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Re:search

STALK OPTIONS:
Turning byproducts into profits

INSIDE

Re:*search*

North Carolina A&T State University
Agricultural Research Program in The School of Agriculture and Environmental Sciences

Dr. James C. Renick, Chancellor
Dr. Alton Thompson, Dean, The School of Agriculture and Environmental Sciences
Dr. Carolyn Turner, Associate Dean, Research
Dr. Donald McDowell, Associate Dean, Academic Programs
Dr. M. Ray McKinnie, Associate Dean, Administrator, The Cooperative Extension Program

Produced by the Agricultural Communications and Technology Unit:

Director: Robin Adams
Editors: Alton Franklin, Cathy Gant Hill, Laurie Gengenbach

Photographer: James Parker
Graphic Designers: Joshua Loftin, Donna Gibbs

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Send change of address and correspondence to:
Re:search Writer, Editor, Laurie Gengenbach
Agricultural Research Program
C.H. Moore Agricultural Research Station
Greensboro, NC 27411

On the cover: Dr. Abolghasem Shahbazi is researching alternative fuels from corn stover.

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20 >

Pokeweed

< 4

Dr. Abolghasem Shahbazi

10 >

Wetlands researcher Dr. G.B. Reddy

< 18

Small ruminant research

Re:*search*

A magazine *of the* Agricultural Research Program *in* The School of Agriculture and Environmental Sciences *at* North Carolina Agricultural and Technical State University

Mission

North Carolina Agricultural and Technical State University is a public, comprehensive, land-grant university committed to fulfilling its fundamental purposes through exemplary undergraduate and graduate instruction, scholarly and creative research, and effective public service. The University offers degree programs at the baccalaureate, master's and doctoral levels with emphasis on engineering, science, technology, literature and other academic areas.

As one of North Carolina's three engineering colleges, the University offers Ph.D. programs in engineering. Basic and applied research is conducted by faculty in University centers of excellence, in interinstitutional relationships, and through significant involvement with several public and private agencies. The University also conducts major research through engineering, transportation, and its extension programs in agriculture.

The purpose of the University is to provide an intellectual setting where students in higher education may find a sense of identification, belonging, responsibility, and achievement that will prepare them for roles of leadership and service in the communities where they will live and work. In this sense, the University serves as a laboratory for the development of excellence in teaching, research and public service.

Director's Desk

Research Making a Difference to Small Farmers

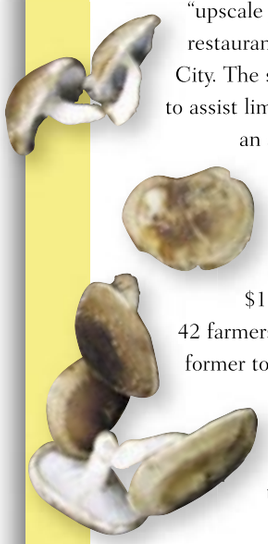
Specialty mushrooms, pork show early success

Dr. Carolyn Turner

Here in North Carolina, the move from tobacco production to alternative crops and other sources of farm income remains a major challenge for many small farmers. The questions we are trying to answer are basically twofold. First, what crops or other income producing activities can replace tobacco income? Second, what do these farmers need to do to make a successful transition to growing or raising these alternative products?

Researchers in the Agricultural Research Program are working with The Cooperative Extension Program at A&T to identify income producing crops and products, and seeking efficient ways to successfully transition into the production of these alternatives. We are particularly encouraged by the early success of two collaborative efforts — funded by the Golden LEAF Foundation — that have promoted the entry of small farmers into specialty pork and mushroom production.

Our specialty pork project has involved the development of "upscale pork" that is currently purchased by restaurants in North Carolina and New York City. The specialty pork project began in 2002 to assist limited-resource farmers with finding an alternative source of income to tobacco by producing pork with a distinctive flavor and characteristics for niche markets. Since 2002, project farmers have sold more than $1 million worth of market hogs. The 42 farmers participating in the project are former tobacco farmers and 92 percent are limited-resource farmers.



The mushroom initiative is providing a viable alternative to tobacco for small farmers across North Carolina. The specialty mushroom, mostly shiitake (*Lentinula edodes*), is in high demand by the state's upscale restaurants. This is a joint project between research and Extension faculty in which researchers are producing high quality substrate for growers, while Extension personnel are assisting with workshops and individual grower support.

Since the inception of our mushroom research project, the number of small farm growers has increased from 20 in 2002, to more than 200 in 2005, and more are coming on board every day. The University is supporting this industry through technical support, while also seeking a successful marketing and production process in the state. This includes leadership in establishing a statewide mushroom growers association, as well as determining the infrastructure for successful marketing strategies. A survey of mushroom growers in 2004 reported they were receiving an average of $10 per pound for shiitakes in sales to local restaurants and farmer's markets.

Our work in both the specialty pork and mushroom production is just beginning to bear fruit. Now we are looking ahead, examining approaches to international export of pork and mushrooms for small farmers. Our goal, at the end of the day, is to see that agricultural research is making a difference in the economic viability of previously tobacco dependent communities.

New process removes allergy proteins from peanuts

Finding is hopeful news for consumers and industry

Food scientists with the Agricultural Research Program have developed a new fermentation process that significantly reduces the allergenicity of peanuts.

The study, led by Dr. Mohamed Ahmedna, found that fermenting whole or ground peanuts with an edible fungus reduced the detectable level of major allergenic proteins Ara h 1 and Ara h 2 by as much as 70 percent.

The research attracted international media attention. Reuters and UPI wire services, as well as *New Scientist* magazine, and "Microbe World," a radio program, reported the findings after they were delivered at the June meeting of the American Society for Microbiology by Dr. Jianmei Yu, one of the researchers on the team.

"Allergenicity to peanuts has been a major issue for the food industry, as well as for consumers who must take great pains to avoid foods containing any peanut products whatsoever," Ahmedna said. Even traces of peanut dust can be enough to trigger an allergic reaction in very sensitive individuals, he added. Food labels must state not only if the contents contain peanut products, they must also indicate if the processing facility handles peanut products of any kind in any of its other foods, he said.

Addressing the allergy issue is important in light of other research taking place in Ahmedna's lab aimed at developing value-added products for peanuts, including low-fat meat substitutes and antioxidants. (See story, page 4.)

The Food Allergy & Anaphylaxis Network estimates that nearly 600,000 children are now affected by peanut allergies — about one of every 125 children. Peanut allergies in children have risen dramatically in recent years, increasing from 0.4 percent in 1997 to 0.8 percent in 2002. Reasons for the increase are unclear, but the popularity of roasted peanuts in the U.S. might account for some of the cases.

"Roasting is known to increase the allergenicity," Ahmedna said. In Asia, peanut allergies are virtually unknown, possibly because they are cooked in other ways, added Yu.

A food allergy occurs when the immune system misinterprets a harmless substance as a hazard and creates IgE antibodies specific to that food. The next time the individual eats that food, the immune system releases massive amounts of chemicals and histamines which trigger allergic symptoms. Symptoms of allergic reactions can range from swelling of the lips or tongue, shortness of breath, or a drop in blood pressure and heart failure.

Reporters from a local television station interview Dr. Mohamed Ahmedna in his lab.

