THE UNIVERSITY OF GEORGIA COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES

2006 Environmental Report

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DIRECTOR'S STATEMENT

The college's administration and faculty work diligently to target our research, educational and extension programs to find solutions and apply them to environmental needs at home in Georgia and at the national and global level. Scott Angle, our new dean, finds the college's commitment to environmental solutions a perfect fit with his research in phytoremediation — using plants to clean up contaminated sites — and with his efforts to reduce pollution in the Chesapeake Bay.

This year's environmental report highlights the hard work and achievements of a handful of our many scientists, engineers, Extension agents and students who continue to search for new solutions, share the latest research results with farmers and their local communities, and help citizens safeguard Georgia's environment.

Often described as the top aquatic entomologist in the world, Bruce Wallace's research is featured in this environmental report. He has worked for more than 30 years studying how tree loss along headwater streams affects stream food webs.

Robert N. Shulstad

Director of the
Office of Environmental Sciences
College of Agricultural
and Environmental Sciences

The recent amendments to the **Clean Water Act** mean that many Georgia communities are now calling upon county Extension agents to help them comply with Phase II regulations. Specially trained agents, like Habersham County's Steven Patrick, are providing technical and educational assistance to local governments. By helping build coalitions of community leaders, they are tackling problems of fecal contamination and excessive sediment in places like the Soque River. And a recent state wide survey of farmers shows a slow-down in water used for irrigation.

One way urban communities are tackling the problems of **stormwater management** is installing rain gardens to collect and filter rain water. Biological and agricultural engineers Rose Mary Seymour and Debbie Borden not only design rain gardens, they also teach workshops and implement plans in local communities.

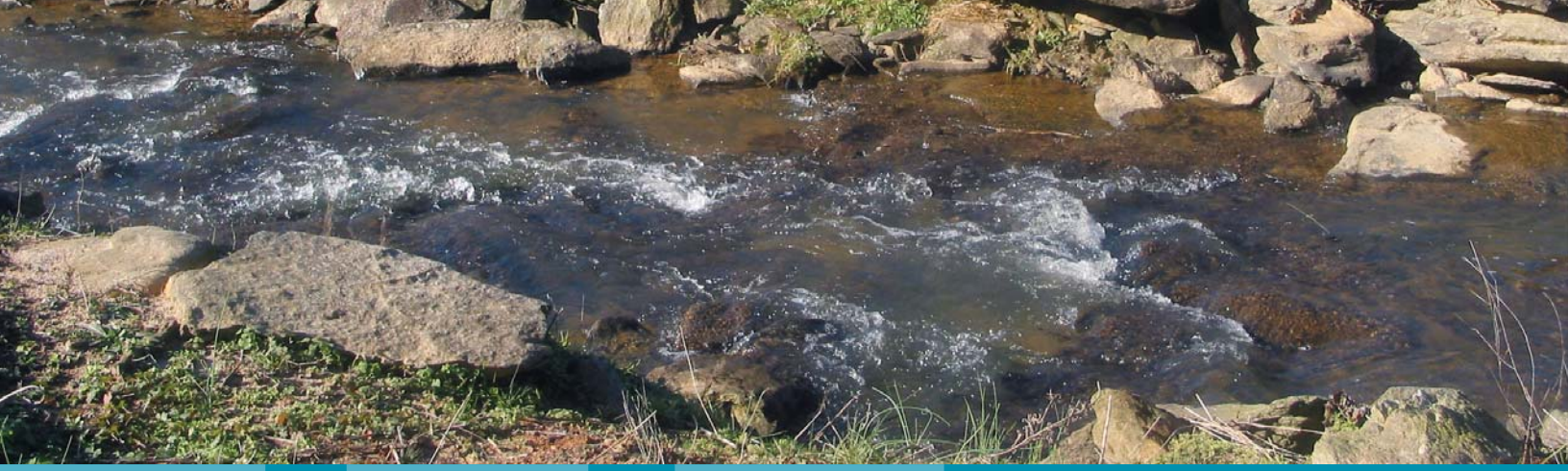
Poultry litter can be a good fertilizer or a pollutant, depending on how much you have and where you put it. An **Internet-based poultry litter exchange** connects farmers who need soil enrichment with poultry producers who have too much. A three-state climate Web site provides farmers with weather information so they can efficiently manage production. And biological and agricultural engineer Steve McCutcheon is studying better ways to use plants to soak up contaminants from water, soil and air.

Amid concerns about air pollution and high gasoline prices, now is a perfect time to convert the University of Georgia fleet to **biofuels.** Tom Adams, director of the UGA Faculty of Engineering Outreach Service, and Bill Fox, campus fleet director, work to provide ethanol for the cars and biodiesel for the buses, while Jim Kastner looks for better ways to eliminate odors from rendering plants.

In much of the **developing world,** peanuts, grains and other staple crops are contaminated by two molds that produce the toxic compound aflatoxin, which can damage the liver and cause cancer. Tim Williams, director of the Peanut Collaborative Research Support Program, is working aggressively to find a low-cost solution to rid the Third World of this fungus that also reduces a person's immunity to the HIV virus and malaria. Check out what animal scientist Susan Duckett learned when she analyzed beef cattle who were given grass rather than grain in the final months of feeding.

Because safe water and food supplies are essential, the college is working very hard to protect both from a terrorist attack or natural disaster.

The college continues to look to the future. For example, this past year UGA's Griffin campus began offering its first undergraduate program with a major in environmental science thanks to Assistant Dean Gerald Arkin who led UGA's effort to partner with Gordon College.



Water quality and water quantity problems remain important in Georgia. Stream ecologist Bruce Wallace has worked for 30 years studying how leaves impact a stream's ecosystem. Cooperative

water

Extension specialists and agents work throughout the state on issues such as total maximum daily loads, erosion and sediment control, stormwater pollution and agricultural water use. Here are several projects in which the College of Agricultural and Environmental Sciences is a major player.

Leaves, debris necessary for aquatic animals survival

BY SUSAN VARLAMOFF & SUSAN EGGERT

Maintaining forested buffers along the headwaters of streams is critical to protecting the diversity of downstream aquatic ecosystems. Not only do trees anchor the soil and prevent erosion of the banks, they also provide leaves, which are an important food source for aquatic organisms.

Bruce Wallace, along with Sue Eggert and Judy Meyer from the University of Georgia, and Jack Webster from Virginia Polytechnic Institute and State University, has spent years studying how removing leaves from headwater streams affects aquatic food webs. "Our many years of work show the importance of subsidies from one ecosystem to another, primarily, the terrestrial-aquatic linkages," said Wallace, who is a UGA stream ecologist and entomologist.

Natural disturbances such as fire, severe storms and human activity like logging, development and grazing can reduce or eliminate trees along a stream. How these activities alter the food chain of southern Appalachian streams has been the focus of Wallace's research since the 1970s.

In the study area in Coweeta Hydrologic Laboratory (U.S. Forest Service) in western North Carolina, headwater streams are fishless, and salamanders are the main predator. Leaves, woody debris and algae serve as the primary food sources for the aquatic food chain. Leaves are in greatest abundance in the small headwater streams.

The breakdown of leaves into nutritious food for aquatic organisms is a complex process. After a leaf falls in a stream, it is colonized by fungi and bacteria. Fungi and bacteria make the leaf more palatable for shredder insects that tear and shred the leaf before eating it. Shredders include insects such as caddisfly and crane fly larvae, and stonefly nymphs.

According to Wallace, "Eighty to 90 percent of what they eat comes out the other end."

The fecal pellets become fine organic matter suspended in the water and transported downstream. Shredders comprise 39 percent of the invertebrate biomass in a stream buffered by a forest.

The pellets are further colonized by bacteria and become food for animals known as collector feeders. Collectors that trap fine organic matter moving downstream are filter feeders and include mayfly nymphs, caddisfly and black fly larvae. Filter feeders come equipped with hairy legs or filtering fans to capture the fine organic matter. Other collectors gather the material where it falls in rock crevices or on the stream bottom. Twenty percent of stream organisms by weight are collectors.

With a full canopy of trees over a stream, little sunlight penetrates the shade and algal growth is limited. A group of organisms called grazers, which include snails, have mouthparts to scrape the algal film off rock surfaces. They account for less than one percent of the invertebrate biomass in heavily shaded streams.

Stonefly nymphs feed on a leaf, left. Crane fly larva feeds on a leaf, right.

Predators are the final functional feeding group. They feed on other animals, which include grazers, collectors and shredders, and are 41 percent of the total stream organisms by weight. Dragonflies and some damselflies are common examples of invertebrate predators in the streams.

Wallace and his colleagues focused their study on two headwater streams at the Coweeta Hydrologic Laboratory in the southern Appalachians. On one, the forested buffer was left undisturbed. On the other, a 170-meter long net canopy prevented leaves from entering the stream. Over a period of nine years, Wallace measured changes in invertebrate numbers, biomass and production in the two streams.

In the stream where leaves were removed by the net canopy, the average abundance of invertebrates in four feeding groups decreased by 47 - 51 percent during a four-year period. The decrease in production in the litter exclusion stream was more pronounced for predators than gatherers, gatherers than shredders, and shredders than filterers. However, scrapers increased an average yearly amount of 13 percent. There was also evidence that during the winter, predators in the stream where leaves were excluded consumed other predators due to a lack of prey. UGA graduate student Sue Eggert saw an increase in the number of organisms that used woody debris as a food source. Another graduate student, Brent Johnson, found fewer salamanders in the litter exclusion stream, and the few that were there grew more slowly.

Disturbances to the linkage between the riparian buffer and the stream affect more than just the immediate stream community. Aquatic ecosystems downstream are impacted when leaves aren't allowed to enter the stream because the reduction in fine organic matter moving downstream means less food for those organisms.

Link between land use and stream health

There is a complex and close interaction between small streams and the land. Shallow, narrow headwater streams trap leaves which are then eaten and transported downstream to feed other organisms. Human activities that alter storm flow frequency and intensity — such as impervious surfaces in a watershed — can wash out the beneficial leaves and woody debris in streams. This ultimately has a dramatic effect on the productivity of aquatic organisms in streams.

Land-use planning must consider riparian buffer zones along streams, particularly in the headwaters. Maintaining the diversity of trees in a natural buffer is important, because leaves with differing decay rates allow the aquatic ecosystem to be constantly nourished. For example, willow leaves decompose quickly and provide a short-term, nutritious source of food for stream invertebrates while slow decomposing oak leaves are a long-lasting food source. Most invertebrates need a variety of leaf types in the stream to complete their life cycles. Thus, the higher the riparian tree diversity, the better it is for aquatic life in streams.

