nongovernment organizations. Yet, when given the opportunity and training, farmers have demonstrated their willingness to protect the environment. Given that premise, the college has increased its efforts to provide education and conduct research to solve environmental problems facing Georgia agriculture.

In 1995, research and extension scientists toured livestock and poultry operations across Georgia and neighboring states to survey the state of animal waste management. Shortly after these "Manure Tours," the AWARE (Animal Waste Awareness in Research & Extension) Team was organized to assist farmers in learning economically and environmentally sound waste management and conservation techniques.

A major focus of the AWARE Team in the past few years has been addressing impacts of the state's animal feeding operation regulations. State law requires farms with more than 300 animal units (a scaled number relative to species) to have at least one certified operator trained in nutrient management and a nutrient management plan written by a certified professional. A nutrient management plan helps a farmer use manure for its agronomic value, providing nutrients for crops and enhancing soil quality.

Currently, 80 swine producers, more than 250 dairy farmers and 20 egg producers are certified operators as the result of state certified AWARE training programs. Additionally, more

than 200 professionals, mostly county Extension agents, have been certified to write nutrient management plans. Because of hard work by county agents, AWARE specialists and farmers, 50 swine nutrient management plans have been completed; and 200 dairy plans along with 20 egg-layer plans are currently in development. In Georgia, this is being accomplished at little or no cost to the producer.

The AWARE team also offers on-site technical assistance, applied research solutions and additional educational programs in the areas of animal waste management, environmental regulations, water quality, sustainable agriculture, economics and composting. Resources include a variety of publications and manuals, Web site, e-mail listserv, newsletter and specialists or county agents.

At 21 million pounds of chicken a day, Georgia farmers lead the nation in poultry production. They are also leaders in safeguarding soil and water quality. AWARE participated in a program under the leadership of the UGA poultry science department to help 4,000 poultry farmers. Nearly all the poultry producers in Georgia completed a training program and nutrient budgeting exercise to "recycle" the nutrient-rich litter properly from their poultry houses into organic fertilizer. What could be an environmental liability is an asset that enhances soil and fertilizes crops and forages.

For more information, visit http:/www.engr.uga.edu/service/aware/ or contact Mark Risse at mrisse@engr.uga.edu.

*Mark Risse is an associate professor in the department of biological and agricultural engineering. He has coordinated the Agricultural Pollution Prevention program, Farm*A*Syst, AWARE team and Sustainable Agriculture Training program.*
Thomas Bass is an educational program specialist in biological and agricultural engineering.

Bugwood Network

by G. Keith Douce

The Bugwood Network hosts 15 Internet sites that contain thousands of images of insects, diseases, plants, wildlife and management practices. These high-quality images taken by hundreds of photographers can be downloaded and copied for educational purposes. In 2001, the Bugwood Network site received more than 10 million hits. Keith Douce, entomologist, developed and operates Bugwood.

Forestry images (http://www.forestryimages.org) and invasive plants (http://www.invasive species.gov) are two widely used sites. More than 65 percent of Georgia's land is forested. The forestry images site uses a searchable database to track scientific information invaluable for forest management. The site is a collaboration with the Warnell School of Forestry and is supported by the USDA Forest Service.

Invading nonindigenous species in the United States cause major environmental damages and losses adding up to more than $138 billion per year. There are approximately 50,000 foreign species and the number is increasing. The primary purpose of the invasive species site is to assist the U.S. Department of Agriculture, Animal Plant Health Inspection Service, Plant Protection and Quarantine, state and federal agencies in the United States and abroad, and other clientele monitor pest populations of regulatory concern.

In today's global economy, goods are rapidly shipped around the world; pests frequently accompany the goods into new environments. Pests like the Asian longhorned beetle and the zebra mussel were accidentally introduced and have become major pests in the United States. Partnerships have been established with East Africa, Europe and South Pacific islands to protect their biodiversity and prevent the entry of invasive species.

For more information, visit http://www.bugwood.org or e-mail bugwood@arches.uga.edu

G. Keith Douce, professor of entomology and Extension entomologist, and David Moorhead (professor, Warnell School of Forest Resources), founded the Bugwood Network in 1995 to develop and use information communication technologies to reach a wider clientele in the areas of forest health, entomology and silviculture.

air issues

THE DEPARTMENT OF biological and agricultural engineering conducts considerable research in the development of alternative fuels from agricultural by-products. Products are tested at university facilities. Buses were run on peanut oil and boilers were retrofitted to burn chicken fat. The Department of Energy has set up an office in the department of biological and agricultural engineering to promote this research. In addition, a partnership established with the Ford Motor Company tests alternative fuel vehicles. Finally, the University of Georgia motor pool benefits from the interest and expertise of Bill Fox, an environmental economics graduate, who stays abreast of developments in the field. He purchases and receives corporate gifts of alternative fuel vehicles to reduce the university's reliance on fossil fuels and improve air quality.