Ahmedna said the study is still in the early stages. More research remains to be done, including optimizing the fermentation process, and defining the mechanism that caused antibodies to no longer recognize the two allergens. The team also plans to conduct sensory evaluations with consumers.

"We need to ensure the fermented product is acceptable or no one will eat it, allergy or not," Ahmedna said.

Dr. Abolghasem Shahbazi

Waste not

The Agricultural Research Program at N.C. A&T is finding ways to convert byproducts into value-added products

Anybody in business knows that there are only two ways to make money: cut your costs, or sell more product. The Agricultural Research Program (ARP) at N.C. A&T is finding ways for farmers and agribusiness to do both, by converting waste into value-added products.

Researchers are discovering how to convert low-value or no-value byproducts — such as stalks, stems, shells and other leftovers — into high-value goods, including polymer films, industrial compounds, nutritional supplements, protein snack foods, renewable energy, animal feed supplements, carbons for water purifiers, and other products. Their work on value-added processes and products is part of a larger trend in agribusiness toward sustainability.

"This is what happens when any industry reaches maturity," said Dr. Mohamed Ahmedna, whose food science lab specializes in value-added products. "Agriculture has moved from subsistence to industrialization, to oversupply, to what we are facing now, sustainability. In making agriculture sustainable, there is no waste per se. We find a way for everything to be converted into a profitable product."

One of the inevitable outcomes is a cleaner environment, he added. But higher profits and cleaner air and water aren't the only impacts. The trend to add value is also spurring innovation and hope for new industries and new jobs.

Dr. Abolghasem Shahbazi, a bioenvironmental engineer and former chair of the North Carolina Sustainable Energy Association, is focusing on renewable energy. He has recently embarked on a project to develop efficient techniques for converting corn stover (leaves, tassels and stalks) into ethanol and hydrogen fuels. He has also completed a study for the North Carolina State Energy Office, which describes the energy potential in crop residues, logging waste and other clean-burning biomass. The office has been working with investors who are investigating the potential for developing a biofuels industry. In a third project, Shahbazi has developed an efficient technique for processing whey into polymers and lactic acid.

Meanwhile, Drs. Ahmedna and Chung Seo are finding ways to turn nut shells into activated carbon for filtering contaminants from water.

Re:information ahmedna@ncat.edu, ash@ncat.edu

Ahmedna also has discovered a low-fat, high-protein food source in defatted peanut flour, the dry residue of which is left behind at the oil press. He also has found that the red skins from peanuts contain potent antioxidants that could be extracted and processed into food supplements.

"The development of new value-added products poses exciting new challenges and avenues for agriculture research, not just at N.C. A&T, but at all our land-grant universities," said Dr. Carolyn Turner, the SAES associate dean for research. "Farmers and agribusiness rely on the technical innovations coming out of our labs to streamline their processes and cut costs."

Making whey

When consumers buy a block of cheddar at the supermarket, few realize that the product represents but a small fraction of the liquid milk required to make it — only about 10 to 20 percent. The rest is left over as liquid whey.

The byproduct has traditionally posed something of an environmental headache for the cheese industry. Without expensive treatment, raw whey can not be released into the environment because it harms waterways and fisheries. Over the years, researchers at land-grant universities have helped the dairy industry become more efficient by creating new techniques for processing this troublesome byproduct into useable products, thereby neutralizing its environmental effects while also making value-added products. The Agricultural Research Program has contributed to this effort by developing a method for creating biodegradable polymers from lactic acid derived from whey.

Other universities have done similar research on whey-based polymers, but Shahbazi has contributed to the field by developing an inexpensive technique. His process captures lactic acid from whey by fermenting and forcing the liquid under pressure through the microscopic pores in a spiral sheet membrane. The process yields not only lactic acid, but a high protein liquid that could be sold for animal feed, or further processed to capture the high protein solids that could wind up in protein powders, shakes and supplements.

Lactic acid, meanwhile, has myriad uses in industry: in food flavorings or preservatives, in pharmaceuticals, in leather tanning and textile dyeing, in making solvents, inks, and lacquers, and, if research pans out, in manufacturing biodegradable plastics. The latter is of special interest to the ARP because of its environmental benefits. Plastics from petroleum can take hundreds of years to break down in landfills, leading to high disposal costs. Hence, industries are interested in biodegradable polymers that could be composted instead of sent to landfills.

The ARP is now collaborating with the University's Department of Chemical Engineering to produce and test the strength, shear, thermo stability and other properties of the lactic acid-derived plastic, under a project led by Dr. Jianzhong Lou, a polymer scientist.

"It does no good to produce a biodegradable polymer if you can't carry your groceries in it," Shahbazi said.

He, Lou and Dr. Salam Ibrahim, a food scientist, are also developing a laboratory for students to work on efficient ways to compost the plastic films.

Renewable energy

Skyrocketing gas prices, global warming, and dependence on Mid-East oil are bringing urgency to the quest for alternative energy — including renewable energy — an arena where agricultural research plays a key role.

Although the scientific community and petroleum industry usually butt heads on global warming, renewable energy from biomass is one place where the two factions could one day find common ground. The North Carolina State Energy Office sees the potential for converting biomass from animal waste, crop debris, wood waste and other sources into fuel, according to Bob Leker, renewables program manager for the State Energy Office.

Corn stover can be converted into biofuels.

"It's been said that North Carolina is the Saudi Arabia of biomass," he said.

The office has been studying the potential in these renewable resources for several years, and contracted with Shahbazi to survey the energy potential in crop debris and wood waste left over from logging. Such resources could contribute a small but significant portion to a renewable energy spectrum that could encompass wind, solar, methane from animal waste, biomass residues and other resources, Leker said.

"We are absolutely confidant that we have all the resources in North Carolina that we need to supply all our own energy needs," Leker said. "Obviously it can't happen overnight. It will take lots of work because we're starting from ground zero."

Others see the potential too. Several investors have been actively investigating the economics of building biorefineries here, he said.

At present, most of the ethanol produced in the United States comes from corn kernels grown in the Midwest. However, ethanol can be made from virtually any agricultural product, through different processing technologies. Shahbazi has found that stalks, stems, husks and other residue left after harvesting can be processed into ethanol, and possibly cheaper than doing so with corn, which is a high-input crop. Cheaper that is, assuming that refineries are built close enough to the source to offset transportation costs.

In terms of energy potential, it makes more sense to convert crop residue into ethanol than it does to incinerate it in power plants. That's because crop residue contains, on average 7,000 BTUs (British thermal units) per pound, compared to wood waste, which yields 9,000 BTUs per pound.

The energy potential in wood waste is best captured by burning instead of converting into ethanol, according to Shahbazi's findings. It makes for a cleaner burning fuel than coal because it produces negligible amounts of sulfur, unlike coal, which is responsible for much of the acid rain that is killing and endangering forests and waterways in many states.

Shahbazi's survey shows that at present levels, crop and wood residue would only supply a fraction of the state's energy needs. For instance, logging residues would supply less than 1 percent of North Carolina's residential electricity needs, while existing crop residues

Pecan shells can be processed into activated carbon for water filtration.

would yield close to 50 million gallons of ethanol (the equivalent of 33 million gallons of gasoline).

Therefore, the feasibility of converting these resources into energy would depend on a larger commitment to renewable energy. One example of such a commitment that Shahbazi proposes is a system of "closed cycle" tree farms, managed so that harvesting would never outpace growth rate. He maintains that such farms could help reduce global warming, because trees remove about twice the carbon dioxide in growing that they give off in decomposing or burning, thus resulting in a net reduction in greenhouse gases.