Human actions have caused a worldwide loss and degradation of riparian zones, thereby altering the supply of leaves to headwater streams. The long-term studies conducted by stream scientists at Coweeta have provided evidence that maintaining or reestablishing these riparian buffers is an essential element of the conservation or restoration of diverse stream food webs.

"This basic understanding of how ecosystems function is critical to agricultural and environmental scientists as sustainable and affordable agricultural production systems are developed. Further, this understanding is essential to us as we develop and implement strategies to improve water quality and maintain and improve the overall quality of our environment," said Raymond Noblett, head of the UGA department of entomology.

Coweeta Long-Term Ecological Research (LTER) Web site: http://coweeta.ecology.uga.edu/webdocs/1/index.htm

Susan Varlamoff is program coordinator for the Office of Environmental Sciences. Susan Eggert is a post-doctoral associate with the Department of Entomology.

Community partners plant trees along a riparian buffer as part of a stream restoration project in the Soque River watershed. UGA Cooperative Extension Agent Steven Patrick is fourth from the left.

It takes a watershed of folks

BY SUSAN VARLAMOFF

Habersham County, located in north Georgia, has become a haven for retirees and weekend warriors due to its rural scenery complete with wineries hugging the hillsides. Unfortunately, this isn't a well-kept secret. The county population is growing at seven percent a year, creating water quality problems in 30 miles of streams in the Soque River watershed.

According to the Georgia Environmental Protection Division (EPD), fecal coliform bacteria and sediment are contaminating the watershed. Leaking septic tanks, wildlife and poultry operations are the potential sources of fecal coliform bacteria. In addition, Hazel Creek, a tributary of the Soque River and the source for the area's drinking water, is filling with sediment eroding off the land from road construction, development and industry.

As water quality concerns escalated within Habersham County, various organizations looked for answers to their individual problems. After attempting to solve the problems alone, each group realized that no one entity held the solution to water pollution. As a result, the Soque River Watershed Association, area municipalities, the University of Georgia Cooperative Extension, Piedmont College and North Georgia Technical College formed a partnership. Cooperative Extension Agent Steven Patrick played a vital role in assembling the partnership because he knows the relevant organizations and their leaders.

"The focus of this partnership was to provide a platform by which all citizens' concerns are addressed, so that Soque as a watershed can come to a consensus on resolving our water quality issues," Patrick said.

The Soque River watershed presents a unique opportunity for the people of Habersham County because the watershed is contained entirely within the county. "Almost every citizen in the county drinks Soque water either through wells or

Little Hazel Creek contaminated with sediment.

a municipal system," Patrick stated. "It is vitally important to maintain the water quality in the Soque River since the watershed supplies approximately one-sixth of the water for 4.5 million Atlantans downstream."

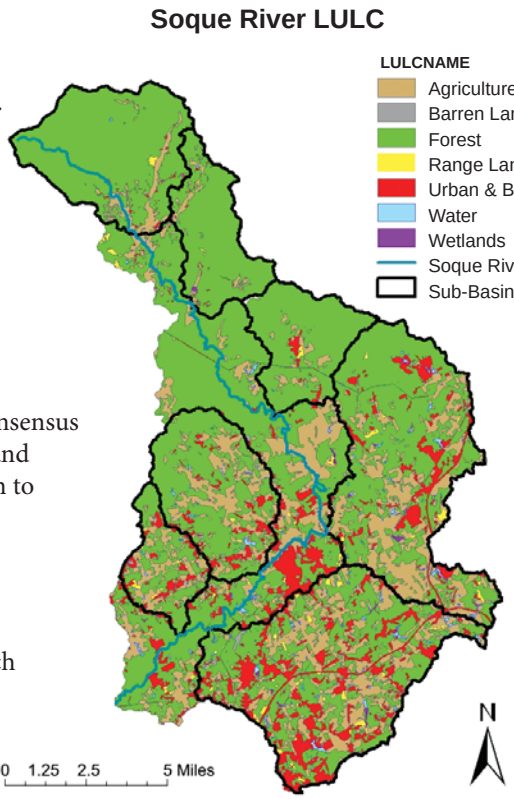
The land use for the watershed is as follows:

- 17 percent national forest,
- 48 percent private forest owners,
- 22 percent agriculture, and
- 12 percent urbanized and developed.

Once the partnership agreed to resolve the water pollution problems, they applied for and received a U.S. Environmental Protection Agency nonpoint source 319 (h) grant for four years to accomplish the following:

- Identify the sources of pollution,
- Form a partnership that builds a consensus around water protection practices, and
- Develop a watershed protection plan to guide future decisions.

Duncan Hughes, a stream ecologist, was hired as the watershed coordinator to manage the grant and collect data. He maintains an office at North Georgia Tech that houses the laboratories where water samples are analyzed.



"Today, citizens are learning through research-based education that everyone has a role in keeping our water clean."

— Steven Patrick

Bank erosion is the most common concern reported by riparian landowners (Hazel Creek).

"It's not about finger pointing," Hughes stressed. "It's about letting science identify the problem and coming up with solutions that are equitable to everyone."

A steering committee and technical advisory committee of stakeholders were established to guide the activities to satisfy the grant requirements.

Currently, water, sediment, insect and fish sampling is taking place to determine areas and sources of pollution. Once this is established, Patrick will assist agricultural producers and homeowners to implement best management practices to reduce nonpoint source pollution that runs off their lands into nearby streams. The U.S. Forest Service and the Georgia Forestry Commission will provide BMPs for forestry and silviculture (cultivation of forest trees), and the Georgia Soil and Water Conservation Commission will conduct educational programs for BMPs in erosion and sediment control. The Natural Resources Conservation Service will develop land use maps, find funding for stream restoration, and assist farmers with BMPs. The Georgia Mountain Regional Development Center will share stream data with the group and the Georgia Department of Resources Wildlife Resources Division will take fish samples. The cities of Clarkesville, Cornelia, Demorest, Baldwin and Mt. Airy agreed to host workshops, and the Upper Chattahoochee Riverkeeper will provide educational programs.

"The Soque Watershed Partnership rose from a lot of adversity initially," said Patrick. "The partnership was born out of necessity to help maintain water quality and the rural character in Habersham. Today, citizens are learning through research-based education that everyone has a role in keeping our water clean."

"This is a model we can duplicate throughout Georgia," said Mel Garber, associate dean for Extension. "The Extension agents can play a major role in managing our water resources through a watershed approach because they know the relevant leaders in their community and are technically trained in this area."

For more information, contact Steven Patrick at stevep@uga.edu or 706-754-2318.

Susan Varlamoff is a program coordinator for the Office of Environmental Sciences.

Gardens, harvesters make best use of rainfall

BY SHARON OMAHEN

When summer arrives, gardeners will wish they could have saved some of the rain that ran down their driveways this spring. A University of Georgia scientist is studying ways to do just that.

"The greatest demand for outdoor water use in Georgia occurs during our state's hottest, driest months," said Rose Mary Seymour, a UGA agricultural engineer.

"Outdoor use is a major component of the total water demand for urban areas of our state. But in times of drought and water restrictions, landscape irrigation will most likely be a low priority for potable water supplies."

Seymour, a researcher in the College of Agricultural and Environmental Sciences, found that using rainwater can reduce the amount of drinkable water used for irrigation.

"Captured rainwater is of suitable quality to be used for irrigation if the rain falls on relatively clean, impermeable areas," she said. "Collecting rainwater in a retention area also helps remove nutrients and other pollutants and recharges the groundwater."

Seymour's studies highlight two rainwater collection methods. One, often called rain harvesting, collects rainwater in a cistern, tank or pond. The other involves installing a rain garden or bioretention area in your landscape.

Rain-harvesting systems

Rain-harvesting systems most often collect rainwater in a storage tank either above or below the ground. A pumping system can supply an automated irrigation system, but the water must be filtered. Or the rainwater can be siphoned from the tank and applied by hand. Unlike gray water, or wastewater from clothes washers, showers, etc., collecting and applying rainwater doesn't require special plumbing codes, Seymour said. It doesn't contain the detergents and chemicals found in gray water.

The catch is that rain harvesting systems are best when they're designed and installed in a new building, Seymour said. "Usually, retrofit rain harvesting systems are more expensive and may not fit well with the existing overall site design," she said. Rain-harvesting systems add some costs over using municipal water alone for irrigation. But Seymour said landscape designers need to be forward-thinking.

"If municipal water costs continue to rise and water utilities set up conservation fee structures, the payback period for rainwater harvesting could be shortened," she said.

Rain gardens and bioretention areas

"Rain gardens and biofiltration areas are both intentional low areas where runoff water from impervious surfaces is diverted and contained so the runoff will infiltrate the soil," Seymour said. Rain gardens are most often used in home or other small-scale landscapes. Using plants that fare well in wet and dry extremes, these gardens create a more natural flow. They keep rainwater in the landscape rather than letting it run into streets and storm drains.

"A rain garden catches the runoff water from a particular impervious area such as a rooftop, patio, driveway or parking area," Seymour said. Ideally, water shouldn't stand in a rain garden more than 48 hours after the rain stops. Since it isn't standing water, mosquito breeding isn't a problem.

Bioretention areas serve a similar function, but tend to be part of large, commercial landscapes. They collect rainwater from large roofs and parking lots.

For more information about rain gardens, visit http://www.cleanwatercampaign.com/what_can_i_do/raingarden.html

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

Farmland irrigation growth slowing, survey says

BY BRAD HAIRE

The number of irrigated cropland acres in Georgia is growing, but at a much slower pace than three decades ago, according to a University of Georgia farm survey. About 1.49 million irrigated acres of cropland are in Georgia, according to the UGA Cooperative Extension 2004 Irrigation Survey. This is about 33,000 acres more than in 2000, the last year the survey was conducted.

Corn, cotton and peanuts account for 76 percent of the total irrigated acres. Turf acres under irrigation have more than doubled over the past decade to about 38,500 acres. Accounting for 49 percent, electric-powered irrigation systems outnumber diesel-powered systems for the first time. This can be attributed to higher fuel costs, said Kerry Harrison, a UGA Cooperative Extension irrigation expert. Smaller systems, too, are being put into smaller fields. These systems are more easily powered by electric motors.

Georgia had only 145,000 irrigated acres in 1970, the first year of the survey. The largest increase since then was between 1977 and 1980. Land under irrigation grew from 592,000 acres to nearly 1 million during this time.

Between 1995 and 1998, irrigated acres grew by about 73,500. Over the next six years (1998 and 2004), it grew less at 63,000 irrigated acres. Most suitable large fields now have irrigation, Harrison said.

Georgia has 3.5 million to 4 million acres of cropland, according to the Georgia Agricultural Statistics Service. Not all of this land is good for irrigation. In 1998, Georgia's Environmental Protection Division placed a moratorium in coastal Georgia on the well permits farmers need to put in a new irrigation system. EPD placed a moratorium on permits in the Flint River Basin in southwest Georgia in 1999. This has slowed the increase in irrigated acres.

