J. PHIL CAMPBELL, SR., NATURAL RESOURCE CONSERVATION CENTER

JPC Research Update

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Highlights

- Training to Facilitate Adoption of Conservation Tillage
- Cows and Cotton in the Same Field
- Cover Crops for Soil Carbon and Grazing

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From the Research Leader

The rapid growth of the Southeast continues to place additional demands on the agricultural sector to meet environmental and conservation standards. The Conservation Center's staff is committed to meeting the needs of agricultural producers and society at large by providing tools to retain agriculture and protect natural resources. Many of our research products are already finding application on farm and providing additional income for producers. Even in the light of our success maintaining a vital and productive research program continues to be a challenge in an era of declining funding and increasing costs.

The employees of the Conservation Center appreciate the support of those who utilize our research and we are proud of the accomplishments of the past year.

Dr. D.W. Reeves

Tailoring Training for the Trainers

As conservation agriculture acreage in the Southeast continues to increase, County Extension agents in Georgia identified a critical need for training in conservation tillage to meet the information needs of producers. A multi-disciplinary conservation tillage educational Task Force, comprised of University of Georgia College of Agriculture and Environmental Sciences (UGA-CAES) staff, USDA-NRCS personnel, USDA-ARS research scientists from the J. Phil Campbell Sr. Natural Resource Conservation Center, Watkinsville, GA, and the Conservation Systems Research Team, Auburn AL developed a training program for Georgia's county agents. A survey of the county agents was conducted to determine their specific training needs and attitudes towards conservation tillage. The survey indicated most county agents had a positive attitude towards conservation tillage, but their knowledge was weak in differences between conservation systems and conventional systems in terms of: economic inputs, equipment, changes in soil quality and fertility, effects on yields and quality of different commodities, and specifics on how to implement conservation tillage practices. Based on the survey, the Task Force developed tailored educational modules and conducted classroom and field training to improve the knowledge level of conservation agriculture for the 90 county agents with agronomic responsibilities in Georgia. The agents significantly improved their knowledge related to soil, water, and agronomic management practices in conservation tillage systems, as indicated by a post-training exam. Some 96% of agents rated the training 'excellent' and 98% would recommend the program to other agents.

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Meeting critical needs for training the trainers

Sunn Hemp Shines as a Cover Crop

Because of the mild winter conditions in the southern USA, many vegetable producers grow crops in both summer and winter. Cover crops grown during periods when no cash crop is grown help maintain soil organic matter. Agricultural Research Service scientists from the J. Phil Campbell, Sr. Natural Resource Center in Watkinsville, GA and the Soil Dynamics Laboratory in Auburn, Al, along with scientists from the University of Georgia and Virginia State University evaluated how to best manage sunn hemp (*Crotalaria juncea L.*), a tropical legume as a cover crop/green manure in the South. The researchers evaluated planting and harvest date effects on sunn hemp biomass and N production at a Piedmont and Coastal Plain location in Georgia. In general, maximum biomass was produced from May and June plantings, depending on the harvest date. Averaged across locations and planting dates, sunn hemp produced 2.1, 3.9, and 4.9 tons/acre biomass and 110 to 180 lb nitrogen/acre after 60, 90, and 120 days, respectively. The researchers developed equations to predict sunn hemp biomass and N accumulation using days after planting and data from the two Georgia locations. This equation did a good job of predicting sunn hemp biomass production for three previous studies in Alabama and one in Virginia and may help producers determine the optimum timing for planting and harvesting. Sunn hemp would be a good summer cover crop/green manure for use on the more than 4 million acres of vegetables and 7 million acres of corn grown in the South.