"The key words are 'closed cycle,'" he said. "You don't want to open the door to cut down our forests."

Adding value to peanuts

Peanuts — a crop worth $70 million a year in North Carolina alone — have been the focus of Ahmedna's research for the past several years. North Carolina is one of the top five peanut producing states in the nation, so Ahmedna thought it made sense to spend time researching how to help the industry add value to the crop by using its byproducts in novel ways.

For instance, why not find a better use for the dry residue left after pressing all the oil out of peanuts, instead of just using it for animal feed, as is done at present? The defatted peanut flour left over from the process is high in protein and low in fat — a perfect combination for health conscious consumers. Following that line of thought, Ahmedna researched several high-protein, low-fat meat substitutes. This use of peanuts represents a new direction in food science, because most meat substitutes nowadays are soy based.

"Nobody has ever done this with peanuts before," Ahmedna said.

His early research has proven promising. A meat substitute suitable for the filling of burritos won first-place in 2001 in the Graduate Research Paper Competition of the Institute of Food Technologists Product Development Division. Two years later, a second snack combined the flour with spices and minced tilapia, garnering a second-place award in the same competition.

But Ahmedna felt the texture of his product was still too soft to be accepted as a true meat substitute. Now he is using food extrusion technology to alter the structure of the protein in defatted peanut flour, in an effort to make it resemble the texture of cooked ground meat. The result could one day be low-fat convenience foods for health conscious consumers in industrialized nations, and a high-protein food staple in undeveloped countries where protein deficiency is an issue.

Dr. Abolghasem Shahbazi, right, discusses a whey fermentation process with Sekou Coulibaly, left, a graduate research assistant, and Dr. Yebo Li, a research associate. The process will produce lactic acid which can be converted into biodegradable polymers.

Ahmedna is working with food scientists in Senegal on yet another use for defatted peanut flour, which, in its raw state, consists of up to 50 percent pure protein. Ahmedna and colleagues have developed a process to isolate the protein from the flour. If commercialized, it could be used in protein shakes marketed to athletes, or distributed to people in countries where the nutritional issue is protein deficiencies.

Peanuts have other properties that make for promising value-added products. Red peanut skins, now fetching a mere two cents per pound for use in animal feed, could gain value if converted into a nutritional supplement, according to findings coming out of Ahmedna's lab. These papery skins are rich in antioxidants, and have other advantages over other plant-derived antioxidants. Peanut skin antioxidants are not only very heat stable, but also exist in higher concentrations than those found in green tea and vitamins C and E. Among the seven major types of antioxidants identified so far is resveratrol, a compound common in red wine attributed to the so-called "French paradox," an expression used to describe the tendency of red wine to offset the harmful effects of a high-fat diet. It works by protecting against free radical damage and cholesterol buildup in arteries. Ahmedna says the compounds in red peanut skins make for even stronger antioxidants than those found in red wine.

Throughout his research on peanuts, Ahmedna has remained mindful of peanut allergies. To address this issue, his recent research has found a way to reduce some of the worst allergens found in peanuts. (See story, page 3)

Byproducts have non-food uses as well. Ahmedna's lab has converted the carbon in pecan shells to an inexpensive activated charcoal for use in water filters. The cost is far less than current technology, which relies upon coal as the source material (about $2 a pound, versus $8). In addition to being more cost efficient to produce, the product also performs better. In all tests to date, the shell-based activated carbon worked "as good or better than the best commercial carbon," Ahmedna said.

Although the movement from laboratory to commercial product is slow and depends on market forces, the aim of research continues to be improved products for consumers, cleaner air and water, and opportunities for business growth in agricultural and environmental industries.

"New industries and jobs are created, less waste means a cleaner environment, and new products that can be created from waste mean our farmers and agricultural industries can remain economically viable," Turner said.

Wetlands and hog waste

It may be true that every problem has a solution, but many a solution in modern agriculture often creates a new problem.

A case in point has been the hog industry in eastern North Carolina. Although a rapid surge in hog production during the 1990s brought a $1 billion a year industry to an economically troubled region, the flipside arrived in a staggering 42 billion tons of hog waste a year — the equivalent of waste from 32 million human beings.

Unlike the treatment of human waste however, the treatment of swine waste was, and remains, a low-tech process. Raw waste is flushed from barns and stored in open-air lagoons for anaerobic (without oxygen) treatment. The liquid is then sprayed on land in prescribed doses, based on the nutrient requirements of the crop or pasture.

Though economical for farms, the proliferation of these systems prompted public outcry over odor, contaminated surface and ground waters, fish kills, and even a few ruptured lagoons. Widespread flooding from Hurricane Floyd further solidified the case against lagoons, leading to a moratorium on new hog farms in North Carolina that has been in effect since 1997. Clearly, solutions were, and are, in order for an industry hoping to grow without harming the environment.

Enter agricultural research.

Since 1998, the Agricultural Research Program (ARP) has been working with the USDA's Agricultural Research Service (ARS) to research constructed wetlands as natural filters for swine waste.

They are by no means the only researchers involved in the complex issue. The Animal and Poultry Waste Management Center at N.C. State University is engaged on a much broader mission to examine 16 different swine waste treatment alternatives — wetlands included. That work is related to ARP wetlands research, although the two projects are unaffiliated.

Researchers have known for some time that wetlands can be effective filters. They know that wetlands seem to work best on nitrogen, while phosphorus removal remains a greater challenge.

continued next page

Dean Forbes, graduate research assistant for Dr. G.B. Reddy, measures reeds in a "floating wetland," which is covered with a blanket of recycled rubber to hold down ammonia gases.

Re:information reddyg@ncat.edu

"Wetlands" continued

Dealing with solids has likewise eluded easy answers. The ARP mission is to find out how best to optimize treatment efficiency for nitrogen, and solve some of the vexing problems with phosphorus and solids.

"We're trying to answer a lot of fundamental questions of wetlands," said Dr. G.B. Reddy, who is leading the ARP constructed wetlands research at the University Farm, in collaboration with Dr. Patrick Hunt of the ARS coastal plains center in Florence, S.C.

"We know wetlands remove nitrogen, but our final goal is to have something to recommend to farmers," Reddy continued. "If we recommend, we need to show them, yes, you can remove this much nitrogen and phosphorus, and here's how to do it, and here's what it would cost."

Constructed wetlands have been used for decades in other countries to clean up municipal sewage. They have also been used sporadically in the United States, for rural homes where soils won't support a conventional septic system. However, very little research had ever been conducted on swine waste treatment in wetlands.

To date, this passive, low-tech approach appears to show promise for producers with no more than 800 hogs. Such an operation would need approximately two acres of wetland, Reddy said. Advantages include affordability and less acreage required for spray fields.

A fix on nitrogen

Research has shown that wetlands can remove up to 70 percent of the harmful nitrogen in waste. That's still not high enough for stream discharge, but enough to significantly cut the amount of land that would be required for spraying treated waste-water onto fields. However, researchers had never been sure of the cleanup mechanism. Was it through ammonia volatilization? Uptake through bulrushes and cattails? Or were denitrifying bacteria in the soil responsible? The project has begun answering some of those questions, and those answers could lead to more effective designs.

