Inside CEFS

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News Briefs:

NEWS BRIEFS

From the Director

Having just returned from the 15th IFOAM (International Federation of Organic Agriculture Movements) World Congress in Adelaide, Australia, I'm very excited about our ongoing work in organic agriculture. IFOAM is the worldwide umbrella organization for the organic movement, representing 771 member organizations in 108 countries. The congress meets once every three years. Over 350 papers were presented at the IFOAM conference. This year was especially interesting because IFOAM was combined with the first ISOFAR (International Society of Organic Agriculture Research) conference. This new scientific society, organized in 2003, promises to be an important outlet for connecting the worldwide organic research community. More than 150 scientific papers were presented through ISOFAR from researchers representing thirty countries. Most interesting for me was attending the full day of presentations about long-term organic research projects from around the world. The long-term research group met following the session to discuss continued interactions for discussions about process and data. As a result, CEFS has been invited to submit a paper on our long-term research trial for a book that is currently in preparation by the group. I am pleased that CEFS will be a part of this important new collaborating group.

We continue to deal with the spiderwort issue at CEFS. Dean Wynne, Steve Leath, and Roger Crickenberger visited CEFS in early October to get a first had look at our process for detection and eradication. They were pleased with what they saw (and didn't see!). In the meantime, spiderwort has been found at various other locations including the Tidewater Research Station, the Horticulture Field Lab at the Raulston Arboretum, and a field in Sampson County. Plants have also been found waiting to be sold to the public in landscape materials at some major suppliers in North Carolina including Wal-mart.

We are pleased to have two new individuals hired who will start this fall and winter and who will add tremendously to the CEFS program and their respective departments. The first, Chris Reberg-Horton, has been hired to fill the organic cropping systems faculty position in the Crop Science department. Many of you know Chris as his Ph.D. was completed in the NCSU Horticultural Science Department in 2002. Since that time, Chris has been a faculty member at the University of Maine in the area of Sustainable Agriculture. Chris brings expertise in a variety of areas including organic production of agronomic crops, organic dairy systems, cover crop use and management, allelopathy, and on-farm research. Chris received his undergraduate degree in 1994 in Environmental Science at

UNC-Chapel Hill and his M.S. degree from the University of California at Davis in Agricultural Ecology in 1997. Chris anticipates starting at NC State in December.

The other new hire about whom we are thrilled is Steve Moore from Pennsylvania. Steve is being hired by NC A&T State University as a research/extension associate to facilitate research by NC A&T SU faculty and also to help develop an extension and outreach small farm program at CEFS. Steve has extensive experience as a farmer and educator, most recently in Pennsylvania. He has served as Director of the Center for Sustainable Living at Wilson College where he initiated several grant funded projects including a sustainable food initiative in the college dining facilities. At the Center he also developed a 135 member CSA farm. Steve was also a founder of the Robyn Van En Center, a non-profit resource for Community Supported Agriculture. Steve has a keen interest and expertise in energy related issues in agriculture, and we are excited about integrating that interest in a range of CEFS activities.

CEFS recently received a grant from the Institute of Conservation Leadership and the Council for Agriculture, Science, and Technology (CAST) to begin a dialogue between CEFS partner organizations, the North Carolina Farm Bureau, North Carolina's sustainable agriculture groups, and North Carolina agriculture and horticulture commodity groups. While all of these important organizations are concerned about the future of North Carolina's agriculture, poor communication has hindered the development of working relationships on important and evolving issues. By hosting a forum of these organizations, we hope to initiate an environment that fosters dialogue among members of these organizations and contributes to an infrastructure for preserving a strong agricultural future in North Carolina.

This November, CSREES/NRI is bringing all of their Project Directors funded through the National Research Initiative – Managed Ecosystems Program (NRI 23.1) and the Agricultural Prosperity for Small and Medium Sized Farms Program (NRI 66.0); and selected Project Directors of the former Initiative for Future Agriculture and Food Systems program and other Federal Administration together for a meeting in Washington DC. We have been invited to present information about the CEFS farming systems and organic research as a case study for the group.

CEFS was on display at the North Carolina State Fair this October as part of the "Our Land, Our Legacy" tent. We were part of an exhibit on sustainable agriculture and farm preservation with several other local organizations. In addition, CEFS had a booth at the National Small Farm Conference held in Greensboro this year and several CEFS researchers gave presentations at the conference. Next on the outreach agenda is the Carolina Farm Stewardship Association's Annual Sustainable Agriculture Conference which will take place in Durham November 4 – 6.

–Dr. Nancy Creamer, CEFS Director

Fall Farm Activities

Weather conditions during August and September have been dry. Corn harvest is complete and we're getting ready to start harvesting the soybean crop. Most of the crops had a reduction in yield due to the dry conditions.

Tropical Spiderwort (TSW) continues to grow with the hot humid conditions. Plant Industry and University staff continue to survey station property regularly to record findings and apply treatments. Compliance agreements are in place outlining regulations and procedures to be followed to control and eradicate TSW.

Planning funds were provided by the Legislature for a joint facility with the Wayne County Cooperative Extension, Farm Service Agency, Natural Resource Conservation Service, Cherry Research Farm and the Center for Environmental Farming Systems. The funding was provided to Wayne County for the planning phase. We will be seeking input from the different organizations to design a facility that will meet all of our needs. This facility could provide broad resources to our agricultural community.

The swine hoop houses are near completion. The final inspection should be completed in October. We currently have three 40' x 90' finishing houses and a gestation house. Plans are to work with Morgan Morrow and Eric van Heugton in the production of antibiotic free pork.

–Eddie Pitzer, Station Superintendent

Four deep-bedded hoop houses for swine production are near completion at CEFS.