Farmers will probably keep putting in new irrigation, Harrison said, but not at the rate seen in the 1970s and '80s.

Improved technology over the past few decades has allowed farmers to produce more per acre, Harrison said.

"The last potentially limiting factor a farmer has each year as far as production is concerned is water," he said. "Irrigation for now is one of the cheapest ways to ensure crops get enough water."

COMPILATION OF GEORGIA IRRIGATION SURVEY

YEARS	1970	1980	1995	2000	2004
ACRES OF IRRIGATION SYSTEMS (THOUSANDS OF ACRES)	144,629	988,356	1,356,726	1,460,235	1,493,079
NUMBER OF IRRIGATION SYSTEMS	6,572	10,599	14,584	17,428	17,017

How much water farmers put on crops varies across the state and even within a county, Harrison said. It depends on how much a farmer wants to spend compared to the potential benefit.

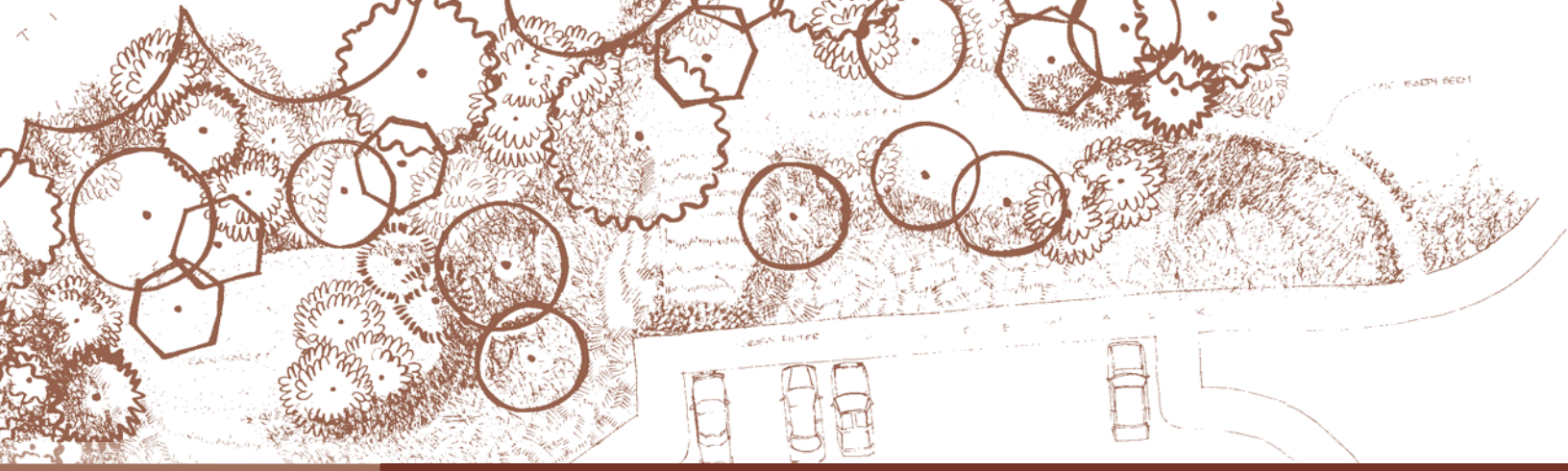
"Irrigation is just another tool farmers use to stabilize their production," he said. "And how a farmer uses that tool depends on the farmer's economic situation and management practices."

The UGA Cooperative Extension irrigation survey is based on information from Extension agents in agricultural counties.

EPD estimates 2.1 million acres, based on the number of acres farmers write on applications when applying for well permits. GASS figures Georgia has 750,000 irrigated acres, based on farmer surveys.

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

Brad Haire is a news editor with the University of Georgia College of Agricultural and Environmental Sciences.



Maintaining the health of the land is always a challenge for farmers. In Guyana, our scientists are advising the local farmers

land

on how to grow peanuts without depleting the soil. In Georgia, a poultry litter exchange has been established to move excess nutrients in the form of chicken litter to farmers who need fertilizer. And certain plants hold promise as a means to clean up toxic sites.

Poultry litter exchange

BY DAN RAHN

The Georgia Poultry Federation has joined the University of Georgia to launch a new Web site designed to help move poultry litter to where it's needed in the state. The Georgia Poultry Federation Litter Market (www.galitter.org) will allow poultry growers with litter for sale to post ads that potential buyers can view. Farmers and others who want to buy litter for its nutrients may post want ads. So can anyone who provides services such as poultry house clean-out or litter hauling or spreading. The service is free.

Poultry growers, brokers and buyers can post ads telling the services they need or the amount and location of litter they have or want. Visitors can browse the ads or conduct searches based on location or other factors.

"We hope www.galitter.org will be a valuable service to poultry growers throughout the state," said Georgia Poultry Federation President Abit Massey. "In many parts of the state, poultry litter is in strong demand for use as a fertilizer for crops and pastures. This Web site should help create a stronger market for the litter and assist poultry growers in linking up with potential buyers."

The Web site could help solve the problem of having too much poultry litter in some places and not enough in others, said UGA Cooperative Extension Engineer Mark Risse.

"We have a few counties in north Georgia where if we land-applied all of the litter there at agronomic rates on every acre of available cropland and pasture, we'd still have too much litter," he said. "We'd still have too much nitrogen and phosphorus. This can cause significant water quality problems if these nutrients run off the land into nearby streams and rivers."

But south Georgia, he said, has many areas where farmers can't get enough litter. "We hope this Web site will facilitate more exchange between north and south Georgia."

Risse said the site could lead to new outlets for litter, too, such as producing compost for organic farmers and gardeners or developing power plants that could produce energy from poultry litter.

"Many applications such as these depend on consistent, dependable supplies of poultry litter," he said. "Hopefully, this Web site could help them find these suppliers."

Georgia is the largest poultry-producing state in the United States according to the U.S. Department of Agriculture. The UGA Center for Agribusiness and Economic Development reports that poultry and eggs generate $4.75 billion dollars

In Georgia, chickens produce about 1.5 million tons of litter per year.

in farm cash receipts. All those chickens produce about 1.5 million tons of litter per year. The nutrients in that litter make it valuable as a fairly low-cost fertilizer. Too much of it in a given place, though, can pollute the environment. That's where the new Web site comes in.

"A few other states have successful litter-broker sites," Risse said. "We're hoping it will be a good solution to having too much of a resource in one place and not enough in another."

As of June 1, 2005, 45 ads had been placed and divided evenly between "Litter Wanted" and "Litter for Sale." Farmers in Gilmar and Pickens counties are offering to sell chicken litter to farmers in Appling, Chatham and Twiggs counties.

Georgia Poultry Federation Litter Market Web site: www.galitter.org.

Dan Rahn is a news editor with the University of Georgia College of Agricultural and Environmental

Plants cleanup toxic sites

BY SUSAN VARLAMOFF

Plants can't walk away from toxins in their environment, so many survive by transforming nearby contaminants into harmless compounds. After several decades of studying detoxification and storage of organic compounds in plant tissue, scientists realized plants could offer a cost effective way to clean up contaminated military, mining and industrial sites. Cottonwood trees now suck up mercury at a former hat factory in Danbury, Conn., and Indian mustard plants soak up selenium deposited by irrigation on California's agricultural lands.

> "Plants have a marvelous capacity to self-engineer their environment."
>
> — Steve McCutcheon

"We've killed a lot of plants but we've also put plants in fairly nasty conditions and had them survive," said Steve McCutcheon of UGA's biological and agricultural engineering department. "Plants have a marvelous capacity to self-engineer their environment."

McCutcheon has worked for almost 15 years in the field of phytoremediation, which involves the use of plants to remove and control wastes or to encourage breakdown by microorganisms in the soil surrounding the roots. He said that in the 1970s, scientists noticed many pesticides that

Steve McCutcheon and research team

Parrot feather growing in the wetlands of Shaking Rock Park, Lexington, Ga., can break down explosives like trinitrotoluene (TNT) and some chlorinated solvents.

Photos by the University of Arizona

Mature pickleweed plant and habitat, above.

Pickelweed found in the Sonoran Desert, Mexico and has been tested to breakdown perchlorate, left.

typically linger in soils were reduced to simpler and nontoxic compounds. On examining the soil, they detected plant enzymes that led them to look at the role plants might be playing in degrading the pesticides.

The term "phytoremediation" was first coined in a 1991 proposal funded by the U.S. Environmental Protection Agency Superfund program.

"Phytoremediation combines engineering and science," said McCutcheon. "It is also important for Extension specialists and agents to see that plants have value for other things besides food."

The toxic wastes that can be managed using phytoremediation are diverse and include heavy metals such as cadmium, zinc and lead; sewage; landfill leachates, and organic chemicals such as pesticides, solvents, explosives (TNT) and air pollutants.

Several mechanisms are involved in removing contaminants from soil, water and air. First, the plant absorbs the contaminants from the various media and transforms them in the roots or relocates them to the plant shoots. Once in the aboveground stem, branches or leaves, the compound may be transformed, transpired (expelled through the leaves) from the plant or accumulated in the plant biomass for harvest. Some plants extract metals such as lead, chromium, cesium and uranium that cannot be broken down and store them in great quantities within their tissues.

Stephan Trapp, Technical University of Denmark, Lyngby

A black elder tree grows in Prussian Blue — a cyanide-iron complex at a former town gas site in Holte, Denmark, an example of where trees detoxify wastes that exceed the lethal dose for humans.

German scientists used the term "green liver" for plants that have the ability similar to the mammalian liver to remove contaminants from their environment. These include a wide variety of aquatic plants, grasses, shrubs and trees that can perform this function and include the following examples:

- Hybrid populars and willow treat chlorinated solvents, pesticides, cyanide and other organic contaminants, nutrients and metals.
- Indian mustard and sunflower extract metals and selenium from mining and industrial sites.
- Duckweed and other aquatic plants filter ponds for wastewater treatment.
- Fescue, rye grass and Bermuda grass stimulate bacteria in the root zone to degrade petroleum in the soil.

McCutcheon stated that phytoremediation is an ideal way to clean up moderate to low levels of contaminants over extensive areas. The process is solar driven, eco-restorative, aesthetically pleasing, and available at a lower cost than the traditional waste management approach of incinerating or landfilling contaminated sites. However, this restoration strategy is limited to the depth of the root system, the time required to grow plants and for them to take up and transform contaminants.

"We humans have overwhelmed the bio-geochemical cycles of the earth with our waste products. Phytorediation is a sustainable way to put the natural systems back in balance," said McCutcheon.

For more information, contact Steve McCutcheon at Steve@uga.edu.

Susan Varlamoff is a program coordinator for the Office of Environmental Sciences.