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"Sunn hemp would be a good summer cover crop/ green manure"

Sunn Hemp in Flower

Grazing and Cover Crops with Wheat and Corn

Integration of crop and livestock operations has the potential for solving many maladies facing modern agriculture by improving nutrient cycling, soil quality, and environmental quality, as well as diversifying farm income. Scientists at the USDA – Agricultural Research Service in Watkinsville Georgia conducted a field experiment during four years to determine (1) the impact of grazing cattle on crop production components, (2) the choice of tillage system on crop and cattle production, and (3) how tillage and cover crop management might impact economic return. Grazing of cover crops by cattle caused a slight reduction in corn grain yield, but had no effect on wheat grain yield compared to a system with unharvested cover crops. Conservation tillage improved corn grain yield, produced greater cover crop biomass production, and contributed to greater cattle production than conventional-tillage management. Economic return followed the order: conservation tillage with grazing of cover crops > conventional tillage with grazing of cover crops > conservation or conventional tillage without grazing of cover crops. This study suggests there is great potential to improve farm-level economic stability and increase economic return on the existing 26 million acres of cropland in the southeastern USA by adopting conservation-tillage management and allowing cattle to graze cover crops.

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Cattle can efficiently and economically defoliate winter cover crops

Tillage-Based Water Conservation

Water utilization is a contentious issue among stakeholders in Georgia and neighboring states. Georgia is forming a statewide water management plan as mandated by The Comprehensive Statewide Water Management Planning Act of 2004. One objective of the plan is to minimize withdrawals of water by increasing conservation. This will affect the farming community, particularly in irrigated agricultural areas. Irrigated water use in Georgia averages about 1.1 billion gallons/day out of a total of 6.5 billion gallons per day. Conservation tillage has great potential for increasing water use efficiency in irrigated and non-irrigated croplands. Conservation tillage minimizes soil disturbance and maintains residue on the field which ultimately leads to increased infiltration. We compared water infiltration from no-till and conventional tillage cotton with rye cover crop. We found an extra 6.9 inches of rainwater infiltrated with no-till in one year, representing about 14% of the average annual rainfall. Over the three million or so acres of harvested croplands in Georgia this would amount to about 564 billion gallons of water annually. Runoff was reduced to less than 2% of annual rainfall soon after conversion to no-till and winter cover crops. Conventional cotton grown each year for 20 years lost an average of 20 tons of soil per acre and 21% of the rainfall annually. Georgia's current draft water conservation plan rightly targets potential waste in irrigated agriculture through retrofitting wasteful irrigation components. Conservation tillage is a tool that is ignored even though it offers water conservation both in irrigated and non-irrigated agriculture.

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Reduced runoff and sediment from conservation tillage (top photo) and increased runoff and sediment from conventional tillage (bottom photo)

Water Quality Protection and Poultry Litter Applications

The poultry industry generates millions of tons of poultry litter annually, much of which is applied to pastures and cropped fields as fertilizer.

Fecal bacteria, some of which are pathogenic to humans, and the potent sex hormones, estradiol and testosterone, are natural components of litter. Scientists, policy-makers, and the poultry industry require information to determine if these components pose an environmental risk when litter is appropriately applied.

Scientists at the USDA-ARS J. Phil Campbell Sr. Natural Resource Conservation Center in Watkinsville, GA, determined the fate and transport of fecal bacteria and sex hormones in the environment from litter applied as nitrogen fertilizer to four cropped watersheds under conservation tillage in the Piedmont area of northeast Georgia. They found that rain events occurring shortly after litter application increased levels of fecal bacteria in runoff, which may impact surface water quality. However, litter applications did not increase the level of sex hormones in the environment.

The scientists cautioned that other researchers have reported higher levels of sex hormones in litter than found in the litter used in this study, therefore, they cannot conclusively say that applying litter at appropriate agronomic rates will not increase estradiol and testosterone in the environment. They recommend that further research is needed to determine the range of hormone concentrations found in litter from various operational practices, and to identify management practices that minimize hormones that may be released to the environment. This information can be used by the poultry industry and environmental agencies to ensure safe application of the 14 million tons of poultry litter generated annually in the USA.

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"further research is needed to determine the range of hormone concentrations found in litter "

The poultry industry is a key part of agriculture in the Piedmont

Animals Did Not Prefer Endophyte-Free Fescue

Tall fescue is the principal cool-season forage grass in the humid areas of the USA. However, there is a fungus that lives within the fescue (an endophyte) that results in decreased animal performance because it produces toxic alkaloids that cause toxicosis in grazing animals. The problem results in losses of over 500 million dollars a year. An improved cultivar named "Jesup" is currently available with a nontoxic endophyte which is marketed as "MaxQ". This combination-has shown improved agronomic performance and warrants further evaluation as a feed for ruminants.