News and Notes from NC A&T

We at NCA&TSU continue to work to refine our vision of our role at CEFS. We will certainly continue to participate in the on-going operation of CEFS. That means staying involved in planning and implementation of each of the units at CEFS; participating in the planning of next year's celebration of CEFS; engaging in projects that use CEFS as a base, such as the North Carolina Choices project; and helping to design and implement the student intern program.

But we are also looking beyond all of these "action steps" to questions focused on the bigger picture. How can we implement a planned research and education program at CEFS to address needs of small, part-time and limited resource farmers in eastern North Carolina? Can we see, somewhere in all the goings-on, a place for a vision of "A&T East"? What mix of research and education programs might

make that happen and serve the needs of small farms in the eastern part of the state?

We have been working on several elements of our plan and have brought them together in a proposal to our administrators at NCA&TSU. The plan covers production topics in crops and livestock as well as a broader theme of "agricultural literacy" as an educational program for school children. Over the next several months we will discuss each of these in turn, but let us begin with the agricultural literacy program.

Less than two percent of all Americans are involved in agriculture and it is generally agreed that most Americans have very little understanding of anything related to agriculture. This has been shown to be true not just in big cities like New York or Baltimore, but also in rural communities like Des Moines, Iowa or even Goldsboro, North Carolina. Recognizing the problem, the Agriculture and Natural Resources (ANR) program at NCA&TSU began an Agricultural Literacy program at the A&T farm in Greensboro. Dr. Keith Baldwin wrote the proposal, and Ms. Travella Free has made the program a success. Last spring almost 3,000 elementary and middle school children got an educational hands-on tour of the A&T farm through this program.

In collaboration with the intrepid local radio personality and CEFS Small Farm manager, Bryan Green, Travella is planning to duplicate the program of an experiential educational tour at the CEFS Small Farm for the benefit of Wayne County schools and educational units (and those in neighboring counties). There will be a student worker-guided tour around the Small Farm with educational teaching points for teachers and students. They will have the opportunity to learn about erosion, soil types, season extension techniques, irrigation, goats, chickens, blueberries, and more. Sound like fun? Sound like an opportunity to learn about opportunities to create new local food systems for and with small farms? Stay tuned!

–Dr. John O'Sullivan, Farm Management & Marketing Specialist

The Farming Systems Unit

We have faced a number of challenges in the FSRU this year, but things are progressing and at the writing of this update we have taken all of our harvest data for the corn in BMP and organic systems, and corn and sorghum in the crop/animal system. Sporadic dry weather during pollination reduced corn yields and it is estimated that birds have consumed 20-40% of the sorghum grain.

In the transition to organic study nested within our organic system, we have sweet potatoes that are doing well and not far form harvest and cabbage that has just been established behind wheat. Dry weather has caused some losses of cabbage transplants (10-18%) and triggered replanting operations. Recent rainfall of about 2 inches has relieved the drought stress for now, but the soil profile has been depleted and we will need more rain soon to keep things moving forward.

Matt Finney and his crew have been doing a great job of keeping on top of the tropical spiderwort problem by GPS mapping and eliminating any emerging seedlings.

Warm-season pastures that were established this year in the crop/animal system are doing well enough that a hay cutting will be taken soon. The cool-season fescue pastures are being readied for fall grazing that will begin in October or November depending on seasonal rainfall.

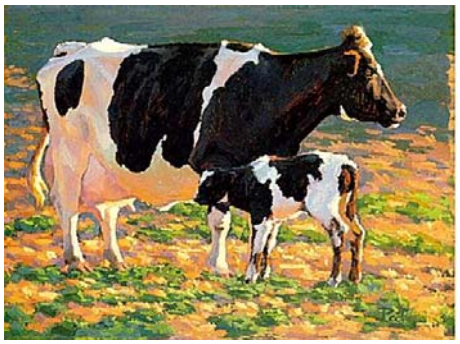
–Dr. Paul Mueller, Farming Systems Unit Coordinator

A stand of longleaf pine in the woodlot system at CEFS

Anticipation Time at the CEFS Dairy Unit

The CEFS dairy experiences an incredible change in pace as the dairy herd proceeds through the seasonal calving period from October through mid December. Following this, we undertake breeding yearling heifers and rebreeding the lactating cows in January to early March. In the fall of 2005, we are expecting more than half of over 160 calves to be born in the month of October alone!

It is no wonder that that the pulse beats a little faster as we look forward to seeing the black and white Holstein calves, the small brown Jersey calves, and the multi-colored crossbred calves that carry genes of varying percentages of both Holstein and Jersey. The poet, Robert Frost, captured some of the magic of calving time as he penned the first verse of "The Pasture":



I'm going out to fetch the little calf
That's standing by its mother.
It's so young,
It totters when she licks it with her tongue
I shan't be gone long – you come too.

There are advantages and disadvantages of seasonal calving dairy herds as well as some tricks used at CEFS to make it work well. Within the last 2 to 3 weeks of pregnancy, all expectant cows are moved to a pasture area reserved for calving. That area is used only minimally for grazing at other times of the year and is close by the facilities and driveway for ease of observation and for fetching the cow and her newborn calf. Calves are usually separated from the cows within a few hours of birth and placed in individual calf hutches. This is done in part to minimize calf exposure to any bacteria which the cow may be shedding in her manure. Calves are weighed within a few hours of birth and provided with a gallon of the "first milk" or colostrum that has been evaluated for immunoglobulin content by a colostrometer. If the calf does not drink the colostrum readily, it is provided to them using an esophageal tube. Colostrum contains antibodies to diseases to which the cow has been exposed, thereby providing passive immunity to the calf.

Early in the calving season, one of the disadvantages of calving seasonally becomes obvious: there seem to be calves everywhere, all of which need to be fed every day. However, because feeding once a day works just as well as feeding twice a day, we can save ourselves some time on this task. Though each calf starts in an individual calf hutch, the farm crew knows that the sooner that they can teach each calf to drink a gallon of milk straight from the top of a bucket, the sooner the calves can be moved to group pens on pasture and provided fresh milk in a trough.

