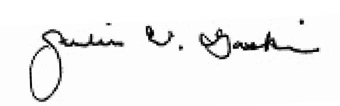



Fall 2018

Well , it's December. This is the time of year to take stock of the past year's growing season and start thinking about the year to come. It was a very "interesting" year weather wise, and heart-breaking for many of our farmers. Many are working hard to recover from Hurricane Michael and some may never recover. Over Thanksgiving the federal government released it's report on climate change. It is sobering news for agriculture and it appears extreme weather will become an increasing problem. The good news is that many of the sustainable ag techniques we often discuss can help mitigate the anticipated changes. This includes more diverse crop rotations, using cover crops, improved irrigation techniques (discussed in this newsletter), and integrated pest and disease management. But, this is not just a farming problem. We all need to be thinking about what we can do in our lives to help mitigate the potential changes we are facing.

Wishing you happy holidays.

Julia Gaskin
Sustainable Agriculture Coordinator



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Upcoming Events

January 23-26: Southern Sustainable Agricultural Working Group (SSAWG) Conference in Little Rock, AR

February 8-9: Georgia Organics Conference and Expo at UGA Tifton Campus

Find more information on these events at
www.SustainaAgGa.org

Also find basic principles of sustainable agriculture, Extension bulletins, research publications as well as archived copies of this newsletter at the above website.

UNIVERSITY OF GEORGIA
EXTENSION

Welcoming New Organic Vegetable Professor-Tim Coolong

Originally from the Adirondack Park region of upstate New York, Dr. Timothy Coolong obtained all three of his degrees (BSA, MS, and PhD) from the University of Georgia's Department of Horticulture. His work focused primarily on improving quality in Vidalia onions. After graduating in 2007 he became the Vegetable Extension Specialist at the University of Kentucky, where he had state-wide responsibilities for all vegetable crops. He mostly worked with small and mid-sized farms when he was in Kentucky, including organic producers. In 2013 an opportunity to return to his roots at the University of Georgia presented itself and he took the position as the state's Vegetable Extension Specialist, working out of the UGA Tifton campus.

Harvesting watermelons in Tifton, GA.

For the past five years he has worked with growers across the state of Georgia, but due to the higher concentration of large-scale farms in the southwest and southeast districts of Georgia, the majority of his time has been spent working on issues important to farmers in those regions. Dr. Coolong's research has focused primarily on variety evaluations as well as improving irrigation and fertilizer recommendations for vegetable crops in Georgia. Due to the more than two-dozen commercially-grown vegetables, he has been quite busy! Coolong's work has stretched beyond the borders of the state, as he has been invited to work on several international projects as well. In 2015, Dr. Coolong was invited to work with a group of educators in the Dakar region of Senegal to help make improvements to schools in the region that focused on experiential learning for young adults learning about farming techniques at the rural/urban interface. Then, in 2017, a collaborative project ect between USAID and Winrock International brought Dr. Coolong to Myanmar to help develop a regional melon production guide for growers to use throughout the region. He also spent time in Lebanon and Jordan , providing nutrient recommendations for the major vegetable crops in those countries.

Looking at an old well in the Dakar region in Senegal to establish an irrigation system for production fields at a local school.

Coolong (pictured fourth from right) with the team in Myanmar working on a regional melon production guide.

In 2018 Dr. Coolong made a transition with UGA as the new associate professor of organic vegetable production. Now back in Athens, Georgia, he has been transitioning throughout the fall as he prepares for the start in this new position in the new year. His position will be an even three-way split between Extension, teaching, and research, with a focus on organic vegetable production.

Dr. Timothy Coolong
Associate Professor
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Grower's Corner

SmartIrrigation

The United Nations Food and Agricultural Organization (FAO) reports that irrigated agriculture represents 20 percent of the total cultivated land but contributes 40 percent of the total food produced worldwide. One way to increase food production for an increasing global population is to increase irrigated lands. The FAO also reports that 70% of the planet's fresh water withdrawals are for agriculture – the vast majority of which are used for irrigation. Twenty-seven countries use more than 90% of their fresh water withdrawals for agriculture. So no, we cannot feasibly or sustainably increase irrigated lands if we continue to irrigate using current practices. However, we can significantly increase our irrigation water use efficiency by adopting SmartIrrigation.

