29th Milan No-Till
Crop Production Field Day Tour Report

with

Crop Variety Demonstrations

Hosted by UT AgResearch
Thursday, July 28, 2016
7 a.m. - 2 p.m.

North Tract of the
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Tour A: No-Till Corn Production

Adding Value through Practical Farm Research

Austin Scott
Field Agronomist
Beck's Seed Company

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Area Team Leader
Beck's Seed Company

On this tour, industry speakers will be discussing different combinations of closing wheels, the importance of seed firmers, and the utilization of nitrogen sealers to protect nitrogen from volatilization. This will be the fourth year of testing at selected industry locations looking at the best combination of closing wheels to reduce sidewall compaction and increase the efficiency of planting in adverse conditions. Additionally, research has been conducted across four states quantifying the added benefit of using seed firmers to increase seed-to-soil contact and promote a quicker, more uniform emergence of corn and soybeans. And finally, nitrogen sealers are a way to protect nitrogen from environmental loss mechanisms and ensure optimum incorporation is achieved.

Frontline Tactics to Manage Corn Diseases

Travis Faske
Extension Plant Pathologist
University of Arkansas

Foliar corn diseases are among the most important yield-limiting factors that affect commercial corn production in the Mid-South. Northern corn leaf blight (NCLB) is an important foliar disease that is caused by the fungus *Exserohilum turcicum.* Symptoms, which are relatively easy to identify in the field, consist of olive green to brown lesions that range in length from 2 to 6 inches on susceptible corn hybrids. The fungus causes similar symptoms on grain sorghum and Johnsongrass, but on these hosts it is often encircled by a round margin.

The fungal pathogen overseasons in crop residues that remain on the soil surface; thus, it is most problematic in some years on susceptible hybrids in no-till or minimum till systems. In these production systems, and any system for that matter, utilizing resistant hybrids is an effective way to manage this disease. There are many good resistant hybrids well-suited for production in the Mid-South. As with most foliar diseases, weather conditions influence disease development, and for NCLB cool temperatures (64 F to 81 F), along with prolonged periods of leaf wetness provided by heavy dew or extended periods of rainfall, favor disease development.

Fungicides are an effective management tool when applied in the presence of disease; however, as the cropping season progresses in the Mid-South the environmental conditions tend to become more favorable for southern rust than NCLB. Thus, fungicides applied to target NCLB may not protect corn from southern rust, requiring additional fungicide treatments, which increase production cost and lowers profit.

Southern rust is caused by the fungus *Puccinia polysora*, which only infects corn and is reintroduced each year from the tropic regions Central America and the Caribbean. Symptoms consist of small, reddish-orange pustules that are typically, and initially, detected in the mid-canopy to the upper-canopy when corn is near early reproductive stages of development. Environmental conditions that favor rust development consist of warm temperatures (80 F to 90 F) and high relative humidity/frequent moisture provided by heavy dew or light rain. Though southern rust can occur as early as mid-June, it is often detected in the northern Mid-South states in July. Thus, planting corn per extension recommendations not only allows for maximum yield but also helps to avoid late summer rust epidemics.

Unlike host plant resistance to NCLB, most corn hybrids are susceptible to southern rust with some variation in the degree of final disease severity. A well-timed fungicide can be useful to slow rust development and protect hybrid yield potential. However, there is no economic threshold for a fungicide application because fungicide action thresholds are complicated by the differences in susceptibility among hybrids, the time required for infected corn to reach maturity, and unpredictability in forecasting the weather. As with most rust diseases, an early warning system can be helpful to determine when rust is a threat and when to apply fungicides to protect the crop. Currently, a monitoring system has been established by extension plant pathologists to report where southern rust has been detected in a given year on the IPM-PIPE website and various university extension blog websites. Thus, fungicides can be applied when rust is a threat, rather than at a stage of growth, which maximizes the benefit of a fungicide to protect corn yield potential. Fungicides are being marketed for applications at early stages of vegetative growth; however, these applications do not

provide season-long protection for late season diseases like southern rust.

This presentation will address the efficacy of commercially available fungicides applied at early stages of growth compared to the traditional VT/R1 timing to manage southern rust and NCLB. Further, the effects of fungicides applied at low, moderate, and high levels of rust severity will be discussed to control foliar diseases and protect yield potential. Given that corn future prices will likely be similar to 2015 prices; variable input costs like fungicides will need to be used judiciously to keep production costs as low as possible for maximum profit and sustainable corn production in the South. Therefore, the goal of the presentation is to provide practical frontline management tactics for managing foliar corn diseases in the Mid-South.

Do You Need a Protectant Insecticide on Your Stored Corn?

Kathy Flanders
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Auburn University

On-farm grain bins can be a perfect place for insects to grow. However, making a few modifications in the way grain is stored can greatly reduce losses from stored grain pests such as maize weevil, lesser grain borer, red flour beetle, rusty grain beetle, and saw-toothed grain beetle. Following these 3 C's will greatly reduce problems with stored grain insects:

Keep it **C**lean
Keep it **C**ool and Dry
Check it Often

Here are some of the pest management tactics that help achieve the 3 C's:

Keep it **C**lean

- Clean out your combine, grain trucks, augurs, and other grain handling equipment. Insects can thrive on the small amounts of grain left in the equipment and be ready to infest the next batch of grain you harvest.
- Clean all the remaining grain out of your grain bin as soon as you empty it, because a surprising number of insects can grow in a very small amount of grain and debris.
- Spray the grain floor and walls, as well as the combine and grain handling equipment, with an EPA-approved insecticide. Apply an insecticide as soon as you finish cleaning, then again about a week before you add new grain. See Stored Grains 2016 Insect Pest Management Recommendations for On-farm Stored Commodities in the Southeast, **IPM-0330** www.aces.edu/pubs/docs/I/IPM-0330/IPM-0330.pdf for more information on insecticides labeled for stored grain.
- Adjust your combine so that it minimizes the amount of fine particles and debris in the harvested grain.
- Apply an EPA-approved insecticide to the grain as it is loaded in the bin. The protectant insecticide provides short-term control of the stored grain insects. The best place to do this is at the base of the augur since the tumbling action helps distribute the insecticide over all the individual kernels. Skip this step if you are loading hot grain from the dryer into a bin, because heat breaks down the protectant insecticide.
- Consider removing a small amount of grain once the bin is loaded in order to remove the core of fine particles that accumulates in the center.
- Every few years, fumigate the area under the perforated grain floor to get rid of any insects.

Keep it **C**ool and Dry

- Harvest the grain at the appropriate grain moisture or use a grain dryer. Insects and molds thrive on wet grain. Suggested moisture content for different grains stored for different lengths of time can be found in the abovementioned IPM guide.
- Don't overfill the storage bin, and make sure the surface of the grain is level. Peaks of grain tend to collect moisture, harbor insects and molds, and interfere with the aeration process.
- After the grain is loaded in the bin, use the aeration fans to cool the grain to the outside temperature. Once temperatures begin to cool in the fall, cool the grain so that it is lower than 60 F. The insects that attack stored grains will not grow and reproduce below this temperature.

Check it Often

- Sample the top layer of grain for insects directly with grain probes, or indirectly with Storgard WB II Probe Traps or Grain. This will provide early warning about insects that have infested the bin. Check the grain often, every 20 days from spring to fall, and every 30 days in winter. Use appropriate safety precautions when you enter the grain bin.

- Sample the grain as it is unloaded, particularly the bottom layer, since insects that were living below the grain floor could have infested the bins.
- Monitor the temperature of the bin using an infrared thermometer aimed at the sides of the bin, or with internal thermocouple cables installed in the grain mass. A hot spot can indicate the start of a big insect or mold problem.
- If you find that insects are increasing in number, it may be time to sell the grain, fumigate the grain, or to reapply a grain protectant insecticide as the grain is moved to another bin.

Because the weather conditions in the Southeast are so favorable for insects, sooner or later insects can build up in the grain mass. The longer you plan to store the grain, the more important it is to implement as many management tactics as possible. This is especially important with wheat and other grains harvested in May or June, since the warm temperatures over the summer favor insect development.

Marketing Corn Based on Growth Stages

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UT Department of Agriculture and Resource Economics

Danny Morris
Area Farm Management Specialist
UT Extension

Developing a marketing plan assists producers in managing risk and maximizing net returns. Due to continuous changes in price and estimated production throughout the growing season, marketing plans need to be simple, flexible, and re-evaluated on a regular basis.

One marketing strategy is to use crop insurance in conjunction with targeted incremental sales throughout the production season. This strategy reduces price and production risk that is inherent in many producers marketing programs. When used properly, crop insurance can establish a revenue floor for the crop growing and provide a starting point for marketing during the growing season. Incremental sales during the marketing year reduces the risk of selling the entire crop when prices are seasonally low, such as during harvest. Incremental sales will not result in obtaining the highest price for your commodity, but it will eliminate selling the entire crop at the lowest price.

Using the marketing strategy described above, our analysis looks at matching revenue protection crop insurance with incremental sales based on the growth stages of corn produced in West Tennessee. Corn production stages can be broadly divided into vegetative and reproductive stages. The vegetative stage includes emergence (VE), first leaf (V1), second leaf (V2), third leaf (V3) . . . n^{th} leaf (VN), and tasseling (VT). The reproductive stage includes silking (R1), blistering (R2), milk (R3), dough (R4), dent (R5), and maturity (R6). All stages of development have the ability to impact yield. Additionally, corn development will vary year-to-year as growing conditions will be different each year. As such, marketers can tailor their marketing program to simultaneously remove price risk as production risk changes with development stage. For our analysis, we use production stages in conjunction with key marketing time periods to create the following marketing intervals:

1) Pre-planting: The pre-planting marketing period extends from the end of harvest (for the previous year's crop) to early April. The post-harvest and pre-planting marketing period may overlap on the calendar; however it is important for producers to distinguish between the two—based on the crop being marketing (i.e., old crop vs. new crop).
2) Planting and emergence: In West Tennessee, corn is usually planted early April through mid-May. The corn plant usually emerges from the soil 6-10 days after planting (late April through late May).
3) Tasseling, pollination, and silking: The tassel typically emerges 3-7 days before the silks. Pollen from the tassel usually starts shedding 2 or 3 days before the first silks are visible. Pollen shedding continues for 5-8 days. Tasseling through silking usually occurs from early June to the end of July.
4) Dough, dent, and mature: After silking it will take approximately 65 days for corn to reach physiological maturity. In West Tennessee, dough through maturity occurs from mid-July to mid-September.
5) Harvest and post-harvest: In West Tennessee, harvest typically starts at the end of August, for early planted corn, and concludes by mid-October. Having access to grain storage can extend the harvest and post-harvest marketing interval into the next calendar year.

Our analysis matches seasonal pricing opportunities with growth stage for corn production in West Tennessee during the five marketing intervals and identifies key market movers including USDA reports, seasonal global influences, and historical trends. Historical price trends were reviewed in order to compare the seasonal highs and lows of cash corn prices for West Tennessee. These trends will be shown to inform producers of the pricing opportunities and challenges they may face during the growing season including price reaction to weather events.

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Tour B: Soybean Variety Selection

Soybean Improvement for the Mid-South

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Alison Willette
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Our University of Tennessee Soybean Breeding and Genetics Program uses modern methods of classical plant breeding together with DNA technologies to develop high-yielding conventional and herbicide resistant soybean varieties for producers in Tennessee and the Mid-South Region. UT AgResearch soybean varieties grown by farmers provided over $60 million in estimated commodity revenue based on statewide average yields and acreages of our varieties that were grown by producers during recent years, at average commodity prices. Yet our varieties are not average and they provide millions of dollars of *additional income* each year as outstanding varieties to farmers.

Our new conventional variety, 'Ellis', was named in honor of Debbie and Lee Ellis who provided 25 and 35 years, respectively of outstanding service to UT AgResearch. 'Ellis' soybean has a relative maturity of approximately 4.9, is resistant to stem canker, and is tolerant to frogeye leaf spot. The seeds of 'Ellis' can produce high protein meal (48 percent meal protein), which provides increased value to processors. 'Ellis' is noteworthy for high seed yield and took first place in many field trials including:

1) Tennessee State Variety Test.
2) Arkansas State Variety Test.
3) USDA Southern Uniform Test.
4) Elite Yield Trial.
5) Preliminary Yield Trial.
6) USB Quality Traits Test.