Even if perfected, the addition of a wetland to a hog farm would still not replace the lagoon/sprayfield system. It could, however, drastically reduce the amount of acreage needed for spray fields. That's why wetlands are deemed more appropriate for small farmers, researchers say. For instance, a typical 100-sow, farrow-to-feeder operation requires at least 10 acres of spray field. Adding a wetland could cut the amount of land needed for spray application to just five acres or less, Reddy said.

"Wetlands might not be the total solution, but they have a role to play in part of a total waste management system," he said.

Reddy and Hunt have been comparing two designs to see which works best, as well as how much waste load each can accommodate. The first is a continuous marsh with a sloped bottom. The second, known as marsh-pond-marsh, consists of a 30-inch deep pond sandwiched between two shallower marsh sections. They thought that the pond would provide more surface area, and hence more oxygen necessary to support the microbes that are important in the nitrogen removal process.

In fact, it was the simpler, continuous marsh design with a sloped bottom that has so far proven more effective than the marsh-pond-marsh experiment. The shallow section of the continuous marsh seemed to introduce more oxygen into the system, while at the same time, the plants helped reduce the amount of harmful ammonia gas escaping into the atmosphere. It was an important finding, and one that might further narrow the field of recommended design options.

"We now have hard data in place of opinion about marsh-pond-marsh," Hunt said.

The data also led to new avenues for research. It was always assumed that bacteria needed oxygen to promote nitrogen removal. However, other anaerobic microbes have been discovered to perform that task efficiently, and with far less oxygen. As a result, researchers are now planning to delve further into the microbiology of wetlands, in an effort to improve effectiveness.

"We have found some answers. But much of the microbial diversity and their role in the biochemical processes we still don't understand," Reddy said.

Before abandoning the marsh-pond-marsh concept, Hunt and Reddy want to answer more questions. They placed air pumps in the pond section, to see if oxygen-rich water could boost the aerobic microbes. They are also experimenting with "floating wetlands," by covering the surface with a floating blanket of recycled rubber, while a pump forces oxygen-rich air underneath. It is hoped that the introduction of air will promote nitrogen removal, while the blanket will hold down excess ammonia gas.

Phosphorus still a challenge

Though effective at removing nitrogen, neither system did a very good job of removing phosphorus. In hopes of finding a practical, low-tech solution, Reddy explored duckweed. He found that the protein- and mineral-rich water plant proved very effective at removing phosphorus. However, skimming and drying duckweed from the wetland surface is labor intensive, and unless someone devises an inexpensive method for doing so, it will remain impractical for use by most farmers in the United States.

His next effort on phosphorus will be to construct filters from different grades of calcium carbonate, to find which grade is best at binding to the phosphorus from animal waste. The end result could be a calcium phosphate fertilizer, which could be used by the farmer, or sold as a value-added product.

Overall, the picture emerging from ARP, as well as from studies at other universities, is that treating hog waste is a complex problem that, for the foreseeable future at least, will demand complex solutions. Though much remains to be learned about wetlands, Hunt and Reddy say these ecologically friendly systems might one day be part of that solution, as research contributes new perspectives on cost-effective designs.

"I think it's a very good technology, and once we more thoroughly understand it, we can confidently recommend it to farmers with no more than 800 animals, as part of a nutrient reduction program," Reddy said.

Others collaborating on the multidisciplinary wetlands research are **Terry Matheny** and **Drs. Mathew Poach** and **Kenneth Stone** of USDA-ARS, as well as **Richard Phillips** and **Dean Forbes** of the N.C. A&T Agricultural Research Program.

Rapid detection for truffles

DNA barcode could help growers know early on if fungi are present in soil

Dr. Omon Isikhuemhen holds a truffle.

Mushroom researchers with the Agricultural Research Program (ARP) are developing a monitoring tool that could help North Carolina growers of the exotic black truffle, a fungus that is considered to be the most lucrative agricultural product in the world.

Approximately 50 former tobacco farmers in the state are now trying their hand at cultivating the delicacy, supported by funding from the Tobacco Trust Fund Commission. However, the truffle organism takes years to get established deep in the soil before it starts bearing fruit, so rapid sampling and detection methods are needed.

To help growers know early on if the organism has survived, the ARP is researching the DNA of the fungus, as well as developing a barcode that will help growers know if it has taken hold on the roots of host trees and in the soil.

Leading the project is Dr. Omon Isikhuemhen, who hopes the detection system will help these growers, as well as any other would-be truffle growers. Funding is from the North Carolina Department of Agriculture and Consumer Sciences.

The Perigord truffles that North Carolina farmers are attempting to grow are knobby, golf-ball sized tubers that grow underground, near the root zones of host trees — usually oak or filbert. Traditionally, they have been gathered in their native habitat in European woodlands. In recent years, however, a few growers around the world discovered a technique for inoculating the roots of seedlings with truffle mycelium, and have tried their hands at cultivation, with varying degrees of success.

Truffles belong to a group of soil fungi that forms a symbiotic relationship with host plants by encasing the roots in filamentous mycorrhizae. These filaments extract micronutrients from the soil that the plant cannot get on its own, while the plant feeds sugars produced through photosynthesis to the fungus. The fungus takes many years to mature before it starts producing truffles near the host tree's root zone, several inches to a foot under the soil.

Prized by chefs and gourmets for their intense flavor, truffles can fetch between $500 and $2,000 per pound, depending on quality and other market forces. Small wonder then, that landowners are interested. However, cultivating truffles is no get-rich-quick scheme, cautions Isikhuemhen.

They are easily out-competed by other soil organisms, and North Carolina's acidic soils are not the best fit for the organism. Even with plenty of lime, irrigation and soil preparation, growers could wait up to nine years before knowing for certain whether or not a truffle host is a winner or a dud. Once established, however, an orchard, or "truffiere," of host trees can continue to produce for decades.

To help ensure growers don't bet the farm on the venture, the ARP has teamed up with Duke University to develop a rapid detection system that relies on DNA barcoding, a relatively new method for identifying species. Once the barcode is established, it will make subsequent identifications easier and quicker.

"We wanted to come up with a molecular approach that is inexpensive, quick and precise for detecting if the fungus is still active in the root," said Isikhuemhen, who is leading mushroom research for the ARP. "We want to make sure farmers aren't wasting their time." He and Duke University researchers are establishing a barcode for a specific gene known to be common to all tubers in the genus *Tuber* and specific to *Tuber melanosporum*.

Duke University researchers collaborating with Isikhuemhen are Dr. Rytas Vilgalys and Ph.D. student Gregory Bonito.

Once the method is perfected and standardized, farmers might expect to pay no more than $5 per sample, and would have results back from a lab within a week, Isikhuemhen said. Present methods cost about $20 per sample. Sampling could be performed by the grower, without damaging the growing tree, he added. He expects to have the process completed by the spring of 2006, whereupon he will begin investigating ways to make the technology widely available to growers. The research team also hopes to develop a more thorough understanding of truffle biology, in an effort to improve cultivation techniques.

Re:information omon@ncat.edu

Dr. Lizette Sanchez-Lugo, left, measures the height of Liz Trujillo, a research coordinator. Sanchez-Lugo and Trujillo are implementing an exercise and nutrition program for overweight Latino women.

