


Spring 2015

Rain, rain… Well I won't say go away since many of us are afraid once the faucet turns off, it may stay off. It would be nice to have a little less right now though. I've threatened to plant rice instead of corn on my research plots. The rain has given us beautiful wildflowers and the pastures look good, so I won't complain. Spring always renews our spirits and our hope.

As usual, folks around the College have been busy and we are bringing you just a few samples of some of the research and extension projects going on. There is fascinating work on perennial grains and a new potential bio-control for a problematic watermelon disease. We also have an article on immigration policy and how that has affected farm labor. Also, news of a grazing demonstration with overseeding of a forage mix. I hope you find these interesting.
Good growing,
Julia

Julia Gaskin
Sustainable Agriculture Coordinator
Crop and Soil Sciences Department
University of Georgia

Contents

Upcoming Events

Organic Certification Training:

May 5, 2015 - Sound and Sensible Organics
College Park, GA - Metro Atlanta Urban Farm

May 6, 2015 - Sound and Sensible Organics Part II
Atlanta, GA - Truly Living Well and Wheat Street Garden
The website has all the details and pre-registration forms: **www.ncat.org/events/**

May 20, 2015 - Spring Workshop for Small, Beginning, and Limited Resource Farmers
Columbus, GA

Find more information on these events at **www.SustainAgGa.org**
Also find basic principles of sustainable agriculture, Extension bulletins, research publications as well as archived copies of this newsletter.

UGA extension

Grower's Corner

High-Five to High Tunnels in the SouthEast

Growing under high tunnels continues to gain popularity across the U.S. and within Georgia. High tunnels or hoop-houses are essentially unheated, passively-vented, plastic-covered greenhouses that modify the microenvironment. They can provide protection from extreme weather events (ex. precipitation, heavy winds, etc.) resulting in higher yields and/or crop quality compared to an open field and expand season extension opportunities, especially during cool months.

Black landscape fabric was utilized for increased heat gain and row covers were draped over the plants when it was predicted to be below freezing.

The cost of a high tunnel structure can range anywhere from \$1.50 to \$5.00 per ft^2 depending on the design and materials. Typically the metal bows that provide the shape and integrity of the structure last for more than a decade, the wood framing for many years, and the polyethylene roof covering for 4 to 5 years. Studies suggest that it may take between 2 to 5 years to pay off the initial investment depending on factors such as experience-level, crop choices, market price, etc. For this reason, most growers optimize the amount of time the high tunnel is under cultivation with high value crops.

High tunnel cost-share programs are available to experienced farmers in Georgia. The National Resource Conservation Service (NRCS) administers this initiative under the Environmental Quality Incentives Program (EQIP). Between 2010 and 2014, NRCS awarded an average of \$5,800 for high-tunnel construction to more than 480 applicants in the state through local offices.

The majority of the information available about high tunnel production hails from colder parts of the country which does not always translate to our humid sub-tropical climate. We think that a wider array of opportunities exist to produce fall, winter, and spring crops under high tunnels here compared to temperate regions. However, SE farmers may have additional challenges to address such as more extreme daily and seasonal temperature fluctuations, different pest and disease complexes as well as soil quality management issues. To better understand these issues, we have started examining the production of cool-season, organic vegetables under high tunnels in Georgia.

Research Technician, Robert Tate, showing off a head of New Year's broccoli!

A two-year study investigating the performance of multiple cultivars of broccoli, cauliflower, baby turnips and ornamental cut kale began in Fall, 2014.

All of the crops were grown under two commercial-size, gothic-arch high tunnels located on certified organic land at the Horticulture Research Farm in Watkinsville. Vegetable cultivars included in the study were chosen based on advertised cold-tolerance and estimated days to harvest.

Three cauliflower cultivars evaluated in our 2014-2015 fall/winter study. Varieties L -> R Amazing, Denali, and Snowball.

The crops were planted at two different dates in October and were harvested from December through February. Data on crop yield, quality, and the microclimate conditions were collected. Preliminary results indicate that on the coldest winter nights, with minimum temperatures ranging from 11-22°F, our high tunnel systems maintained soil temperatures 10-15°F warmer and air temperatures 5-10°F warmer than the open field. Overall, crop quality appeared very high although plants were slower to mature than what would be expected with an earlier fall or spring planting date. In the coming months, we will analyze the differences among the cultivars and then repeat the study in 2015-16.

Volunteer extraordinaire, BJ Garrett, collects baby research turnips after data collections and transports them to the NE GA Food Bank.