Our newest glyphosate herbicide resistant variety, USG 75T40, carries the original Roundup Ready gene. The variety showed 5 percent tall off-type and was recently reconstituted by pulling single plants, forming plant rows for selection, conducting yield trials and pooling seeds of the best two pure lines. In the Tennessee State Variety Test these two sister lines ranked No. 1 and No. 3 for yield. For farmers who have fields still able to utilize glyphosate herbicide, USG 75T40 may provide a cost-effective alternative when purchasing seeds. Its notable traits include extraordinary resistance to soybean cyst nematode (SCN) Race 2, and strong field tolerance to sudden death syndrome (SDS).

In June 2015, the FDA issued its final ruling banning the sale or use of partially hydrogenated oil in any food product in the USA. Soybean has long been the dominant vegetable oil used in this country, and the FDA ban essentially wipes out that domestic processing use. However, we are rapidly achieving success in making soybean oil essentially equivalent to that of extra-virgin olive oil, requiring no hydrogenation, creating zero trans-fats, and providing extraordinary oxidative stability. In Tennessee, our High Oleic soybeans have produced over 80 percent oleic acid (monounsaturated) and some of our newest lines have topped the yield trials. We are working with the Tennessee Soybean Promotion Board and the United Soybean Board along with colleagues from Minnesota to Georgia to produce high oleic soybeans adapted to every major USA growing region.

We work to improve soybean protein to make its meal more nutritional for humans, poultry, and swine. Historically, soybean breeders making selections for increased seed protein have been met with a negative genetic correlation with seed yield. The more protein goes up, the more yield goes down. We are targeting DNA selections of a narrow genetic region on chromosome 20 that will increase seed protein with no detrimental change in yield. We are conducting field trials this year as a proof of concept project that will demonstrate the effect of the chromosome 20 locus on yield and protein.

Our graduate research assistants are a vital component of our soybean research. For example, graduate student Mia Cunicelli has a set of near isogenic lines (NIL) that are genetically identical except for one region on chromosome 20. She will be able to demonstrate the improved nutritional value of high protein soybean meal inherited from that region and determine whether or not it leads to a reduction of seed yield in Tennessee environments.

Alison Willette is a new graduate student working with a population of recombinant inbred lines (RIL) inheriting any of 81 different genetic combinations resulting from the segregation of four genes governing high oleic acid along with low linolenic acid. Our goal is to find the minimum number of genes needed to achieve greater than 80 percent oleic acid coupled with less than 3 percent linolenic acid. The end product will be soybean oil with superb oxidative stability and zero trans fats. That type of soybean oil will be valuable for the food industry and for industrial paints, inks, and biodiesel fuel.

Greyson Dickey is our newest graduate student. His study involves 115 RIL tested in East Tennessee and West Tennessee. He will be studying the effects of genetics and epigenetics on regions of the chromosome responsible for soybean cyst nematode (SCN) resistance. His research will lead to new SCN resistant varieties with excellent seed yield for producers in Tennessee and the Mid-South region.

Impact of Charcoal Rot and Frogeye on Soybean Yield

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Jason Deffenbaugh
Biological Science Technician
USDA-ARS, Jackson, Tennessee

Charcoal rot of soybean is a root and stem disease that can reduce soybean yield and seed quality leading to plant death. It is common during hot, dry weather and has long been associated with high temperatures and drought. In the Southern United States between 2011 and 2012, this disease ranked second and first, respectively, in importance among all soybean diseases reported for the Southern US. More recently, charcoal rot has been found affecting soybean with increased frequency in fields of the upper Midwest with reported disease outbreaks in Illinois, Indiana, Iowa, Minnesota, North Dakota, and Wisconsin. The causal agent of charcoal rot is a soil-borne fungus known as *Macrophomina phaseolina* and has a host range of over 500 plant species.

Recently, a few moderately resistant cultivars have been identified. However, in the past, drought avoidance was the only effective control measure and yield loss measurement was impossible. It was impossible because the effect of the disease is confounded with drought. In a two year study where plots were either irrigated or non-irrigated, yield loss was measured using two moderately resistant and two susceptible soybean cultivars. The result showed that charcoal rot caused yield loss even in irrigated plots. An estimated 15 percent loss for charcoal rot and 22 percent combined loss due to charcoal rot and drought were determined. Additionally, the yield advantage of moderately resistant over susceptible soybeans was estimated as ranging between 11 and 49 percent in infested plots. This study suggested that charcoal rot can be an economically important disease in causing a significant yield loss even with irrigation and a conducive environment for soybean growth. There is a definite need for identifying a high level of resistant soybeans with a high yield potential to reduce such losses.

Breeding Soybeans for Economically Important Diseases in West Tennessee

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In 2014, Tennessee soybean farmers produced 74,060,000 bushels of soybeans with a production value of $785,036,000. An additional 3,780,000 bushels are estimated to have been lost to two economically important diseases: Frogeye leaf spot and soybean cyst nematode. The USDA-ARS soybean breeding program located at the West Tennessee AgResearch and Education Center in Jackson develops new soybeans to combat these diseases and yield losses.

JTN-5110 is an advanced MG V conventional soybean line with established resistance to multiple cyst nematode populations and Frogeye leaf spot. Also a high yielder, JTN-5110 averaged 61 bushels/acre over 3 years (2013-2015) in the Soybean Variety Performance Tests in Tennessee. This technology has already been

transferred to major seed companies and public universities.

New soybean lines JTN-5116, JTN-5216, JTN-5316, JTN-5416, and JTN-5516 enter into multistate testing in 2016. JTN-5116 and JTN-5216 are early MG V lines with yields comparable to JTN-5110, when tested in Milan and Jackson in 2015. Preliminary testing indicates these lines have resistance to Frogeye leaf spot and multiple races of soybean cyst nematode. JTN-5316, JTN-5416, and JTN-5516 have a common wild parent that introduces genetic diversity to these lines. Early testing indicates broad cyst nematode resistance in all three of these lines, and genetic diversity may help provide more durable resistance to this important pest.

Soybean lines in earlier maturity groups with other sources of genetic diversity and cyst nematode resistance are in preliminary on-station yield trials in 2016.

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Tour C: No-Till Soybean Production

Pursuing High Yield Soybeans

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Kacey Cannon
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High yield contest winners have achieved yields over 150 bushels per acre, thereby demonstrating the yield potential of modern soybean cultivars. Some of their techniques may have scientific merit and warrant further investigation, including skip or twin-rows to support larger planting densities and increase light penetration to lower pod sites, techniques to increase light penetration may promote branching and branch pods, inhibiting the apical meristem may promote branching and increase pod-set, supplemental nitrogen application after nodulation may improve yields.

Two-year results from an ongoing United Soybean Board funded project will be discussed at this field stop. This project assessed the effects specific high yield techniques have on plant physiology, morphology, and crop yield to provide clues on how we might boost yields in a production environment and assess the economics and feasibility of adapting these techniques to a production environment. Field trials were conducted under well-watered and high-fertility conditions to assess several techniques used by high yield contest winners. Physiological and morphological measurements were taken at key growth stages to determine the effects of planting density (100,000 and 140,000 seeds/ac), row spacing (30 inches, 15 inches, and 15-inch 2-1 skip row), apical dominance inhibition (Cobra application), and post-nodulation high nitrogen application on branching and major yield components.

Yield Robbing Diseases in Soybean

Heather Kelly, Assistant Professor
UT Department of Entomology and Plant Pathology

Binbin Lin, Postdoctoral Associate
West Tennessee Regional Forensic Center, Memphis, TN

For a disease to develop, have significant effect on yield, and become a significant **PEST** there are four major factors that have to align:

- **P**athogen presence—Influenced by field history.
- **E**nvironment—The right conditions for disease to develop.
- **S**usceptible host—A cultivar that is susceptible to disease.
- **T**ime—Regarding the growth stage of the plant and when the disease develops.

Continuous soybean production and no-till cultivation can increase disease risk in soybean, and most soybean diseases can develop in the warm, humid environment that occurs in the Mid-South soybean production area. Correctly identifying diseases is necessary to choose the best management options to reduce yield loss and prevent future disease epidemics. Choosing appropriate fungicides and applying as needed at the best time is very important to optimize disease control and prevent or manage resistance. Disease identification and management information on the common yield robbing diseases in soybean in the Mid-South will be discussed and informational packets will be available to assist in scouting programs and management decisions.

Managing Soybean Irrigation

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UT Department of Biosystems Engineering and Soil Science

Tim Grant
Research and Extension Assistant
UT Department of Biosystems Engineering and Soil Science

During the rainy growing seasons of 2013, 2014, and 2015 in West Tennessee, significant soybean yield increases of 25 percent, 10 percent, and 10 percent were obtained by initiating irrigation at R5 (beginning seed) with low amounts of irrigation in deep, well-drained, silt loam soil. This result indicates that soybean irrigation

can be beneficial in most years, especially when soils with lower water holding capacity are irrigated. However, soils with lower water holding capacity may require earlier irrigation with more water. Also, many producer fields contain poorly drained areas that lose yield in wet years combined with hill slopes that inhibit infiltration of rain and irrigation water. Therefore, this project has moved irrigation research to producer fields to achieve the following objectives:

- Identify areas of varying water status in center pivot irrigated fields based on soil water holding capacity, drainage, erosion, and slope.
- Test soybean yield response to varying irrigation rates in the areas of each field that have identifiably different water status.
- Create Irrigation Management Zones that optimize soybean yield using speed control for pie-shaped zones and determine how to manage each zone using the MOIST water balance and matric potential sensors in each zone.

Six row crop producers are included in the project for 2016. These producers do not have variable rate center pivots with section control, but their pivots are capable of speed control which will allow for the optimization of soybean production in nine pie-shaped zones. In order to implement this project, high-resolution maps of soil water holding capacity will be developed from soil texture based on core samples and sensor technology. Next, weather instruments will be installed to operate the MOIST scheduler, and sensors will be placed in the predominant soil types. Finally, irrigation amounts will be varied over the predominant soil types, and yield data will be obtained in these irrigation zones via the producer's yield monitoring combines.

This project is supported by a USDA-NRCS Conservation Innovation Grant (CIG) and grants from the Tennessee Soybean Promotion Board (TSPB) and the Southern Soybean Research Project (SSRP).

Integrating Cover Crops into Soybean Weed Management

Garrett Montgomery and Alinna Umphres-Lopez
Graduate Research Assistants
UT Department of Plant Sciences

Unfortunately, there is no new Roundup that will control Palmer amaranth greater than 4 inches on the way for 2016, and to complicate issues even more, PPO resistant Palmer has been found in much of West Tennessee. However, there are still some options for controlling this weed in soybeans. Monsanto will introduce soybeans tolerant to both dicamba and glyphosate (trade name Roundup Xtend) and Dow will introduce 2,4-D, glufosinate and glyphosate-tolerant soybean (Trade name Enlist) hopefully in the near future. These technologies, along with what we currently have (Liberty Link), require more management than the old Roundup system to consistently control weeds and to delay herbicide resistance developing.

With approximately 80 percent of the acres in Tennessee being minimal or no-tillage acres, one of the management practices that is gaining traction is the use of cover crops. Cover crops can be implemented easily into these tillage systems while also assisting with early season weed control. Termination of high-residue cover crops utilized for weed suppression is imperative for the production of a successful cash crop. Currently herbicide options for controlling these high biomass cover crops usually incorporate two passes of non-selective herbicides; however, 2,4-D and dicamba tolerant crop technologies in the pipeline will increase the flexibility and efficacy of cover crop termination options while also allowing new modes of action for in-season weed control.

Common cover crops utilized for weed control in Tennessee include cereal rye, wheat, hairy vetch, and crimson clover. Mixtures of grass and legume species are very effective for creating biomass and adding to early season weed control. Terminating these mixtures can be difficult; however, our research has indicated that the ability to utilize an auxinic herbicide increases the consistency and efficacy of control. Also, in soybeans, termination of these covers can be delayed all the way until at or after planting without negatively impacting soybeans. This delay in termination increases cover crop biomass and ultimately early season weed suppression from the cover. The ability to utilize new herbicide technologies at or after planting greatly increases the flexibility of the cover crop and allows for more consistent weed suppression.