SmartIrrigation allows us to grow more crop per drop by linking emerging technologies with fundamental knowledge of crop physiology. Fundamental knowledge allows us to understand the timing and amount of irrigation water required to capture as much of a crop's yield potential as possible. Our team has been developing SmartIrrigation tools ranging from smartphone based irrigation scheduling apps to dynamic variable rate irrigation (VRI). All use state-of-the-art technologies, incorporate fundamental physiology knowledge, and are designed to appeal to a diverse group of farmers.

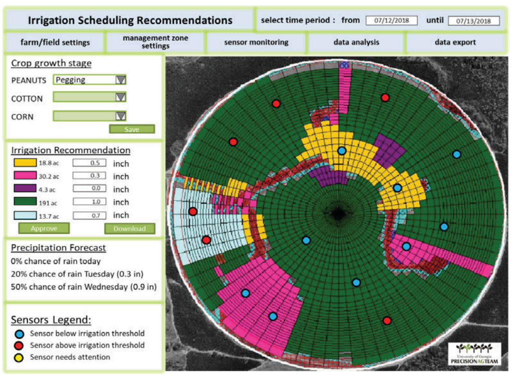
The SmartIrrigation apps, available for iOS and Android phones, are developed in conjunction with colleagues at the University of Florida and are available for a wide variety of crops including avocado, citrus, cotton, strawberry, vegetables (tomato, cabbage, watermelon), and residential turf. Apps for soybean and blueberry are in beta-testing with farmers and will be available in 2019. Corn is under development and will be available in 2020. All the apps use detailed weather data to estimate daily crop water use and send notifications when irrigation is needed. In studies, the apps have outperformed common irrigation scheduling methods. For example, over the past 5 years, the Cotton app has resulted in an average reduction of 44% in irrigation water use and an average 13% yield gain when compared to the UGA Extension calendar or checkbook method. More information is available at www.smartirrigationapps.org.

Screen shots from the SmartIrrigation Cotton App show notifications sent to the user(left) and the main app page that shows the moisture available in the soil profile (right).

VRI allows center pivots to apply different amounts of irrigation water to individual irrigation management zones (IMZs) within a field to address the variability in soils and crop water needs that exists in most fields. The application rates are coded into an application or prescription map. Currently most prescription maps are static meaning that once they are developed and the IMZs assigned application rates, those same rates are used throughout the growing season and year after year. This process can be improved by using actual crop water requirements to determine the application rates each IMZ. We call this concept dynamic VRI.

Dynamic VRI in action with the pivot delivering different water rates to the farmed area of the field. Note that the sprinklers are completely off over the non-farmed area which results in immediate water savings. Photo by Matt Hanner.

Our approach for creating dynamic prescription maps is to use large numbers of soil moisture sensors to estimate the amount of irrigation water needed to return each IMZ to an ideal soil moisture condition. Any soil moisture sensing system that can cheaply populate a field and transmit data wirelessly can be used but we have developed our own. Data from sensors are uploaded hourly to a web portal where decision support tools use the sensor data to estimate the amount of irrigation needed in each IMZ. These estimates are used to develop dynamic prescription maps that can be downloaded to the VRI pivot controller remotely. When the controller receives the new prescription map, it adjusts the application rates accordingly and each IMZ receives the prescribed amount.



Dynamic VRI user interface showing the field divided into irrigation management zones (IMZs) and the irrigation recommendations developed by the decision support tool. Irrigation recommendations are a function of soil moisture and crop physiology. The circles in the map indicate the location of soil moisture sensors. The user approves the recommendations and downloads the prescription map to the pivot controller.

We have tested our dynamic VRI system on farmer fields for the past three years on peanut and have achieved irrigation water use efficiency gains ranging from 16 to 40 percent and yield gains ranging from 2 to 4 percent. We are optimistic that we will achieve similar gains in other crops as well. Some pivot manufacturers are now in the process of offering their own dynamic VRI solutions. The use of irrigation technology such as SmartIrrigation and VRI help our growers become more sustainable by decreasing water use while maintaining yields.