Dr. Suzanne O'Connell
Assistant Professor
Horticulture Department
University of Georgia

Extension

Troup County Grazing Craze

Improving grazing quality has been on the minds of many livestock producers over the years. It is only recently that the idea has surfaced that you can improve both the grazing quality and the soil at the same time. The key to better soil quality is increasing the organic matter content of the soil. Raising soil organic matter by 1% can increase the water holding capacity of the soil by 27,000 gallons. It also can add as much as 1,000 pounds of nitrogen per acre, and 100 pounds of phosphorus, potassium and sulfur. In pastures, good grazing management is known to improve soil organic matter. Recently, people have speculated that improving the amount and the number of different kinds of forage in a pasture can increase the development of soil organic matter, because it increases the amount and variety of roots below the ground. The roots themselves add to soil organic matter as they die-back and decay. The living roots also produce organic acids, enzymes and other organic compounds that are the energy source for soil micro-organisms.

The plots were planted in late September into sod no-till. The bermuda was actively growing on the Vaughan Farm.

This project overseeded a mix of winter forages into existing pastures to see how these forage mixes would perform on two farms in Troup County. Much of the topsoil in Troup County was depleted many years ago by cotton farming and can use more soil organic matter, but this project did not measure soil organic matter directly. Two farm

UGA extension

families, the Hoffman's and Vaughan's participated in the project. The project was funded by the Natural Resource Conservation Service, Two Rivers Resource Conservation and Development, the Georgia Grazing Lands Conservation Coalition and the National Grazing Land Coalition.

Calibrating the planter is essential! The seed tubes were gathered together, the seed collected, and weighed after traveling 200 ft. The planter was adjusted and checked again.

We planted the mix of forage species into the living sod with a no-till grain drill in late September to disturb the least amount of soil as possible. Planting a potpourri of forages is a current trend in grazing. The Hoffman plot was planted with a mixture of alfalfa, medium red clover, hairy vetch, crimson clover, cereal rye, winter barley, turnips and radishes. The vetch, rye and barley were planted at a rate of 6.25 pounds/acre, the crimson clover at a little over three pounds/acre, 'Hunter' hybrid turnips at 1.5 pounds/acre, the 'Nitro' radishes and red clover at one pound/acre, and the alfalfa at just under a pound/acre. Calibrating the drill was a little different with the disparity of seed sizes. The smallest seeds were placed in the legume (small seed) box and the larger seeds in the grain (large seed) box of the drill. The legumes were inoculated before planting to ensure the right rhizobia was present to promote nitrogen fixation.

The Vaughan farm was planted with a mixture of hairy vetch, winter peas, and cereal rye at a rate of ten pounds/acre. Purple top turnips were planted at a rate of two pounds/acre and medium red clover at one pound/acre.

NRCS grazing specialist Philip Brown examines one of the turnips that survived the winter.

Neither field was irrigated and we experienced very sparse rainfall at both plots until December. With the first heavy rain, the seeds began to germinate, but it was too late for any of the turnips or radishes to germinate and provide fall grazing. The hairy vetch and winter peas began to make an appearance at the Vaughan farm, but only the vetch grew at the Hoffman farm. Grazing was restricted by electric fence until April 7th. The timely spring rains helped the rye, barley and clovers grow.

The vetch and winter peas at the Vaughan Farm.

Both plots were ready to graze by the beginning of April. Forest Hill of Two Rivers RC&D was impressed by how the hairy vetch sowed at what is considered a low rate, 6.25 lbs/acre and 10 lbs/acre, was the dominant species in both plots. The rye and barley were visible, but not a strong influence in the pasture mix.

The height of the forages was approximately seventeen inches. The grazing specialist with the Natural Resource Conservation Service, Philip Brown, visually estimated that the forage produced was at least 3.35 tons per acre. With a current market value of $100/ton that is $335 worth of forage. He also estimated that the vetch put at least 50 to 75 pounds on nitrogen back into the soil. Brown says the best way of improving the soil is with root growth. Root growth will decrease compaction and improve the environment for soil microflora as well as earthworms. We saw some qualitative evidence of this. While checking the fields, every shovel full of soil had earthworms in it. We also saw the nitrogen fixing bacteria were clearly visible in root samples as well.

Earthworms are alive and well in this pasture!