Preemergence (PRE) herbicides are still necessary tools in a cover cropping weed management system. Although cover crops suppress weeds early in the season, year in and year out, having a PRE applied at or near planting will greatly increase the consistency of the system. Commonly used PREs like Valor, Dual, Warrant, and Zidua or premixes such as Fierce, Prefix, or Warrant Ultra can be effectively implemented into a cover cropping system.

Previous research has indicated that using multiple effective herbicide modes of action (MOA) per

application can exponentially decrease the likelihood of selecting for resistant biotypes of pigweed species. With new herbicide tolerant cropping technologies, the ability to utilize older herbicide MOAs in-season gives hope to improving the sustainability of soybean weed control systems. Utilization of other, non-herbicide management practices such as cover crops can also increase the sustainability of our herbicides by taking some of the selection pressure off frequently used herbicides. Achieving the most effective and sustainable weed control system in the future will require producers to integrate many different strategies that are both herbicidal and non-herbicidal.

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Tour D: No-Till Cotton Production in Tennessee

Varieties and Nutrient Management

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Introduction

Variety selection, plant growth regulation, and nutrient management are more interrelated now than ever before. Maximum return on applied inputs hinges upon an understanding that decisions in each of these categories often impact decisions in one (or both) of the other categories. This presentation will briefly cover the basics of each of these topics, summarize the most recent results of research conducted by the UT Cotton Agronomy program, and highlight University of Tennessee recommendations.

Variety Selection

Variety selection is still largely influenced by yield potential, stability, and fiber quality, but value-added traits are quickly becoming the dominating criteria which drive selection. Earlier maturing varieties typically outperform later maturing varieties at this latitude due to heat-unit constraints. These trends can be observed through UT conducted Official Variety Trial data and County Standard Test Data. During 2016, over 2,100 variety test plots have been planted. The 2016 UT Official Cotton Variety Trials, small plot trials open to any commercially available variety sold within Tennessee and experimental varieties, consists of thirty-five entries. Six locations have been planted. The 2016 UT Cotton County Standard Trials, open to companies that have a substantial market share in the previous year, consists of fifteen entries. These plots average 6 rows wide at 650 feet in length and are placed on producer farms. Fourteen locations have been planted during 2016. Data from each of these studies should be considered when selecting varieties, beginning with summaries across the state and fine-tuning selections based on local responses.

Nutrient Management

Nutrient management cannot be ignored if optimum yields are to be achieved. When addressing fertility, the first step is always pH. The target range for cotton is between 6 and 6.5. Maintaining a pH within this range will typically result in the greatest yields and highest fertilizer efficiencies. The University of Tennessee recommends nitrogen (N) rates from 60 to 80 lb N per acre with lower rates associated with bottom ground where rank growth has been noted in prior years. Over-application of N often results in rank growth and subsequently complicates management and harvesting operations. Potassium (K) is the second-most important nutrient in cotton production and is of particular interest in regions that typically plant earlier maturing varieties, as research has suggested these varieties require more K in order to prevent “bronzing,” a classic symptom of potash deficiency. Finally, sulfur (S) deficiencies have become more common in recent years due to a decrease in deposition. A particular emphasis in the UT Cotton Agronomy program has been placed on reducing input costs under current market conditions. Subsequently, numerous trials examining nitrogen rate and timing, as well as potassium source, rate and placement have been established across multiple locations. Additionally, new methods of determining deficiencies on-the-go (potentially from a sprayer or tractor traveling through the field) are being developed to maximize the efficiency of applied fertilizers. Recent evaluations of the University of Tennessee recommendations have supported currently recommended rates. These recommendations should be followed to maximize returns on investments.

Plant Growth Regulation

Proper plant growth regulation is largely a function of environmental conditions, variety selection, and fertility. Adequate to excessive soil moisture levels, warm temperatures, excessive nitrogen, or low fruit retention can support rapid internode expansion and increase the need for plant growth regulator applications. Later maturing varieties typically require more aggressive management, but there are inherent differences in variety sensitivity to plant growth regulator applications. Recent work at the University of Tennessee has evaluated the response of multiple varieties to plant growth regulators. Given the relatively “new” status of many currently grown varieties within the state, it is wise to consider multiple low-rate applications based upon current growth to prevent insufficient or excessive plant heights.

Cotton Weed Control

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Professor
UT Department of Plant Sciences

Ethan Parker
Graduate Research Assistant
UT Department of Plant Sciences

No-till weed control in cotton has become more challenging in recent years with the spread of glyphosate-resistant (GR) weeds. GR Palmer amaranth, in particular, has become a major issue in cotton. Starting clean with a good PRE is especially important in cotton because there are few POST options until the cotton is large enough for a hood. Caparol, Cotoran, and Reflex are good choices for PRE residual control of GR Palmer pigweed. A new herbicide called Brake FX received a section 3 label for use in 2016. The residual control it provided in 2016 was mostly good, but there was some inconsistent performance due to either soil type differences or lack of rain for activation. For residual control in crop after the PRE has worn off, Dual Magnum and Warrant can extend residual control of GR Palmer pigweed. However, once weeds have emerged, few POST options exist in cotton.

Due to GR Palmer amaranth, many growers have moved from a glyphosate-based system to a Liberty (glufosinate) based system starting 5 years ago. Liberty is a non-selective herbicide, like glyphosate, but there are several differences. First of all, Liberty will not control large (greater than 6 inches) amaranth like glyphosate once did. The label states pigweed should be 4 inches or less for consistent control, but Liberty may control 6- to 8-inch pigweed when the conditions are right. Another major difference is that glyphosate is a systemic herbicide while glufosinate is a contact herbicide. This means you need COVERAGE with glufosinate. At least 15 GPA is required. Today, we have several different nozzle types available on the market, and when drift is a concern, air induction or Turbo TeeJet nozzles are good options for reducing the risk of particle drift. While these nozzles reduce drift, they also reduce coverage, which is required for Liberty to be effective. Flat-fan or dual fan nozzles are better options and are recommended with herbicide applications that include Liberty. In addition, time of day of application may be a factor for pigweed control with Liberty. For glufosinate to work in the plant, it must be actively photosynthesizing. Therefore, growers should avoid applying glufosinate early in the morning. Our research indicates that growers should wait at least 2 hours after sunrise before applying Liberty.

In Tennessee, there was a major shift toward utilizing cover crops integrated with herbicides to achieve good weed control. Our cover crop research suggests that with cotton a cereal cover crop blended with a legume can provide excellent horseweed control and good early suppression of Palmer amaranth. A PRE applied herbicide is needed with this system to fill in holes in the cover crop.

If and when the new herbicide trait technologies can be utilized fully in cotton production, growers for the first time will have major weed control tools that they can integrate. Traditionally used cotton herbicides like Cotoran, Caparol, glyphosate, and Dual Magnum will be able to be used alongside Liberty. The new herbicide use patterns in cotton associated with the new tolerant traits like dicamba or 2,4-D will give us more flexibility to control weeds. Integrating these herbicides with cover crops will provide growers for the first time in many years the ability to control GR weeds like Palmer amaranth and horseweed in cotton.

Insect Control: New Technologies

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UT Department of Entomology and Plant Pathology

Scott Stewart
Professor
UT Department of Entomology and Plant Pathology

This presentation will discuss new GMO technologies for control of cotton insect pests. These new Bt cotton technologies will be compared with current pest management approaches. Various Bt cottons for the control of caterpillar pests such has the tobacco budworm, bollworm, and fall armyworm have been commercially available since 1996. These pests feed on the flower buds (squares), flowers, and fruit (bolls) of cotton. Newer Bt technologies include Bollgard III, TwinLink Plus, and WideStrike 3, and they improve the control of caterpillar pests provided by Bt cotton. They may also potentially affect the likelihood that resistance will develop to Bt toxins. Data presented will show the relative efficacy of these Bt technologies relative to those that are currently available and discuss the potential need for making supplemental foliar insecticide application.

Because of boll weevil eradication and the widespread use of currently available Bt cotton varieties, thrips and the tarnished plant bug have become primary insect pests cotton in the state of Tennessee. Over the past five years, these pests combined to cause nearly 75 percent of the

total insect-related yield losses in the state. Thrips injure plants by sucking juices from cotyledons and newly emerging leaves with rasping-sucking mouth parts. This can lead to delayed maturity, deformed plants, and a reduction of yield. Due to several factors, including the loss of Temik (aldicarb), developing resistance to key insecticide seed treatments and the limited effective alternative treatments, there is a demand for new technologies to help combat this pest in the southeastern United States. The tarnished plant bug is a primary pest of cotton from the middle of the season through cutout. While early season feeding can delay plant maturity and cause deformed plants, most economic damage is caused by feeding beginning at the firstsquare (flower bud) and continuing through mid-bloom. During this time, it is a direct pest feeding on squares, flowers, and fruit. Numerous insecticide applications are needed to control this pest annually. Increased resistance to several classes of chemical insecticides have made this pest difficult to manage. Monsanto has been developing a Bt trait for the control of thrips and tarnished plant bugs. Tests at the University of Tennessee are evaluating the efficacy and potential value of this technology to growers. Data will address the potential impact that this new Bt trait has on insect pest management in cotton.

Irrigation Management

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Cotton is typically thought of as a drought tolerant crop. With its indeterminate growth habit the ability for cotton to compensate for adverse environmental conditions is better than some other row crops. Cotton water use is often based on the amount of water used by evaporation and transpiration also known as evapotranspiration (Et). Water use during the growing season in cotton remains relatively low until reproductive growth begins (squaring). As plants continue to grow both vegetatively and reproductively, water use continues to increase during bloom until it peaks at approximately 0.28 inches of water per day. From this point, water use in cotton then begins to decrease the remainder of the growing season.

Properly scheduled irrigation events can help reduce unnecessary irrigation costs, use water resources more efficiently, and minimize over- or underwatering, while maximizing yield. One of the ways that cotton growers can better manage irrigation is with the use of soil moisture sensors to determine when to irrigate. There are two common types of soil moisture sensors currently available: sensors that read soil water content and sensors that read soil water tension. Sensors that read soil water content take into account soil type, rooting zone, and maximum allowable depletion to trigger irrigation. Sensors that read soil water tension determine how tightly water is being held to the soil. If the water tension is too great, the plants cannot overcome this tension, making the water unavailable to the plant and irrigation is triggered. Both types of sensors have their advantages and disadvantages such as cost, accuracy, and ease of collecting data. However, knowing how to interpret sensor readings is key to proper irrigation scheduling regardless of which sensor is being used.

Generally, in areas where natural rainfall is adequate early in the season, irrigation initiation is not needed in cotton until it begins reproductive growth when the water demand begins to increase. Overwatering early in the season could lead to shallow rooting cotton or unnecessary irrigation costs that are not attributing to maintaining or increasing yield. Irrigation termination is also an important aspect of irrigation management especially with cotton. Harvesting issues, boll rot, hard lock bolls, and difficulties defoliating can all be associated with over irrigating late in the season with cotton. The current recommendation in Mississippi for irrigation termination is to terminate when the lowermost first position bolls begin to crack open across the field in furrow irrigation systems and to terminate a week to 10 days after the lowermost first position bolls begin to crack open across the field for center pivot systems.

Research is currently being conducted at Mississippi State University evaluating irrigation scheduling using soil moisture sensors at different growth stages and soil moisture deficits in cotton as well as evaluating irrigation termination timing in furrow irrigation.

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Tour E: Beef—Integrating Crop and Cattle Production

Cattle Production Dynamics in Predominantly Row Crop Areas

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Beef cattle production in the southeastern United States is primarily based on pasture and forages. Areas that are not suitable for row crop production but that are ideal for forage production are most often populated by cattle. Essentially, pasture can be thought of as the crop and cattle as the harvester. Because cattle are ruminants, they can convert the grass into a protein source that is extremely important to human health, development, and well-being.

In areas where topography and soil types allow for a large percentage of the acres to be used for row crop production, there are still intermittent spaces that are more ideally used for grazing. This makes beef cattle production—either cow/calf or stocker—a natural diversification tool for farms whose primary source of revenue comes from grain production. Since row crop farms tend to have larger land holdings than strictly beef cattle operations (aside from western range-based ranches), the interspersed grazing acres can add up to more total forage base than the average of the latter.