Alternative Fuels — A National Security Need

by Thomas Adams

While going to war over petroleum is a real scenario, fighting over chicken fat is not. The UGA Engineering Outreach Service was thrust into the national spotlight when they successfully heated the UGA campus with chicken fat for several periods during the winter of 2002. Boilers were retrofitted for less than $30,000 to burn 300,000 pounds of four kinds of fat and grease. Mixtures of petroleum, animal fat, and spent vegetable cooking oils were tried as well as 100 percent chicken fat, pork fat and other greases.

For the past 20 years, UGA engineers have researched the use of alternative fuels. In the 1980s, campus buses were fueled by peanut oil that smelled like "Nutter Butter," according to Bill Fox, who was a student then and is now the director of the UGA motor pool. Of particular interest is biodiesel derived from crops like peanuts, corn, soybeans and canola as well as by-product oils.

Today, scientists are looking at animal fats. Tom Adams, Director of the UGA Engineering Outreach Service, said the idea is not new. People have been using biofuels for years. It's an idea so old that most people had almost forgotten about it. In fact, fish and whale oils were used for heat and light in the 19th century.

In the United States each year, approximately 1.5 billion gallons of poultry fat, yellow grease, choice white grease and tallow are produced. The annual production in Georgia of poultry fat alone exceeds 100 million gallons. With the inclusion of brown grease, the total for biofuel oils generated in the United States may top 3.0 billion gallons per year. Some of these products are used for animal feed and pet food, but the public is demanding lower-fat feed for their animals, so demand and prices for fats have decreased. By-products, such as brown grease, are being disposed of in landfills.

At the time of last winter's tests, the fats and by-product oils cost 20 to 30 percent less than #2 petroleum fuel

Research scientist Tom Adams and research engineer Bob Synk monitor their tests at UGA's steam plant.

oil and have similar heat values, according to Bob Synk, a research engineer who worked on the Bio-Fuel Project. Benefits to the environment include very low emissions of nitrogen oxides, sulfur and particulates with no net carbon dioxide emissions, a major greenhouse gas that contributes to global warming.

Synk, head of Athens-based Project Management Resources Inc., said the nation's dependence on foreign oil is increasingly seen as a threat to national security. The U.S. energy plan calls for supplying up to 20 percent of the country's energy needs through alternative fuel sources within two decades, he stated. The U.S Department of Energy Office of Energy Efficiency and Renewable Energy provided a grant to the UGA Engineering Outreach Service for an on-campus office to organize Georgia's efforts for developing biomass fuel, power and biobased industrial products. The office is also headquarters for the Georgia Industrial Technology Partnership, a partnership of industrial, academic, state and federal institutions. Scientists assist industry in developing visions and road maps, and implementing plans to attain energy efficiency, renewable energy and sustainability goals.

The UGA Engineering Outreach Service represents the university in the Georgia Environmental Partnership. This partnership works with industries to prevent pollution, conserve resources and add value to industrial by-products. The past year's biofuel work was a GEP project. GEP is a collaboration between UGA's Engineering Outreach Service, Georgia Tech's Economic Development Institute and the Pollution Prevention Assistance Division of the Georgia Department of Natural Resources.

For more information, contact Thomas Adams at tadams@engr.uga.edu.

Tom Adams is a research scientist in the department of biological and agricultural engineering working in areas that include bioprocessing, resource conservation, by-product recovery and utilization. He is also director of Engineering Outreach Service, a group that delivers practical solutions for economic development to Georgia's industries, municipalities and agencies that result in energy efficiency, sustainability and water conservation.

Ford Partnership Tests Alternative Fuel Vehicles

by Susan M. Varlamoff

A UGA/Ford partnership reflects the mutual interest of both organizations to reduce air emissions and reliance on foreign oil and nonrenewable resources. The Ford Motor Company, under the direction of Chairman Bill Ford, promotes cleaner technology for automobiles by providing alternative fuel vehicles (AFVs) for demonstration and testing.The University of Georgia has been selected as one of only two universities in the United States to test Ford alternative fuel vehicles.

Since the Atlanta metro area is designated as an ozone nonattainment area, driving cars with low emissions, a precursor of ground level ozone, is important. The first vehicle to arrive

on campus was a bi-fuel F-150 truck. With a flip of a switch, the truck gives the driver the choice of running either on gasoline or compressed natural gas. CNG has low emissions and is a good choice for smog filled cities like Atlanta. The University of Georgia maintains a CNG pump for its AFVs so refilling was easy. Unfortunately, the truck was recalled by Chairman Ford for an environmental rally in Detroit.

A white, liquid propane F-150 truck arrived to replace it. This packed-with-all-the-extras vehicle was used by President George W. Bush as Ford's answer to cleaner technology. Liquid propane gas gives a similar range to gasoline and is available at RV and U-Haul stores. With decals on the truck proclaiming "A Cleaner Choice," Bob Shulstad, director of the Office of Environmental Sciences, makes an environmental statement driving Georgia's highways and byways to meetings.