Above: Newborn calves learn to drink from a bucket in individual hutches. Left: Calves are moved to a group pen and given milk from a shared trough before being weaned at 8 weeks.

Group pens greatly simplify the feeding system but do require the "eye of the master" to be sure that all calves continue to drink readily and are doing well. The calf feeder needs to quickly note the calf who seems a bit slow, has a droopy ear, or has early stages of diarrhea. Good stockmanship is critical, and even though feeding is only once a day, a second trip through the calf hutches and calf pasture areas is recommended to be sure that each calf continues to thrive.

The CEFS calves are weaned from milk at about 8 weeks of age but weaning earlier should work as well. We have weaned some CEFS calves from milk at 6 weeks without a problem, and Dr. Brinton Hopkins has done studies with successful weaning at 4 weeks of age at the Piedmont Research Station in Salisbury, NC. A high quality calf starter with 16 to 18% crude protein fed at 3 to 5 pounds per calf per day along with fresh ryegrass pasture ensures that our calves get off to a good start. The calf starter ration includes a coccidiostat as a preventative measure. Sometime between 4 and 10 weeks of age, all calves are dehorned and bull calves are castrated. After a bit more transition until about 12 weeks of age, calves are moved from the milk feeding pastures to another site on the farm for the rest of the winter. There calves continue to be fed a grain supplement along with fescue or ryegrass pasture and supplementary hay. The grain supplement does contain the ionophore, lasalocid, which improves feed efficiency.

In the past, we have dewormed calves at 12 weeks of age and again the following spring or summer. However, data collected for Bianca Thompson's thesis revealed that most of our fall calves did not have a significant internal parasite problem until late spring or early summer, so the 12-week deworming has been discontinued. Deworming is an area that we continue to examine as we consider the possibility of rearing the calves organically at CEFS. If we choose to raise calves organically, then the coccidiostat in the starter ration and the ionophore in the growing ration will need to be eliminated and a source of organic grains will be needed. Our efforts to learn more about internal parasites and minimize exposure through improved pasture management will create opportunities for organic rearing of dairy replacement heifers or dairy steers for pasture-finished beef at CEFS and throughout the Southeast.

Once the incredible fast-paced calving season is over and the calves are weaned from milk feeding, the chores could get simpler again, except that we move into the breeding season for both yearling heifers and lactating cows starting after Christmas– a topic we will leave for the next issue of Inside CEFS.

- Dr. Steve Washburn, Dairy Unit Coordinator

Calves are moved to rye or fescue pasture for the winter

EXTENSION

Organic Grain Variety Trials

Winter red wheat varieties (14 soft and 5 hard) will soon be planted in replicated plots at CEFS and at the Caswell Research Farm in Kinston. Three coastal plain organic farmers have expressed interest in planting a set of these varieties using their equipment. This will enable us to correlate on-farm results with research station performance of these varieties. The project is sponsored by a grant from the Small Grain Growers Association. Plans are to conduct the research over a two-year period.

The earliest maturity soybeans in the variety comparison trials are just starting to be ready for harvest. Yields will be taken at various times as the different varieties mature. We were fortunate not to encounter any soybean rust problems. Overall, it appears the crop has performed fairly well despite a deficit in precipitation. All varieties will be analyzed for protein and oil content and the food grade varieties will also be analyzed with a tofu quality test. The two-year project is sponsored by the North Carolina Crop Improvement Association.

- Phil Rzewnicki, Organic Unit Coordinator

Organic Grain Project Update

The July 21 Organic Grain and Oilseed workshop at CEFS was very successful. There were over 40 farmers, extension agents and specialists, conservation district staff and organic grain buyers in attendance. The organic production systems at CEFS were showcased along with an organic soybean variety trial and a demonstration of summer cover crops and alternative grain crops. The CEFS staff demonstrated weed cultivation equipment, and the first organic grain budgets for North Carolina were presented. The workshop introduced new ideas to many of the attendees about organic production and the economics of organic agriculture. Look for an article on the workshop in a future issue of *Perspectives* magazine (the quarterly magazine of NCSU's College of Agriculture and Life Science).

The website for the Organic Grain Project is up and running. Please visit it at www.cropsci.ncsu.edu/organicgrains/ and advertise it to those who might be interested. Feedback on the site and information presented is welcome. More information and pages will be added in future weeks and months.

More extension and research activities are being planned for this fall and winter. This fall, organic wheat variety trials will be planted at CEFS and a few other sites in North Carolina. Workshops for extension agents and farmers on organic grain production and marketing will be held in various counties over the winter, and an out-of-state farm tour is being planned in order to see some farms with long-term experience in organic grain production.

–Molly Hamilton, Organic Grain Project Coordinator

RESEARCH REPORTS

IPM: Pest and Beneficial Insects in Cotton

Beneficial insect habitat borders have been shown to increase numbers of predatory insects when planted near cotton. The current study evaluated whether habitat borders reduced cotton pest populations and crop damage in 2004 and 2005. In addition, comparisons of pest and beneficial insect populations were made between conventional and organic systems.

Methods

The number of replications was increased from three in 2004 to four in 2005 with two replications in field C-11, and two in 43a. Each replication consisted of a "conventional" (best management practices) control that was compared with two organic treatments - one with and one without beneficial insect habitat borders. Organically approved and conventional insecticides were applied if necessary. The habitat treatment consisted of an organic cotton plot bordered and bisected by a 3 meter wide mixed planting of soybean, millet, and buckwheat. The habitat was planted at a rate of soybeans 35 lbs/acre, buckwheat 26 lbs/acre, and foxtail millet 10 lbs/acre on 2 May 2005. Both organic and conventional cotton were planted on 18 May 2005.