According to the USDA-NASS 2012 Census of Agriculture, the Tennessee counties west of the Nashville Basin (roughly the western third of the state) account for nearly 80 percent of the state's corn production and only 22 percent of the beef cow herd. These data also indicate that the average cow herd size per producer increases moving from East to West Tennessee. So, while there are certainly fewer total cattle in the row crop areas of the state, these numbers do not fully reflect the opportunity for increased beef cattle production in West Tennessee where marginal row crop land could be used for grazing (aka "flex acres") when the economics of either or both commodity classes (livestock and/or grain) make major shifts in margin opportunity.

Opportunities also exist for stocker cattle, backgrounding, and cow/calf production using crop residue and harvested grain. According to *Rabo AgriFinance*, and echoed by others, much of the expected growth in cow/calf and stocker cattle production will occur at the interface of cropping and cattle. These areas that can make use of confinement or partial confinement will be able to avoid some of the relatively high infrastructure costs for increasing cattle numbers in complete grazing operations. They go on to cite this as a method for increasing revenue for land-locked row crop producers or an easier entry into cattle production for young producers.

With dramatically increased acres under irrigation in West Tennessee, models for mixing cattle and crop production from more western states might now apply to the southeast and Mid-South. For instance, wheat grazing prior to harvest (a practice widely used in the southwest) might be an option. "Farmer-feeders"—corn producers that finish cattle rather than marketing the harvest—are popular in the Midwest, having less drastic swings in the heat index and with packing capacity that can accommodate a large supply of finished cattle. With an increasing interest in local beef production and more USDA-inspected packing capacity, a seasonal finishing operation could prove viable.

Diversification has long been known as one of the most effective risk management tools in any business. But division of labor (or specialization) is also known to enhance input and production efficiencies. Finding the appropriate balance between these approaches, based on long-term planning, is a key to success. The Beef Tour this year will focus on taking advantage of opportunities for diversifying row crop production by introducing or expanding cattle production. This first discussion sets the stage for that by taking a closer look at the current numbers and trends for cattle in row crop and transition areas. The subsequent presentations will present details for evaluating and implementing specific cattle production methods that interface successfully with crop production.

Feeding Row Crop Commodities in Cow-Calf and Stocker Production

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UT Department of Animal Science

Various situations often present the opportunity to utilize row-crop commodities as a source of nutrients for beef cattle. The viability of direct feeding as an alternative to marketing commodities is centered on utilizing cattle as an avenue to add value to a crop. Such situations often include less than favorable market conditions, adverse weather conditions that severely decrease crop yield or delay harvest, or post-harvest storage issues. Contrary to popular belief, corn grain can be a valuable supplement

for cattle on pasture or consuming a roughage-based ration in a dry lot. Other major row crops such as soybeans, wheat, barley, and rye also can be of great nutrient value.

Utilization of these commodities as supplemental feedstuffs has the ability to enhance nutritional status and yield positive results. Some of the expected responses include enhanced reproductive and growth performance. These commodities provide supplemental energy to not only the animal, but also to rumen microorganisms. When fed at relatively low levels (1 to 4 lbs per head per day for mature cows), these commodities will not only increase forage digestion, but will also enhance the ability of rumen microorganisms to generate protein for the animal.

As the saying goes, a little bit of a good thing can be a great thing, while too much can be a bad thing. Overfeeding these commodities can result in some negative consequences. Feeding grain and oilseed crops to cattle on pasture or a roughage-based diet at levels that exceed 15 to 20 percent of the total ration (approximately 4 to 5 lbs per day for a mature cow) can have a negative effect on fiber digestion. This occurs due to high levels of starch or fat that indirectly depress the population of microorganisms that digest fiber.

Transitions must occur gradually when incorporating any of these commodities into the diet of beef cattle. This includes not only inclusion of a new commodity to replace another, but also the amount of inclusion. Think weeks, rather than days, when making a dietary change. Amount fed should be consistent from day to day, with exception to increasing rates of inclusion during a transition. Unlike some of the fibrous byproducts such as corn gluten feed, distiller's grains, and soyhulls, grain and oilseed commodities also need to be fed daily, as inconsistent or intermittent feeding practices can result in digestive issues. Consistent daily feeding and supplementation practices are generally the best ways to prevent digestive upsets.

Additionally, there are some general rules of thumb to follow when feeding specific grains and oilseeds, such as wheat and soybeans. Wheat is very similar to corn in terms of its energy density and starch content; however, wheat starch is more readily available, which leads to an increased rate of ruminal fermentation. This can result in a level of acid production that exceeds the animal's capacity for absorption, which can lead to a digestive upset known as ruminal acidosis. Because of this, wheat should never be processed (ground, rolled, etc.) prior to feeding, as processing increases the risk of acidosis. Barley and rye are much safer alternative small cereal grains to wheat due to lower starch availability and higher fiber content.

Soybeans are also a nutrient-dense oilseed that can provide a substantial amount of supplemental energy and protein to beef cattle. However, soybeans naturally contain compounds that inhibit the function of some enzymes, which interferes with normal digestive and metabolic processes. Exposure to heat through the roasting process destroys these inhibitors; however, they remain intact and functional in raw soybeans. The rumen microorganisms of weaned calves and mature cattle are capable of detoxifying these compounds and rendering them harmless, as long as cattle are not being supplemented with a source of non-protein nitrogen such as urea. Simultaneously feeding raw soybeans and urea to beef cattle can result in ammonia toxicity and death. Thus, the two should never be fed together. Young, nursing calves are unable to detoxify the inhibitors in raw soybeans. This can lead to ammonia toxicity and death when raw soybeans are fed to calves. As a general rule of thumb, raw soybeans should never be fed to young calves, cows nursing young calves, or cows that are being supplemented with non-protein nitrogen.

As indicated, individual crops and specific management scenarios impact the degree to which a particular commodity can be utilized as a feed source for beef cattle. Nonetheless, following these general rules of thumb can help to make cattle a viable and effective means of adding value to row-crop commodities in certain situations.

Beef Confinement Considerations

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University of Kentucky

Immediately following the high grain prices in the 2008-2010 period, beef cattle prices followed the upward trend with corn. This upward movement in the grain markets escalated cash rental rates of land and increased the competition between forage and grain production. Ultimately, cash crops pulled more acres away from forage production and put pressure on beef managers to find land to expand during this time of high beef prices. This combination of increased land competition, high beef prices, and increased environmental pressure led to a growing interest in confinement management of beef cattle. While confinement beef cattle management is nothing new, particularly for feeders/finishers, within the US, limited numbers of beef cows are managed year-round in confinement. Before making a substantial

investment in facilities for managing beef cows in confinement a few things need to be considered.

The best managers will run the numbers first to know what the potential profit margin will be for a new enterprise. Beef prices have fallen and using a short-term market trend to make a long-term investment is not wise. Visit with your ag economist or whoever you feel can best provide you with a reasonable outlook on the costs and returns of confinement beef cattle enterprises. Don't overlook the small things. For instance, one producer I know saw a $200 monthly electric bill once the fans and lights were turned on in his 55-cow barn, which added $44/year to the cow maintenance costs. But this was a necessity to keep the pack dry and the air quality to maintain livestock health.

The discussion of fans leads me to the next point, most of the confinement builders promoting these facilities come out of the upper Midwest or Upper Plains states. Having lived through the winters and the summers of the upper Midwest, I can tell you that heat stress is more of an issue in the Southeast than the cold stress they experience. Ventilation is critically important and discussing the proper structure design with an ag engineer will be beneficial. High side walls, open ridge vents, narrower buildings, and proper site selection are all things that should not be overlooked when constructing these facilities. In addition, if considering a composted pack barn, fans are essential, and one can't avoid them as the additional heat and moisture given off by the pack must be managed.

Bedding costs are real and should not be overlooked either. On average, for a deepstack bedded facility, the numbers of 3-6 lbs/head/day are used often for feeders/finishers. This number is expected to be 5-10 lb/head/day range for cow-calf pairs to minimize the risk of disease, but this is not known for certain at this point. Dairy herds studied in Kentucky suggest the daily bedding cost was near $0.40/day. This adds an additional $145 to the annual cow cost that most beef producers don't have with current non-confinement facilities. However, there is a fertilizer value in the bedding/pack that will aid in offsetting this cost if the producer takes advantage of it.

The cost of the building itself can and will vary greatly. The average for a barn without a feed alley was found to be near $500/cow, while having an attached feeding alley increased the cost to slightly over $1,000 per cow for Kentucky dairy operations using composting bedded pack facilities. Recently a popular farm supply magazine listed a complete turnkey beef hoop barn that was 54 feet wide and 180 feet long with a ridge vent for just over $98,000. If one were to assume 120 square feet per cow-calf pair and assuming the layout was such that this was adequate, the cost per head would be approximately $1,200 per cow-calf pair in construction without site preparation investments. The point is that one needs to know what is needed from a design perspective and then request bids for various structures that meet the design needs. At the end of the day the facility must produce cash flow.

Overall management is increased in these facilities. Cattle must be fed daily, waterers cleaned and checked, and bed pack monitored and stirred daily if it is a composting bedded pack facility. Herd health cannot be overlooked either. Some think that a composting bedded pack facility is a sterile environment. This is far from the truth as bacteria are doing the composting and the surface temperatures of the bedding are not high enough to prevent the growth of organisms. From our limited experience, a sound scour and respiratory vaccination program is essential for the health of calves. The cows need to be vaccinated and boostered annually as well. There are several pointers that can be shared from those that have started these facilities. To date, the facilities in Kentucky have had one calf crop and I am anxious to see what the disease pressure will be like for the second calf crop, as the facilities will be "fully inoculated" for this second calf crop.

In summary here are a few pointers from what I have observed from confinement beef cow operations.

1.) Bedding—Storage is needed to take loads when it is available. Infrequent addition is likely to be an issue leading to wet packs for composting bedded pack facilities. Don't skimp on the bedding, plan for 8-10 lbs for pairs daily (it is not added daily and is averaged over time) but it could be more or less depending on the ration and bedding type.
2.) Ventilation—Proper site selection is one that is on a ridge or open area that provides access to winds for natural ventilation. High sides, 14-16 feet as a minimum, to ensure ventilation combined with adequate ridge vent openings are a necessity. For composting bedded pack barns go ahead and install fans. Install them such that every other one or each one can be individually controlled to give more control over ventilation.
3.) Herd Health—Visit with a veterinarian to develop a solid preventative health program for the cows and calves. Test incoming females and bulls for diseases such as Johnes to lower the risk of exposing the entire herd.
4.) Feeding program—The maintenance energy value is much lower, 10-20 percent less, as the

cows are not having to walk as much. Monitoring body condition and adjusting the ration accordingly is needed to ensure cows are maintained at ideal targets.

5.) Creep and feed adjustments—Calves will need access to feed early in life. Often feed bunks have too high of throat heights for young, light calves. A creep area or special area in the bunk line to allow calves access is an important consideration. Be sure to account for the amount of feed the calves will consume if feeding in the bunk with the cows and provide adequate bunk space for calves to get feed.
6.) Costs—Sharpen the pencil and do your best to account for all expected costs before building. These facilities are expensive to construct and have a relatively high annual maintenance cost. Bedding, water, electric, insurance, maintenance, taxes, and other costs begin to add up quickly. Don't utilize current prices to consider profit margins, rather utilize short- and long-term averages to get a range of expected returns to ensure the facility will return profit margins to your desired expectations.

Livestock Protection/Black Vulture Depredation Permit

Tennessee Farm Bureau Federation

Tennessee Farm Bureau staff will be available to share information and answer questions on the Black Vulture Depredation Permit authorized by US Fish & Wildlife to the Tennessee Farm Bureau. TFBF will be providing sub-permit applications to livestock producers who are experiencing black vulture damage.