UGA scientists help Amerindians grow peanuts

BY BRAD HAIRE

University of Georgia farm experts are helping the Amerindians of Guyana grow peanuts better. They're trying to preserve the region's environment and provide a staple, moneymaking crop for the impoverished South American natives.

"The Amerindians are economically disadvantaged in an already poor country," said Bob Kemerait, a plant pathologist with the College of Agricultural and Environmental Sciences. "Peanuts provide a staple food source for their villages and can give them a much-needed source of cash income."

Kemerait and other CAES scientists are teaching the Amerindians how to use fertilizers and other farm management tools to grow peanuts in an environmentally friendly way. They're also showing them how to store the peanuts and avoid the development of aflatoxin, a group of potentially deadly toxins produced by fungi.

A $350,000 U.S. Agency for International Development grant funds the project, which started three years ago and will continue for at least two more. It's coordinated through the UGA Peanut Collaborative Research Support Program in cooperation with the Beacon Foundation in Guyana.

Kemerait and UGA Cooperative Extension soil scientist Glen Harris, engineer Jay Williams and entomologist Steve Brown have all made several trips to Guyana, as have plant pathology researcher Dave Wilson and department head John Sherwood.

Guyana is in northern South America, and about 1.4 times the size of Georgia. About 770,000 people live there, and Amerindians make up seven percent of the population.

The Amerindians live in the Rupununi region in southern Guyana, known for its vast savannah. To grow peanuts, they cut and burn the surrounding forest. The ashes from the burn fertilize the ground. And now the scientists are showing them a better way to farm.

Many farm chemicals and fertilizers aren't easily available to the Amerindians' remote villages. "But some of them are starting to seek out these common farm tools because they understand the benefit of using them," Kemerait said.

Amerindians, he said, have grown peanuts for more than 50 years. They transport their peanuts north to sell in Georgetown, Guyana's capital, which is on the Atlantic Ocean. Roads are scarce and in poor condition. Transportation is slow. Perishable crops like vegetables spoil before they can reach the Georgetown markets.

The Amerindians have learned to be businessmen, too, and to think about supply and demand. They are now selling peanut butter made with their peanuts to a school lunch program.

The scientists are conducting field tests in the region. What they learn can help the Amerindians farm better, Kemerait said. But it can also help farmers back home.

Disease-resistant peanut varieties that may help Georgia farmers can be found in Guyana and other South American countries, he said. Scientists refer to the variety that the Amerindians grow as the Guyana Jumbo. It has strong resistance to diseases like peanut leaf spot and rust that cause problems for Georgia growers.

Kemerait and other CAES scientists are teaching the Amerindians how to use fertilizers and other farm management tools to grow peanuts in an environmentally friendly way.

The Amerindians will never produce enough peanuts to compete with American farmers, Kemerait said. In fact, Guyana imports U.S.-grown peanuts. "Our work will hopefully allow them to improve their lot in life."

The Amerindians of Guyana have a lot of land and water at their disposal to grow a crop like peanuts, he said. The

Makushi and Wapishana tribes the UGA team have worked with live in simple mud homes with no running water or electricity, he said. They're a shy, quiet people. Men, women and children work in the fields. A large farm would be five acres.

To plant a field, the Amerindians drag a hoe or a board that has many hoes fixed to it across the ground to make rows. They plant seeds and cover them with dirt by hand. They dig peanuts from the ground with a pitchfork and dry them in the field. Then they pick and shell them by hand and store them in sacks.

Brad Haire is a news editor with the University of Georgia College of Agricultural and Environmental Sciences.

New pecan cultivars resist disease

BY SHARON OMAHEN

With production expected to reach 90 million pounds this year, Georgia pecan growers have a lot to smile about. They still frown, however, at the mention of pecan scab. Each year the state's growers spend $200 to $300 per acre on fungal sprays to fight pecan scab. The disease develops and spreads in wet weather, particularly when the nuts are growing.

Nuts infected with pecan scab develop black spots on the shuck. Many will be so covered with scales that the entire nut turns black and falls before it's fully developed.

Existing cultivars losing resistance

For decades, commercial growers have relied on just two varieties, Stuart and Desirable, for most of their pecan crop. "Stuart was selected in the 1880s, and Desirable came along in the 1930s," said Patrick Conner, a pecan breeder with the College of Agricultural and Environmental Sciences. Both had good resistance to pecan scab when they were first selected. Decades later, though, both are now very susceptible to the disease.

"Over time, the scab fungus adapted and overcame their resistance," he said. "Lately, scab has been very difficult to control on these varieties, even with fungicide sprays."

Working closely with the state's growers, Conner became the pecan breeder in 1998 after the state's pecan commission rallied for the position. From his Tifton, Ga., laboratory, he works closely with growers to develop new varieties.

When growers find what appears to be disease-resistant pecan seedlings in their orchards, they bring them to Conner. "When we find one that has good qualities, we put it through research trials alongside our crosses and see if it has potential to be a new variety," he said.

Conner recently got a $6,000 grant from the Georgia Pecan Commodity Commission. The grant will help fund his search for new disease-resistant pecan varieties.

"When it comes to commercial nuts, size is a major factor, because people like larger pecans," Conner said. "The percent kernel, or the way the kernel fills out the nut, is also essential."

Pecan breeding takes time

Each spring since 1999, Conner has made new pecan crosses. His first crosses, or potential new varieties, have just begun to flower. Next year they will produce their first crop of nuts.

Conner says the breeding program works in two phases. First, he evaluates seedlings for disease resistance and overall nut quality. This first phase takes five to 10 years.

The selections that pass this phase are then reproduced and inspected for other qualities like tree productivity and regular bearing. This phase of the breeding program takes about 15 years.

"Once we get the program running, we'll be releasing new varieties every few years," he said. "We hope to have our first new resistant variety from our crosses in 15 to 20 years." In the interim, Conner is evaluating selections from Georgia growers, Auburn University researchers and the U.S. Department of Agriculture breeding program in Texas.

"There's a USDA selection we're testing that looks good," he said. "We're sending it out to selected Georgia growers this spring to try. It's so new it's referred to by a number, 70-6-15. It appears to have very good quality and disease resistance."

Growers have to look way down the row to see the help on the horizon. "In the future, hopefully, growers will be able to plant new, improved varieties when they replace trees," Conner said, "rather than continuing to plant the same variety over and over."

For the meantime, Georgia growers keep waiting, and Conner keeps focusing on daily accomplishments. "It's definitely a long process," he said of breeding pecan varieties. "But once you get a variety, the benefits will be long-term."

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

Farmers can benefit as rural Georgia goes wireless

STORY AND PHOTOS BY BRAD HAIRE

Using a wireless Internet connection inside a south Georgia conference room, farmer Wade Mitchell checked the environmental conditions of his grain bins in Iowa. That's just one way wireless technology has made his farm more efficient.

"It's hard to inspect and keep track of all the things you need," Mitchell said at the "UnWired '05: Rural Wireless Conference" in Tifton, Ga., Nov. 2.

Mitchell's 2,500-acre, fifth-generation corn and soybean farm is covered by a wireless network with high-speed Internet access. He and his son Clay use it to auto-steer tractors, monitor fields and instantly get weather reports and spray recommendations.

The Mitchells' network has helped them cut chemical usage by 20 percent and make crop sprays 30 percent more efficient.

Wireless technology, Mitchell said, "has turned our tractor cabs into mobile offices. It has saved us hugely in labor and time and allowed us to be more accurate in our operation."

Craig Kvien, chair of the National Environmentally Sound Production Agriculture Laboratory in Tifton, said there is "little doubt that wireless technology will have a profound impact on agriculture."

Most farmers now can handle sophisticated equipment but freeze up when it comes to computers, said Paul Mask, assistant director of the Alabama Cooperative Extension System. "But the tools we'll need in the future," he said, "are the tools we're talking about here today."

John Helm of Vivato, a company that makes high-powered wireless equipment, said wireless connectivity will enable rural areas to compete globally. His firm has helped cities and small towns wirelessly connect emergency services and law enforcement employees.

Hard wire, or fiber, is still the best for reliable service, said Donovan Adkisson with CityNet in Tifton. But it isn't economical in some rural areas, costing $25,000 per mile. His company plans to run fiber as much as they can and then use wireless technology to connect rural residents by early 2006.

Stuart Pocknee, a program coordinator with the UGA National Environmentally Sound Production Agriculture Laboratory in Tifton, Ga., uses a laptop computer to control an experimental autonomous tractor and monitor an irrigation system via the Internet.

Having the potential for wireless access, however, doesn't mean you can get it. Wireless signals can shoot over valleys or get stopped by hills or tall pine trees, said John Mascoe, chief executive officer of VanCoe Environmental. VanCoe is creating a 100-square-mile wireless network in Calhoun County in rural southwest Georgia.

Rural areas, Mascoe said, "need an infrastructure of multi-use 300-foot towers to hold wireless equipment. Height is your friend. That would cure any coverage problems."

The conference was sponsored by the University of Georgia, the Georgia Center of Innovation for Agriculture and the Tifton/Tift County Chamber of Commerce.

Brad Haire is a news editor with the University of Georgia College of Agricultural and Environmental Sciences.

Air

Global warming concerns have exacerbated this year while gasoline prices have skyrocketed. The timing is perfect to consider biofuels for UGA's fleet after more than 20 years of research. Biological and agricultural engineers are looking for better solutions to reduce odors omitted from rendering plants. And a new climate Web site can predict a farmer's yields.

Plans to run UGA's fleet on biofuels

BY SUSAN VARLAMOFF

"When Henry Ford invented the automobile, he had ethanol in mind as the fuel," said Tom Adams, director of UGA's faculty of engineering outreach service. "And when Diesel invented the engine which bears his name, he ran it on peanut oil when it was first exhibited."

With the price of gasoline sky-high and rising, and the effects of global warming becoming more apparent every day, UGA is looking into homegrown fuel — the original vision of Ford and Diesel. A campus biorefinery will produce ethanol from by-product flour for its fleet cars and biodiesel from peanut oil for its trucks and buses.

Whether it is wood chips, by-product flour, peanut oil or even chicken fat or litter, Georgia is the Saudi Arabia of biomass. The state has 23 million acres or 70 percent of the total land use in forestry and agriculture. It is also the poultry capital of the United States and has 1.5 million tons of used chicken litter that can pose water quality problems if improperly applied. Biomass waste is often landfilled when it could be refined into renewable fuel for Georgia's vehicles.

"In the same way that petroleum refineries transformed the 20th century, biofuels will transform the 21st century," said Helena Chum, a scientist with the National Renewable Energy Laboratory, at a recent Georgia Biofuels Symposium. "Georgia has the potential to be a leader in this field as we move from a petroeconomy to a bioeconomy."