Addressing Latino health

A survey of Mexican immigrants in one North Carolina county indicates that obesity is becoming as big an issue for this population as it is for others.

Dr. Lizette Sanchez-Lugo, a nutrition researcher, conducted the survey in 2004 by collecting data from 354 Mexican immigrants living in Guilford County. She is now using the information to develop an intervention program that addresses the special needs of this population.

Sanchez-Lugo found that 62.5 percent of men and 72 percent of women were overweight or obese, as determined by body mass index higher than 25.

Obesity is nothing new in any population, and others have observed Hispanic Americans seem to be at high risk, but these numbers surprised even Sanchez-Lugo. By comparison, the overall rate of overweight and obesity in Guilford County is 59.7 percent, and the statewide rate is 63.1 percent.

"I thought maybe there was some mistake, but then I found these rates correlated with the higher caloric intake reported. It was much, much higher than what we would recommend as healthy for the average man or woman," said Sanchez-Lugo.

The surveys showed that no single food or food group could be pinpointed as the cause. Instead, the phenomenon was the product of overeating across the board.

"The most significant factor in obesity was total calories," Sanchez-Lugo said. "That means we have to show this group of people how to eat healthier and move more, because they will also be at risk for diabetes and heart disease, and if they don't have insurance, then medical bills are going to take a toll."

While Latinos comprise nearly 14 percent of the total U.S. population, they represent more than 20 percent of all Medicaid beneficiaries, according to Families USA, a non-profit health advocacy organization. This is partly because Latino workers are the least likely to have employer-sponsored health insurance coverage.

Sanchez-Lugo's study was limited to Mexicans because they comprise most of the Latino immigrants to North Carolina, but her findings echo similar studies of overweight in Hispanic Americans in general.

Sanchez-Lugo's study leads to new questions: Are there cultural or genetic factors at work? Were the survey participants overweight when they moved here, or did they develop excess weight as a result of the American diet and lifestyle?

"It would be interesting to compare this to the rates of obesity in Mexico," she said. "It used to be obesity was a phenomenon observed only in industrialized nations, but now it is a worldwide epidemic."

For now though, Sanchez-Lugo is concentrating on developing an intervention program that will include exercise, behavior modification, and healthy cooking instruction geared toward the lifestyle of the typical Mexican woman. The hope is that participants will transfer their new health awareness to the whole family.

"People get really confused by all the controversy over fat, trans fats, low carbohydrates and so forth," Sanchez-Lugo said. "But in the end, the message for all of us is really quite simple. We have to limit our total number of calories to maintain good health, and match the calories we eat with proper physical activity."

Re:information lizette@ncat.edu

Space age agriculture

If you want to know precisely what is happening on the ground, then your best bet is to get a bird's-eye view from the air.

That's why precision agriculture might one day become the crop farmer's best friend.

This form of high tech farming is still in its infancy in North Carolina — it is mostly used in the corporate mega-farms of the Midwest — but as it matures, the Agricultural Research Program will be in a good position to contribute findings. That's because the University Farm was selected in late 2004 as the site for a monitoring tower for a new nationwide upgrade to the Global Positioning System (GPS). The tower is one of 130 now being constructed around the country to bring greater accuracy to the GPS. (Those familiar with the system refer to this upgrade as the "High Accuracy-Nationwide Differential Global Positioning System" — HA-NDGPS.)

Prior to the upgrade, just five stations around the globe monitored the 24 satellites in the GPS system and measurements could be off by as much as 20 meters. The new towers will reduce error to three meters or less, making precision agriculture more achievable for small farmers.

Precision agriculture works because of satellite maps that indicate the proper rate and precise location at which to apply fertilizer, pesticides and seeds. Instead of treating every field as a unit, farmers are able to fine-tune production inputs to specific spots within their fields. For farms hoping to maximize yield or reduce production inputs, accuracy in mapping can make a significant difference in profitability.

Healthy stock

Research is showing that traditional remedies can play a role in disease management

Animal scientists in the Agricultural Research Program (ARP) hope to shed light on how traditional remedies can fight disease and strengthen immunity. The research is becoming increasingly important as disease-causing organisms develop resistance to commercial drugs.

"If we can find alternative treatments to help animals fight the disease, then farmers won't have to rely as heavily on drugs," said Dr. Mulumebet "Milli" Worku, an animal scientist who has led several studies examining how alternative remedies function on a molecular level. "They will still need drugs of course," she added, "but they will be able to use them more strategically."

Worku's research into using whey (a byproduct of cheese production) as a treatment for mastitis in dairy cattle led to the discovery of several genes in *E. coli* that play a role in the inflammatory disease. Another *in vitro* study showed that the numbers of Fc receptors increased on bovine neutrophils (white blood cells) that were exposed to shiitake mushroom extracts. Fc receptors are responsible for attracting pathogens to the neutrophil, which then engulfs and destroys the intruder. An increase in receptors, therefore, indicates an enhanced immune response, Worku said.

Though her research on drug alternatives is preliminary, Worku is encouraged by the findings. She plans to conduct similar research on garlic, neem extract, tobacco with copper sulfate, wormwood and diatomaceous earth. She became interested after finding that goats that were treated with these substances remained healthy, despite carrying heavy parasite loads. That finding indicated to her that the treatments were somehow enhancing the immune system.

"The treatments didn't destroy the parasites, but they helped the animal cope better with the infection," Worku said. "In that sense, we can look at the use of traditional remedies as a win-win. If we don't have to worry about eradicating parasites or pathogens, and as long as production doesn't suffer and the animal remains healthy, then we don't have to rely so heavily on drugs and we can slow the emergence of drug-resistant strains."

All this is good news for North Carolina's goat farmers, for whom parasites are the most troublesome pathogen. For a variety of reasons, these farmers must increasingly depend on natural alternatives to commercial de-wormers. Not only are the drugs expensive, but their effectiveness is waning as drug-resistant parasites arise. Drug companies, meanwhile, are slow to develop new medicines for small ruminants.

"We definitely need research on alternatives," said Martha Mobley, an Extension agent in Franklin County who works closely with the North Carolina Meat Goat Producers, which now has 700 members. "If you are a goat farmer, you have to experiment with other treatments, because if you rely solely on commercial drugs, then you will not make any money."

Re:information worku@ncat.edu

Dr. Mulumebet "Milli" Worku, left, and Odette Alexander, graduate research assistant, use the FAMACHA© System to check for parasites.

In addition to examining alternative remedies, Worku is working with Mobley to introduce a farmer-friendly disease management tool known as the FAMACHA© System. Farmers can easily detect parasite infections by checking under the animal's eyelid, and comparing the color to a swatch chart. The whiter the color, the more anemia the animal is suffering from blood-sucking parasites. Depending upon the severity of disease, farmers can then decide to treat the animal with traditional remedies, cull it from the herd in hopes of developing more parasite-resistant stock, or, as a last resort, dose it with a commercial drug.

Patricia Matterson, Research Associate

North Carolina and other states in the South are particularly in need of parasite management tools. Here, the hot, humid climate creates perfect conditions for parasite larvae to accumulate in pastures, and, ultimately, in animals. Ruminant parasites are not a human health hazard — they do not infect meat or milk — and fortunately, cattle are large enough to withstand their effects. Smaller ruminants, however, are more susceptible. The most troublesome for goats is the barber pole worm (*Haemonchus contortus*).