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Tour F: Herbicide Trait Technology

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Numerous new herbicide traits presented will aid in weed resistance management, including Xtend soybeans, Liberty Link soybean, Roundup Ready Soybean, Inzen Grain Sorghum, Xtend Cotton, and Enlist cotton. The Xtend soybean and cotton technologies enable Xtendiflex (Monsanto) or Engenia (BASF) to be applied over the top of soybean or cotton. Xtendiflex with Vaporgrip technology (Roundup + Dicamba) or Engenia (Dicamba-BAPMA) will provide additional control over broadleaf weeds than Roundup alone. The Vaporgrip and the Engenia formulation have been made to reduce fines and be less volatile than traditional formulations of dicamba. Use of these products must be specific with the label in regards to set back buffers, nozzle tips, windspeed and boom height. Liberty Link soybean enables the use of Liberty over the top in crop. With Roundup-resistant pigweed, Liberty Link soybeans have become an alternative that many growers are adopting. Roundup Ready soybeans were introduced in 1996 and have become the most widely grown soybean in the country. Enlist cotton is being sold on select farms this year and expects to have a full launch next year as Enlist has not received a Section 3 label. Enlist is 2,4-D choline, which is a lower-volatile 2,4-D than the traditional ester and amine formulations (Dow AgroSciences). Enlist will be labeled to apply over the top of cotton for expanded broadleaf control. It will also aid in Roundup resistant weed management. Inzen grain sorghum is a DuPont Pioneer product that enables Zest, a combination of nicosulfuron and rimsulfuron, to be sprayed over the top of grain sorghum for grass control. It will control Roundup-resistant grasses.

These new technologies are exciting to see for our future toward managing resistant weeds. They will allow additional options, particularly in soybeans, where PPO resistance has been found.

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Tour G: Soil Fertility and Nutrient Management

Nitrogen Fertilizer Enhancement Products

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Loss of nitrogen through ammonia volatilization (escaping of ammonia gas into the atmosphere) has been of concern to growers for some time. The problem is primarily associated with the use of urea as a nitrogen source under conservation tillage systems where urea-containing fertilizer materials are broadcast or banded onto the soil surface and not quickly incorporated by tillage, rainfall, or irrigation. Urea nitrogen when applied to a soil is hydrolyzed by the urease enzyme (urea amidohydrolase) and converted first to ammonium bicarbonate [$(NH_4)_2CO_3$] and then to ammonia gas (NH_3). Urease is everywhere in the environment and can be found in soils and manures and on plants and plant residues. Within the soil, this ammonia gas becomes the ammonium cation through a reaction with the soil water and is held onto the soil cation exchange complex instead of being lost. Four factors of major importance when considering potential for nitrogen volatilization are temperature, soil pH, soil moisture, and nitrogen application rate. In general, for a moist soil as soil temperature, soil pH, and nitrogen rate increase, losses of nitrogen as ammonia gas increase from surface applied non-incorporated urea-containing fertilizers. This presentation briefly summarizes the results of current University of Tennessee field research evaluating the effects of urea-nitrogen fertilizer treated with various chemical additives or coatings on corn grain yield. These yields were compared to yields obtained with ammonium nitrate (no nitrogen volatilization loss expected) and untreated urea (highest volatilization loss of nitrogen expected). Some initial work was completed at Milan, Tennessee, in 2011, and more studies were conducted at Milan/Jackson and Springfield, Tennessee, during 2013-2015. The studies were set up in an experimental design so that yield and other results could be evaluated using commonly accepted statistical procedures. Corn was planted in 4 to 6 row plots that were 30 feet long and the middle two rows of each plot were harvested for yield determinations. Generally at

planting we tried to achieve a plant population of about 32,000 per acre. Lower nitrogen rates of 110 and 150 pounds of nitrogen per acre were used to better ensure the separation of products that may not have any effect in reducing volatilization. The nitrogen fertilizers and additives/coatings evaluated included ammonium nitrate, untreated urea, urea treated with N butyl thiophosphoric triamide (NBPT, Agrotain, 20 percent), urea treated with NBPT (Agrotain Ultra, 26.7 percent), urea treated with calcium (Ca) salt of maleic polymer (Nutrisphere-N, 30-40 percent), and polymer coated urea (Environmentally Smart Nitrogen, ESN). Product effects were looked at over the combined nitrogen fertilizer rates for each product. Yield results of all 7 site years showed that ammonium nitrate resulted in the highest corn grain yields in 7 of 7 site years. Untreated urea gave the lowest corn grain yields in 6 of 7 site years. Ca salt (Nutrisphere-N) treated urea resulted in corn grain yield similar to untreated urea corn grain yield for all 7 site years. NBPT product (Agrotain, 20 percent) equaled ammonium nitrate 3 of 7 site years and exceeded untreated urea for 6 of those 7 site years. Polymer coated urea (Environmentally Smart Nitrogen) equaled ammonium nitrate 1 out of 6 site years, equaled NBPT products 6 of 6 site years, and exceeded untreated urea 5 of 6 site years in terms of corn grain yields. ESN was not included in the test conducted in 2011. In summary, ammonium nitrate appears to be the best product for avoiding volatilization loss of nitrogen in these no-till corn systems studied. The NBPT products and ESN give better results than untreated urea, but not always as good as ammonium nitrate.

Profitable UT P and K Fertilizer Recommendations Verified

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Following the steep rise in P and K fertilizer prices during 2008, the University of Tennessee Soil Testing Committee removed row crop recommendations for P fertilizers on those soils testing high for that nutrient and likewise for K. Field studies were started in 2009 at two locations on soils testing high and on soils testing medium to low in those nutrients. The studies were put into a corn, wheat, and soybean rotation. Yield results at these sites have verified that producers can save P and/or K input costs when that nutrient tests high or better by the current University of Tennessee calibration for those nutrients. No corn, soybean, or wheat yield responses were measured on high P or K soils at two locations over a 7-year period with 10 crops. Mehlich 1 P values dropped to borderline medium and K to low by 2015.

During that same period and crop sequence, yield response on medium to low P or K soil becomes more frequent after 4 years beginning in 2013. All P and K control plots were in the low range since 2012 (after 4 years, five crops). On low-testing soils, rates of P or K fertilizer currently recommended appear adequate to build out of the low to medium testing range. Farmers can save P and K input costs when soils test high or very high in the tested nutrient. Adequate fertilization when soils fall into the low range for P or K maintains maximum yields and thus profits for producer fields and builds soil test levels in most cases.

Secondary and Micronutrient Needs in Tennessee

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The University's secondary and micronutrient recommendations and guidelines are based on past and currently ongoing field research. Some recommendations are based upon soil test values interpreted as either satisfactory (levels adequate for excellent crop production) or unsatisfactory (levels indicating a need for fertilization). For other micronutrients, such as boron or molybdenum, a general recommendation is made for those crops observed to respond consistently to such fertilization. For copper, the soil test is currently only used to monitor changes in soil copper levels, especially where manures, biosolids, or byproduct materials are being utilized. A general discussion is provided for sulfur, as it is often included in fertilizer blends, but seldom increases yield in Tennessee. Soil testing, along with a plant analysis and some understanding of field soil and environmental

conditions, will give a better diagnosis of the need for sulfur application. A weak acid extractant called Mehlich 1 is used by UT to test soils for most nutrient levels. An ammonium acetate extract is used for sulfur determinations. This talk will discuss current research efforts and data evaluating need for zinc, boron and sulfur.

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Tour H: Precision Agriculture

Making Yield Data Turn a Profit for You

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The driving factor of precision agriculture comes from input costs, commodity prices, the ease of technology implementation, and field variability. Input costs have been on the rise and will continue to increase into the future. Whether these costs are associated with technology fees for specific seed traits, fertilizers or chemicals, fuel, or equipment, they will continue to increase especially as the demand to produce higher yields and higher quality products intensifies. To help compensate for the rising cost of inputs producers must find a way to better manage their inputs to meet their specific production scenarios in each individual case. The direct answer is the implementation of precision agriculture and the utilization of data collected from precision agriculture strategies. The implementation of a sound precision agriculture strategy includes the creation and utilization of profit maps to better manage certain areas of the field. Profit maps can be created by using yield data in combination with input costs. Profit maps can help producers identify areas in the field in which they should either focus more time and resources or less. In some cases, it is best to remove certain areas of the field from production either for a few years or permanently to prevent profit loss.

A critical piece of technology in any precision agriculture strategy is a yield monitor. Yield monitors are basically a standard equipment option on most crop harvesters today, with the exception of peanuts; thus, most producers are already mapping their yields throughout the field. However, the utilization of yield data that is collected from the yield monitor can be difficult to immediately be applied to the decision-making process. Two main problems with yield monitors are the need for calibration and analysis of data. In many cases producers do not get the full value out of the yield monitor either because it is not properly calibrated or in some cases not calibrated at all. Proper calibration of yield monitors is the first step in developing a useful georeferenced and accurate yield map. A yield map can be used even if the data is not calibrated, but critical management decisions should not be made from the data. The uncalibrated data can only be used to see visual relative differences in yield and should not be used to make quantitative decisions.

Once a yield monitor is properly calibrated, a producer can then begin to use it to develop yield stability maps and discover trends that are consistent year after year. Most if not all producers can take you to a field and point out areas within that field that are the “best” or highest yield areas and areas that are the “worst” or lowest yielding areas. The yield monitor provides producers with the ability to quantify these differences within a field. The quantification of yield can then provide information on how to change production practices to become more profitable within selected areas of the field. Ideally, positive yield responses will become apparent after a precision agriculture strategy is implemented.

Profit maps developed from properly calibrated yield data can provide the producer with an opportunity to make production decisions based on profitability identified spatially throughout the field. Once the high and low profit spots are identified, then decisions on what types of management strategies that should be implemented to improve both production and profitability across the entire field can be made. A yield monitor has the potential to be one of the most powerful and useful tools on a farm if it is properly calibrated and utilized.

Even though there are many challenges when facing the adoption of precision agriculture, there are also many benefits from its utilization and implementation. Benefits can be more quickly realized if more than one type of technology is adopted and correctly applied to the production requirements in each case. A yield monitor and valid yield data are two of the most critical pieces of technology available as they provide the ability to quantify the yield of a field and any inherent changes that are made due to the adoption of new precision agriculture strategies.

Increasing Planting Capacity: Wider or Faster Planters

Michael Buschermohle
Professor
UT Department of Biosystems Engineering and Soil Science

Planting is one of the most time-sensitive farming operations. The size of your farming operation and the number of days suitable for planting are important components in selecting the proper planting equipment. Until recently, row crop planters have offered either speed or precision—but not both. All that changed with the introduction of the new high-speed planters. For proper planting management decisions, planting capacity information is crucial. To determine the capabilities of a planter on a particular farming operation, it is imperative to understand planter performance. Theoretical planting capacity is defined as the maximum capacity obtained by a planter operating at 100 percent of its width for a given speed. Theoretical planting capacity cannot be sustained for long periods of time. A variety of factors that occur during planting can influence the planter's capacity and prevent it from operating at its full potential. Planting capacity is a function of theoretical planting capacity and planter efficiency. Planter efficiency is a metric that is used to predict how planters will perform in a specific farming operation and also determines the timelines of planting. This tour stop will show the results from a study that looked at how planter width, planting speed and seed loading methods influence planting efficiency, or more importantly, how many acres you can expect to plant in a day.

Seed loading can be classified into one of three methods: filling individual seed boxes with bags, filling individual seed boxes with seed tenders, and filling central fill hoppers with seed tenders. As you would expect, the time required to load seed is a function how much seed you are loading and the seed loading method. The average time to load one and two bags of seed into individual hoppers by hand was found to be 38 and 60 seconds per row-unit, respectively. The use of seed tenders to refill individual row-units reduced seed loading times. Loading the equivalent of two bags of seed with a seed tender took 45 seconds compared to 60 seconds when loading two bags by hand. The average time to load two bulk containers of seed into a central fill hopper was 11.2 minutes.