Biofuels have low emissions and are renewable alternatives to foreign oil. Ethanol produced at the UGA biorefinery will cost considerably less a gallon than gasoline at $1.75 .

"This is a wonderful opportunity for agriculture," said Adams, who has worked for 20 years doing research in the area of biofuels. "Today, the economics are there. That's what makes it sustainable."

A grant from the federal government provided $1.5 million for the project. The state of Georgia added $400,000. An ethanol plant was donated by U.S. Biofuels, Inc. in Rome, Ga. Traditional industries provided funds to research how forest and food by-products may be used for biofuels.

"University of Georgia is part of the Georgia Environmental Partnership (GEP), which takes us all over the state providing on-site technology transfer. These activities keep our finger on the pulse of technology and market needs for business and industry and give us the knowledge we need to accomplish economic development," Adams said.

Ethanol made from corn is available at public gas stations in many midwestern states such as Iowa and Nebraska. In Brazil, sugar cane is the source for ethanol and will make the country energy independent in 2006. At UGA, a mixture of 90 percent gasoline and 10 percent ethanol or E-10 will fuel the campus fleet's standard cars. When the cars wear out, they will be replaced with flex-fuel vehicles produced by companies like Ford or General Motors that can use E-85, or an 85 percent ethanol and 15 percent gasoline mixture.

Even though by-product flour will be refined into ethanol for the UGA fleet, Adams envisions sweet potatoes or other crops being used to make ethanol for Georgia's cars and trucks.

"An acre of sweet potatoes produces so much biomass," said Adams. "We will look at this next."

Scientists are investigating the economics of using peanuts to make biodiesel. Cultivars high in oil similar to Spanish peanuts (50 percent oil) may be planted for fuel.

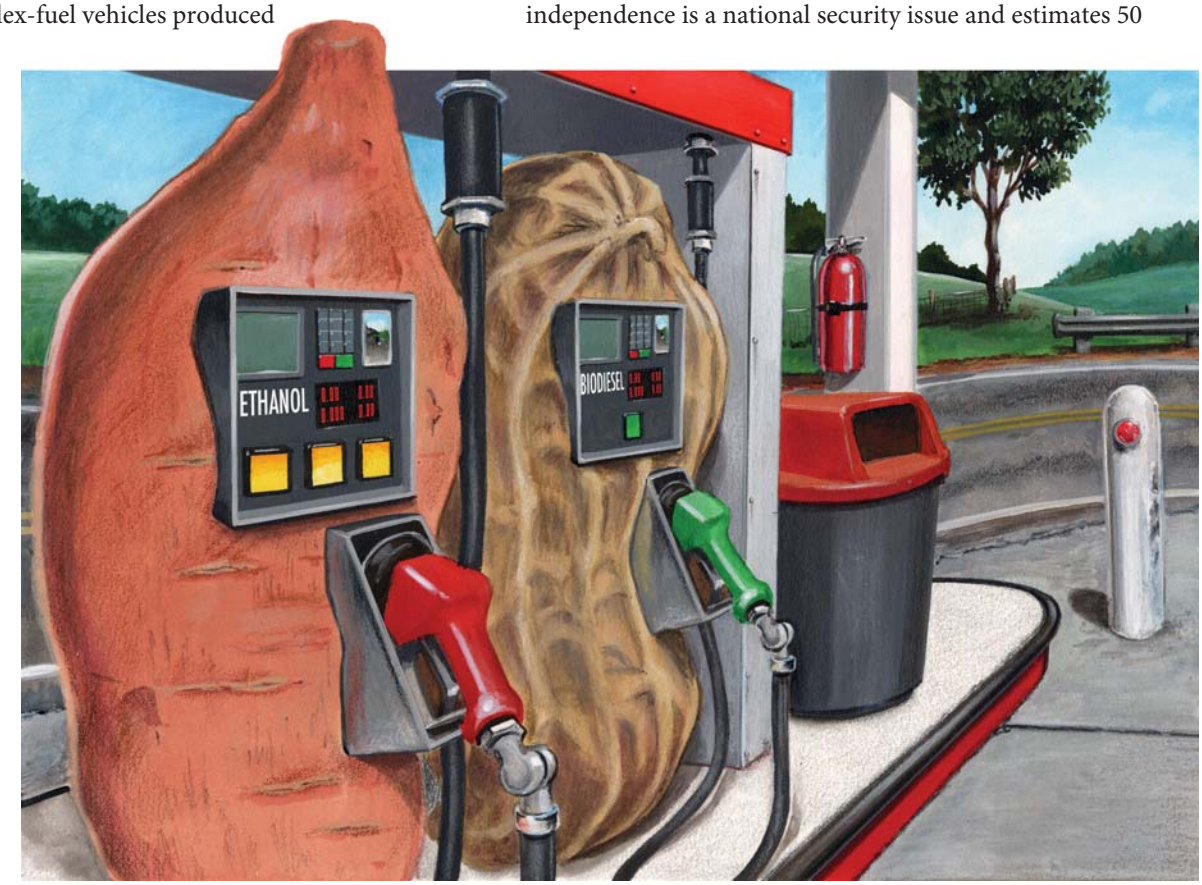
A blend of 20 percent biodiesel and 80 percent petroleum diesel or B-20 will be used for the campus trucks and buses.

"With the price of gasoline about two-and-a-half times what it was 10 years ago, this is a good time to use alternative energy for the campus vehicles," said Bill Fox, campus fleet director, who holds a master's degree in agricultural economics. "It just makes good economic sense. And with lower emissions, we have the side benefit of polluting the air less."

UGA's transportation system with 47 buses, 800 cars and 200 trucks is the largest at a public university and the second largest in Georgia. Only MARTA is larger.

Fox estimates that using E-10 in the cars and B-20 in the trucks and buses will save UGA about $100,000 a year at the current price it pays for gasoline. When the campus cars are flexible fuel models, the savings will be substantially greater. He sees economics as the driver for cleaning up our air.

James Woolsey, former CIA director, believes energy independence is a national security issue and estimates 50 percent of our current gasoline use can come from biomass. He says if hybrids were manufactured to take E-85 — "a trivial expense," — the United States would be energy independent.



Jay Bauer

UGA scientists hope to turn table foods such as sweet potatoes, peanuts and corn into the next automobile fuel source.

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

Susan Varlamoff is a program coordinator for the Office of Environmental Sciences.

Odor eaters reduce rendering plants' smell

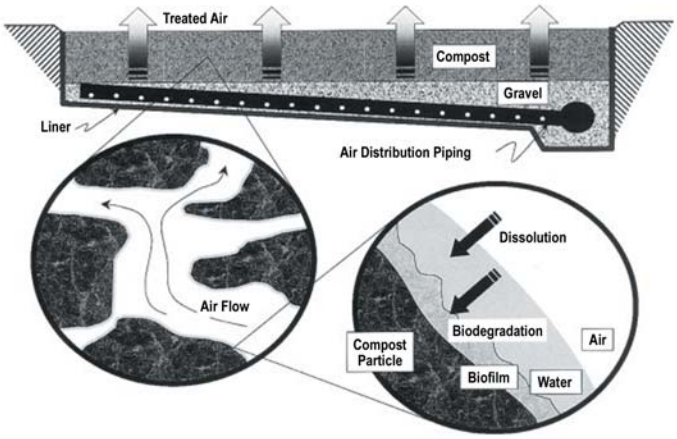
BY JAMES KASTNER

Poultry rendering plants have always attempted to be the best of neighbors, but encroaching suburbs and air pollution regulations are prompting the industry to find ways to reduce odor and volatile organic compound (VOCs) emissions. Odors coming from processing chicken by-products are often offensive and prompt complaints. In addition, as air regulations become tougher and metro Atlanta's smog spreads, many plants must limit the amount of VOCs they emit.

Since Georgia ranks number one in broiler production in the United States, poultry rendering plants abound throughout the state. Many rendering plants have invested in chemical wet scrubbers to remove odors, but recent research indicates that some of the VOCs are not efficiently removed with these systems. Moreover, the scrubbers use large volumes of water and costly chemicals. Recently, the rendering industry has invested in new, more environmentally friendly treatment technologies such as biofiltration and catalytic oxidation.

In the department of biological and agricultural engineering, we are looking at various ways to reduce odors and volatile organic compounds from rendering plants to make them better neighbors. Two methods our research group is exploring are biofiltration and catalytic oxidation. In a biofilter, air pollutants are collected and passed through a reactor containing packing material such as compost lined with a microbial biofilm. The air pollutants are transported from the gas phase to the stationary biofilm that contains microorganisms where they are degraded to carbon dioxide and water. The many advantages of biofiltration include:

1. Low energy costs and oxidation of contaminants to inert compounds,
2. Continuous degradation without the use of chemicals,
3. Diverse microbial community capable of mixed contaminant degradation,
4. More cost effective than adsorption, catalytic oxidation and incineration,
5. Waste material that can be reused in biofilters, and
6. Reduced water consumption compared to trickle bed or scrubber systems.



In a biofilter, air pollutants are collected and passed through a reactor containing packing seeded with microbial biofilm.

Pictured is a typical wet scrubber used in rendering industries along with many other industries to remove air pollutants.

Drawbacks of this method are low degradation rates and long residence rates (meaning reactors are large and costly), a limited temperature range (temperatures above 40°C inhibit or destroy biofilters), and many poorly water-soluble compounds can't be practically treated (e.g., hexane used in oil extraction).

A potential alternative to biofiltration and other air pollution control technologies is catalytic ozonation. This technology could be coupled with other methods to enhance overall air pollutant removal. In this process, ozone generated on-site is mixed with the VOCs and passed through a bed filled with solid catalyst particles. The catalyst accelerates a reaction between the VOCs and ozone resulting in the rapid breakdown of the VOCs to carbon dioxide and water.

The goals of this research project are to develop inexpensive catalysts from waste materials such as wood fly ash and peanut hull char (charcoal) and measure how fast the reaction occurs and how the rate can be increased. Ultimately we hope to develop new value-added products from agricultural and forestry waste residues (i.e., environmental catalysts). In addition, we are trying to develop smaller reactors that are lower priced, easier to install, and remove air pollutants at low temperatures (20-40°C and thus lower energy costs) with minimal need for water addition.

For more information, visit http://www.engr.uga.edu/people/jkastner/

Jim Kastner is an associate professor in the College of Agricultural and Environmental Sciences Department of Biological and Agricultural Sciences.

Climate Web site helps farmers plan

BY SHARON OMAHEN

In 2005, Mother Nature appeared to be cutting Georgia farmers some slack. A new, three-state Web site can help them prepare for whatever the weather offers, whatever the year.

"Now's the time to prepare for rough weather," said Joel Paz, an Extension agrometeorologist with the College of Agricultural and Environmental Sciences. "We're having a normal-weather year. When you're experiencing an El Niño, you have to have your contingency plans ready."