Bill Fox, director of the university's motor pool, incorporates a number of additional AFVs into the fleet. They include bi-fuel passenger vans and trucks, electric vehicles and a compressed natural gas passenger van.

Electric vehicles are ideal for campus use, as most campus vehicles travel only 5 miles a day. The Office of Information Technology and housekeeping use them because they are small and easy to maneuver in tight spaces next to buildings. Cars can be recharged at a 110-volt outlet every 35 to 40 miles. Electric cars have zero emissions.

According to Bill Fox's records, gasoline use from 2000 to 2002 declined by 15,000 gallons or 4 percent of the total used. Reduction in gasoline use promises to improve as more AFVs are added to the UGA fleet.

As new technology emerges from Detroit, such as the hybrid car and a vehicle powered by a hydrogen cell, UGA scientists will have the privilege of testing them also. This important partnership, facilitated by April Dents of Ford Motor Company, has the potential to pave the way for cleaning up our cities and reducing our reliance on petroleum.

For more information, contact Susan Varlamoff at varlamof@arches.uga.edu or April Dents of the Ford Motor Company at adents@ford.com or 678-376-3905.

— April Reese, UGA student intern, contributed to this story.

(Left to right) Assistant Dean Gerald Arkin, Dean Gale Buchanan and Assistant Dean Robert Shulstad admire Ford's bi-fuel truck.

Georgia Weather Web site

by Gerrit Hoogenboom

For an instant weather report, visit the Georgia Automated Environmental Monitoring Network (AEMN) at http://www.Georgiaweather.net. It was established in 1991 by Gerrit Hoogenboom, biological and agricultural engineer on the Griffin Campus. Fifty weather stations operate throughout the state to collect reliable information for agricultural and environmental applications. Each station monitors air temperature, relative humidity, rainfall, solar radiation, wind speed, wind direction and soil temperature at 2-, 4-, and 8-inch depths every second. Many stations also monitor barometric pressure and soil moisture.

The weather data is updated on the Web site every 15 minutes and used by a variety of individuals, including farmers, to work more effectively. In addition, government officials

use it for public policy decisions.

The AEMN Web site provides a state map marking the monitoring stations, as seen in **Figure 5.** With a click of the mouse, a visitor can learn the current weather conditions at any station within the state. Various other state maps show contours reflecting air temperature, precipitation, soil temperature and so on. Current climate conditions can be compared with maps showing weather in years past.

Tracking this climate data has important implications for farmers. Knowing the frost date determines when farmers need to harvest crops; having soil moisture information helps schedule irrigation. Properly implementing Integrated Pest Management depends on temperature, humidity and the dew point, all of which are available on the Web site.

Using the network to track the drought is very important for government officials and policy makers who make informed decisions about conserving Georgia's natural resources. The Environmental Protection Division of the Georgia Department of Natural Resources relies on this information to determine if a drought should be formally declared and what level of water restrictions should be imposed to conserve water. The site's rainfall data and evaporation rates are used by negotiators in the Tri-State Water Compacts to determine a water allocation formula for Alabama, Florida and Georgia.

Industry also uses the Web site information. Air conditioning and heating companies refer to charts to determine heating/cooling loads. Construction workers can predict how long a job will take to complete if they know the weather forecast and current rainfall conditions. Power companies can use the information to determine energy requirements during extreme weather conditions.