Predicted field efficiency and capacity values across forty-one fields in this study at planting speeds ranging from 4 to 12 mph are shown in Table 1. Increasing planting speed decreased planting efficiency and increased planting capacity across all planter widths. For example, planting efficiency for a 38-foot-wide planter with individual row-unit seed hoppers decreased from 76.4 to 58.2 percent and planting capacity increased from 14.1 to 26.8 ac/hr when planting speed was increased from 4 to 12 mph. Roughly a 24 percent drop in planting efficiency was observed for a 57- and 76-foot-wide central fill planter across this same planting speed range. Increasing planter width was also found to decrease planting efficiency and increase planting capacity. Planting at 6 mph, a 38-foot-wide planter with individual row-unit seed hoppers had a planting efficiency and capacity of 69.0 percent at 19.1 ac/hr compared to 56.9 percent at 25.6 ac/hr for a

	Planter Width					
	[1]38-ft		[2]57-ft		[3]76-ft	
	Efficiency	Capacity	Efficiency	Capacity	Efficiency	Capacity
mph	%	ac/hr	%	ac/hr	%	ac/hr
4	76.4%	14.1	70.1%	19.4	65.7%	24.2
5	72.5%	16.7	65.6%	22.7	60.9%	28.1
6	69.0%	19.1	61.8%	25.6	56.9%	31.4
7	65.9%	21.3	58.4%	28.3	53.4%	34.4
8	63.1%	23.3	55.5%	30.6	50.4%	37.1
9	60.6%	25.1	52.8%	32.8	47.7%	39.5
10	58.2%	26.8	50.4%	34.8	45.2%	41.7
11	56.1%	28.4	48.2%	36.6	43.1%	43.7
12	54.1%	29.9	46.3%	38.3	41.1%	45.5

[1]38-ft-wide planter with individual row-unit seed hoppers—refilling seed with a seed tender
[2]57-ft-wide planter with central fill hopper—refilling seed with a seed tender
[3]76-ft-wide planter with central fill hopper—refilling seed with a seed tender

Table 1. Field efficiency and capacity for 38-, 57-, and 76-foot-wide planters for planting speeds of 4 to 12 mph.

76-foot-wide central fill planter. Since field efficiency decreases as a function of planter width, the relationship between planter width and field capacity is not a 1 to 1 relationship. Thus, doubling planter width does not double field capacity.

Getting Started Using Unmanned Aerial Systems

Robert Freeland
Professor
UT Department of Biosystems Engineering and Soil Science

Utilizing small unmanned aerial vehicles (UAVs) for agricultural purposes such as scouting and mapping crops, checking livestock, and assessing inventory of nursery stocks has caught the attention of many producers. This presentation will discuss the various models of UAVs and the pros and cons of each type. Essential hardware components and currently available software for processing the data collected from UAVs will be covered, as well as current local, state, and federal regulations with regard to their use in Tennessee.

Field Demonstration of Unmanned Aerial Systems

Farmspace
John Castellaw
Derick Seaton

901 Drones
Marco Sterk
Kerry Sterk
Brandon Turk

Earl Dudley, Inc.
Chuck Snow

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Tour I: Soil Management

Cover Crop Mixtures and Crop Yield

Neal Eash
Professor
UT Department of Biosystems Engineering and Soil Science

Brian Kozlowski
Research Associate II
UT Department of Biosystems Engineering and Soil Science

Winter cover crops have been promoted for many years in Tennessee. There are many reasons why cover crops are an important component on cropping systems, including reducing soil erosion over the winter months, weed suppression, increasing soil organic matter, increasing water infiltration, and improving overall soil health. If legumes are used as a cover crop, nitrogen fertilizer costs can be reduced. They can also help scavenge residual nutrients from the main crop and thus improve water quality.

In 2013, two cover crop research and demonstration sites were established at the AgResearch and Education Center at Milan in West Tennessee. Following the termination of the cover crops, corn or soybean was established as the main crop. The main crops alternate each year in a corn-soybean rotation common in West Tennessee. One study is assessing the effect of planting date and the other study the effect of seeding method (broadcast vs. drill). Biomass production, weed suppression, and corn and/or soybean yield following the different cover crops are measured in each study. In the planting date study, we are comparing the effectiveness of three of the cover crop mixes, and an unseeded control. In the seeding method study we are comparing six of the cover crop mixes and an unseeded control. This presentation will summarize the biomass production, weed suppression, and corn and/or soybean yields from 2014 and 2015.

In the planting date study, no differences in percent cover crop establishment were observed in the fall or spring within a planting date during the 2013/4 season in the cover crops planted before corn. All cover crops suppressed weeds compared to the no cover control. After the corn harvest in 2014, the latest planted cover crop (October 20, 2014) had the least ground cover among cover crops during the winter and spring and had the highest percentage of winter annual weeds compared to the two earlier planting dates. No differences in ground cover were observed for the two earlier planting dates (September 22, 2014, and October 6, 2014) at termination in late April 2015. The rye in combination with vetch produced the most ground cover. No differences in corn or soybean yields were observed compared to the no cover crop control in 2014 or 2015 (respectively).

In the seeding method study we found no significant differences between the two seeding methods in cover crop establishment, average biomass, or weed suppression in the 2013/14 season. All cover crops significantly reduced weeds compared to the no cover controls. In the 2014/15 season, lower seeding rates were used to establish the cover crops and more weeds were observed in the broadcast plots compared to the drilled plots. No differences in soybean or corn yields were observed compared to the no cover crop control in 2014 or 2015 (respectively), except for corn following rye where we observed a lower average yield. In 2014 there was only a 1.5 bu/ac average difference between the highest and lowest soybean yield across all cover crop treatments (including the control).

Cover Crop Economics

Jim Larson
Professor
UT Department of Agriculture and Resource Economics

Chris Boyer
Assistant Professor
UT Department of Agricultural and Resource Economics

Soil erosion has been a challenge for agricultural producers in Tennessee for decades. Erosion does not just negatively impact crop yields from soil loss but also results in nutrient runoff and sedimentation in water sources, causing environmental issues. These concerns over soil erosion have resulted in a considerable amount of research on using best management practices to reduce soil erosion and nutrient runoff with cover crops being the primary focus. Using winter cover crops in crop production has been found to increase soil residue that can reduce soil erosion, conserve nutrients, build organic content, and improve water retention in the Southeast US. These agronomic benefits have resulted in positive yield gains for some species of cover crops in crop production, but economic analyses of using cover crops have reported mixed results.

Many questions remain about the profitability of using cover crops in Tennessee. Recent changes in the USDA NRCS cover crops recommendations have switched to

encouraging producers to plant mixes of cover crop species instead of one species. There have been no economic analyses conducted on the profitability of mixtures of cover crop species compared to single species. Additionally, with growing concerns about herbicide-resistant weeds, researchers and producers are looking into using cover crops as a possible method to suppress weed pressure. The thought is that early planting of cover crops could suppress weed pressure and increase yields. However, little is known about the effectiveness of the cover crop planting date on yields and producers' profits.

Therefore, the objective of this presentation is to determine the profitability of using cover crop mixtures and single species in corn and soybean production. Additionally, we discuss results to an economic analysis of cover crop planting dates on the net returns of corn and soybean in Tennessee.

Data for these analyses comes from a 2-year study conducted at Milan, Tennessee. The experimental design for the cover crop mixtures and single species consisted of a randomized split-plot design with four replications of the seven treatments. The treatments included cereal rye/crimson cover; cereal rye/hairy vetch; wheat/winter pea; wheat; cereal rye; soil health mixture (cereal rye, whole oats, purple top turnips, daikon radish, crimson cover, and winter pear); and no cover crop. In 2014, soybean plots were planted in each of the treatments and corn plots were planted in each treatment in 2015. Yield data were collected for each treatment and year. The experimental design for the cover crop planting timing study consisted of a randomized complete block design with three replications of the four different cover crop treatments. In 2013, cereal rye, wheat, and cereal rye plus hairy vetch were drilled in soybean plots on October 3, October 13, and November 11 following USDA NRCS seeding rate recommendations. Corn was planted in 2014 in these plots. In the fall of 2014, the same cover crop treatments were planted in the corn plots, followed by soybean in the spring of 2015. Yield data for corn and soybean were collected.

Results from this study will provide insight to producers about the profitability of cover crop mixtures and the timing of planting cover crops. As pressure increases to conserve soil and reduce water pollutants such as nutrients, economic analyses on using cover crops will become more important to producers making profitability management decisions.

Impact of Cover Crop Adoption of Nutrient Losses from Row Crop Agriculture in the Obion and Red River Watersheds

Shawn Hawkins
Associate Professor
UT Department of Biosystems Engineering and Soil Science

Nutrient loss from agricultural fields contributes to a "dead zone" of low dissolved oxygen concentrations near the mouth of the Mississippi River in the Gulf of Mexico. Efforts are underway in many states within the Mississippi River basin to reduce crop nutrient loss. In Tennessee, Soil and Water Assessment Tool (SWAT) water quality models were developed to evaluate the nutrient load reduction for winter wheat cover crops on corn and soybean fields in the Red River and South Fork of the Obion River watersheds. SWAT is a simulation model that links hydrology and nutrient cycling with crop growth. Model inputs included digital elevation data, crop satellite imagery (Croplands Data Layer), and soils data. Rainfall inputs were from a Next Generation Radar database developed for Tennessee. The Tennessee models were calibrated using river discharge. Crop management schedules (planting, fertilizer applications, harvesting) were established in consultation with corn and soybean producers and included modifications of important parameters (USLE_P, USLE_C, and OV_N) resulting from the adoption of contour and no-till planting. Incorporation of an unfertilized winter wheat cover crop throughout the entire watershed resulted in substantial river discharge reductions of total nitrogen (30-50 percent) and total phosphorus (12-32 percent).

The Tennessee Nutrient Loss Reduction Strategy

Forbes Walker
Associate Professor
UT Department of Biosystems Engineering and Soil Science

Plant nutrients such as nitrogen (N) and phosphorus (P) are essential for crop growth. If these nutrients are over-applied to crops they can potentially be lost to the environment and negatively impact water quality in streams, rivers, and lakes both locally, downstream and even large ecosystems such as the Gulf of Mexico. Nutrient enrichment of waterbodies can result in the excessive growth of algae and other aquatic plants in a process known as eutrophication. This can lead to

reduced dissolved oxygen levels that can be harmful to fish and other aquatic life. According to the Tennessee Department of Environment and Conservation (TDEC), in 2012 there were 3,375 river and stream miles and 15,692 acres of lake in Tennessee impacted by nutrients and may contribute about 5 percent of all the N and P delivered to the Gulf of Mexico.

All states within the Mississippi River basin have developed state-specific nutrient loss reduction strategies (www.epa.gov/ms-htf/hypoxia-task-force-nutrient-reduction-strategies). The Tennessee Nutrient Reduction Framework (or Nutrient Reduction Loss Strategy) was developed by several state agencies (TDEC, Tennessee Department of Agriculture and the University of Tennessee) from 2011 to 2015 to address the United States Environmental Protection Agency (EPA) long-term goals of protecting water quality by measures that reduce nutrient loads from both point and non-point sources. As part of the Mississippi River basin the Tennessee strategy also addresses the concerns of nutrient enrichment in the Gulf of Mexico from the Mississippi River.

The Tennessee agricultural non-point source reduction strategy (www.tn.gov/assets/entities/environment/attachments/tennessee-draft-nutrient-reduction-framework_01-21-2015.pdf) focuses on four concurrent implementation strategies (best management practice implementation, monitoring, economics, and outreach/education). Agricultural best management practices (BMPs) that are emphasized in the Strategy are the use of the University of Tennessee Extension nutrient management recommendations; the continued use of no-till; the adoption of winter cover crops and vegetative buffers to reduce erosion and keep nutrients in the field; and the adoption of precision agriculture technologies to better manage the selection, placement, and application of nutrients within each field.

The economics of BMP implementation and the adoption rates of different BMPs will be monitored and their impact on water quality assessed through trend analysis. Outreach and education activities will be conducted by a number of partners including TDEC, Tennessee Department of Agriculture, the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), and University of Tennessee Extension.

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Tour J: Wheat Production

Wheat Varieties and General Management Practices

Ryan Blair
Extension Area Specialist II
UT Extension

Please join us to discuss wheat topics concerning general practices and variety selection. With wheat prices remaining low, it is important to consider inputs and cost while focusing on high yields and returns. Today's wheat varieties are as good or better than ever with many high producing varieties well suited for our environment. Variety selection should certainly be a starting point when considering your production practices. This year's wheat county standardized variety test (CST) will be discussed in detail, looking at what varieties are statistically performing best in our area. In 2016, we have twenty-two wheat varieties represented in the CST program from seven companies. I would like to briefly discuss economic returns on variety selection. Along with variety selection, I will go over some of our common production practices. Much interest has been placed on very high yielding practices. Intensive input production systems will be covered, including multiple fungicide applications, high population seeding, and high nitrogen application to see if this system is justifiable. UT Extension and UT AgResearch are currently working on population and N-rate trials that we will be going over to determine what our most profitable cases are. The use of plant growth regulators, specifically Palisade, has been increasing in high N-rate wheat. I will discuss UT's trials on Palisade and N-rate and some economics on this system. Hopefully from this tour, growers will be able to take home the needed information for a profitable wheat crop by better understanding what production systems have performed the best in our trials and be confident in their wheat production decisions this fall.