Paz is on a multi-university team of researchers who have developed the Web resource to help farmers stay ahead of the weather. The site can help them prepare for many weather conditions driven by the El Niño -Southern Oscillation (ENSO) phenomenon.

The Southeast Climate Consortium issues quarterly forecasts to help farmers in Alabama, Florida and Georgia manage their crops. The forecasts are online at http://www.agclimate.org. The SECC Web site uses data collected from university resources and the National Climate Data Center. It's based on more than 50 years of weather data and provides monthly rainfall and temperature forecasts for Alabama, Florida and Georgia counties. It offers advice, too, for neutral, El Niño and La Niña ENSO phases.

Florida State University's Center for Ocean-Atmospheric Prediction Studies produces the SECC climate forecasts. At the Tallahassee center, researchers monitor surface temperatures in the Pacific Ocean near the equator to predict potential weather effects in the southeastern United States. Periodic warming or cooling of those ocean surfaces, known as El Niño or La Niña, can affect U.S. weather patterns. El Niños bring increased winter rainfall. La Niñas have the opposite effect. Pacific Ocean surface temperatures are near normal now, or in a neutral phase.

Farmers make many business decisions based on unknown weather conditions, Paz said. They decide whether to buy crop insurance or grow a particular crop. The AgClimate Web site allows them to select their county, soil type, irrigation method and past yields. The site creates a personalized prediction of the farmer's yields based on his fields, the climate forecast and planting dates.

The site has data for peanuts, potatoes and tomatoes. The team plans to add cotton and other southeastern vegetable crops soon. The site covers cold weather factors, too. Farmers who grow peaches, blueberries, strawberries and other fruits will benefit from the chilling-hours data.

"There's a big difference between climate data and weather data," Paz said. "Weather information is used day-to-day. Climate information affects farmers' future decisions, including variety selection and management regimens."

The Web site was designed for farmers, but Paz says many other groups will find the climate information useful.

"We're starting to target the information to government agencies like the emergency management agencies," he said. "And we've found that water-resource managers also find the data quite useful."

The SECC's fall outlook, made available in early September of 2005, indicated whether the neutral phase is continuing, Paz said. As with most weather and climate projects, there's always a margin of error.

"We look at probabilities based on history," he said. "Our Web site is accurate. But you've always got to give yourself some wiggle room."

SECC member universities besides UGA are Auburn, Alabama-Huntsville, Florida, Florida State and Miami. The SECC is funded by the National Oceanic and Atmospheric Administration's Office of Global Programs, the U.S. Department of Agriculture's Cooperative State Research, Education and Extension Service and the USDA's Risk Management Agency.

Climate Web site: http://www.agclimate.org

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

environmental health

Our scientists are always looking for ways to improve the quality of our food. Conclusive evidence shows that a person infected with the fungus aflatoxin has reduced immunity to HIV and malaria, and a low-cost solution for the developing world may save many lives. Research proves what a cow eats in the latter stages of feeding affects the quality of beef. And blueberries, with their rich sources of vitamins, are a 'fruit farmacy.'

Low cost prevention for global food contamination

BY SUSAN VARLAMOFF

Seventy-five percent of the earth's population is exposed to aflatoxin, a food contaminant found primarily in the developing world. Scientists have learned that a small amount of clay mixed with food can adsorb aflatoxin and improve health.

Aflatoxin is a leading cause of liver cancer in developing countries. It seriously impairs the immune system's ability to fight malaria, tuberculosis and HIV and suppresses the body's absorption of micronutrients such as vitamin A, D, B and iron. It is a major factor undermining the health of people living in tropical climates.

Aflatoxins are produced as secondary metabolites by *Aspergillus flavus* and *Aspergillus parasiticus* fungi when temperatures are between 24–34 degrees Celsius (75–93 degrees Fahrenheit). The fungus grows on staple crops such as rice, corn, peanuts and cassava. The area most affected is 40 degrees north and 40 degrees south of the equator. Aflatoxin can develop before and during harvest and particularly in storage if the food is not properly dried.

One inexpensive approach that can be implemented at low cost is mixing clay, alumino-silicates, in food that selectively adsorbs aflatoxin and prevents it from being absorbed by the gastro-intestinal system. This approach has been successful in the animal industry. Studies on chickens show that a 0.5 percent addition of enterosorbing agents to highly contaminated feed decreased exposure to aflatoxin by 95 percent.

According to Tim Williams, program director of the Peanut Collaborative Research Support Program (Peanut CRSP), "This is the cheapest solution of all for the third world — $1 per person per year. It is cheaper than salt."

Peanut CRSP is an organization dedicated to supporting research opportunities related to the global constraints of peanut production and its sustainable use world-wide.

He said clay could be put in food as we put iodine in salt. "The evidence is available that this approach would effect changes in nutrition and immune systems that may in turn change the course of HIV for communities and infected individuals."

The World Health Organization and the Centers for Disease Control endorse this approach.

"The solution is so simple, people doubt. With a small amount of money, we can have affordable health intervention," Williams said.

Williams coordinates 10 projects that look at aflatoxin contamination of peanuts, other crops and animal feed in 14 countries in Africa, Asia, Latin America and Eastern Europe.

"In Indonesia, we tested the food at a market, and 10 percent of the samples had more than 10,000 parts per billion," said Williams. "That is 500 times more than U.S. regulations allow. But when people are hungry, contaminated food is better than no food at all. Every time there is a famine, aflatoxin spikes."

In developed countries where crops are produced by large-scale food production systems, a regulatory approach has been successful. Unfortunately, food is produced by subsistent farmers in developing countries where it is not economically feasible to do costly testing and screening for aflatoxin on each farm. As a result, the food grows toxic mold from improper food management and is consumed by the people. In Sub-Sahara Africa, aflatoxin was detected in 50 percent of breast milk samples. And in 2005, an outbreak of acute aflatoxicosis in Kenya killed 130 people. All the maize in one district had to be replaced.

"There is the problem of ignorance. Ninety percent of the people we surveyed never heard of aflatoxin, including doctors," Williams said.

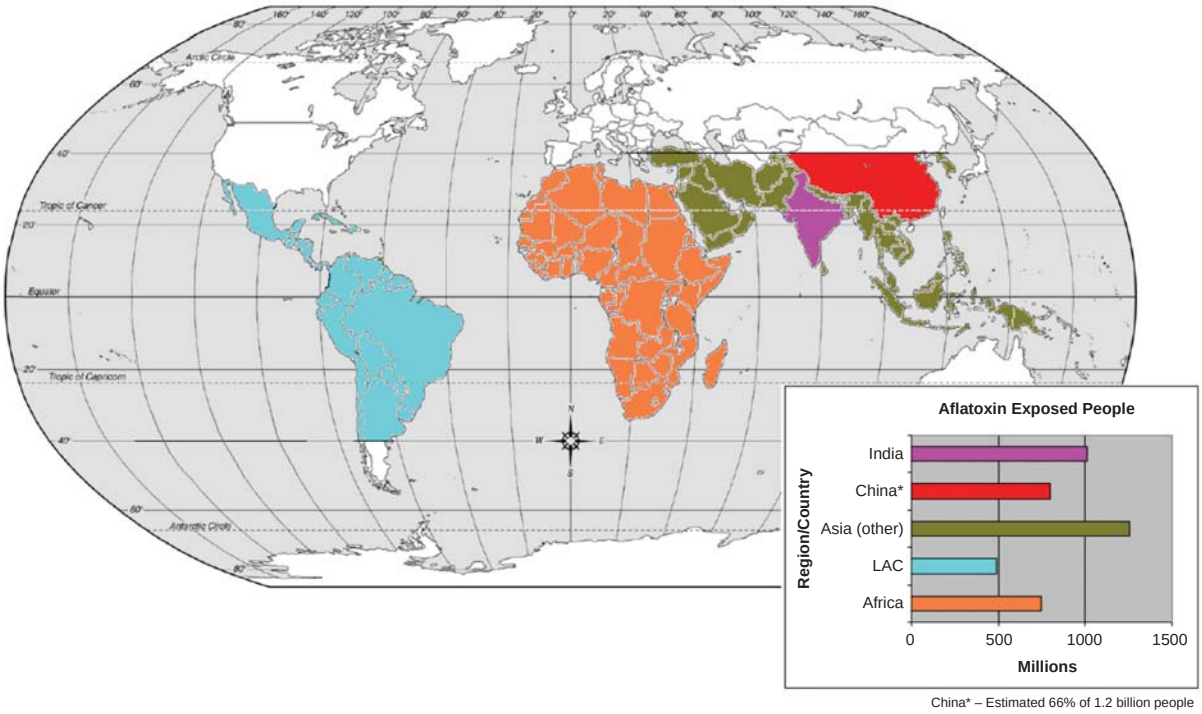
Peanut and corn infected with aspergillus.

"Aflatoxin is not just a problem in developing countries. The U.S. Food and Drug Administration considers aflatoxin a contaminant and has set strict limits at 20 ppb for human consumption and 300 ppb for animal feed. Fifteen percent of the price of corn and peanuts in the United States is spent on reducing and removing aflatoxin contamination."

Finding a way to reduce aflatoxin contamination in humans is an important focus for William's research programs. Because aflatoxin suppresses the immune system, studies have been conducted to see if there is a correlation between people who have high levels of aflatoxin and those who test positive for HIV. This is especially relevant for Africa, where a significant portion of the population is infected by the HIV virus. Using data from the World Health Organization for HIV infected adults, and adult estimated dietary exposure to aflatoxin, **a strong relationship has been established between dietary exposure to aflatoxin and HIV infected adults.**

As early as 1970, research showed that fungi could contaminate crops in the field before harvest. For peanuts,

Aflatoxin Exposure Demographics



China* – Estimated 66% of 1.2 billion people

Farmers dry peanuts to prevent aflatoxin contamination, above.

Typical grain storage hut, left.

drought during the growth stage, insect damage in the field, crop variety and soil characteristics have proven to be determining factors in preharvest contamination.

Gerrit Hoogenboom, biological and agricultural engineer, studied weather conditions in Mali, West Africa, to develop an early warning system to prevent the general public from eating contaminated peanuts. Of particular concern were the approximately 140,000 HIV/AIDS patients living in the area.

Studies were conducted during peanut growing, harvesting and storage.

While precautions need to be taken to prevent aflatoxin contamination, farmers are not able to exploit many of these approaches for economic reasons. Irrigation is rarely an option, pesticides are not used to control pests, and drying food before storage is weather dependent.

A Famine Early Warning System (FEWS) was established to alert governmental, nongovernmental and international agencies to supply food to areas where famine is occurring. This will prevent the community's health from deteriorating from either lack of food or from eating contaminated food.