Pest populations were monitored by methods appropriate to the developmental stage of the cotton and pest species populations. Early season data consisted of thrips collection that began soon after the cotton plants emerged. Sweep net samples were also an important measure of both beneficial and pest insects. Four sets of ten sweeps per plot were taken weekly from 6 July through 2 September 2, 2005. In addition to sweeping the cotton itself, in 2005 the habitat was sampled as well.

Results/Discussion

Preliminary analysis shows a high number of *Geocoris* immatures and adults in the habitat. Now, if only these important predators would move into the cotton! Also, two of the three species that make up the pest stink bug complex (brown and Southern green) have appeared in higher numbers in the habitat samples than in the cotton samples. The habitat may act as a sink for these pests.

Pest egg parasitism and predation studies continued in 2005 as well. Naturally laid bollworm eggs were marked on four dates in the field; however, due to a severe rain event, eggs from only two dates were recovered. Parasitism levels do not appear to differ significantly between treatments. Predation rates between the treatments do appear to be significantly different. Predation rates averaged over the two dates were 28.99%, 17.31% and 13.44% for organic with habitat, organic without habitat, and conventional, respectively.

Cotton yield and quality data will be taken in October. Statistical analysis of data from 2004 and 2005 is in process, and final results will be available at the end of this year. *–Lisa Jackson, NCSU Department of Entomology*

Does Grazing High Quality Forage Late in Pregnancy Increase Birth Weight and Calving Difficulty?

Dystocia, or calving difficulty, is a problem experienced by all beef producers. In the big picture, a few difficult births are expected and are not really a major problem if cows are monitored and given early assistance. Calving difficulty rates of about 20% in heifers and 5% in mature cows would be considered "normal," although the percentages in well managed herds may be consistently higher or lower.

There are several factors that can cause calving difficulty. Characteristics of the cow, such as age, weight, pelvic area, and body condition can influence calving ability and potentially lead to dystocia. Research suggests, however, that the birth weight of the calf is more often the cause of calving difficulty. Factors that influence birth weight include genetics of the sire and the dam, sex of the calf, and the weather in late pregnancy. Some of these factors can be controlled by the producer. Calving difficulties may be minimized by assuring that heifers are in good condition when bred and breeding to bulls known to have small calves and low expected progeny difference (EPD) for birth weight.

Nutrition is often discussed as a cause of calving problems, with the general perception being that feeding cows too well in late pregnancy will increase the birth weight of the calves, potentially leading to more calving problems. Because of this perception, many producers believe that heifers should be starved prior to calving. There is a great deal of research demonstrating that underfeeding heifers in late pregnancy will reduce birth weight, but not necessarily decrease calving difficulty. Furthermore, calves from underfed cows may be weak at birth resulting in high levels of sickness and/or death loss, and the heifers will be slow to breed back due to poor body condition.

Cows grazing ryegrass early in the study (late October).

Studies have also shown that overfeeding heifers either protein or energy during late pregnancy has a minimal impact on birth weight and calving difficulty. Field observations in North Carolina, however, contradict these findings. There is anecdotal evidence from numerous cases in which there was a high level of calving difficulty in herds allowed access to high quality forages like rye or ryegrass in late fall and early winter. Though winter-calving herds are generally expected to have high birth weights (due to effects of cold weather on blood flow to the uterus) and in many of these cases high growth sires were had been used, the occurrence of calving difficulty in cows fed high quality forages is frequent and may be due to more than simply coincidence. The effects of forages comparable in quality to those found in North Carolina on birth weight have not been studied. Fall rye and ryegrass are generally higher in protein, energy, and minerals than the feeds that have been used for previous research. Crude protein and TDN recordings are as high as 30% and 78%, respectively, for these species in the region.

Undergraduate research assistant, Emily Glover, measures ryegrass pasture forage availability at CEFS.

The purpose of this research was to evaluate birth weight and calving difficulty rate in cows grazing high quality ryegrass pasture as compared to those fed medium quality hay and/or haylage during the last 3 months of pregnancy.

Methods

This project was carried out at the Center for Environmental Farming Systems in Goldsboro, NC, in 2004 and 2005. A herd of 110 cows that calve in late January and February is maintained at CEFS, and ryegrass is one of the primary cool-season forages. Several strategies have been employed to reduce calving difficulty within the herd including appropriate heifer development, use of low birth weight sires, and selection of moderate birth weight EPDs for all bulls. Despite these efforts, there have been some years with exceptionally high birth weights and more calving difficulty than anticipated, especially in the heifers. The calf crop born in 2004 was an example of this - many calves were over 100 lbs (this is high for moderate sized Angus-based cows), and the rate of calving difficulty in heifers was greater than 40%.

In late October 2004, cows expected to calve early in the calving season were separated into two equal groups, including all the heifers and the mature cows pregnant to the first artificial insemination (A.I.) service. The groups of approximately 30 cows were balanced by age, breed type, and the bull to which they were bred. The cows were weighed and body condition scored before they were put on nutritional treatments. One group was placed on ryegrass pasture that had aproximately 2000 lbs of available forage mass, while the second group was placed in a dormant warm season grass pasture with free-choice hay (the designation "hay" refers to hay/haylage mix). The ryegrass was strip-grazed, with cows rotated to a fresh strip of grass every 2 to 3 days. Cows had a constant, ample supply of available forage. The hay-fed group received new hay when they had nearly consumed the previous feeding. The hay was a mixture of crabgrass and bermudagrass, or maxQ fescue. At the end of December the cows were placed back together for about one week, after which they were weighed, body condition scored, and pelvic measurements taken.

Results/Discussion

Average composition of the hay and ryegrass is shown in Table 1. The hay was near the nutritional requirements to slowly gain weight, while the pasture was far better than cows in late pregnancy require. As a result, the cows on pasture gained weight much faster than the cows on hay and had a larger increase in body condition (Table 2). The cows grazing on ryegrass gained nearly 2 lb/day more than those fed on hay, and also had a greater increase in body condition. However, the cows that were fed on hay did gain some weight and body condition during the period, and were at a desirable body condition at the time they calved (body condition scores of 5 and 6).

