AgResearch

Milan No-Till

Crop Production Field Day

with

Crop Variety Demonstrations

Thursday, July 22, 2010

7:00 a.m. - 3:00 p.m.

North Tract of the
AgResearch and Education Center
Milan, Tennessee

(731) 686-7362

http://milan.tennessee.edu

THE UNIVERSITY of TENNESSEE
INSTITUTE of AGRICULTURE

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TOUR A: FARMLAND LEGACY

Planning Today for Tomorrow's Farms

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The objective of this program is to provide Tennessee farm families a solid foundation upon which they, and all of the people involved, can understand basic farm and forest succession planning concepts and processes. Farm succession planning is a complex process that involves many dynamic factors. Families need to be equipped and prepared to start the discussion and effectively and properly develop the plan.

Agriculture is often thought of as an intergenerational venture and one that is handed down through the generations. Farm family members are integrated into the enterprise early on, fulfilling age-appropriate chores. Eventually, 'pitching in' evolves into actual employment and a means of generating income. A ***principal operator*** or a core group of family members often serve as the key decision makers, therefore risk bearers, and likely run/own the business – depending on the structure. As these key family members age, day-to-day responsibilities may shift, but ownership often remains a much stickier situation.

Although the intent may be to hand the family farm venture down from generation to generation, the devil is in the details. The situation becomes even more challenging if realizing your dream of ensuring your farm's legacy is complicated by the lack of interested family members or those whose vision does not align with yours. In addition, many family farms are a relatively complex mix of relationships, business structures and revenue streams that make planning and succession challenging, as well as precipitating a need for professional guidance.

With this in mind, you have probably decided to come to this session because you want to have some peace of mind about where your farm and farm family are going to be in the future. There are resources available, including a manual designed to assist you and your farm family as you go through the planning process necessary to position yourselves for a successful transition of your business. Though not a comprehensive resource, the manual aims to prepare families who own businesses to seek the appropriate professional assistance that is often required to build a farm ***succession plan***.

The manual includes information outlined as follows:

Chapter 1: Why Succession Planning? – Introduces the basic concept of succession planning and provides insight as to why succession planning is so important to farm families and Tennessee's agricultural sector.

Chapter 2: The Family Discussion –Examines the critical importance of communication in the farm succession process.

Chapter 3: Taking Stock of Your Estate –Guides the process of generating records for succession planning as well as those needed for improved decision making.

Chapter 4: Business and Organizational Structure – Presents the various options for structuring a farm or family business and describes the factors that should be considered in choosing a particular structure, including how the structure fits into a succession plan.

Chapter 5: Estate-Planning Tools – Covers wills, trusts, powers of attorney and other documents and information for developing an estate plan to transfer assets to the next and future generations.

Chapter 6: Acquiring Professional Services – Provides guidance on identifying, choosing and working with professionals, such as attorneys and accountants, to formulate and execute a succession plan.

Chapter 7: Retirement Planning – Presents available options and emphasizes the need to plan properly for retirement.

Additional information regarding the manual and other resources can be found at www.farmlandlegacy.org.

TOUR B: AGRICULTURAL ECONOMICS

Marketing Strategies for 2010 and Beyond

Chuck Danehower, UT Extension Area Specialist, Farm Management

Many agricultural and non-agricultural factors affect the direction of commodity markets. Agricultural-related influences include fundamental supply-and-demand information, acreage reports, crop conditions, weather – and the list can go on. Non ag-related influences include currency valuations, direction of the stock market, crude oil prices and fund positions, to name a few. We have gone in the last two years from a demand-driven market for grains and soybeans concerned about having enough supplies to fill needs, to one that has adequate supplies with the potential to be burdensome. The cotton market has been the opposite, as large stocks have been reduced through a reduction in production and now teeter on the edge of a demand-driven market.

A marketing plan as a part of an overall farm financial plan is as important now as it has been in the past. Producers have many alternatives in marketing, whether it is through a grain elevator, cotton buyer, direct to an ethanol plant or hedging with futures or options through a commodity broker. Producers need to decide which marketing tools they want to use as well as which marketing tools they need to learn about. Tools include forward contracts, futures-only contracts, delivery contracts with the price not set, futures market and options. Deciding on the tools that a producer is comfortable with and understands can go a long way to developing which strategies to use in a marketing plan. If a producer is not clear or does not understand how a particular tool works, then it is best to not use that tool, but commit to learning more about it. At times, market prices can be volatile, so having a written marketing plan that can be updated in place is a valuable part of the farm business plan and operation.

This tour stop will provide updated fundamental supply-and-demand information, acreage estimates, latest weather forecasts, impact of outside markets and price outlooks for the upcoming harvest and winter. Marketing scenarios comparing various pricing tools will also be analyzed. For updated weekly marketing comments, go online at http://economics.ag.utk.edu/cropcomm.html .

Profitability Outlook in Current Environment

Chuck Danehower, UT Extension Area Specialist, Farm Management

Jimmy Castellaw, UT Extension Area Specialist, Farm Management

Many changes and cost adjustments have been made since the budgets and projected returns in the table below were first developed.