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Research

Biocontrol with Benefits: Enhancing Sustainability by Adding Value

Peachtree borer, *Synanthedon exitiosa* (Fig. 1), is a major pest of peaches and other stone fruit trees in the southeast and throughout the USA. Currently, methods of control for peachtree borer include the use of broad spectrum chemical insecticides, primarily chlorpyrifos. Due to severe environmental and regulatory concerns alternative methods of control must be developed and their impact on cropping system assessed. Implementation of a targeted biocontrol strategy that positively impacts other aspects of the orchard system (such as overall plant health and suppression of plant diseases/plant-parasitic nematodes) could be a powerful approach in establishing sustainable orchard practices.

Figure 1: Peachtree borer larva (photo USDA)

This Southern SARE funded project builds and expands upon a previously funded SSARE grant focused on peach orchard systems. Our studies focus on integrating safe and effective biocontrol solutions into peach systems. Specifically, we are investigating the use of beneficial nematodes (also called entomopathogenic nematodes) (Fig. 2) for control of peachtree borer. These nematodes (unlike harmful plant parasitic nematodes) only attack insects or other arthropods and are safe to humans, plants and the environment. Results are relevant to both organic and conventional growers and will also be applicable to control of other insect pests in other cropping systems.

Figure 2: Beneficial nematode (USDA-ARS, Juan Morales)

In research conducted under our previously funded SARE grant as well as other related research we discovered that late summer and fall applications of the beneficial nematode, *Steinernema carpocapsae*, controls peachtree borer at the same level as chemical insecticides such as chlorpyrifos. In this approach, the nematodes are applied within the same timeframe as chemical insecticide application and can be sprayed using standard equipment including handgun, boom sprayer or trunk sprayer. In a curative approach, the nematodes can also be applied in applications in the spring to kill any remaining peachtree borers that were missed during summer/fall applications. This reduces damage to the trees and prevents a subsequent generation of peachtree borers from emerging and reproducing. Although the curative approach is highly effective when using beneficial nematodes, it is not an effective approach when using chlorpyrifos. The nematodes are applied at a rate of 1 million to 1.5 million per tree.

Despite the success indicated above, grower adoption in using nematodes for peachtree borer control may be hindered due to cost. Entomopathogenic nematodes cost approximately $15.00 per acre, whereas chemicals like chlorpyrifos may cost as low as $5.00 to $10.00 per acre. In our new research, we are investigating additional benefits that entomopathogenic nematode application may provide for peach production.

Additional benefits will enhance the attractiveness of entomopathogenic nematodes as biocontrol applications and thus lead to expanded use. Specifically, we are investigating the following potential benefits that may be gleaned from applying nematodes for peachtree borer contols:

- Control of harmful plant-parasitic nematodes (the "good" nematodes killing the "bad" nematodes).
- Control of various root-feeding weevils found in peaches (there are various root-feeding weevils that attack peaches in Georgia and Florida and elsewhere in the Southeastern USA).
- Suppression of the fungal disease *Armillaria* root rot, *A. tabescens.* A natural bacterial symbiont that is found in association with the beneficial nematodes has been shown to suppress *Armillaria* root rot in laboratory studies.
- Overall impact on tree health and productivity.

Preliminary research in other systems indicate high potential to achieve the benefits listed above. The findings will lead to effective incorporation of biological control methods into orchard cropping systems.

David Shapiro-Ilan[1] Brett Blaauw[2] Dario Chavez[3] and Larry Duncan[4]

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2 Departments of Entomology, University of Georgia
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Research

Biomanagement: Healthier Soils and Agroecosystems for Healthier Food

Soils are an essential natural resource that provide a host of important ecosystem services. In order to ensure a soil's sustained capacity to carry out these services, we have to consider the health of our soil resources. One way of doing this is by maintaining a healthy, balanced soil microbial community. The living communities within the soil perform many of the functions and services that we associate with healthy soils. Some of these functions are decomposition of organic material, retention and recycling of water and plant nutrients, and disease suppression. Our lab is doing research on a microbial inoculant that we refer to as LEM for Local Effective Microorganisms. LEM is unique compared to many other microbial inoculants in that it can be produced on-farm with simple, available ingredients and is derived from microbes that are naturally occurring in forests near the location where it is to be used.

Kishan Mahmud and Laura Ney making Local Effective Microorganisms (LEM) using on-farm inputs.

Our lab has been conducting research at the Organic 2 research plots at the JPC Sr., Research and Education Center in Watkinsville, GA. We are looking at the impacts of LEM on soil health, crop productivity, and nutrient density across a range of crops, fertilizers, and cropping systems. We collect data on the soil microbial communities, nutrient cycling in the soil, plant yields and crop nutrient density.