Peanut CRSP Web site:
http://168.29.148.65/home.cfm
Susan Varlamoff is program coordinator for the UGA College of Agricultural and Environmental Sciences Office of Environmental Sciences.

Cows' grass and legume diet creates low-fat beef

BY SHARON OMAHEN

For health-conscious shoppers, a new kind of beef may be getting onto the dinner menu. University researchers in three states and the U.S. Department of Agriculture say Appalachian forage-finished beef has a lot to offer. In a three-year joint research project, cattle were raised solely on forages in Virginia and West Virginia. The meat was then sent to the University of Georgia to be analyzed.

"The goal of this project is to document how animal feeding systems impact meat quality," said Susan Duckett, an animal scientist with the College of Agricultural and Environmental Sciences. Duckett analyzed the beef in the project in her Athens, Ga., laboratory.

U.S. beef cattle normally start out grazing grass or other forages. But they "finish," or gain their last 400 pounds or so, eating corn or other grains in feedlots. Duckett compared the forage-finished beef with grain-finished beef in quality, composition, tenderness, palatability, juiciness, flavors, fat coloring and marbling.

She found the fat content of the forage-finished steaks to be 40 percent lower than that of grain-finished steaks. They had higher concentrations of omega-3 fatty acid, and a better ratio of omega-6 to omega-3.

"Health professionals recommend a balance of 2-to-1 or less of omega-6 to omega-3 fatty acids," she said. "Grain-finished beef typically has a 5-to-1 ratio or higher," she said. The forage-finished beef had a ratio of less than 2-to-1.

Duckett said the forage-finished beef was higher in fat-soluble vitamins like vitamin E and beta carotene. It also had double concentrations of conjugated linoleic acid. CLA is a cancer-fighting compound in products like milk, ice cream, butter, beef and lamb.

"It all comes down to the fact that the forage contains a lot of these things," Duckett said. "And when the animals consume

this diet, they're able to deposit these valuable phytochemicals into the meat."

Some taste difference

Forage-finished meat is a healthy alternative to traditional beef. But it tastes different. It can be gamey, Duckett said, like venison and lamb.

For the past five years, Gwen Roland of Pike County, Ga., has driven three and a half hours one way to pick up her yearly supply of forage-finished beef. "If you buy from a producer who uses breeds that finish well on grass and who uses the right forages, it's the best beef you're ever going to eat," Roland said. "I've bought from two farmers, and they both supply outrageously good meat."

The research project includes researchers from the USDA Agricultural Research Service, Virginia Polytechnic Institute and State University and West Virginia University. This fall, the team plans to begin taste-panel studies and start comparing three types of forage feeding systems.

"We need to determine how the feeding systems impact flavor and palatability," Duckett said. "Our first objective was to look at the quality and production. Now that we see benefits, we'd like to partner with someone in the retail arena to get the product out to consumers."

Through a separate project in Georgia, Duckett started the Georgia Grass-fed Beef Initiative, which has helped educate farmers on finishing their cattle on forages.

Susan Duckett has transferred to Clemson University where she is an animal science researcher.
Sharon Omahen is a news editor with the College of Agricultural and Environmental Sciences.

Blueberry 'farmacy'

BY GERARD KREWER

For more than 60 years, the University of Georgia's blueberry-breeding program has developed varieties adapted to the state where farmers now have the fifth-largest blueberry production in the nation.

Growers have planted millions of blueberry bushes as a cash crop. Homeowners have planted countless bushes, also. Everyone knew the delicious berries were great to eat. But only recently has their hidden health value been revealed.

It turns out that this humble fruit, native to the river basins of south Georgia, is one of the world's great health treasures.

Antioxidants

Blueberries are one of the richest sources of antioxidants, which help human bodies prevent cancer, heart disease and stroke.

Scientists have long known that blueberries contain

vitamins A, C and E. This is where some of the antioxidants are located. However, anthocyanins and other compounds, some of which provide their rich blue color, are blueberries' major sources of antioxidants.

Researchers at the U.S. Department of Agriculture and Tufts University have shown that blueberry extract can improve the motor skills of both mice and humans. Mice fed blueberry extract had improved memory, and research is under way to see if blueberries can improve human memory.

Still more

Blueberries also contain the cancer-fighting compound ellagic acid. And they have significant amounts of dietary fiber, which helps prevent colon cancer. Recent research by UGA food scientists indicates that phenolic compounds found in blueberries work against colon cancer cell lines.

These amazing berries contain a compound that helps prevent urinary infections by keeping bacteria from attaching to the urinary tract lining. As you can see, blueberries have benefits from the top to the bottom. You can get fresh blueberries locally grown in season from the grocery store or produce market.

Frozen blueberries are another economical source of health benefits. You can pick you own at many Georgia farms and freeze them. Or you can buy them in plastic bags at the store.

If you'd like to plant blueberries in your yard, they're fairly easy to care for and can provide years of health-enhancing berries. The online Georgia Extension publication, *Home Garden Blueberries* (pubs.caes.uga.edu/caespubs/pubcd/l106-w.html), can show you how to grow them. Or ask your Cooperative Extension county agent, who can direct you to any nearby pick-your-own blueberry farm.

Gerard Krewer is a Cooperative Extension horticulturist with the University of Georgia College of Agricultural and Environmental Sciences.

education/ extension

The University of Georgia Griffin campus now offers a degree program for local students with an environmental resource science major. The Extension Drinking Water Team has developed an innovative method for detecting problems with private wells. And we are working aggressively to train Extension agents to safeguard our water and food. Lastly, students from several disciplines worked together to design rain gardens for Athens-Clarke County.

UGA degree programs offered on Griffin campus

BY SHARON OMAHEN

In August 2005, the University of Georgia began offering two degrees on its Griffin campus. A biological science major will lead to a bachelor of science in agriculture, and environmental resource science major will lead to a bachelor of science in environmental sciences. The new majors will be convenient for south-metro Atlanta students. Sixteen students enrolled for the fall semester.

The programs are expected to be very popular, said Gerald Arkin, assistant dean of the Griffin campus. For more than a century, the Griffin campus has housed members of the College of Agricultural and Environmental Sciences research faculty. "Griffin campus faculty have traditionally taught undergraduate classes," Arkin said. "Over the years, many Griffin faculty have traveled to Athens to teach. And in some cases they provided instruction from Griffin to Athens via distance education. Griffin campus faculty also engage in graduate education for master's and Ph.D. students, many of whom do all or part of their research here in Griffin."

The Griffin campus degrees are designed to work in partnership with area two-year colleges. Students must have 60 hours of transferable college credit before enrolling in the degree programs. "Partnering with Gordon College in a 'two-plus-two program,' students will take their freshman and sophomore classes on the Gordon campus and their junior and senior classes on the University of Georgia Griffin campus," Arkin said.

"Gordon College's close proximity and course offerings make the partnership an attractive one for students and institutions alike," he said. "I look forward to working with Gordon's President Larry Weill and his staff in this new venture."

Weill is equally supportive. "We're glad to have the

opportunity to help a sister institution with their program," he said. "This is also an opportunity to keep local students attending school in the area."

Many Gordon students seem to like the idea. "More than 70 percent of the Gordon students we polled expressed interest in earning an undergraduate degree from UGA if the junior and senior years were offered on the Griffin campus," said Marilyn Johnson, coordinator of Griffin campus academic programs. Of those students, she said, 49 percent said they'd be interested in these two majors.

Sharon Omahen

UGA Griffin campus Assistant Dean Gerald Arkin (left) and Gordon College President Larry Weill celebrate the official approval of a joint educational project between the colleges. In the fall of 2005, students started taking UGA classes in Griffin, Ga.

Johnson also polled students at the two largest high schools in Griffin and Spalding County. At Spalding High, 71 percent showed an interest in getting a UGA undergraduate degree in Griffin. At Griffin High, 68 percent were interested. Asked specifically about the new degrees, 36 percent of Spalding students and 46 percent of Griffin students found them appealing.

In the past, students pursuing bachelor's degrees in the Griffin-Spalding County area have had to travel to Clayton or Bibb counties, Arkin said. "Offering UGA undergraduate degree programs on the Griffin campus is a major step in making higher education ever more accessible to students."

"The University of Georgia Griffin campus undergraduate degree programs are intended to offer convenience and accessibility," he said, "for students who cannot go to Athens for their degrees because of jobs, family, or other commitments."

The new majors require students to meet UGA's transferring student requirements of at least 60 hours of credit and at least a 2.5 grade point average.

"After they meet all the university standards, our Griffin students will become bona fide, I.D.-carrying UGA students," Johnson said.

UGA Griffin campus Web site: www.uga.edu/griffin

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

UGA Extension drinking water team

BY PAUL VENDRELL

How often do we answer calls on private drinking water wells? For a Georgia Cooperative Extension agent, this is part of an everyday routine. Many times the calls are routine, with people wanting to know why the water has an odor or why it stains their laundry. However, in the past three years we have been asked new questions — why did the quality of my water suddenly change — which requires technical and research based information. As a result, the University of Georgia Cooperative Extension is actively addressing drinking water concerns with education, research and outreach through a new team, the Extension Drinking Water Team, comprised of specialists and county agents.

The drinking water team was developed to design and oversee Extension educational programming to address critical needs in the area of drinking water and human health in

The UGA Extension drinking water team demonstrates the down well camera.

Georgia. The focus of the team includes:

- increasing public awareness of ground water contamination and its impact on human health,
- reducing or eliminating potential contaminants in homes and farms to protect Georgia's ground water resources,
- improving water testing and treatment, and
- educating the public on current drinking water policy and regulations.

The team has been challenged to create new tools to educate private well owners. With a camera that can be lowered into a well, Georgia's Extension wellhead protection program goes beyond the traditional aboveground inspection. This down-well camera produces live video images that are digitally recorded for later analysis in the laboratory. Now we have a new realm of information that can help us explain to well owners how water quality problems may result from inadequate, faulty or damaged well components or problems that may have occurred during construction. The camera's footage provides powerful visual information, inspiring the development of new educational materials to help well owners understand concepts that in the past would have been difficult to describe in words and diagrams.

Images clipped from the down-well footage visually convey complex hydro-geological processes in figures 1 – 7. Some of the complex hydro-geological process are: (1) groundwater under the direct influence of surface water from tree roots, (2) casing leaks in the alluvial zone, (3) microbial colony, (4) terrestrial organisms, (5) artesian flow, (6) water bearing fractures in crystalline rock, and (7) various types of damaged and inadequate casing.

In summary, this team has produced 13 circulars related to drinking water from private wells, Farm*A*Syst material for assessing whether a well is at risk of becoming contaminated, a 20-minute video for educating private well owners, a Web site that can perform initial interviews with well owners, and a three-panel display for assisting with the presentation of county level programs on drinking water and groundwater protection.