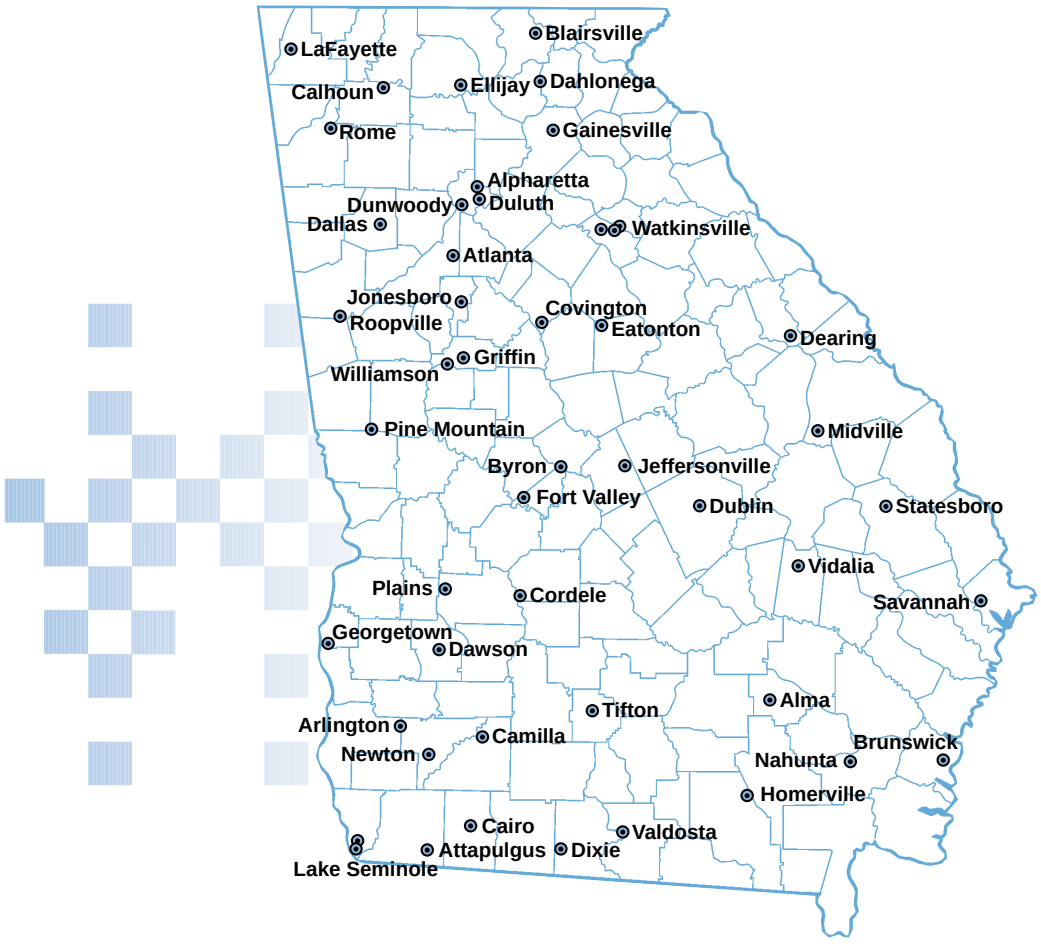
And teachers make use of the site for their science classes. Students in grades K – 12 can learn about the different data collected and the implications. They can also compare values throughout the state and with past years to see trends.

The National Oceanic and Atmospheric Administration is providing funding to look at the impact of long-term climate change and variability in the state mitigation strategies for producers.

For more information, contact Gerrit Hoogenboom at gerrit@griffin.peachnet.edu.

Gerrit Hoogenboom is a professor in the department of biological and agricultural engineering. His areas of research include impact of climate change and climate variability on crop production and automated weather station operation and data management.

Figure 5. Georgia weather monitoring stations.



ENVIRONMENTAL HEALTH

SCIENTISTS WHO CONDUCT research in the area of environmental health work principally in the department of food science and for the Center for Food Safety. However, other departments, such as those featured here, have had a great impact locally and even internationally in saving lives.

The Center for Food Safety at the University of Georgia was established in April 1993 with a mission of maintaining and improving the safety of foods through the development of methods that detect, control or eliminate pathogenic microorganisms or their toxins. State-of-the-art facilities, located on the Griffin Campus, allow faculty to conduct cutting-edge research in food safety that benefits both the food industry and the consumer. Through its programs, strong collaborative ties have been developed with the Centers for Disease Control and Prevention, the USDA Russell Research Center and other research groups. Research findings are communicated through scientific publications, an annual report, a quarterly newsletter, a Web site (http://www.griffin.peachnet.edu/cfs) and an annual meeting.

Integrated pest management and digital diagnostics have made important contributions to environmental health. IPM is used in eradicating pests that cause illness and digital diagnostics allows for quick identification of plants and animals that may be injurious to health.

Food Microbiologists Honored by CDC

by Sharon Omahen

University of Georgia food microbiologists Larry Beuchat and Michael Doyle have been awarded the Partners in Public Health Award by the Centers for Disease Control and Prevention.

Beuchat and Doyle are researchers with the UGA College of Agricultural and Environmental Sciences' Center for Food Safety in Griffin, Ga. They were nominated for the award by administrators at the National Center for Infectious Diseases.

Beuchat is an internationally recognized expert on fruits and vegetables. He was selected for the CDC honor based on his work on several outbreaks of salmonellosis that were associated with raw tomatoes.

Doyle, director of the Center for Food Safety, was selected for his participation in several investigations of large foodborne disease outbreaks.

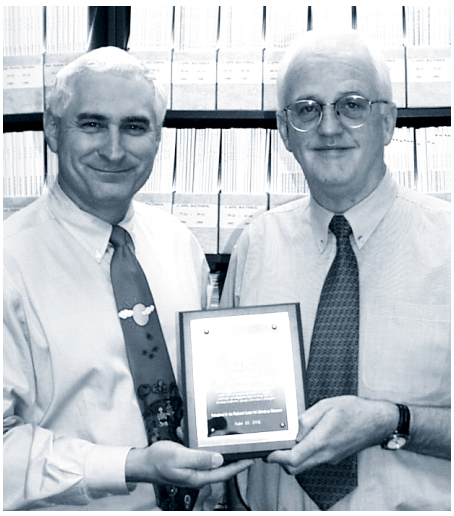
These investigations included a 1985 Midwestern U.S. outbreak of salmonellosis that affected 250,000 people and the 1993 hamburger-associated *E. coli* O157:H7 outbreak in western U.S. states.