Insect Control in Wheat

Sandy Steckel
Extension Assistant I
UT Department of Entomology and Plant Pathology

Jeff Lannom
Director
UT Extension Weakley County

Wheat insect management can be broken up into three sections: at-planting insecticide seed treatments to control aphids and/or Hessian fly, fall or late winter insecticide applications for aphids, and spring management for cereal leaf beetle and armyworms.

Year in and year out, aphids cause the most consistent yield loss in wheat. Damage is generally not the direct result of their feeding but rather from their ability to transmit Barley Yellow Dwarf Virus (BYDV) to wheat plants. Earlier infections cause the most wheat stunting and potential yield loss. Aphid populations in wheat may get established in the fall. Oat-bird cherry aphids and English grain aphids are the more common species found in Tennessee.

If an insecticide seed treatment is not used, early planted wheat is especially likely to have aphids present. It is a good idea to scout for aphids beginning about three weeks after emergence. Consider treating aphids in wheat during the fall if populations exceed two to three aphids per foot of row but before populations exceed eight aphids per foot. Otherwise, consider a late winter (January-February) insecticide application. UT data suggests that a late winter insecticide application for the control of aphids often results in a yield increase by reducing or delaying BYDV. This application kills resident aphids before populations begin to increase and spread disease. However, this may be less valuable if aphid populations were already well established in the fall, as disease transmission may have already occurred. Benefits of a late winter application are less consistent on wheat treated with an insecticide seed treatment.

It is important to remember the fly-free date is approximately October 15 for Tennessee, and UT Extension does not recommend planting prior to this date. Wheat planted before this date will be at greater risk to Hessian flies and fall infestations of aphids or fall armyworm. Wheat planted too early can also serve as a nursery for the fall generation. The subsequent spring generation can seriously damage any late-planted fields. Producers need to be mindful of this as many are adopting wheat as a cover crop for weed suppression and other attributes. Early established wheat cover crops, especially over a large portion of the landscape, may bring unintended insect problems.

Seed treatments offer the greatest value for wheat planted before the recommended fly-free date. The products that can be used on the seed are Gaucho 600 at 0.8–2.4 fl oz per 100 lb seed, Cruiser 5 FS at 0.75–1.33 fl oz per 100 lb seed or Nipslt Inside (5F) at 0.75–1.79 fl oz per 100 lb seed. All three of these products contain 5 lbs of active ingredient per gallon and have a similar mode of action. The typical use rate applied by distributors is in the range of 0.8–1.0 oz of product per 100 pounds of seed. However, the highest labeled rates

are recommended for control of Hessian flies. You should consider using these higher rates if you intend to plant before the recommended planting date. It is important to know exactly what rate of insecticide seed treatment you are buying as rates lower than those above may not provide sufficient protection.

Cereal leaf beetles and armyworms can cause very visible injury of wheat during the spring. Infestations typically occur in April and May when wheat is heading. Often their feeding injury on leaves looks bad but causes little harm to yield. However, excessive defoliation or head clipping by armyworms can effect yield. For wheat in the milk stage, consider treating for armyworms when six or more larvae are present per square foot. Once wheat reaches the soft dough stage, treatment for armyworms is not recommended unless head clipping is observed and armyworms are still present. Consider treating when more than 2 percent of heads are clipped. Relatively low rates of pyrethroid insecticides typically work well.

Fall armyworms at times can also cause problems in the fall before frost. Treatment is recommended when four or more larvae are present per square foot. The usual insecticides of choice are the synthetic pyrethroids.

Wheat Disease Control

Jamie Jordan
Research Associate II
UT Department of Entomology and Plant Pathology

Wheat is an important crop in Tennessee and serves several important functions. Wheat is used as a cover crop, an early summer cash crop, and for its beneficial qualities for soil conservation and moisture retention. Similar to our other crops, wheat can host a variety of different diseases caused by fungal pathogens. To protect the yield potential of the crop, it is important to recognize these pathogens and take a proactive approach in prevention and treatment.

Diseases such as leaf blotch (*Septoria tritici*), glume blotch (*stagnospora nodorum*), powdery mildew (*Blumeria graminis*), fusarium head blight/scab (*Fusarium species*), stripe rust (*Puccinia striiformis*), and leaf rust (*Puccinia tritcina*) are the most common fungal diseases in Tennessee. When conditions are favorable, yield losses to these fungal diseases can be substantial. However, most of these disease can be managed by variety selection and timely applications of fungicides. When selecting varieties, it is important to take into consideration the disease packages available. This proactive approach will reduce many problems associated with these yield robbing diseases and provide stability in expected yields.

Correctly identifying the symptoms of the diseases will also improve disease control by applying a targeted fungicide application. Diseases often discolor roots, stems, leaves, and heads in wheat. Many times these unique patterns of discoloration can be used to identify the causal organism or organisms. I will be discussing these signs and symptoms in greater detail and will have informational packages available to assist in scouting programs and fungicide selection. I will also review some of the research results that we have found over the last two years in West Tennessee including variety selection, disease prediction resources, and application timings of fungicides.

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Tour K: Crop Variety Demo

The No-Till Crop Variety Demonstrations will have varieties of corn, cotton, and soybean technology on display. Participants may interact with representatives from the various companies represented. This tour will be located immediately behind the bus loading area.

Agrigold Hybrids

Monsanto

NK Seeds

Phytogen

Steyer Seeds

UniSouth Genetics

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Tour L: Your Farmland Legacy

Your Farmland Legacy

Joseph T. Howell
Attorney at Law

Your estate plan should lay a framework for a smooth transition of farm or ranch ownership and management. Without proactive planning, the state legislature will determine how your assets pass, to whom they pass, and when they pass. Topics will include assessing your current estate plan in order to preserve your farmland for future generations, planning for long-term care, and avoiding other unnecessary expenses.

Farmland Forever and Income Tax Deductions through a Land Trust

Gary Moore, Farmland Conservation Director:
931-581-1148
The Land Trust for Tennessee (LTTN):
www.landtrusttn.org

Talking Points

*The Land Trust for Tennessee was founded in 1999 as a nonprofit and non-governmental organization by then Mayor Bredesen, CEO/President Jeanie Nelson, and twelve likeminded individuals to form the board. Today, we have Liz McLaurin as the new president and CEO, sixteen fulltime and part-time employees, and thirty-six board members. We are funded by grants and grant foundations, donors/donations, philanthropic minded individuals/entities, and estate bequeaths.

*The Mission: To conserve and protect the unique character of Tennessee's agricultural, natural, historical, and cultural landscapes and sites for future generations.

*According to University of Tennessee Extension, our state has lost 600,000 acres belonging to 3,000 farms during the period of 2007-2012 to development for commercial, industrial, residential, and transportation purposes. Many times these losses represent many acres of prime and/or good farmland or forests.

*We are committed to conserve and protect the following land uses for willing landowners or units of government: critical watersheds and river corridors; community and historical/cultural resources; natural landscapes and recreation corridors/open spaces; and working lands—farms and forests.

*The conservation easement is the primary tool we use for protecting land that lasts forever by being attached to the deed. It is a legal agreement with restrictions that is flexible and tailored to specific property and landowner's needs and desires that can be phased in over a period of time and totally voluntary. The property can be passed down or sold at any time.

*One primary benefit of a conservation easement is three forms of tax relief. If your farm is already in a greenbelt status, the easement may or may not further reduce your property taxes. Estate tax relief for landowners may allow heirs to keep the land in the family rather than be forced to sell it. The most popular tax relief is through the federal income tax deduction where landowners are able to take sizeable deductions in relieving them of some or all of their annual tax burden over a period of years.

*To date and since 1999, we now have protected nearly 101,000 acres on 319 properties in 59 counties; of this amount, working farmland is 150 farms for over 37,000 acres.

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Tour M: Opportunities to Protect and Promote Pollinators in Agricultural Landscapes

Factors Affecting Pollinator Health

Mohamed Alburaki
Postdoctoral Research Associate
UT Department of Entomology
and Plant Pathology

Various species of bees, such as honeybee and bumblebees, are known to be the most efficient and recognized pollinators for agriculture. Honeybees are by far the most important commercial pollinating agents in the world. Millions of honeybee hives are contracted yearly as pollinators by beekeepers. The value of bee pollination in nature and human food and nutrition is immense and difficult to quantify. The pollination effect of just one pollinator (honeybee) on only US food crops was estimated to be $15 billion in food crop value. It is commonly said that about one-third of our nutrition (fruits, vegetables, crops) is due to bee pollination. It is well known currently that the honeybee populations around the world have started to significantly decline during the last decade. This phenomenon of global honeybee decline called Colony Collapse Disorder (CCD) represents a major challenge for scientists and beekeepers, especially that its causes are still not well determined. We should keep in mind that if the bees disappear on a large scale, 80 percent of the vegetables and fruits we enjoy eating would not be available anymore. The main known factors that contribute in pollinator decline, whether for bees or other pollinator insects, can be summarized as follows: 1) The excessive use of agricultural pesticides, 2) Loss of pollinators' habitat and forage, 3) Global warming and climate change, 4) Decrease in biodiversity, 5) Honeybee industrialization and overexploitation, 6) Increase in hive transhumance and pathogen transfer. In order to limit pollinator decline, global sustainable plans and strategies capable of enhancing pollinator diversity and survival are strongly needed.

Pollinator Species for Bobwhites, Bees, and Butterflies

Brittney Viers
Quail Forever Farm Bill Wildlife Biologist
Huntingdon, Tennessee
quailforever.org

Many landowners have recently become interested in wildflowers, sometimes referred to as "pollinator stands" in USDA programs. What is a pollinator stand? We will discuss what is required of pollinator stands and how they can benefit a wide range of species and conservation objectives. Our goal is to educate landowners by providing advice on how to establish pollinator habitat from a small scale, such as a plot or garden, to a large scale where we assist with cropland and pasture land conversion into a diverse expanse of wildflowers.

Pollinator plants are very diverse and care should be taken when determining how many seeds of each plant is needed for the site. Soil type, surrounding native flora, bloom timeframe and color, insect and wildlife species use, seed flow, and planting methods are just a few of the things that should be considered when planning pollinator stands.

Anyone can establish pollinator habitat regardless of size and attract native bees, honeybees, and certain species of butterflies. However when this is done on a landscape scale, the benefits include many native wildlife species as well, including northern bobwhite (an imperiled grassland bird), white-tailed deer, wild turkey, and other grassland songbirds, such as Henslow's and grasshopper sparrows, just to name a few.

A standard pollinator seed mix (required for USDA programs including CRP and EQIP) consists of a minimum of nine native wildflower species. The concept is to have at least three blooming in spring to early summer, three in midsummer, and three in late summer to early fall. When we assist with wildflower mix design, we often include additional species as well to try to attract as many species as possible. There are many species of bees and butterflies that rely on a single species of wildflower or just a few wildflowers in a single plant family.

In addition to including extra wildflowers, we also strongly encourage landowners to plant shrubs, which typically add a fourth bloom period to the restoration site. Most shrub species, such as Chickasaw plum, indigo bush, silky dogwood, and southern crabapple bloom even earlier than most native wildflowers. Shrubs provide a great early nectar source for pollinators and

provide vital escape and loafing cover for bobwhite quail. Adequate shrubby cover is extremely important for all early successional wildlife and is often lacking on the private landscape. Also, certain bees select this cover type to build nests.

We will discuss in more detail selecting wet site or wet tolerant wildflowers for planting in creek bottom and poorly drained soil sites, wildflowers that have adapted to a wider range of soil moisture and dryness, and wildflowers that are considered upland, often prairie remnant species that are ideal for highly erodible lands and woodland/savanna restoration sites.

For more information on USDA programs like the Conservation Reserve Program (CP42 practice), Environmental Quality Incentives Program (EQIP), and more please visit www.tn.nrcs.usda.gov.