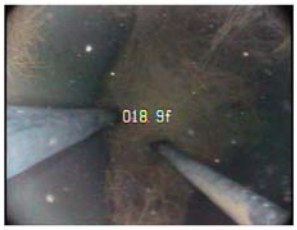


Figure 1. Tree roots alluvial zone

Figure 4. Terrestrial organizisms (centipede)

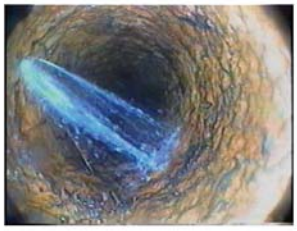


Figure 2. Casing leak in alluvial zone

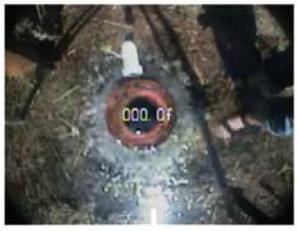


Figure 5. Artesian flow

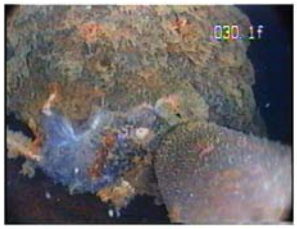


Figure 3. Microbial colony on the pump intake

Figure 6. Water bearing cracks in rock

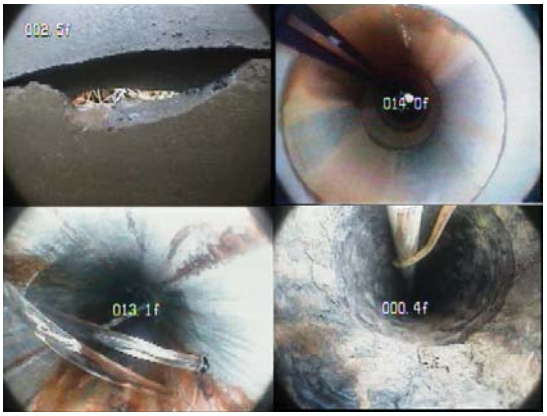


Figure 7. Damage and inadequate casing

For more information, contact Paul F. Vendrell at: 706-542-7690, http://aesl.ces.uga.edu/, pvendrel@uga.edu.

Downloads:
Household water quality circulars:
http://aesl.ces.uga.edu/publications/watercirc/index.html

UGA Extension Drinking Water Team display:
ftp://aesl.ces.uga.edu/vendrell/Well%20Water%20Dislay/

Clips of down-well videos:
ftp://aesl.ces.uga.edu/vendrell/Georgia%20Well%20Videos/

Introductory video:
ftp://aesl.ces.uga.edu/vendrell/Well%20What%20Do%20You%20Know/

Paul Vendrell is a program coordinator with the UGA Agricultural and Environmental Services Labs.

Agrosecurity training

BY BRAD HAIRE

About 125 University of Georgia Cooperative Extension county agents from south Georgia taught farmers, emergency workers, veterinarians and others in their counties how to recognize and respond to an incident that might jeopardize Georgia's food supply or farm economy.

Members of the Georgia Committee on Agriculture and Food Defense trained the county agents. Armed with what they've learned and new training materials, the county agents will establish a network of people to become the eyes and ears for the state in the case of an accidental event or deliberate attack on the agricultural industry, said Don Hamilton, Extension homeland security coordinator.

"Once people complete the training," Hamilton said, "they'll have a much better idea of what an agrosecurity incident looks like and what to do if it occurs."

Georgia is the first state to develop and offer an agrosecurity training program, said Lee Myers, assistant commissioner for the Georgia Department of Agriculture and chair of Georgia's Committee on Agriculture and Food Defense. It could be used as an example for other states to follow. The committee plans to have 3,500 people from around the state trained by the end of spring 2006.

The use of chemical or biological weapons to destroy crops or livestock is not a new concept. In World War II, the Germans successfully infected horses that were shipped from the United States, Morocco, and Argentina with anthrax. The potato beetle was intentionally introduced to destroy potato crops.

Most people are not aware how vulnerable the food supply is to agroterrorism, Myers said. Agroterrorism is defined as any intentional use of chemical, biological, radiological agents or explosives to destroy crops and livestock or to disrupt food distribution.

"Most cities have less than a seven-day food supply," she said.

People who take the training can also help the state respond to natural disasters like hurricanes and floods, said Corrie Brown, a professor with the UGA College of Veterinary Medicine. "Mother Nature may be the ultimate terrorist."

The program will also teach people how important Georgia's agricultural industry is to the state's economy, said Hamilton. Georgia's agricultural industry contributes about $58 billion to the state's economy and employees one out of every six Georgians, said Bill Thomas, who is coordinating the grant for the project. It is funded by a $1.6 million grant from the U.S. Department of Homeland Security through the Georgia Department of Agriculture.

The program also will be an opportunity for certified personnel, like emergency workers and veterinarians, to receive free training hours to maintain their certifications. Having trained individuals would also help small communities become eligible for grants from the U.S. Department of Homeland Security, said Phil Williams, who is with the Georgia Emergency Management Agency.

"… the county agents will become the eyes and ears for the state in the case of an accidental event or an attack on the agricultural industry," said Don Hamilton, Cooperative Extension homeland security coordinator.

Carol Williamson

From small farms to the supermarket shelf, food and agricultural disasters can affect all Americans.

Agrosecurity Web site: www.agrosecurity.uga.edu

Brad Haire is a news editor with the University of Georgia College of Agricultural and Environmental Sciences.

Students pool talents to design rain gardens

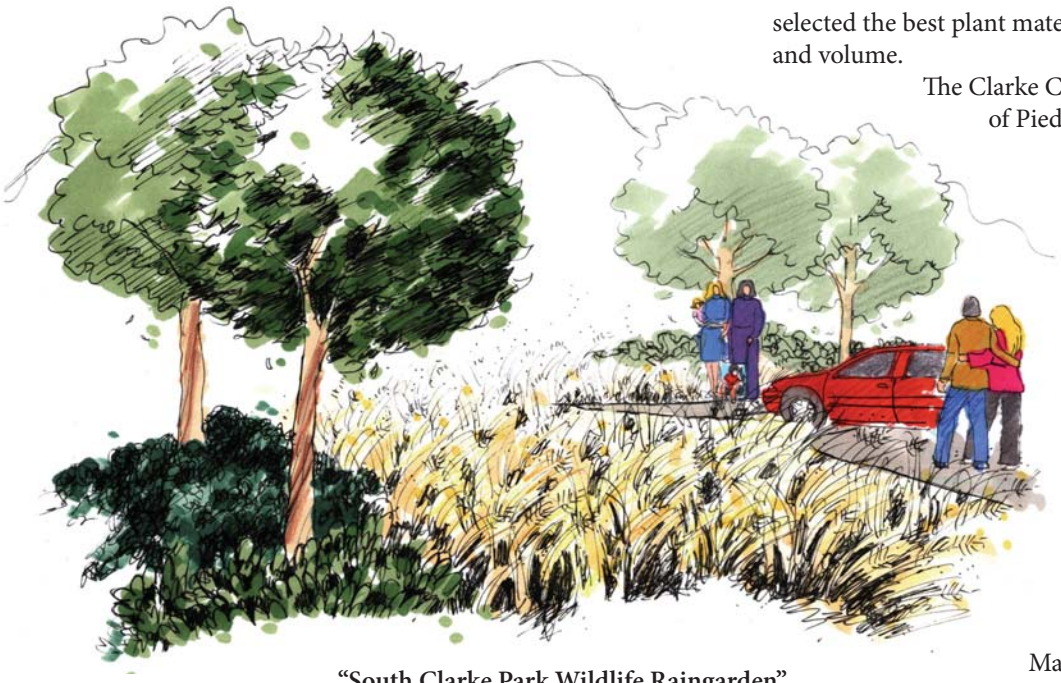
BY LINDSEY MANN

The Athens community will soon enjoy new wildlife habitats in the form of rain gardens thanks to a project completed by a group of University of Georgia students.

The 13 students — from the School of Environmental Design, College of Agricultural and Environmental Sciences and Institute of Ecology — worked on two teams. One team focused on drainage improvements for Southeast Clarke Park while the other worked on mitigating storm water from a parking lot at Clarke Central High School.

Both sites had runoff problems caused by typical modern development where impervious surfaces flush pollutants directly into watersheds. The students' designs reduced storm volume and prevented pollutants from entering streams.

Rain gardens are excavated low-lying vegetated areas designed to capture storm water and filter pollutants. They are filled with a pervious soil mixture in which a variety of plants are installed that can tolerate short periods of wetness.



"South Clarke Park Wildlife Raingarden"

For Southeast Clarke Park, the rain garden was proposed for an area where mosquitoes breed in standing water and where soil is eroding from a nearby parking lot. Despite these negative factors, the site is ideal because it connects to a major stream and wildlife corridor.

The new design maintains a balance within the ecosystem by preventing long-term flooding, erosion and anaerobic conditions that can cause odors. Since the area was overrun with invasive exotic plants, it needed to be retrofitted with native Piedmont habitat for the wildlife.

Along with the ecological focus of the design, the team of students decided to provide a place for park visitors with a less manicured design consisting of local grasses, shrubs and trees. Construction began in the fall of 2005.

At Clarke Central High School, a huge parking lot drains directly into the storm sewer at unregulated volumes with minimal filtration, leading the UGA students to choose a grassy area adjacent to the baseball field for their proposed rain garden. Although construction for Clarke Central High School's rain garden is currently waiting on available funding, the students have finished the design work.

Treating water quality and mitigating high runoff volume were primary goals of the project. The UGA engineering students used the Georgia Stormwater Manual to calculate the dimensions and properties of the high school's rain garden. Design students worked to implement the calculations into a creative and sustainable design. And the ecology students selected the best plant material for treating water quality and volume.

The Clarke Central team chose a rich variety of Piedmont plant species to provide a diverse and peaceful environment with shade. The design also includes a small, circular outdoor classroom and a series of ponds or micro-habitats which can be used by biology classes. A hardscape plaza was proposed to give a more formal and aesthetic gathering area and transition from the garden to the main school building.

Both sites are highly visible, which will also allow the improvement project to become an environmental education area. Mary Carol Hunter, a UGA professor of landscape architecture, and Debbie Borden of CAES engineering outreach initiated the interdisciplinary project for its hands-on value.

A grant from the U.S. Fish and Wildlife Service provided the park project with materials and some labor. When the rain gardens are constructed, the county will supply equipment and labor. Volunteer group Friends of the Park will manage the project.

For more information, e-mail Lindsey Mann at lmann108@uga.edu.
Mann is a third year student completing a master's degree in landscape architecture.