Experts agree it will be impossible to eradicate parasites from North Carolina's pastures anytime soon, and that it is only a matter of time before the de-wormers now approved for small animals will no longer be effective. Therefore, Worku and others say the answer for goat farmers is a management program which entails a combination of monitoring, pasture rotation, culling susceptible animals, selective use of commercial drugs and alternative remedies.


Dr. Ipek Goktepe

New research on old remedies

Dr. Ipek Goktepe is trying to tap the healing properties of several traditional remedies, including pokeweed.

Re:information igoktepe@ncat.edu

An herb common throughout the Southeast and esteemed by rural folk for its tonic properties is beginning to gain the respect of modern medicine.

In recent years, research has shown that common pokeweed (*Phytolacca americana*) produces a potent antiviral protein that slows the advance of HIV and other viral infections. A handful of researchers have an interest in pokeweed's anti-cancer and antimicrobial properties. Among them is Dr. Ipek Goktepe, a food scientist and environmental toxicologist with the Agricultural Research Program. Her interest represents a growing trend in science to establish a research base for folk medicine, a trend which followed the establishment in 1998 of the National Center for Complementary and Alternative Medicine.

Pokeweed is one of four folk remedies Goktepe is researching. The others are rosehips (*Rosa canina*), a popular home remedy used in her native Turkey to treat myriad ailments from headaches to hemorrhoids, as well as bitter kola nut (*Garcinia kola*) and king tuber oyster mushroom, (*Pleurotus tuberregium*) both of which are common remedies in western Africa. Goktepe plans to research their effectiveness against breast and prostate cancer, as well as their antimicrobial properties.

Plenty of anecdotal accounts describe these plants' healing powers, but little verifiable research has been published. Goktepe hopes to contribute to the basic understanding of the chemistry and molecular activity of these plants and fungi.

Her early findings on pokeweed are encouraging. Crude extracts of roots and berries proved effective *in vitro* against breast cancer cells, inhibiting growth at 20 milligrams per milliliter and halting cell growth at 40 milligrams per milliliter. Although the extracts were not effective against *E. coli* 0157. H7, they did kill several foodborne pathogens, as well as a strain of Staphylococcus bacteria that is especially troublesome in hospitals.

However, the plant contains approximately 50 chemical groups, many of which are highly toxic, so much work remains to be done before there is testing on animal or human subjects. If medicines are to be developed, they would have to first be identified and isolated from the plant's other compounds, Goktepe said. She plans to use microarrays to study the molecular activity of the different constituents on breast and prostate cancer cells, before moving on to animal studies.

Pokeweed was used by Native Americans for centuries against mastitis, breast cysts, and breast cancers as well as on other types of cancers, and is still used today by mountain herbalists in North Carolina, who swear by "poke sallat" as a spring tonic, Goktepe said. The remedy as traditionally prepared consists of young shoots and leaves picked before flowering, boiled twice with the liquid discarded both times, then the greens fried with fatback or eaten plain.

However, most authorities caution against casual use of the plant because of the toxins it contains, especially in the seeds and berries which contain phytolaccatoxin histamines, Goktepe said.

Pokeweed was used by Native Americans for centuries against mastitis, breast cysts, and breast cancers as well as other types of cancers, and is still used today by mountain herbalists in North Carolina, who swear by "poke sallat" as a spring tonic.

Agricultural Research Program at N.C. A&T State University Active Projects

Funding is from the United States Department of Agriculture, unless otherwise indicated.

Department of Agribusiness, Applied Economics and Agriscience Education

Assessment of Community Based Organizations (CBOs) in Black Belt States
Investigators: Thomas, T.; Gray, B.
Assessing the success of Community Based Organizations (CBOs) in creating social capital and building institutional capacity.
Contact: Terrence Thomas, 336-334-7059, twthomas@ncat.edu

An Economic Assessment of Farmland Loss in North Carolina
Investigators: McDowell, D.; Yeboah, A.
Examining the potential impact on the state's economy resulting from continued loss of farmland.
Contact: Donald McDowell, 336-334-7665, mcdowedr@ncat.edu

Edible and Medicinal Mushroom Production and Marketing in Community Business Development
Investigators: Isikhuemhen, O.; Yeboah, O.
Developing exotic mushroom production businesses in North Carolina.
Contact: Osei-Agyeman Yeboah, 336-334-7056, oyeboah@ncat.edu

Hard to Reach Consumer Food Safety Research and Outreach in the Southeast
Investigators: Adu-Nyako, K.; Willis, W.; Goktepe, I.; Ekanem, E.; Rao, R.
Providing food safety education to consumers receiving public food assistance and conducting research to assess their food safety perceptions and behavior.
Contact: Kofi Adu-Nyako, 336-334-7426, adunyako@ncat.edu

Impact of Agricultural Industrialization on North Carolina's Black Belt
Investigator: Ejimakor, G.
Examining impact of industrialized agriculture on limited-resource farms and using case studies to highlight such impacts on small farms and rural communities.
Contact: Godfrey Ejimakor, 336-334-7943, ejimakor@ncat.edu

Impacts of Trade Agreements and Domestic Policies on Southern Agriculture
Investigator: Yeboah, O.
Examining impacts of U.S. Food Security and Rural Investment Act; European Union Common Agricultural Policy; World Trade Organization; Free Trade Area of the Americas and North American Free Trade Agreement (NAFTA).
Contact: Osei-Agyeman Yeboah 336-334-7056, oyeboah@ncat.edu

Promoting Collaboration Among CBOs, 1890 Institutions, Business and Government Agencies in the Black Belt
Investigators: Thomas, T.; Gray, B.; Thompson, A.
Developing an understanding of the role of community-based organizations in the Black Belt region of the U.S.
Contact: Terrence Thomas, 336-334-7059, twthomas@ncat.edu

Understanding Underlying Factors that Determine Health Status in the Black Belt
Investigators: Gray, B.; Thomas, T.; Thompson, A.
Developing a repository of science-based knowledge of underlying factors that lead to low health.
Contact: Benjamin Gray, 336-334-7072, grayb@ncat.edu

Department of Animal Sciences

***Campylobacter jejuni* Studies with Non-antibiotic Additives in Poultry Production**
Investigator: Willis, W.
Exploring antibiotic-free ways to protect and improve the health status of broilers, both to improve animal performance, and to protect consumers from campylobacter infections.
Contact: Willie Willis, 336-334-7786, willisw@ncat.edu

Characterization of Enterotoxigenic *Escherichia Coli*
Investigator: Allen, J.
Identifying the mechanisms of antibiotic resistance in scours infections in newborn swine.
Contact: John Allen, 336-334-7615, allenj@ncat.edu

Deciphering Gene Expression Associated with the Inflammatory Response to *E. Coli* Endotoxin in Cattle
Investigator: Worku, M.
Researching gene expression profiles in E. coli-*induced mastitis.*
Contact: Milli Worku, 336-334-7615, worku@ncat.edu

DNA Methylation Effects on Mammalian Development
Investigator: Branch, S.
Funding: National Institute of Environmental Health
Characterization of genes involved in birth defects and investigating the role of epigenetic modification.
Contact: Stacy Branch, 336-334-7709, sbranch@ncat.edu

Genetic and Functional Genomic Approaches to Improve Production and Quality of Pork
Investigator: Worku, M.
Researching the underlying genetic factors in pork quality and animal health, as well as strategies for their genetic advancement.
Contact: Milli Worku, 336-334-7615, worku@ncat.edu

Genetic Models for Upscale Pork Markets
Investigators: See, T.; Cassady, J.; Ahmedna, M.
Comparing phenotypes of boar lines, and utilizing alternative diets to improve pork quality.
Contact: Department of Animal Sciences, 336-334-7547

Department of Human Environment and Family Sciences

Advancing Technology through Web-based Course Delivery
Investigators: Ray, G. ; Walker, J.; McMillan, V.; Sanchez-Lugo, L.; Gillispie-Johnson, C.
Building the capacity for computer-mediated instruction.
Contact: Geraldine Ray, 336-334-7785, gray@ncat.edu

Tamekia Broughton, graduate research assistant, left, and Veronica Campbell prepare a sensory evaluation for sugar-free doughnut glazes.