The CDC also applauded the scientists' research into prevention recommendations. The award nomination listed as an example a multistate outbreak of shigellosis in 1998.

The Minnesota State Health Department was investigating three outbreaks that appeared to be linked to three separate restaurants. Health officials soon discovered the outbreaks, as well as *Shigella* outbreaks in several other states, were all linked to parsley.

Working with the CDC, Beuchat and Doyle conducted research to see whether *Shigella* multiplies in parsley under restaurant conditions and, if so, how this can be prevented.

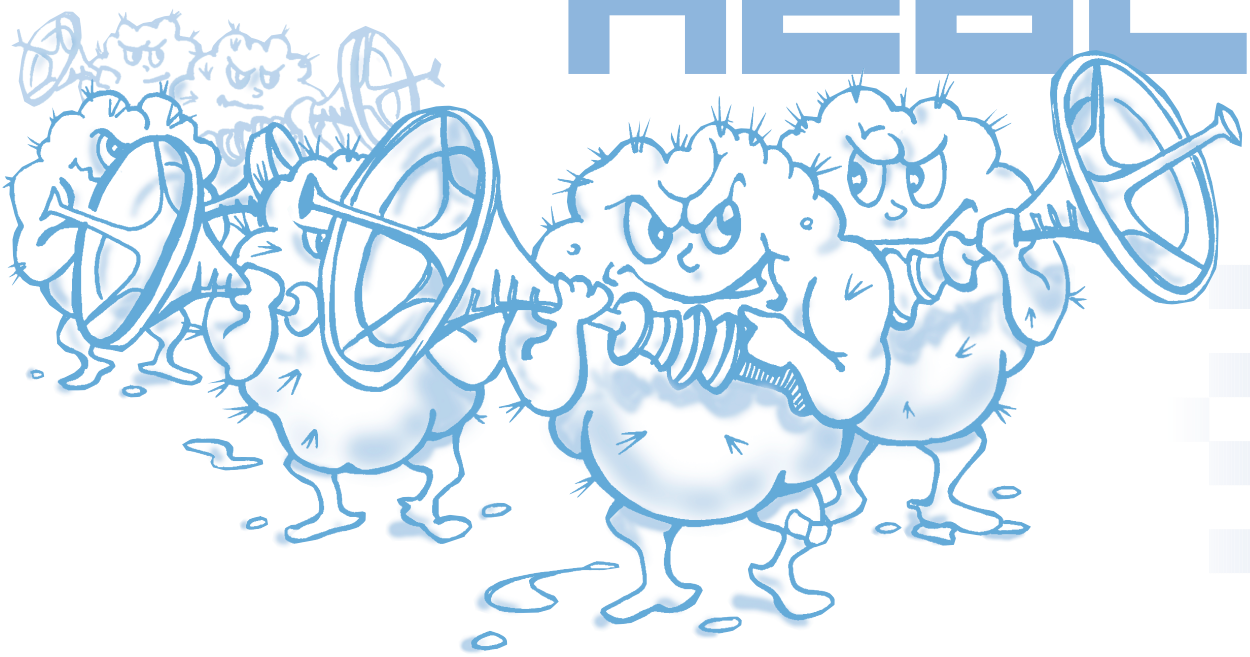
Their studies revealed *Shigella* bacteria multiply much faster when parsley is chopped and kept at room temperature, a common practice in the restaurant business. As a result of the study, the UGA researchers now recommend parsley be decontaminated by being soaked in either diluted bleach or diluted vinegar.



Michael Doyle (left) and Larry Beuchat, food microbiologists, display CDC award.

Beuchat has worked on joint projects with the CDC for the past seven years and Doyle for the past 15 years.

HEALTH



E. Coli Eliminator

by Sharon Omahen

Researchers are confident they've found a way to dramatically reduce *E. coli*, one of the nation's deadliest foodborne pathogens, where it starts. Food scientists at the UGA Center for Food Safety in Griffin, Ga., have isolated beneficial bacteria in some cattle's intestines. Feeding cultures of these bacteria to cattle, they say, dramatically reduces *E. coli* in both their intestines and their feces.

The university has received a patent for the cultures. The U.S. Food and Drug Administration must now review the new treatment method. If the FDA approves, the cultures can be made commercially available as a treatment in cattle feed. Funded in part by the FDA, the UGA studies took advantage of what was already working.

"We examined about 1,200 bacteria isolated from cattle that didn't carry *E. coli* O157:H7," said Michael Doyle, director of the UGA Center for Food Safety. "We looked for beneficial bacteria that prevent *E. coli* O157:H7 from being carried in the intestinal tract of cattle."

The resulting probiotic bacterial culture was fed to weaned calves and adult cattle. The treatment dramatically reduced the carrying and fecal shedding of *E. coli*. It eliminated *E. coli* O157:H7 in 80 percent to 90 percent of the treated cattle.