One of the preliminary conclusions from the test plots is that mixtures containing more than three species sown at low rates may be dominated by the forage species suited to the particular growing conditions on the farm. Without adequate rainfall in the fall, the turnips and radishes did not make much of an appearance and did not provide any fall grazing opportunities. The forage produced by the vetch was outstanding and more than adequate to provide for the needs of lactating livestock. Forages such as hairy vetch and winter peas tend to dominate in fields that have lower nitrogen in the soil because these can fix their own nitrogen.

Nitrogen fixing bacteria are attached to the roots of the legumes.

Improving the organic matter content is a long term project. Adding a mix of forages to winter pastures may help improve soil organic matter. Farmers should evaluate this practice and look at it on small areas on their farms to see what works best for them. They can then look at the cost of forage mixes compared to the benefits these provide.

Brian Maddy
Troup County Extension Agent
University of Georgia
LaGrange, GA

Research

Organic Farms and Immigrant Labor

It is no secret that many farms in the Southeast use undocumented workers particularly for seasonal tasks such as planting and harvesting. In 2007, when a more aggressive stance on immigration control began at the federal level, researchers from UGA and Fort Valley State University wanted to look at the linkage between these policies and the availability and cost of farm labor. They used organic farms as well as conventional farms for their research because organic farms are typically more labor intensive.

A survey conducted among organic and conventional farms in several states in the Southeast revealed that the majority of the respondents indeed had experiences of difficulty in hiring such workers, with the severity of the problem ranging from periodic ("sometimes") to constant ("always") frequencies. There were different strategies with conventional and organic farms to cope with gaps in the seasonal farm labor supply. Conventional farms primarily considered an input substitution scheme where more machinery will be acquired to reduce labor requirements.

This choice reflects the fact that the conventional farms are already more mechanized and typically had been in business longer than their organic farming peers. On the other hand, the most popular strategy for organic farms was to change production plans to involve less labor-intensive crops.

As part of the study, the researchers also interviewed several South Georgia organic fruit and vegetable farmers. These farmers laid out all sorts of strategies they have considered to lure domestic workers to work on their farms, including using WWOOFers, internships and help from friends and neighbors. When crops were obviously ready and overready for harvest, some farm families had to ask their children and spouses to take leaves of absence from school and office jobs to somehow help out in the farm. Family labor contributions, however, were usually not enough to fill in the work demands of their businesses.

The respondents confided that their hiring predicament and woes were more than just a wage issue. The greater challenge was finding skilled, productive, efficient workers among domestic workers and dealing with workers' work attitudes ("laziness"). These farmers cited their prospective employees' complaints that farm work was too taxing and that farm working conditions were unbearable. These workers would either shun farm employment or produce significantly below par outputs before eventually abandoning their farm positions.

Popular Strategies for Dealing with Farm Labor Scarcity
2007 Southeastern Farm Survey

Organic Farms	Conventional Farms

• Change Production Plans
  • Crop choice
  • Production Methods
• Family Labor
• Downsizing
• Reduce Off-Farm Work Time
	• Mechanization
	• Downsizing
	• Family Labor
	• Change Production Plans
	  • Crop choice
	  • Production Methods

Since the initial study, Georgia enacted a set of strict immigration policies in 2011 that almost resembled the controversial Arizona mode of immigration control. During that year a study conducted by the University's Center for Agribusiness and Economic Development and the Georgia Fruit and Vegetable Association validated that 80% of the study's respondent farms had labor sourcing problems that translated to about 5,244 unfilled positions and resulting in about $75 million crop losses in 2011 alone.

The only legal recourse for bringing in farm workers from other countries to perform farm jobs formerly held by the displaced illegal immigrants is the H2A farm guest worker visa program. Recently, the same team of UGA-FVSU researchers received another Southern SARE grant to investigate the effectiveness of this visa program. However, the H2A program has not been a popular hiring alternative among many farmers as the number of certified or approved H2A positions remains only a small fraction of the total number of workers hired by farm businesses in each year. This current project will provide a detailed analysis and evaluation of the H2A amended provisions from the producer's viewpoint.

Policymakers have been pressured to revisit existing legislation on H2A to identify areas of improvement in the current program provisions and procedures. Farmer groups nationwide have openly criticized the difficult, costly and cumbersome features of the current program. A meeting of minds between these two sectors would be crucial in resolving the farm labor scarcity predicament. This project has a strong potential of uncovering important issues that might help make the program a more useful and usable instrument to promote farm business growth. Although the H2A issue may currently affect more the larger organic farms that require more seasonal workers, a more improved H2A program with more simplified requirements and procedures may attract other organic farms to consider such hiring alternative to fill in their farm labor demands and expand their businesses.