Sugar free doughnuts

In the low-carb, low-calorie world, where even sugar-free candy is an option, the idea of sugar-free doughnuts doesn't seem too far-fetched. Veronica Campbell, a graduate student in food and nutritional sciences, decided to take on the challenge as part of her final research project.

The idea came to her while talking with a diabetic customer at a bakery where she worked part-time.

"He said, I really love doughnuts. I wish they would make a sugar-free doughnut."

Inspired by his comment, Campbell and her advisor, Dr. Salam Ibrahim, decided to research sugar-free glazes that consumers would find good enough to eat. Campbell developed three glazes from common sugar substitutes: xylitol C, lactitol, and a commercial sweetener that contains saccharin. Saccharin is the oldest non-sugar sweetener on the market, and is a derivative of coal tar. Xylitol comes from birch trees, and lactitol, from milk.

Tasters used a five-point Hedonic scale to rate appearance, sweetness, taste, texture and overall acceptability. Xylitol was preferred over the other two substitutes. Lactitol produced a glaze that consumers consider to be too thin, while the saccharin product left a bitter aftertaste.

Campbell isn't the first food scientist to seek the great-taste-fewer-calories holy grail. In 2004, the Tasty Baking Co. introduced sugar free — albeit unglazed — doughnuts as part of its Sensables line of low carb treats, which relies on the sugar substitute, malitol.

Campbell hopes others might pick up where she left off.

"This is just a start," she said.

Assessment of Triazole Exposure Among Farm Workers in North Carolina
Investigators: Goktepe, I.; Nylander-French, L.; Ibrahim, J.
Developing a methodology for measuring farm workers' exposure to triazoles and potential health effects.
Contact: Ipek Goktepe, 336-334-7963, igoktepe@ncat.edu

Development of Spice Meat Analogs & Technology Transfer of Value-Added Products from Peanuts
Investigator: Ahmedna, M.
Funding: University of Georgia
Low-fat or fat-free, high protein meat substitutes.
Contact: Mohamed Ahmedna, 336-334-7963, ahmedna@ncat.edu

Development of Value-Added Products from Peanut and Aflatoxin Detoxification
Investigators: Ahmedna, M.; Goktepe, I.
Funding: United States Agency for International Development
Removing aflatoxins from peanuts; developing value-added products.
Contact: Mohamed Ahmedna, 336-334-7963, ahmedna@ncat.edu

Enhancement of Micribiological Quality of Probiotic Dietary Supplements
Funding: Jarrow Formulas
Investigator: Ibrahim, S.A.
Developing and licensing new technology to improve stability of bifidus bacteria.
Contact: Salam Ibrahim, 336-334-7328, ibrah001@ncat.edu

Evaluation of Select Plant Extracts as Potential Food Preservatives and Anticarcinogens
Investigators: Goktepe, I; Isikhuemhen, O.; Willis, W.; Ibrahim, J.
Researching natural and nontoxic compounds from plants.
Contact: Ipek Goktepe, 336-334-7963, igoktepe@ncat.edu

Effect of Diet and Culture Conditions on the Nutritional and Microbial Quality of Fish
Investigators: Seo, C.; Ibrahim, S.
Studying the effects of diet and aquaculture conditions on the nutritional content, including omega-3 fatty acids, in cultured southern flounders, summer flounders, and black sea bass.
Contact: Chung Seo, 336-334-7933, seoc@ncat.edu

Factors Influencing Leadership Development and Community Involvement in Limited-Resource Communities
Investigators: Walker, J.; Gray, B.
Examining factors influencing leadership development in rural areas; identifying Community Voices graduates' perception of the program.
Contact: Jane Walker, 336-334-7785, walkerj@ncat.edu

Functional Food Ingredients From North Carolina Agricultural Byproducts
Investigators: Ahmedna, M.; Hanner, T.
Isolating nutraceutical compounds, testing their biological activity, incorporating active compounds/fractions into functional food carriers that are acceptable to consumers.
Contact: Mohamed Ahmedna, 336-334-7963, ahmedna@ncat.edu

Active Projects

Housing Challenges of New Manufactured Home Owners in Rural North Carolina
Investigator: Hinnant-Bernard, T.
Determining how problems with installation or set-up of manufactured houses are resolved, and how satisfied consumers are with the resolution.
Contact: Thess Hinnant-Bernard, 336-334-7069, thinnant@ncat.edu

An Integrated System for Addressing Obesity and Weight Management of African American College Students
Investigators: Ahmedna M.; Sanchez-Lugo, L.; Swearingin, B.; Wilson, S.; Gruber, K.
Monitoring weight, food intake, and physical activity of freshmen and sophomore students.
Contact: Mohamed Ahmedna, 336-334-7963, ahmedna@ncat.edu

Low-cost Water Filtration Systems Using Agricultural Byproduct-Based Activated Carbons
Investigators: Ahmedna, M.; Goktepe, I.; Ilias, S.; Adu-Nyako, K.; Ibrahim, M.
Developing and testing of low-cost water filtration systems using granular activated carbons derived from underutilized agricultural byproducts.
Contact: Mohamed Ahmedna, 336-334-7963, ahmedna@ncat.edu

Novel Approach to Produce Lactose-Free Dairy Products
Investigators: Ibrahim, S.; Shahbazi, A.; Shirley, V.
Developing a technology to produce lactose-free dairy for the nutritional benefit of the estimated 50 million Americans who are lactose intolerant.
Contact: Salam Ibrahim, 336-334-7328, ibrah001@ncat.edu

A Nutrition, Physical Activity and Behavioral Intervention Program to Improve Healthy Eating and Physical Activity Among Hispanic Women
Investigator: Sanchez-Lugo, L.; Melton, D.
Developing a diet and exercise program for Hispanic American women.
Contact: Lizette Sanchez-Lugo, 336-334-7850, lizette@ncat.edu

Prevention Program for Rural African American Families
Funding: University of Georgia
Investigators: Shelton, G.; McMillan, V.; Baldwin, M.
Testing and evaluating the feasibility of widespread dissemination and implementation of a family-centered program for rural African American families.
Contact: Valerie Jarvis McMillan, 336-334-7785, vmcmilla@ncat.edu.