The Centers for Disease Control and Prevention estimate 100,000 cases of foodborne illness are linked to enterohemorrhagic *E. coli* each year. The CFS culture suppresses *E. coli* O157:H7, the deadliest type, along with some other strains.

For information on *E. coli* and food safety issues, see the CFS Web site at www.griffin.peachnet.edu/cfsqe/.

Sharon Omahen is a news editor with the University of Georgia College of Agricultural and Environmental Sciences.

Marinades Kill Microorganisms

by Romeo Toledo

Who would have thought that marinades and glazes may contain ingredients capable of killing harmful bacteria on meat? These marinades and glazes contain derivatives of household products such as acetic acid found in vinegar and citric acid found in citrus fruits such as lemons. Romeo Toledo, UGA food scientist, has developed methods to eliminate harmful bacteria on raw chicken by coating it with a variety of marinades and glazes.

By combining acetic acid with its sodium salt, microbial growth can be slowed without the strong smell of vinegar. When combined with the lowered pH from citric acid, growth of salmonella and spoilage bacteria is inhibited. Shelf life of raw chicken can be extended 5 to 10 days after treatment with the marinades applied as a glaze. In addition, glazes have been shown to retain moisture resulting in

a juicy cooked product.

There are a variety of applications, both commercial and residential, for marinade use on meat. When chicken is shipped to Russia, it leaves the United States frozen. Because of a lack of refrigeration in Russia, the meat thaws as it travels to its destination within the country. By coating the meat with an antimicrobial marinade before it is frozen, chicken can reach the consumer without the buildup of microbes even after the meat is thawed.

Extending the shelf life of raw meat in the supermarket is important to grocers, especially in the summer months. Coating the chicken with antimicrobial marinades and glazes can more than double the length of time the meat can be safely sold without risk of foodborne illness from pathogens.

Romeo Toledo is a professor in the department of food science and technology with teaching and research responsibilities in the area of food process engineering. His research concentrates on developing processes for food preservation aimed at maximizing food quality and safety.

Integrated Pest Management

by Raymond Noblet

Integrated Pest Management is one of the greatest environmental success stories. UGA entomologists have provided key leadership in the development and implementation of several statewide, nationally and internationally recognized Integrated Pest Management programs. IPM promotes the use of cultural, biological and mechanical means of controlling pests. It integrates a regular monitoring program with correct diagnosis of pest problems. Pesticides are recommended only when necessary to avoid serious damage to plants. IPM programs are dynamic in nature due to changing cropping systems, local and global environment, introduction of new pest species, advances in biotechnology, changing environmental policies and many other factors.

IPM research and extension programs address environmental and public health concerns. When a farmer, professional landscape manager or even homeowner applies pesticides, there is always a risk it may run off a landscape or farm to contaminate surface water. Because pesticides are toxic, precautions must be observed when handling them. Minimizing their use and using them wisely reduces damage to the environment and health.

Examples of leading interdisciplinary IPM research and extension programs include cotton IPM, IPM in transgenic crops and public health IPM.

The *Cotton IPM Program* has undergone dramatic changes since it began in the early 1970s. Back in those days, farmers relied totally on insecticides to eliminate the boll weevil. Today, farmers try to conserve the natural enemies of the boll weevil on their land for pest control. Georgia cotton producers have moved from an average of 16 pesticide applications per year in 1986, when the boll weevil eradication program began, to an average of 1.9 in 2001. These advances in Cotton IPM have led to a reduction of more than 50 percent in pesticide use and have been instrumental in Georgia growers remaining competitive in cotton production

Transgenic cotton was developed to resist key agricultural pests and introduced in 1996. It contains a gene that releases a Bt protein known for more than 40 years to control pests effectively. Transgenic cotton revolutionized insect pest management, especially in the southeast. Scientists in the department of entomology played important roles in several phases of transgenic plant development. They were involved in producing the concept and studying how the Bt toxin works to resist various pests. The mechanisms of resistance will provide the basis for new and improved Bt transgenic crops for agricultural producers.

IPM in the public health arena is often challenging. Insects that carry diseases to humans and animals frequently breed in aquatic habitats, a great concern when considering IPM tactics. Black flies, which transmit diseases such as African River Blindness, breed in flowing streams. They are a significant public health threat worldwide. *Bacillus thuringinesis,* var. israelensis (Bti) is a protein that works specifically to control mosquitoes and black flies. Bti proved to be the ideal

cornerstone for an IPM program funded and conducted by the World Health Organization to reduce cases of river blindness. UGA scientists developed laboratory and field bioassay systems that were adopted using Bti instead of chemical insecticides. This IPM program is regarded as a premier contribution to public health. The environmental impacts again are exceptionally significant with respect to improved water quality through reduced pesticide use.