Dr. Cesar Escalante
Associate Professor
Agricultural and Applied Economics
University of Georgia

Biological Control Seed Treatments for a Scourge of Watermelons

Watermelon is a popular crop with consumers and one of the most economically important vegetables in Georgia. The UGA Center for Agribusiness and Economic Development estimates the Georgia watermelon crop was worth $98.6 million in 2011. However, each year watermelon is threatened by plant diseases that can cause devastating yield losses. One of the most severe diseases is bacterial fruit blotch. This disease can directly reduce fruit yield and also impacts seed quality, since the pathogen is seedborne and transmitted from seeds to seedlings. There is a high risk of bacterial fruit blotch developing in Georgia during the watermelon growing season because high temperatures and high relative humidity favor the disease.

Bacterial fruit blotch can affect above ground parts of watermelon plants at all growth stages. Symptoms of the disease first appear on seedlings as water-soaked spots on the lower surface of the cotyledons (Figure A). On mature leaves distinct dark to reddish-brown irregular-shaped lesions develop along veins (Figure B). Fruit symptoms start as irregular water-soaked spots that appear greasy and olive-colored. Lesions start small, but rapidly expand on the upper fruit surface. Cracks can develop within these lesions, which may eventually produce amber- colored or effervescent ooze (Figure C).

Figure A *Figure B* *Figure C*

Bacterial fruit blotch is caused by the gram-negative bacterium, *Acidovorax citrulli*, which can be introduced into fields by infected seeds, seedling transplants, and infected volunteer watermelons or cucurbit weeds such as wild burr gherkin and citron melon. However, infected seeds are the most important source of the disease. Watermelon seed infection can occur when the bacterium infects the stigma of female flowers and migrates to the young fruit that produces seeds. Because the bacterium is deposited inside the seed, the pathogen is protected. In fact, the bacteria has been reported to survive for more than 30 years in stored cucurbit seeds!

Most farmers transplant greenhouse-grown seedlings to ensure a good stand, earlier harvest, and to increase the efficiency of seed use. Hybrid and triploid seeds are expensive so transplants are more cost effective. However, greenhouse conditions are highly conducive to bacterial fruit blotch development. In the greenhouse and the field bacterial fruit blotch can be spread by overhead irrigation that leads to splash dispersal of bacteria and by movement of contaminated irrigation equipment and infected plants.

Currently, there is no commercially available plant resistance to bacterial fruit blotch and a range of strategies are employed to manage the disease. These include producing pathogen-free seeds in regions with cool, dry climates and no history of bacterial fruit blotch. Seed treatments including fermentation, sodium hypochlorite, and hydrochloric acid are also used, but the effectiveness of the seed treatments varies widely because the bacteria can be located under the watermelon seed coat where they are protected from externally applied chemicals.

Consequently, despite these efforts, bacterial fruit blotch outbreaks continue to occur sporadically with severe economic consequences. We are currently working on a new seed treatment approach. This approach uses the same flower invasion pathway naturally exploited by the pathogen to deposit a beneficial biocontrol bacteria deep within the seed. Our research has shown that a non-pathogenic strain of *A. citrulli* (AAC00-1ΔhrcC) can be applied to watermelon seeds. This non-pathogenic strain will colonize germinating seeds and significantly reduce seed-to-seedling transmission of bacterial fruit blotch.

Now we are working to see if we can deposit the non-pathogenic bacteria as a biocontrol into the endosperm of seeds by inoculating female flowers (Figure D). Using the non-pathogenic strain of the bacteria that causes the disease has an advantage over other biocontrol agents because it can infest watermelon seeds and occupy the same niches as pathogenic strains. Introduction of the non-pathogenic bacteria this way has great potential for commercial adoption since vegetable seed companies could easily do this during their hybrid seed production operations. Current hybrid seed production systems require hand pollination of female flowers. We hope this will significantly improve the efficacy of biological control.

Figure D

We have conducted experiments to see how much of the biocontrol bacteria is needed to for effective control. Our data suggest that 107 CFU/blossom is optimal for seed inoculation under greenhouse conditions. This sounds like a lot of bacteria, but a flower can be inoculated with a single drop of liquid carrying the bacteria.