Average birth weight was increased by about 4.5 lbs (over 10%) for the cows on the pasture, but birth weights were reasonable for cows of this size (1200 lbs). The dystocia score given in Table 2 is on a scale of 1-4 where 1 is no problem, 2 is an easy pull, 3 is a hard pull and 4 is a caesarean section. There was a low incidence of calving difficulty in 2005, with no differences between the groups. This was even the case for the first-calf heifers.

Several observations from this experiment are of interest. First, nitrate concentration in ryegrass was high due to dry conditions in Goldsboro. The average nitrate concentration was 1.67% nitrate ion over the grazing season and was highest when cows were first turned the cows out (3.9% nitrate ion). This quantity of nitrate is considered sufficient to lead to serious health problems such as abortions or even death. The fact that the cows fed on ryegrass experienced no such problems emphasizes our lack of understanding of nitrate toxicity. It is known that cows adapted to nitrate that are grazing high-nitrate pasture may be less prone to problems. Though nitrate toxicity was not an issue in 2005, this is not an indication that it is acceptable graze forages that are high in nitrate.

Also of note is the relationship between foot circumference, chest circumference, and birth weight. Figures 1 and 2 show how foot circumference and chest circumference related to birth weight. The R^2 values indicate how strong the relationship is between the two variables (the closer the R^2 value is to 1, the better the relationship). We observed that the chest circumference was a much better indicator of birth weight than was foot circumference, and that foot circumference was not at all useful in predicting birth weight. The results of this trial suggest that though circumference of the front foot has been promoted as an easy way to estimate birth weight, chest circumference may be a more reliable tool for making this prediction.

The preliminary data presented in this report suggest that grazing high quality forage in late pregnancy can cause a substantial increase in birth weight, but that this increase does not necessarily lead to calving problems. Additional data from this trial have yet to be analyzed, and this experiment will be repeated over several years to further elucidate the relationship between high quality forages, birth weight, and the incidence of dystocia.

–Dr. Matt Poore, Beef Unit Coordinator, April Shaeffer and Emily Glover, NCSU Department of Animal Science

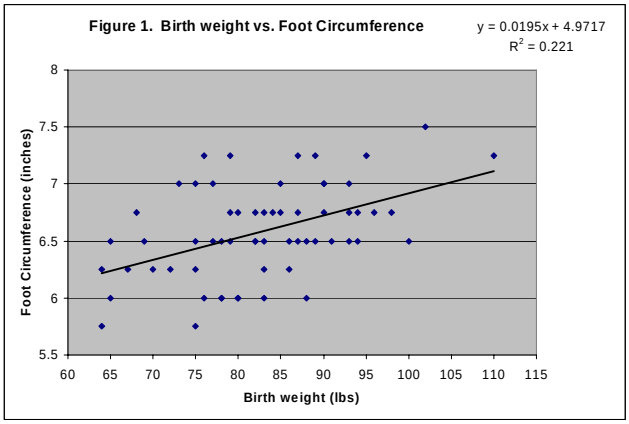
Table 1. Composition of hay and pasture fed to cows during late pregnancy.

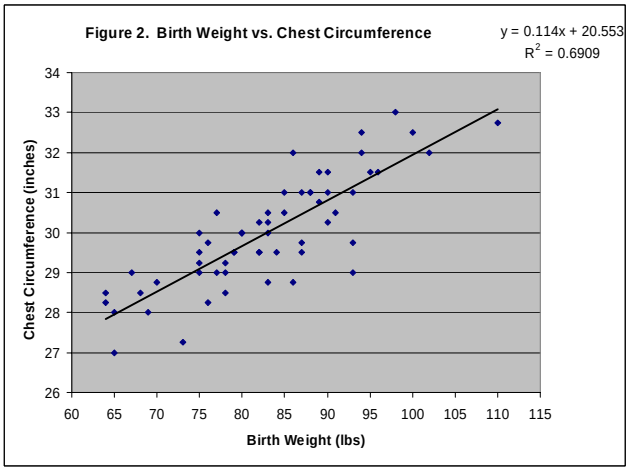
	Hay	Pasture
Crude Protein	11.9	25.5
TDN	59.6	75.9
Nitrate ion	0.09	1.67
Calcium	0.38	0.47
Phosphorus	0.33	0.38

Table 2. Body condition score, weight gain and calf birth weight for cows fed hay or grazed on ryegrass pasture during late pregnancy.

Item	Hay	Pasture
Number of Cows	31	30
Final BCS	5.63[a]	6.29[b]
BCS Change	0.14[a]	0.79[b]
Weight Gain, lb/d	0.78[a]	2.66[b]
Dystocia Score	1.18	1.24
Birth Weight, lbs	78.9[a]	83.4[b]

[a,b] When superscripts differ, means are significantly different ($P < 0.05$)





High Residue Conservation Tillage for Row Crops

Though CEFS does not currently have a formal conservation tillage unit, a dedicated group continues to dig into this critical area of research. We are busily engaged in tactical operations behind the wire, and this is the first installment of what we hope will become an intermittent series of dispatches from the "underground" – reports on our work that focus on the rooting environment.

The purpose of conservation tillage studies underway at CEFS is to seek ways of overcoming soil physical and chemical constraints that limit root growth, and hence, yield. In other words, how do we create a soil environment in which crops can express their genetic potential as free as possible from stress? This is, in a nutshell, the fundamental concern of soil management. To counteract stress in the rooting environment we must employ an integrated program addressing the problems of soil erosion, crusting, compaction, moisture retention and storage, carbon fixation, and fertility. Tillage, in our view, is a disruptive and energy-demanding task that should be limited to modifying the soil environment to overcome constraints in the rooting zone.