Raymond Noblet is a professor and head of the department of entomology in the College of Agricultural and Environmental Sciences. His research interests include the development of bioassay systems for microbial agents for use in vector control programs.

Digital Diagnostics — A Tool for Biosecurity

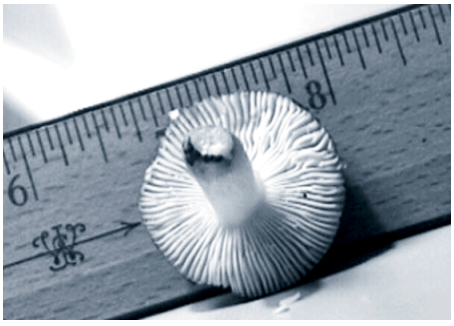
by Don Hamilton and Julian Beckwith

Agriculture and forestry generate more than $21.7 billion for the economy of Georgia. Because of a long growing season and hot humid weather, insects and diseases multiply and thrive in our forests, on our farms and golf courses and at green-industry sites. In addition, nearly every homeowner at one time or another faces the daunting task of trying to identify pests before they damage landscapes. Rapid diagnosis of pest problems is now possible by county agents of the Georgia Cooperative Extension Service using the Distance Diagnostics through Digital Imaging System.

Before 1998, Georgia's county Extension agents collected samples of ailing agricultural and urban plants and sent them through the mail to diagnosticians at the University of Georgia. Today, each Extension office is connected to the Internet and comes equipped with a digital camera. One hundred counties also have microscopes that can capture magnified views of diseases and other pests. These images are sent instantly via the World Wide Web to scientists who have expertise in the particular area. Average diagnosis time has been reduced from four days to two days, with emergencies handled in just minutes.

This system was conceived and developed by Edward A. Brown, plant pathologist, and Robert "Don" Hamilton, specialist in information technology. It was the first of its kind in the country and has important implications for human health, the environment and even biosecurity.

Several times, when children have eaten poisonous plants, their lives were saved with quick identification of the plants. In another instance, a child was bitten by a copperhead snake. It was identified in time to administer the antidote.



Farmers also benefit if pests are diagnosed early. Crops can be saved before an infestation occurs. In addition, with early diagnosis, less pesticide is required, posing less potential damage to the environment.

In instances where a terrorist attack may involve use of an invasive and damaging foreign species of pest, plant or disease, the system is in place to determine the agent quickly, allowing for quick response.

The success of UGA Distance Diagnostics has attracted the attention of Illinois, Texas, Louisiana, Alabama and Hawaii. These states have contracted for development of their own systems, hosted by UGA, for identifying, diagnosing and managing disease and other pest problems. International inquiries include New Zealand and Australia.

For more information, visit http//www.iiseyes.org or e-mail Julian Beckwith at jbeckwit@uga.edu.

Don Hamilton is co-principal investigator of the Internet Imaging System project that includes Distance Diagnostics through Digital Imaging. He is the director of the Office of Information Technology in the College of Agricultural and Environmental Sciences.

Julian Beckwith is the project manager of the Internet Imaging System. He has spent 33 years teaching and doing research in the Warnell School of Forest Resources and working as an Extension wood products specialist.

education

THE COLLEGE OF Agricultural and Environmental Sciences offers a number of undergraduate, graduate and certificate programs that focus entirely on environmental protection and resource management. Other graduate and undergraduate programs have components that pertain to environmental stewardship. In addition, the Office of International Public Service and Outreach sponsors programs, like the ones listed here, that provide students with opportunities to explore the environment and environmental issues from the perspective of other countries.

Bachelor of Science

Agriculture

Major	*Career Opportunities*
Agricultural Communication	Science or environmental reporter, magazine writer or editor, public relations for agribusiness or government.
Agriscience and Environmental Systems	Farm management, agribusiness, environmental programs using the latest techniques in precision agriculture, sustainable development, environmental engineering.
Entomology	Environmental specialist using Integrated Pest Management for work in government, Cooperative Extension Service, agricultural industries.
Horticulture	Research scientists, garden writers, horticulture therapists, Extension agents, teachers, public gardens, and landscape and nursery business.
Food Science	Food safety in the food industry, work as Extension agent or teacher.
Landscape and Grounds Management	Landscaping for a variety of clients to protect and enhance the enviroment using water conservation techniques, integrated pest management, and wetlands reclamation.
Plant Protection and Pest Management	Managing diseases for private business and work as extension agent or teach and conduct research.

Agricultural Engineering

Major	*Career Opportunities*
Agricultural Engineering	Natural resource management, including irrigation, drainage, waste management and soil conservation.

Biological Engineering

Major	*Career Opportunities*
Biological Engineering	Environmental engineering to include water and air quality, waste management and bioremediation. Bioprocessing involving the recovery of by-products.