This summer we will begin field trials to generate watermelon seeds that are inoculated with the biocontrol agent, then we will test these seeds to see how well these limit bacterial fruit blotch seed-to-seedling transmission. This research will provide an ecologically safe and sustainable approach for managing bacterial fruit blotch and possibly other seedborne bacterial plant diseases. Ultimately, watermelon growers would benefit greatly from this biocontrol seed treatment strategy because they would have a reduced risk of bacterial fruit blotch outbreaks without additional effort. We are grateful for financial support from Southern SARE, who is funding this research through a graduate student support Grant.

Dr. Ron Walcott
Professor of Plant Pathology
and Safira Sutton
PhD Plant Pathology Candidate
University of Georgia

Perennial Grain Crops; Useful and Possible

At the beginning of the agricultural revolution, our ancestors domesticated annual plant species most likely for their large seeds and ability to survive in the disturbed environments created by humans. Thus, today's major grain crops, which supply the majority of human calories, are annuals. However, this basic feature of our staple crops — annuality — has begun to be reevaluated. Annual grain crops have been significantly improved over the past century thanks to plant breeding efforts. Yields have doubled for some grain crops since the 1950s, for example. However, as the global population increases, it is not clear if incremental increases in yield will be sufficient to meet future demands. Some have suggested simply expanding the planting area to boost yields. This could have serious risks in the form of soil degradation.

Soil degradation is the decrease in soil quality caused by improper use. It includes physical, chemical, and biological deterioration. Lands that are categorized as having moderate or severe soil degradation total an area larger than the size of the United States. Degraded soils are not productive for farming or for the natural ecosystem. Areas of the world like India, China, and parts of Africa have particularly severe levels of soil degradation (Figure 1).

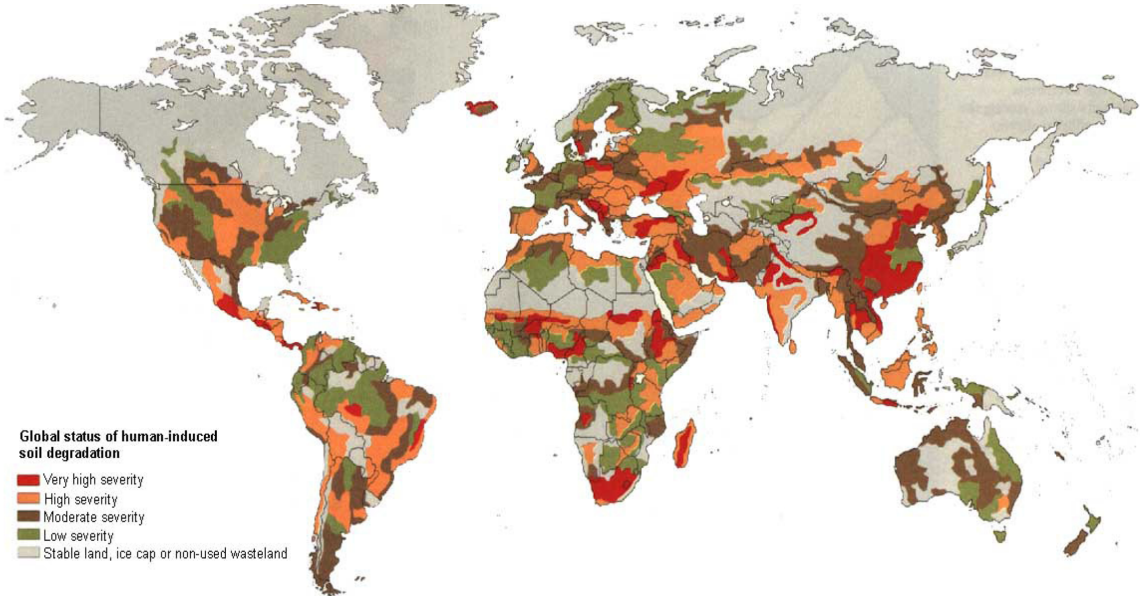

Figure 1. Human-induced soil degradation across the world. Source: Food and Agriculture Organization of the UN.

When annual crops are planted on lands best suited for them and best agricultural practices are used, they pose a low to moderate soil degradation risk. When planted on ill-suited lands, they pose a high risk. These ill-suited lands, also known as marginal lands, are defined by the Food and Agriculture Organization of the UN as having severe limitations for continual use due to "soil constraints, steepness of terrain, [or] unfavorable climatic conditions." Despite these adverse conditions, 50% of the world population is supported on marginal lands.