Establishment and Maintenance of Pollinator Stands

Mike Hansbrough
USDA NRCS
Area Resource Biologist
Jackson, Tennessee

This presentation will summarize establishment and maintenance techniques for pollinator plants like forbs (wildflowers) and shrubs that are mixed with smaller amounts of native grasses. While establishment of native warm-season grasses is fairly well understood, many of the common native grasses and forb mixes are not used in pollinator stands and create new challenges.

Seeds used for pollinator stands can be composed of smaller, more diverse seeds than traditional conservation covers. Seed mixtures of 5-8 lbs. of Pure Live Seed (PLS) can more easily flow out of a no-till drill very quickly if care is not taken to calibrate during seeding and reduce output to a minimum. Even specialized no-till drills can gravity flow small native pollinator seeds too quickly when planting. Broadcast seeding and seeding using modern agricultural drills is possible if care is taken in the selection of pollinator materials and other seed carriers. Sometimes fluffy native grass seeds can lodge with other seeds and make seed flow difficult through modern planters. Smooth-sided seeds tend to work very well in all drill types but may need a benign seed carrier to add bulk and allow for better calibration.

Care should be taken when using herbicides, as many chemicals or chemicals from previous crops are soil active and can reduce the amount of wildflowers within the newly planted stand. Some weeds are expected and common in the first year of establishment, however they quickly fade in the next year or two after planting. It is common in the establishment year to mow high during the first growing season only to help take out unwanted competition, but when pollinators reach blooming stage all mowing should cease. Weed control methods and timing will be discussed, however, as pollinator stands age, some disturbance (mowing, disking, and herbiciding) will be needed to rejuvenate desirable species, especially with pollinator stands older than 3 to 4 years.

Opportunities exist for landowners and producers to establish pollinator stands with a variety of USDA programs like the Conservation Reserve Program (CP42 practice), Environmental Quality Incentives Program (EQIP), and more. For more information on USDA programs and opportunities please visit www.tn.nrcs.usda.gov.

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Tour N: Natural Resources

The Perils of High-Grading Your Woodland

Wayne Clatterbuck
Professor
UT Department of Forestry, Wildlife and Fisheries

Concern exists among forest practitioners, owners, industry and the public that high-grading—the practice of harvesting those trees that will give the highest intermediate economic return—may lead to a widespread decline in the forest resource. Recent statewide forest inventory statistics (from USDA Forest Service, Forest Inventory Analysis) for Tennessee indicate that the grade of hardwood trees is diminishing. About 3 out of every 10 hardwood sawtimber trees are considered culls with minimal value or usable volume.

High-grading harvests the most saleable, and the largest, most valuable trees and leaves the poor quality, defective and low-value trees—the **unacceptable** growing stock—to populate the next forest. The practice does not give consideration to regeneration, growth, or species composition of the future forest.

For most forests in Tennessee, smaller-diameter trees are not necessarily younger trees. Most of these smaller trees are:

- Slower growing trees of the same age, but different species, that are not capable of growing into the overstory when larger trees are removed (many midstory species such as dogwood, blackgum, sourwood),
- Trees capable of release but of an inferior species (red maple), or
- Trees of the same species and age as the larger trees, which did not grow as quickly as their larger-diameter counterparts due to greater competition between trees. These trees have low-vigor and sparse crowns at an advanced age with low probability of responding to overstory release.

High-grading promotes survival and growth by less well-adapted trees especially at the expense of well-adapted trees that are harvested. Because slower-growing and poor-quality trees are retained, high-grading diminishes the diversity, tree grade, and economic value of the future stand. The practice can be driven by short-term economic considerations without regard to the future forest. Immediate cash flow may be greater with high-grading, but potential environmental degradation and decreased future timber values will more than cancel the immediate cash advantage.

Avoid high-grading by leaving some desirable trees with the potential to increase in growth and value. Generally leaving a minimum of 50 ft^2 of basal area/acre in desirable trees (**acceptable** growing stock) with the capability of future growth and development is recommended. If stocking of desirable trees is less than 50 ft^2 of basal area/acre or if inferior, less desirable trees predominate, then the stand should be regenerated with a complete cut (silvicultural clearcut). Recent hardwood market reports indicate that prices for grade 1 sawlogs (depending on species) are 3 to 6 times greater than the poorer grade 3 logs. Higher quality (better grade) timber is more in demand, less in supply, and yields greater prices. Growing higher quality trees gives a much greater financial return during a rotation than short-term high-grading.

Best Practices When Selling Timber

Caley Monigan
Extension Summer Intern
UT Department of Forestry, Wildlife and Fisheries

Steps when selling timber include (1) Consult with a professional forester, (2) Perform an inventory and an appraisal to assess the amount of timber being sold and its worth, (3) Market your timber as competition between different buyers invites higher prices, (4) Sell your timber by sealed bid to gain the best price, (5) Do NOT rely on an oral agreement, prepare a timber sale contract to improve communication between the buyer and the seller, (6) Follow forestry Best Management Practices (BMPs) to maintain water quality, (7) Inspect and retire the timber sale area, and (8) Remember tax considerations. Each of these steps will be discussed in the presentation.

Timber is bought and sold every day in Tennessee. However, most landowners sell timber once or twice in their lifetime. Selling timber is quite different from most agricultural commodities. Knowing the procedures of selling timber is essential in obtaining the best price from buyers.

Do not allow a second party (buyer) to dictate the terms of your assets. Work with a professional forester who has the experience in your local area, knows the markets, and how timber should be sold and logged. Your trees and property are your responsibility and you as the seller (with your forester), not the buyer, should be the one to set the terms for the timber sale to your satisfaction.

Don't Cut Yourself Out of Business

Larry Tankersley
Extension Specialist II
UT Department of Forestry, Wildlife and Fisheries

Owning land with growing timber on it can be considered money in the bank. This is especially true if the trees are good size, good species, on good ground and in a good market. Timber value grows. The trees get bigger and their value typically increases with this growth. Prices for standing timber do fluctuate but over the course of the life of a stand of trees, prices typically rise with inflation thus some folks consider holding timber an inflation hedge.

Managing timberland with this in mind becomes a renewable resources as a timber harvest is an opportunity to renew the "crop". Individuals and families that plan to hold on to land for long periods of time should plan for the next timber sale at each timber cut. It is always important to consider what remains when the last truckload of logs leaves your woods. Are you planning to grow another stand of yellow-poplar, oaks, pines trees with good timber value or elms, gums, hackberry; miscellaneous hardwoods with relatively low value? In the long-term it makes a difference whether you are in the timber business or not.

Floating Island: How to Use Your Pond for Small Scale Enterprising

Ron Blair
Director and Area Fisheries Specialist
UT Extension Henderson County

Let's Get More Out of Your Pond

Tennessee has approximately 200,000 small lakes and ponds. With proper management and planning, property owners can enjoy recreation and a source of food for the table. Often, ponds are not managed to maximize food production due to management and water quality.

There are many opportunities to harvest fish for food or improve water quality with relatively inexpensive options.

Option 1: Landowners who want to maximize production may consider fertilizing or feeding. Feeding can increase growth in catfish only ponds, sunfish and infertile bluegill/bass ponds.

Option 2: Cage Cultures. This is an option where pond owners feed food fish in confined cages within the pond. It is possible in West Tennessee to "double up" by stocking catfish or tilapia in the spring to be harvested in the fall and feed a second crop of rainbow trout to be harvested in the spring.

Option 3: Floating wetlands or gardens. This option is best suited where pond owners wish to improve water quality, attract wildlife, or to be an attractive landscape feature that can also add fresh greens and herbs for the cook of the house.

This program will touch on different methods and techniques to allow pond owners to get more out of their ponds. This stop will show cage culture, feeding strategies, and floating garden construction techniques.

Developing a Crop Budget for Hardwood Timber is Challenging

David Mercker
Extension Specialist III
UT Department of Forestry, Wildlife and Fisheries

Most farmers are familiar with "enterprise budgets" for livestock, such as cattle or goats or field crops such as corn or soybeans. These budgets are used to estimate revenue, production costs, and the potential for profit. Many farmers also own some hardwood forestland, from which periodic timber harvesting offers the potential for significant revenue. Thus, it is logical to ask: Should landowners who own hardwood forests prepare budgets for their timber crops?

This presentation addresses this question by discussing the components of an enterprise budget and highlighting the significant differences between hardwood timber and other farm products. The challenges in predicting revenues, expenses, and net profit will be examined. The focus is on hardwood forests, which are the most common timber type in Tennessee. Softwood (pine) forests are simpler systems, are harvested more frequently, and are more amenable to budget considerations.

Revenue
Revenue is generated when products are sold. To estimate potential revenue, the number of units to be sold is multiplied by the price per unit. For corn, this is fairly straightforward. A farmer might expect a yield of 150 bushels of corn per acre and the per-bushel price is

widely reported. For a beef cow-calf operation, it may be a little more complicated because there is more than one product: cull cows, heifer calves, and steer calves, with different prices and weights for each.

For hardwood timber revenue, the potential revenue calculation is far more complicated. Some of the important variables include long harvest intervals, a diversity of species to consider, varying tree quality, growth rate is not constant, markets vary and are unpredictable, and more. These variables have very wide ranges and they interact with each other. The result is that, while general trends and tradeoffs can be identified, making a precise estimate of future value is not practical.

Variable Expenses

With traditional enterprise budgets, the costs associated with establishing and tending a crop or raising the livestock are "variable"—the total expense will depend on how many acres planted or animals raised, and which management activities the farmer chooses (e.g., irrigation, supplemental feeding). The costs of conducting the active business of farming tend to be ongoing and large, relative to the potential revenue.

For most owners of hardwood timber in Tennessee, the variable costs are small and infrequent. Most of the forestland consists of naturally regenerated trees that receive little active management as they grow. Thus, the costs of establishment and follow-up management are small. This is different than pine plantations, where there is more active management and higher variable expenses, such as planting, thinning, and fertilizing.

Hardwood Timber Crops are a Different "Enterprise"

Hardwood timber is different from cattle or corn, and so too are the budgets. Although revenues may be infrequent and hard to predict, there is a potential for large periodic returns from harvesting timber. Attempts to evaluate and even improve the timber "crop" may be worth the additional costs, but calculating a precise enterprise budget for hardwood timber is highly variable because of the uncertainly associated with long harvest intervals and the unpredictability of markets, revenues, and expenses over several decades.

Although hardwood timber is fundamentally different from other farm crops, hardwood forests can benefit greatly from management. As mentioned, there are many factors that can affect the future value of a timber harvest. One of the best predictors is knowing where you are starting from in terms of the number, species, size, and quality of trees you have now. A timber inventory is needed. Then, from the inventory, a management plan can be developed that will guide the proper development of the forest. For that, see a professional forester.

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Tour O: Farmers vs. Hunger

Sponsored by:

Hunters Sharing the Harvest Inc.
Cargill
Tennessee Soybean Promotion Council
Farm Credit Mid-America
Outreach Inc.

Other sponsors will be listed at the Field Day.

On-site Coordinator:

Chuck Danehower
UT Extension Area Specialist—Farm Management

This tour will run continuously from 9:00 a.m. to 2:00 p.m.

Stop by the West Tennessee Agricultural Museum, cool off from the hot sun, and participate in the Farmers vs. Hunger tour stop. This stop is a unique blend of what can be accomplished when farmers and others in the agricultural community come together to address the needs of those who are in need. This stop features a hands-on activity where participants will assemble a soy meal protein and vitamin-enhanced macaroni and cheese product that is a substantial meal for children and adults. The soybean ingredient is a vital component of this nutritious and affordable meal. Soybeans are grown on 1.6 million acres in Tennessee and are the largest row crop in the state.

In Tennessee, 17.1 percent of the state's population, including 24.7 percent of the children, are food insecure and can't afford enough food to consistently meet their basic needs. The meals packaged at this tour will be distributed to food banks and food pantries throughout the local area. Stop in and help stamp out hunger while attending the Milan No-Till Field Day. Activities will begin at 9:00 a.m. and will continue throughout the day.

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Disclaimer

This publication contains pesticide recommendations that are subject to change at any time. The recommendations in this publication are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. The label always takes precedence over the recommendations found in this publication.

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