Researchers at the Conservation Center teamed with a USDA-ARS Scientist from the Plant Science Research Unit in Raleigh, NC to test animal preference for hays made from Jesup tall fescue that varied in endophyte status. Hays either had no endophyte, the nontoxic endophyte, or a wild-type endophyte that produces toxic alkaloids associated with fescue toxicosis. We tested for preference using goats, sheep, and cattle. Animals preferred the cut of hay with the greater nutritive value over a second cut of hay; however, endophyte status was not a factor in the preferences. It appears that there is no effective mechanism that results in animals preferring fescue without the toxic alkaloids. This means that it is unlikely that animals will preferentially select improved fescues and avoid plants with toxic endophytes. This information is important in renovating the approximately 30 million acres of fescue in the USA. Renovation to eliminate the fescues with toxic fungal endophytes is more likely to be successful since it does not appear that animals will over graze the newer cultivars.

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Fescue hay is one of the primary supplemental feeds in the Southeastern USA

"...it is unlikely that animals will preferentially select improved fescues and avoid plants with toxic endophytes"

Grazing of Stockpiled Fescue as related to Fungal Endophyte

Stockpiling is the practice of deferring grazing of selected fescue pastures until mid to late winter. The can greatly reduce the need for conserved forages and reduce the cost of maintaining a herd in the winter. In the use of tall fescue, introducing novel endophytes that don't produce the toxic fungal alkaloids can prevent negative impacts on animal performance while improving stand persistence.

Over a period of 3 years cooperating ARS scientists from Watkinsville, GA and Raleigh, NC partnered with a researcher in Columbia, MO to test for impacts of these fungal endophytes on nutritive value and agronomic performance of fescue stockpiled for winter grazing. We utilized 'Jesup' tall fescue with a novel endophyte (Max Q), a wild type endophyte, and without any endophyte. With all three types, forage was accumulated from mid-August with grazing and forage nutritive value estimated in the middle of October, November, December, January, and February. The endophyte status did not influence production of forage, forage removed by grazing, proportions of leaf, stem, and dead material, or nutritive value (except for the presence of the toxic alkaloid in the wild type). However, as grazing was deferred later and later through the winter, stand loss occurred and stand loss was more severe in the fescue without any endophyte. Both the wild type and novel (Max Q) had some stand loss but they were similar. The results support the use of the novel (Max Q) endophyte in 'Jesup' Fescue for winter stockpiling. It is also important for managers to keep in mind that some stand loss is likely to occur. In some years, weathering may result in a gradual loss of available forage. A decrease in digestibility from approximately 75 percent to the upper 60s is likely. Crude protein was relatively stable. Stockpiling fescue with the wild type endophyte past December decreased levels of the toxic alkaloid.

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"The results support the use of the novel (Max Q) endophyte in 'Jesup' Fescue for winter stockpiling."

Aeration of Soil to Protect Water Quality

Surface-applied manures are of particular concern in the Southern Piedmont (USA) because of a high concentration of broiler production and increasing dairy production in the region. As these manures can contribute to phosphorus (P) in runoff, a study was conducted to examine the water conservation potential of mechanical aeration of grasslands which has potential to reduce P transport by increasing infiltration of rainfall and binding of P with soil minerals. Scientists from the USDA-ARS J. Phil Campbell Sr., Natural Resource Conservation Center, the University of Georgia, and Mississippi State University examined the effects of three aeration treatments and a control (aeration with cores, "no-till" disk aeration perpendicular to the slope, slit aeration with tines, and no aeration treatment) on the loss of sediments, particulate forms of P, and dissolved forms of P in overland flow induced by rainfall. Broiler litter, dairy slurry, and no manure were evaluated before (January) and after (June) simulated compaction by cattle. Rainfall simulations were done on a typical southeastern clay soil (Cecil series) with mixed tall fescue-bermudagrass vegetation on 8 to 12% slopes. Manures were applied to meet P requirements of the vegetation. Aeration influenced the form of P lost in overland flow before and after simulated compaction. The core aeration treatment had greatest reductions in P losses. When broiler litter was applied, export of particulate P was reduced by 55% and dissolved P was reduced by 62% on core-aerated plots compared to controls. Core and no-till disk aeration also reduced P export from applied dairy slurry. Given that Cecil soil is common in pastures receiving broiler litter in the Southern Piedmont pairing core aeration of these pastures with litter application could have a widespread impact on surface water quality. This information can be used by land management planners to develop more efficient nutrient management strategies and more productive forage systems to reduce contamination of nearby aquatic systems.