To avoid a high risk of soil degradation on already poor lands, we should not rely on increasing yields by planting annual crops on marginal lands. One solution for using marginal lands may be shifting to perennial crops.

Perennial species grow extensive roots systems that delve much deeper into the soil than annuals (Figure 2). These deep root systems are one of the reasons perennial plants can be useful on marginal lands. They help mitigate soil degradation by anchoring soil to prevent soil erosion and chemical runoff. The deep and extensive root systems of perennials add more soil carbon than annuals and can access deep water reserves typically out of range for annual roots. Perennial roots are also able to retain five times as much water and thirty-five times as much nitrate than annual species. After the first year of planting, perennial plants develop leaf canopies earlier than annuals, which shade out weedy competitors while also allowing for a longer season for photosynthetic light energy capture. Additionally, perennial species typically have better defenses against pests. These attributes of perennial plants not only make them good candidates enduring the severe limitations of marginal lands, but they could actually improve the soil conditions of those lands.

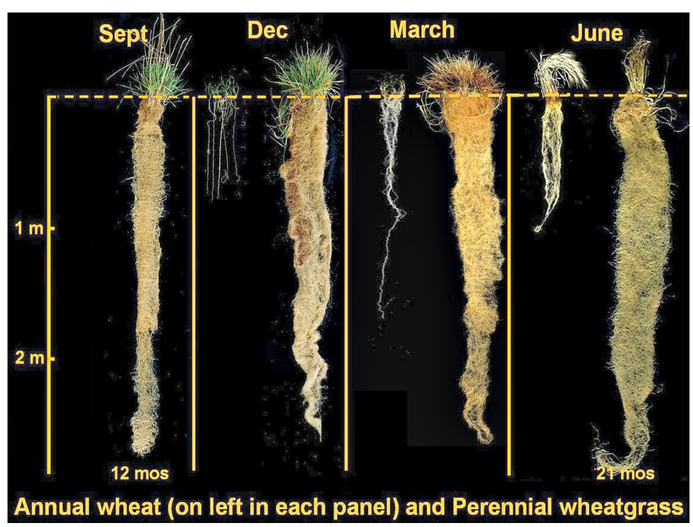

Figure 2. Roots of intermediate wheatgrass, a perennial grain candidate compared to those of annual wheat (at left in each panel). Source: The Land Institute.

Although there are perennial crops already available, there are currently no perennial grains. Scientists, working to solve the problem of meeting calorie demands of the growing world population without further destroying soils, have started to convert annual grain crops to a perennial growth habit.

The Land Institute in Salina, Kansas has been working towards developing a perennial farming system since the 1970s. For example, at the Land Institute, scientists have started to selectively breed intermediate wheatgrass, a perennial relative of wheat, for

Figure 3. Bag of Kernza flour from the Land Institute. Source: The Yale Sustainable Food Program.

higher yield and flour quality. This new type of intermediate wheatgrass is known as Kernza and is estimated to be a commercially available crop in ten years (Figure 3).

Fengyi Hu at the Yunnan Academy of Agricultural Sciences in China has developed a perennial rice variety that produces yields close to those of annual rice for four years or more. Hu and his colleagues say the perennial rice variety performs well on lowland paddies and will be ready for marginal land conditions after more breeding work.

Kernza and perennial rice are only two examples of the research being done on perennial grain crops. Scientists all over the world are beginning to ask questions about how to breed for perenniality and how to better understand the underlying genetic mechanisms at work. The Two research labs at the University of Georgia have recently joined the effort. Andrew Paterson of the Plant Genome Mapping Laboratory is collaborating with the Land Institute and other research partners to study perenniality in sorghum and Kelly Dawe of the Plant Biology and Genetics department has begun pilot studies of perenniality in corn.

Caroline Coatney
MS Plant Biology Candidtate
University of Georgia

Mark your calendars:

Organic Twilight Tour
June 23, 2015 Athens, GA

Sustianable Production Field Day
June 25, 2015 Watkinsville, GA

Georgia is home to several food hubs and new food hubs are being developed. Several new food hubs have asked us to help them identify growers who are interested in being part of a food hub. If you are interested in developing wholesale as part of your marketing plan, here are the new food hubs who have asked us to help get the word out:

Food Hub of NE GA in Rabun County, TJ Smith – foodhub@foodbanknega.org
The Local Source in Atlanta, Susan Pavlin - smpavlin@gmail.com

UGA Extension is developing educational programs to help growers with small farm business planning and production, particularly for small fruits and vegetables and small ruminants.