Research plots in the spring. Cereal rye cover crop can be seen here as the patches of green. CO_2 respiration chambers are installed in the previously mowed annual ryegrass plots.

When we analyzed the bacterial community of the LEM and soil where LEM inoculum was applied, both had a wide range of microbial diversity with multiple phosphorus-solubilizers and N-providing organisms (proteobacteria, actinomycetes, cyanobacteria, nitrospirae, acidobacter and firmicutes). This microbial diversity creates redundancy of function, which can provide plant nutrients under varied environmental conditions. We assumed this redundancy would result in agroecosystems that were more resilient and resistant to stress. We found LEM had the ability to improve resilience and stress resistance when used in low nutrient or disturbed ecosystems. For example, in biosolarized ("sterilized") soils, LEM application improved kale yield and leaf nitrogen concentration in soils that received no fertilization.

Biosolarization strips "sterilize" soils by preventing emergence of many annual weeds and controls soilborne pathogens and pests by increasing the soil temperatures to unfavorable levels for extended periods of time.

Data we have collected on LEM's effect on crop yield and nutrient density have shown calcium and zinc content of wheat grains and edamame beans to be higher in LEM-treated plots. This indicates a carbohydrate and protein source of food that is better balanced in macro (Ca) and micronutrients (Zn). This effect may be helpful in sandy soils and developing countries where micronutrients in diet is often deficient. LEM treated soybeans also had higher sucrose content (sweeter edamame beans) and higher ash content (minerals). While there are many more research questions to answer, so far we have found LEM to be an affordable, locally-available product that can fortify the sustainability of agroecosystems by building soil food-web function and resistance to these stresses and by improving N availability of manures.

Laura Ney, Kishan Mahmud, Subash Dahal,
Anish Subedi and Dr. Dory Franklin
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Grower's Corner

New Extension Publication: Organic Cool-Season Vegetable Crop Rotations for the Southeast

Interest in organic food has been growing over the past twenty years. In Georgia, growing conditions during the summer are particularly difficult for organic producers due to high insect, disease, and weed pressure. However, pest pressures are much reduced when the weather cools. The moderate conditions of late fall to spring are ideal for production of many cool-season crops in the Southeast, including many crops that are traditionally grown as summer crops in other parts of the country. Shifting cash crop production to the fall through spring season may allow farmers to produce high-value crops more efficiently. This strategy may be particularly effective for those interested in wholesale production.

Pictured here are vegetables from the cool-season crop rotation study (from left to right: carrots, onions, oat/Austrian winter peas, and broccoli). A sprinkler system was initially used to establish the carrots early on, and then drip irrigation was used after establishment to supply water more efficiently by delivering water directly to plant roots. Black plastic was used to help suppress weeds around the onions, a crop highly sensitive to weed pressure. The oats and Austrian winter peas (a cool-season annual legume) were planted as a cover crop mixture in this study.

This also leaves a window in the summer for cover crops that have many benefits. Cover crops are an integral part of an organic vegetable production system. One requirement of the USDA's National Organic Program (NOP) is that the farmer "maintain or improve the physical, chemical and biological condition of the soil and minimize soil erosion." Cover crops can help organic farmers meet these requirements. Using cover crops to build and maintain soil organic matter is particularly importantfor organic farms larger than 5 acres because using compost as a soil amendment to build or maintain soil health can become expensive.

The key to maintaining soil organic matter is adding more carbon than is lost from the soil. Carbon is the major component of soil organic matter. This can be challenging for farmers in the Southeastern U.S. where the relatively warm and moist climate creates conditions conducive to microbiological activity nearly year-round. Most soil carbon is lost as carbon dioxide as the soil's microbial community breaks down organic matter. Summer cover crops such as sorghum-sudangrass hybrids or sunn hemp can produce 10,000 pounds per acre of aboveground biomass, which is about 4,000 pounds per acre of carbon, plus a similar amount of below-ground biomass in the roots. Even cover crops that produce lower biomass, such as buckwheat or millet, still add carbon to the soil. Consequently, cover cropping is a critical practice for maintaining soil organic matter.

This bulletin (1498) discusses organic cool-season vegetable production and gives guidance for maintaining both soil health and successful vegetable production. You can find this publication at: extension.uga.edu/publications.