A Strategic Alliance Between Farmers and University to Increase Farm Incomes
Investigators: Seo, C.; Purcell, R.; Ibrahim, S.
Establishing an efficient and economical model for a light processing plant for leafy vegetables, and providing training to farmers.
Contact: Chung Seo, 336-334-7933, seoc@ncat.edu

Department of Natural Resources and Environmental Design

Alternate Flooding and Draining to Enhance Nitrification in Marsh-Pond-Marsh Constructed Wetlands to Treat Swine Wastewater
Investigators: Hunt, P.; Reddy, G.B.
Improving nitrification and denitrification of swine waste in marsh-pond-marsh constructed wetlands.
Contact: G.B. Reddy, 336-334-7543, reddyg@ncat.edu

Animal Waste Management Practices and Alternate Treatment Technologies for Limited-Resource Farmers
Investigator: Reddy, G.B.
Investigating best management practices for animal waste management, with surveys of small hog farms in Alabama, Arkansas and North Carolina.
Contact: G.B. Reddy, 336-334-7543, reddyg@ncat.edu

Biotechnology Development for Improving Seedling Inoculation Efficiency and Transplanting Success Rates for North Carolina Truffle (*Tuber melanosporum*)
Investigators: Isikhuemhen, O.; Vilgalys, R.
Establishing method for quick, low-cost identification of truffles in host trees for North Carolina growers.
Contact: Omon Isikhuemhen, 336-334-7779, omon@ncat.edu

Commercializing Breadfruit Production in Jamaica
Funding: U.S. Agency for International Development; Environmental Foundation of Jamaica
Investigators: Gayle, G.; Panton, C.; Reddy, M.R.
In collaboration with the University of Northern Caribbean, Jamaica, investigating cost-effective and sustainable ways to commercialize breadfruit production to supply demand in U.S., Canada and Europe.
Contact: Godfrey Gayle, 336-334-7787, gayle@ncat.edu

Composting of Pelletized Wood Used as Bedding Material in Swine Production
Investigators: Shahbazi, A.; Li, Y.; Baldwin, K.
Studying the economic potential of using wood waste as a bedding material in swine production.
Contact: Abolghasem Shahbazi, 336-334-7787, ash@ncat.edu

Conversion of Cheese Whey into Value-added Products
Investigators: Shahbazi, A.; Ibrahim, S.; Shirley, V.
Harvesting value-added products from whey, including organic acids, cell biomass and antimicrobial compounds.
Contact: Abolghasem Shahbazi, 336-334-7787, ash@ncat.edu

Efficiency Improvement of *In Vitro* Regeneration for Chestnut Transformation
Investigators: Yang, G.; Glass, M.
Improving the rooting ability of micropropagated chestnut shoots to provide a reliable production protocol for transformation, toward a long-term goal of enhancing blight resistance.
Contact: Guochen Yang, 336-334-7779, yangg@ncat.edu

Expediting Production of Alexandrian Laurel
Investigator: Yang, G.
Developing a protocol for efficient germination of an ornamental evergreen shrub.
Contact: Guochen Yang, 336-334-7779, yangg@ncat.edu

Identification and Reduction of Nutrient Load at the Upper Haw River Watershed
Investigator: Reyes, M.
Determining sources of nutrients draining into the Jordan Lake, an important drinking water supply for Raleigh, Durham and Chapel Hill, so best management practices can be recommended and implemented.
Contact: Manuel Reyes, 336-344-7787, reyes@ncat.edu

Improving *Grifola frondosa* for High Yields and Medicinal Values
Investigator: Isikhuemhen, O.
Developing commercial strains of maitake mushrooms from indigenous sources, and examining for medicinal properties.
Contact: Omon Isikhuemhen, 336-334-7779, omon@ncat.edu

Improving Soil Quality through Soil and Residue Management
Investigators: Raczkowski, C.; Reddy, G.B.; Baldwin, K.
Evaluating effects of cover crops, compost, no-till on nutrient availability, crop productivity, and soil quality, and conducting workshops on techniques used to improve soil quality.
Contact: Charles Raczkowski, 336-334-7779, raczkowc@ncat.edu

Production and Characterization of Low-cost Biodegradeable Polylactic Acid Using Cheese Whey
Investigators: Shahbazi, A.; Li, Y.; Ibrahim, S.; Lou, J.; Willett, J.
Synthesizing and testing a biodegradable polymer from whey.
Contact: Abolghasem Shahbazi, 336-334-7787, ash@ncat.edu

Power Management and Distribution Using PV Technology
Investigators: Shahbazi, A.; Li, Y.; Roberts, K.
Funding: National Renewable Energy Laboratories
Simulating the performance of photovoltaic modules and power conversion systems using a transient simulation model.
Contact: Abolghasem Shahbazi, 336-334-7787, ash@ncat.edu

The Southern Region Water Quality Coordination Project — Swine Waste Treatment Technologies
Investigator: Reddy, G.B.
Funding: Texas A&M
Recovery of solids and phosphorus in swine wastewater.
Contact: G.B. Reddy, 336-334-7543, reddyg@ncat.edu

Specialty Crops in Rotation of Cover Crops, Nitrogen Management and Sustainability
Investigator: Reddy, M.R.
Determining the feasibility of production of specialty melon (sprite) and specialty corn (sweet corn) in rotation of cover crops; studying the effects of the two cropping systems on nitrogen and carbon; determining the potential leaching of nitrate in-situ from the decomposition of cover crops.
Contact: M.R. Reddy, 336-334-7779, muchha@ncat.edu

Treatment of Swine Wastewater and Herbicides in Constructed Wetlands for Water Quality
Investigator: Reddy, G.B.
Examining the effectiveness of constructed wetlands in treating swine wastewater and herbicides in runoff.
Contact: G.B. Reddy, 336-334-7543, reddyg@ncat.edu

Strong families, SAAF Families

Laura Smith left, and son, Jaymar Roudy engage in Strong African American Families — SAAF— a family intervention program, at Hoke County (N.C.) Cooperative Extension. Child development and family sciences researchers at N.C. A&T have partnered with the Center for Family Research at the University of Georgia to conduct a five-year study to evaluate the effectiveness of delivering a family intervention program through Cooperative Extension. Researchers on the SAAF project are Dr. Gladys Shelton, principal investigator, and Drs. Jean Baldwin and Valerie McMillan, co-principal investigators.

Re:information gshelton@ncat.edu

Use of Tobacco Transplant Greenhouses for Specialty Cut Flower Production
Investigator: Niedziela, C.
Evaluating the suitability and feasibility of tobacco greenhouses for production of cut flowers, and developing production systems and budgets for selected species.
Contact: Carl Niedziela, 336-334-7054, cniedzie@ncat.edu

Multidisciplinary

Assessment of Health and Safety of Black Farmers in the Southern Coastal Region
Investigators: Thompson, A.; Ibrahim, M.; Ahmedna, M.; Okafor, C.
Developing a database on health and safety data on African American farmers in the southern coastal states.
Contact: Alton Thompson, 336-334-7979, altont@ncat.edu

 cniedzie@ncat.edu

Dr. Carl Niedziela walks through a former tobacco greenhouse, the site for his research in cut flower production. He estimates that at least half of the state's tobacco greenhouses are now obsolete, due to the official end of the tobacco quota system. Farmers who once relied on the golden leaf as their primary source of income are now seeking alternative crops, and cut flower production in unused greenhouses could be one option. "The idea is to find alternative uses for tobacco greenhouses to give farmers some supplemental income," he says. "We've found that we are able to grow the plants in these environments, but we're still looking at the question of profitability."

Re: search

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