Our research group also looks for ways to reduce off-farm purchased inputs as far as may be practical without sacrificing productivity. On the other hand, we accept the fact that modern agriculture relies on a diverse array of technologies and approaches to be successful, and that ultimately it's the farmer who must decide upon the best mix. Our research may be described as adaptive, where no *modus operandi* is taboo provided it boosts productivity, quality, income, and is consistent with the principles of good land husbandry. In short, we are mavericks looking for answers wherever, and in whatever guise, they may be found.

Our focus over the past few seasons has been to evaluate the mechanical roller-crimper as a residue management tool concurrently at CEFS and at the Upper Piedmont Research Station (Fig. 1).

Figure 1. Mechanical cover crop roller, section detail.

Mechanical rollers have long been used by farmers in Brazil, Argentina, and Paraguay to successfully manage high density cover crop residues in production systems using the guiding principles of 'zero' and 'minimum' tillage. Basically, the roller-crimper uses the weight of a cylindrical roller to flatten and crimp mature standing residue, leaving a pressed, intact blanket of soil protective mulch oriented in the direction of planting. This has been termed *high-residue* conservation tillage (Lee et al, 2002; Reiter et al, 2002; Torbert et al, 2002). Although a precise definition of 'high-residue conservation tillage' has not been coined, it is defined herein as an agricultural production system consisting of: (1) limited or no-tillage and (2) intensified production of crop and cover crop residues to maintain full soil cover prior to crop canopy closure.

Initially, interest in the high residue concept was spurred by soil nitrogen recovery studies with small grains at the Thompson Farm over the period 1999-2002. As it happened, some of the small grain plots were left undisturbed, allowing the plants to mature and subsequently flop over and die. Wherever this had occurred, a canopy of dead residue covered the soil surface. Peering beneath this canopy one could see that few, if any, weeds had germinated as late as the first week of July. In contrast, the plots that had been clipped of residue were flush with weeds. The question arose: could this effect be duplicated in row crop production?

At about the same time, visits to Latin America by workers from the National Soil Dynamics Laboratory in Auburn, Alabama, brought home news of the use of residue rollers by farmers in Brazil. Prototype rollers were built and field tested in Alabama. The results were encouraging, but (at the time) limited in scope. These reports led to more questions: could residue rollers be used to create a closed canopy of residue on the soil surface?; would this canopy suppress early-season weeds *and* provide soil protection benefits at the same time?

The idea of high-residue conservation tillage itself is not new. Gardeners who use the deep-mulch method have been using this practice all along. Researchers from Virginia Tech, USDA Beltsville, and NCSU, among others, have also applied this model to larger scale vegetable production systems. Our goal is to extend the concept to address the problems of soil carbon loss, soil crusting and compaction, and reduction in the risk of short-term droughts in row crop production systems of the southeastern U.S. There's still much that is not known about the overall impact of high-residue conservation tillage systems on long-term soil moisture balance, fertility, weed, disease, and insect management. But in order to paint a picture, one must start by inking the brush…

Objectives

The objectives of current research are directed toward evaluating weed suppression, residue management, and soybean and cotton lint yield response a in high-residue conservation tillage system to determine: (1) the physical effect of surface pressed, intact residue and residue orientation on early-season weed suppression using different weed control programs; (2) the relationship

between residue decomposition and incident weed pressure; and (3) the effect of residue management on soybean and cotton stand establishment, growth, and yield.

Methods

Work was initiated in fall 2003 by establishing a small grain cover crop (rye cv. 'Abruzzi') at each of two sites, field C-9 (cotton) and C-10 (soybean). Soil at both sites was nearly level, well-drained and moderately permeable Wickham sandy loam. Prior to rye growth termination, residue cover was estimated using 0.5 m^2 quadrats. Rye growth was terminated mechanically or with glyphosate at 24 oz/A, and the standing rye residue flattened using one pass of the roller-crimper (Fig. 2). Full-season soybean (Pioneer 95B97) was planted on 14 May 2004 using a six-row John Deere Maximerge vacuum planter calibrated at 8 seeds/ft on 30" rows. Cotton (DP 451) was planted on 17 May 2004 using a four-row planter calibrated at 3.5 seeds/ft on 38" rows. Weed management programs included: (1) rye residue + no herbicide; (2) rye + glyphosate only for burndown; (3) rye + glyphosate + pre-emergent herbicide; (4) rye + glyphosate + pre + post emergent herbicide. Pre- and post-herbicide treatments for soybean (metolachlor + imazaquin pre-broadcast; bentazon + sethoxydim post-broadcast) and cotton (fluometuron pre-broadcast; MSMA post-directed) were applied at NCDA recommended rates. Fertilization and insect control were also managed per NCDA protocol. All plots were planted no-till except in cotton, where a rip- strip treatment was included. A clean-till treatment and one no-till treatment that excluded the roller, was used for comparison in both studies.

Figure 2. Rye residue flattened after burndown with the roller.

Weed counts were made at planting and at 2 and 6 weeks post-emergence at three points alone a diagonal transect in each plot. Total weed biomass was then estimated at lay-by. Residue decomposition was evaluated by placing folded, intact residue in 2-mm nylon mesh bags at rates equivalent to field conditions and retrieved at 2, 4,6, 8, and 16 weeks after planting. Cotton and soybeans were machine-harvested on 22 October and 10 November 2004, respectively, and yields determined. A randomized complete block design with four replications was used for statistical analysis of data in both studies.

Results

In 2004 cotton (Figs. 3 and 4) and soybean (Fig. 5) stands were successfully established in the rolled rye residue.