Environmental Sciences

Major	*Career Opportunities*
Environmental Economics and Management	Managing pollution prevention and compliance for manufacturing firms and consulting firms specializing in environmental research; government agencies that formulate, analyze, implement and enforce environmental policies.
Environmental Soil Science	Field monitoring, consulting and managing for private firms and local, state and federal government. Areas of emphasis may be hazardous waste management, environmental toxicology and environmental ethics.

Bachelor of Science CONT.

Environmental Health

Major

Environmental Health Science

Career Opportunities

Develop, implement and evaluate environmental data as a scientist in government and industry. Address environmental causes of human diseases in public health.

Applied Biotechnology

Major

Applied Biotechnology

Career Opportunities

Develop environmentally friendly products and processes that will improve the cost effectiveness of agriculture, forestry, and medicine.

education

Master of Science

Agricultural Engineering
Biological Engineering
Entomology
Environmental Economics
Environmental Health Science
Environmental Soil Science
Food Science
Horticulture

Master of Plant Protection and Pest Management

Doctor of Philosophy

Biological and Agricultural Engineering
Entomology
Food Science
Horticulture
Plant Pathology

Certificate Programs

Atmospheric Sciences - http://www.uga.edu/atsc/
Environmental Ethics - http://www.uga/eecp/
Environmental Education - http://www.eeingeorgia.org/
Water Resources - http://www.uga.edu/water/

International Study

For years agricultural and environmental concerns have played an important role beyond the borders of the United States. Today, because of world trade agreements between foreign countries, the opening of new foreign markets and a growing world population, U.S. companies are rushing to compete in an ever growing global marketplace. The University of Georgia College of Agricultural and Environmental Sciences provides interested students with the opportunity to study environmental issues abroad. Several current educational experiences include:

- Kenya
  A Natural Resource, Environmental, and Educational Management Course
- Sustainable Agriculture in Morocco
- Tropical Ecology and Agriculture
- Sustainable Development, Agriculture and Ecology in Tropical South America
- The Brazil-U.S. Consortium in Agroecology

For more information, visit http://www.uga.edu/discover/

4-H Environmental Education

by Diane Davies

"In the traditional school setting and in the more urbanized lifestyle, children are unlearning their connection to the environment," said Diane Davies, director of Georgia's 4-H environmental education. "In years past, children grew up on the farm. They understood natural resources, where food came from, and they enjoyed hunting and fishing. Today, children lack that connection with the natural world."

Georgia is the nation's largest provider of residential environmental education for children. Last year, Georgia 4-H Environmental Education welcomed nearly 50,000 children to four 4-H centers located throughout the state. The camps conduct classes that bring children out of the walled classrooms and into nature's classroom to study biology, science, history and other subjects.

The location of the camp determines the nature of the environmental issues emphasized. At Rock Eagle, located in the Piedmont area, students learn about forest ecosystems including tree identification, the process of decay, measuring the age of trees, and lake and stream ecology. In Dahlonega, Camp Wahesega 4-H'ers study mountain life, conservation and rock climbing. At coastal centers located at Jekyll Island and Tybee, campers learn beach ecology, the food web found in salt marshes and the make-up of a maritime forest. Urban landscapes and urban environmental issues are the focus at Camp Truett-Fulton located in Atlanta.

The 4-H program began more than 100 years ago to teach young people about agriculture and preserving food. Geogia boasts having formed the first club in 1902. With the inauguration of the Cooperative Extension Service in 1914, the program became part of this organization, where it remains today.

"4-H has always been evolving," said Bo Ryles, Georgia's state 4-H program leader. "That's how we have remained vibrant to the lives of the children in the state."

Today, more of Georgia's 4-H'ers live in central cities than live on farms. "In Georgia 4-H, we will be focusing on urban agriculture issues and will continue to emphasize environmental education," stated Bo Ryles.

For more information, visit www.georgia4h.org or call 706-484-2875.

Diane Davies is director of the Georgia 4-H Environmental Education program. In 1991, Ms. Davies was selected as a Kellogg National Leadership Fellow to travel throughout the world to study conflict issues surrounding the use of national parks, game reserves and public lands.

Gardening in Georgia

by Wayne A. Gardner

"Gardening in Georgia," a Georgia Public Television show, gives viewers practical "how-to" information on plant selection and care for gardens, landscapes and homes. The show provides in-depth explanations of gardening problems and solutions. Host Walter Reeves presents a unique blend of real-life expertise and the latest unbiased, research-based information from the University of Georgia's College of Agricultural and Environmental Sciences. Strong emphasis is placed on best management practices to reduce use of water, pesticides and fertilizers to protect Georgia's natural resources.

"Gardening in Georgia" airs twice a week on Georgia Public Television. Each show is broadcast at noon Saturday and is re-broadcast at 7 p.m. Saturday. As many as 164,000 Georgians see the program each week, making it the most-watched locally produced show on GPTV.

For more information, visit http://www.griffin.peachnet.edu/ggarden/.

Wayne Gardner is faculty leader of the Georgia Station Research and Education Garden and executive producer of "Gardening in Georgia."

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