"… to develop more efficient nutrient management"

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Aeration with Cores

Aeration with Slits

Aeration with Disks

Cattle and Cotton Production Combined

We are in the second year of a new project to study the costs and benefits of grazing stocker cattle on winter annual forage. We will determine spatial effects of winter grazing on cotton production and use this information along with costs associated with cover crop establishment and returns from grazing stocker cattle to develop an economic assessment of each system. We will establish criteria for management zones and decision aids for alleviating subsoil compaction following grazing. The ARS location at Watkinsville is cooperating with the USDA-ARS Soil Dynamics Lab in Auburn, AL for this research project.

We'll be able to determine spatial and economic effects of grazing winter annual small grains with stocker cattle on cotton production.

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USDA-ARS

Research to sustain agriculture and protect the environment

The J. Phil Campbell, Senior, Natural Resource Conservation Center was established in 1937 by the United States Department of Agriculture with a mission to reduce soil erosion from agricultural lands. As part of the Agricultural Research Service the current mission of the Center is to conduct research to improve crop and animal production practices and protect soil, water and air resources. The Center is located on more than 1100 acres in Oconee County and has a herd of 500 to 600 Angus cattle. The Center's budget of nearly 3 million dollars supports scientists and staff who work together with other ARS and University of Georgia scientists as well as land owners and managers solving problems that impact all residents of the Southern Piedmont.

Sources of Additional Information about our Research

Fact Sheets — http://www.ars.usda.gov/Main/docs.htm?docid=13762
Publications:
Integrated Watershed Research —
http://www.ars.usda.gov/Main/docs.htm?docid=14775
Integrated Farming Systems —
http://www.ars.usda.gov/Main/docs.htm?docid=13356
Manure Management to Protect the Environment —
http://www.ars.usda.gov/Main/docs.htm?docid=13409
Soil Management and Carbon Sequestration —
http://www.ars.usda.gov/Main/docs.htm?docid=13368
Water Quality and Conservation —
http://www.ars.usda.gov/Main/docs.htm?docid=13343

Conservation for Yield and Drought

Soil management practices like conservation tillage must be evaluated at the field scale because producers are reluctant to adopt management recommendations derived from small plots. ARS scientists at the J. Phil Campbell Sr. Natural Resource Conservation Center, Watkinsville, GA and the Soil Dynamics Research Unit in Auburn, AL, cooperated with Auburn University scientists to determine the impact of management practices on yield, soil water, and indicators of drought stress for cotton grown in a 20 acre field in Alabama.

Conventional systems and conservation systems were tested. In conventional systems, tillage consisted of chisel plowing/disking + in-row subsoiling; no cover crop was used in winter. Conservation systems consisted of only non-inversion in-row subsoiling plus winter cover crops to provide 4 to 6 tons/acre of residue for complete soil coverage. Management practices were arranged so as to cross the maximum landscape variability in the field. Conservation systems had greater rainfall infiltration, improved water use efficiency and less drought stress, resulting in 14% higher yields compared to conventional systems.

Yearly variations in yields were also reduced with conservation systems. The study showed conclusively, even at the scale of operations used by producers, that conservation systems using no-tillage and high-residue producing cover crops minimized drought stress, reduced economic risks from yield variations, and increased cotton yields.

This information can be used by State Cooperative Extension Systems, USDA-NRCS, crop consultants, and producers to promote the use of environmentally and economically sustainable conservation practices on the 3.1 million acres of cotton grown in the Southeast.

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