Stands for both crops were reduced in the rolled residue mainly due to lifting of the planter's gauge wheels in places where the residue was unevenly distributed (Table 1). Rye residue production averaged 2 tons/acre in cotton and 3 tons/acre in soybeans*. Mechanical rolling alone was not as effective at terminating rye growth as glyphosate. When good weed management was achieved, yields for soybean and cotton lint in rolled treatments were about equal to conventional clean-till (Table 1). However, in all but one case (soybean), reducing herbicide inputs resulted in a yield penalty (Table 1, italicized data). Weed surveys conducted at two and four weeks after planting showed an early establishment of weeds where herbicide inputs were either reduced or eliminated despite a lack of soil disturbance and heavy mulch cover. Dominant weeds included pigweed (*Amaranthus* spp.), lambs quarters (*Chenopodium album*), eclipta (*Eclipta alba*), and signal grass (*Brachiaria platyphylla*).

* Interpretation of these numbers: in terms of residue cover: 2 tons/acre residue is, uniformly spread, enough to provide full soil cover at planting plus a moderate smother effect; 3 tons/acre residue, enough to provide full soil cover plus a heavy smother effect uniformly spread. In practice, this was difficult to achieve without a means of controlling the positioning of the residue during knock-down.

Figure 3. Cotton, early post-emergence in rolled rye with strip-tillage.

Figure 4. No-till cotton in rolled rye residue.

Figure 5. No-till planted soybean row flanked on either side by a carbon-rich, soil protective mulch.

Figure 6. Broadleaf signal grass emerging from a rye cover in the inter-row. This plot received glyphosate treatment at burndown, but no pre-emergence herbicide. Photo taken 13 days after planting.

Decomposition of the rye residue followed an exponential decay function with approximately 70% of the original residue decomposed at 16 weeks after planting.

In cotton, an interesting trend developed in the rip-strip treatments. Table 1 shows that ripping increased cotton lint yield versus no-till over all levels of weed management. None of the differences were statistically significant but a trend was established, with the difference in lint yield between rip-strip and no-till increasing as a function of the level of weed management. Overall, highest lint yield was obtained by rolling and ripping combined with pre-and post-emergence weed management. Despite above-average rainfall during the growing season in 2004, sub-soiling a Wickham sandy loam combined with good weed management increased cotton lint yield nearly ½ bale per acre over no-till. This indicates that subsoil compaction, whatever its cause, may be a greater yield-limiting factor at CEFS and on coastal plain soils in general than we realize.

Interpretive Summary

Figure 7. Weed germination in the furrow cut by Maximerge row marker.

Early results indicate that row crops can be adapted successfully to high residue conservation tillage systems using the cover crop roller. However, neither high residue density (2-3 tons/acre) nor residue orientation appears to suppress annual weeds sufficiently to overcome the need for early-season weed management using herbicides, cultivation, or a combination of both. Overall, weed germination was encouraged by soil disturbance, including such minor breaches caused by wheel traffic and row markers (Fig. 7). Unfortunately, it's not possible to completely avoid the disturbance of soil and residue in agricultural production systems even under so-called 'zero tillage' conditions. However, we also must recognize that high residue systems may take longer than one or two years to establish. It's possible that, with timely weed control early on, continuous no-tillage or minimum tillage coupled with full residue cover prior to canopy closure may ultimately mature into a production system that relies on fewer herbicides for weed management.

Further Reading

Lee, R.D., D.W. Reeves, R. Pippin, and J. Walker. 2002. High-Residue Conservation Tillage System for Corn and Cotton in Georgia. In: E. van Santen (ed). 2002. Making Conservation Tillage Conventional: Building a Future on 25 Years of Research. Proc. 25th Annual Southern Conservation Tillage Conference for Sustainable Agriculture. Auburn, AL. 24-26 June 2002. Special Report No. 1. Alabama Agric. Expt. Sta. and Auburn University, AL. 36849.

Reiter, M.S., D.W. Reeves, and C.H. Burmester. 2002. Nitrogen Management for Cotton Grown in a High-Residue Cover Crop Conservation Tillage System. *Ibid.*

Torbert, H.A., J.T. Ingram, J.T. Ingram Jr., and R. Ingram. 2002. High-Residue Conservation Tillage System for Cotton Production: A Farmer's Perspective. *Ibid.*

- Robert Walters, NCSU Department of Soil Science

Watch for reports on more IPM investigations and research on no-till & organic systems at CEFS in the coming issues of Inside CEFS. If you'd like to submit a research report on these or other topics, please contact the newsletter editor, Denise Finney (denise_finney@ncsu.edu).

Table 1. Cotton lint and soybean yield and stand count under ten weed management and tillage regimes at Goldsboro, NC.

TREATMENT	COTTON LINT YIELD (Lb/A)	SOYBEAN YIELD (Bu/A)	COTTON STAND (plants/ft)	SOYBEAN STAND (plants/ft)
ROLL NO HERB NT*	*416*	*36*	1.84	5.00
ROLL NO HERB RST**	*434*	---	1.64	---
ROLL+GLY § ONLY NT	*590*	*41*	2.58	5.18
ROLL+GLY ONLY RST	*772*	---	2.15	---
ROLL+GLY+PRE HERB NT	*723*	53	2.41	3.18
ROLL+GLY+PRE HERB RST	*878*	---	2.44	---
ROLL+GLY+PRE+POST HERB NT	949	56	2.70	5.17
ROLL+GLY+PRE+POST HERB RST	1170	---	2.56	---
NO ROLL+GLY+PRE+POST HERB NT	917	53	2.56	5.18
GLY+PRE+POST HERB CT***	1045	53	3.02	6.52

* NO-TILL; ** RIP-STRIP TILL; *** CLEAN TILL; § GLYPHOSATE

EDUCATION

Agroecology Minor

Our agroecology minor program at NCSU is setting down roots has developed in many ways. As I begin teaching the Introduction to Agroecology (CS 230-001) course this fall semester, it amazes me how far we have come in a short time. The course is now in its third consecutive semester of being offered and has continued to attract a diversity of students with majors in agronomy, animal science, soil science, horticulture, environmental science, engineering, and even political science. The course continues to evolve primarily from what I am learning from the students. Students are encouraged to interact and communicate with each other through student-led discussions and to interact with local producers when on a farm tour during the course. This semester I am also working to develop the next agroecology course, Advanced Agroecology (CS 430), that will be offered next spring semester. Unlike CS 230, this course will include a laboratory so we will have time to provide students with hands-on experiences in sustainable agriculture. Please inform students that you are in contact with about these new agroecology courses and the agroecology minor program.

Students from the Introduction to Agroecology course learn from Dr. John Dyker as he explains his rotational grazing practices for Charolais cattle at New Hope Farm in Siler City, NC.

We have officially taken the Introduction to Agroecology course (CS 230-601) online this semester. Through an Innovation in Distributed Education Applications (IDEA) grant at NCSU, Lisa Forehand was hired last semester to help develop the online materials, and I am teaching it for the first time this semester. One of the course highlights is a virtual tour of Peregrine Farm owned by Alex and Betsy Hitt. In the video, Alex leads the students through the farm describing their soil management practices, crop diversity and vision for sustainable agriculture in the future. The virtual tour also serves as a way to promote interaction among students online. The online course will be offered spring semester and summer session.

We now have new websites for the Agroecology minor program (http://www.cropsci.ncsu.edu/agroecology/) and for the Introduction to Agroecology course (http://courses.cropsci.ncsu.edu/cs230/). On the Agroecology minor website, you can find more information about the minor curriculum and courses. I am working on updating the faculty involved in agroecology teaching and research link, so please send me an email if you are interested in being included on this list.

Machete on hip, Laura Vance works to bag bananas during the Tropical Agroecology course in Costa Rica.

Last, but not least, we are developing a collaboration with the University of Georgia to offer a joint summer course in Tropical Agroecology taught in Costa Rica. This past summer, Drs. Jean-Marie Lugingbuhl and Paul Mueller accompanied five NCSU students (Jeannie Newell, Aimee Schmidt, Laura Vance, Renee White, and Lora Young) on the course. Next summer, I will co-instruct this course with the University of Georgia, and we hope to recruit more students from NCSU. You can take a look at where the students will travel to, what they will see, and check out photos from our students on the course website at http://www.cropsoil.uga.edu/courses/tropag/ Please contact me if you are interested in the course or have any questions.

For further information on the Agroecology minor program and new Agroecology courses contact Dr. Michelle Schroeder (michelle_schroeder@ncsu.edu).

–Dr. Michelle Schroeder, Agroecology Minor Advisor

2005 CEFS Graduates: Where Are They Now?

Congratulations to CEFS graduate students who received their degrees during the 2004-05 academic year!

Danielle Treadwell, PhD Horticultural Science, is an Assistant Professor in the Horticultural Sciences Department at the University of Florida, specializing in Organic/Sustainable Vegetable Production.

Matt Bertone, MS Entomology, is pursing a PhD in the Department of Entomology at NC State.

Denise Finney, MS Horticultural Science, serves as the Coordinator of the Sustainable Agriculture and Natural Resource Management Consultative Research Support Program at NC State.

Lisa Forehand, MS Entomology, is currently a research technician in the Department of Entomology at NC State.

Robyn Stout, MS Crop Science, works full-time as a mom to 4-month old son Wendell.

Upcoming Events in Sustainable Agriculture

November 4-6, 2005: Annual Sustainable Agriculture Conference sponsored by Carolina Farm Stewardship Association in Durham, NC. Visit the CFSA website for more details: www.carolinafarmstewards.org

November 30-December 2, 2005: 2nd annual Hands-on Farmstead Cheesemaking Short Course sponsored by NCSU. Cheesemakers will receive hands-on experience and classroom contact designed to teach the basics for newcomers and practical technique and troubleshooting knowledge for those already well into cheese production. An application can be downloaded at: www.ces.ncsu.edu/chatham/ag/SustAg/FarmsteadNewsletter05-07.pdf. Space is limited! For more information on the North Carolina Farmstead Cheese Program contact: Gary Cartwright (Gary_Cartwright@ncsu.edu) at 919-513-2488.

January 19-21, 2006: Southern Sustainable Agriculture Working Group (SSAWG) Practical Tools and Solutions for Sustaining Family Farms Conference in Louisville, KY. For more information, contact SSAWG at info@ssawg.org or visit www.ssawg.org/conference-.html

May 9, 2006: CEFS Swine Unit Dedication and Kick-off to the "Season of Sustainable Agriculture" celebration of CEFS. More details coming soon.

The Art of Farming

The Man Born to Farming

The Grower of Trees, the gardener, the man born to farming,
whose hands reach into the ground and sprout-
to him the soil is a divine drug.

He enters into death yearly, and comes back rejoicing.
He has seen the light lie down in the dung heap,
and rise again in the corn.
His thought passes along the row ends like a mole.

What miraculous seed has he swallowed
That the unending sentence of his love
flows out of his mouth
like a vine clinging in the sunlight,
and like water descending in the dark?

Wendell Berry, 1970

From: Collected Poems of Wendell Berry, 1957-1982. 1987.
New York: North Point Press.

Secure embrace

This vine is perennial...
no flash of flowers followed by fibrous demise
The meristem is steadfast -
growing ever upward
sometimes twisting through the shadows
but always impelled by light

The tangled tendrils
may seem to wind in mysterious directions
but the stable post within
is wrapped in a secure embrace

Joel Gruver, 2005

Inside CEFS is the quarterly newsletter of the Center for Environmental Farming Systems (CEFS), a partnership of the North Carolina State University College of Agriculture and Life Sciences, the North Carolina A&T College of Agriculture and Environmental Science, and the North Carolina Department of Agriculture and Consumer Services. Additional information about CEFS is available at www.cefs.ncsu.edu. Inside CEFS is edited by Denise Finney, denise_finney@ncsu.edu. The next edition will be published in January 2006; the submission deadline is Jan 10.