Variable costs are seed, fertilizer, chemicals, fuel, repairs and labor. Crop insurance is not included. Land costs are based on 25 percent of gross revenue. Yields and prices are estimates only to be used in planning purposes. Cotton price estimate includes the loan rate plus an estimated loan equity payment and seed and hauling allowance. Producers should use their yields and prices estimates in their budgets. Technology and seed selection will vary among individual producers. This budget example assumes the following: Cotton – Bt II or Wide Strike RR Flex; Corn 120 bu. – RR; Corn 150 bu. – Bt II RR; Soybeans - RR.

2010 Estimated Net Returns per Acre

	Cotton	Corn	Corn	Soybeans	Wheat/soybeans
Yield	850 lbs.	120 bu.	150 bu.	40 bu.	60 bu./30 bu.
Price	$.69 lb.	$3.60 bu.	$3.60 bu.	$9.25 bu.	$4.60 bu./$9.25 bu.
Revenue	$587	$432	$540	$370	$554
Variable cost 1	$416	$265	$327	$214	$380
Returns above variable	$171	$167	$213	$156	$174
Land costs 2	$147	$108	$135	$ 93	$138
Returns above specified costs	$ 24	$ 59	$ 78	$ 63	$ 36

One of the major changes occurred in early May, as excessive rains and floods caused acres to be replanted, planted to another crop or have weed control applications reapplied. At this time, it is difficult to estimate the full impact on profitability caused by that weather event. What can be estimated and will be explored at this stop will be the effects on profitability on controlling glyphosate-resistant weeds. It is no doubt that this weed control issue is more widespread than earlier thought, but one where careful planning can lead to adequate control.

The UT Extension annual budgets as well as archived budgets can be found on-line at http://economics.ag.utk.edu/budgets.html or at your local county Extension office. These budgets should be used as a guide, as it is unlikely that farmers will have the exact same yields and inputs and definitely not the same selling prices or input prices. Land costs are not normally included in our budgets, but we have thrown in a 25 percent share as an example. Farmers should use their own rental rates or land payments as applicable.

To assist producers in making informed decisions regarding their cropping plans, examining the returns above variable costs is useful. This method is used when there is very little equipment change being made and fixed costs are not changing. If the farm is making operational changes, then a whole-farm plan should be examined. If the farm is share-rented, that particular share should be considered as a cost.

From projecting profitability, several observations can be made: 1) Yields are important, and above-average production is still needed for sustained profitability. 2) With changing input costs, marketing the crop has become even trickier. Market too soon and increasing costs could make what appeared to be a great price, only fair. 3) Continue to watch for opportunities to lock in inputs at lower than market levels. Every year there are opportunities for producers who plan ahead to make favorable arrangements. 4) Net profit margins may be reduced by higher costs. Crop insurance may be a necessity, especially if leverage is high. 5) Don't put all your eggs in one basket. We don't know which crop will have the best yield or price, so spread your risk among the crops you can raise. 6) It is important for producers to develop their own budgets and costs of production and incorporate this into a whole-farm financial plan. A whole-farm financial plan will give producers the ability to know where they are and which direction they are going. For assistance in whole-farm financial planning, contact your county Extension office or call the Tennessee MANAGEment information line at 1-800-345-0561.

TOUR C: BIOENERGY 101

Switchgrass Management Research

Don Tyler, Professor, UT Biosystems Engineering & Soil Science
Ryan Blair, Research Associate II, UT Biosystems Engineering & Soil Science

Switchgrass is a dedicated biomass feedstock that can be used to produce electricity; liquid transportation fuels such as ethanol; and other bioproducts such as adhesives, solvents, plastic precursors and other organic chemicals. It is a widely adapted perennial herbaceous grass with a very high biomass production potential for many years after establishment. We are investigating the adaptability of this crop to different soil and landscape positions in Tennessee. The soils range from well-drained to poorly drained and the positions range from uplands to bottomlands. Studies evaluating seeding rates, nitrogen fertilization, variety selection and weed control are superimposed on the varying soil and landscape positions. The switchgrass in all areas was planted using no-tillage, and yield and other growth characteristics are being measured.

The seeding-nitrogen rate studies compare five seeding rates: 2.5, 5, 7.5, 10 and 12.5 lbs pure live seed of Alamo switchgrass fertilized at each seeding rate with four different nitrogen rates of 0. 60, 120 and 180 lbs N/ acre as surface-applied ammonium nitrate applied from the second growing season. Over the first six growing seasons on most locations, there has been little or no difference in yield across the seeding rates and usually, except with poor initial stands, there have been no significant yield differences in nitrogen rate above 60 lbs N/acre.

The variety studies are unique because they compare the commonly grown, naturally selected variety to three experimental varieties from two switchgrass breeding programs, one at the University of Georgia, the other at Oklahoma State University. The three experimental cultivars have a more vigorous growth habit than the common Alamo cultivar, but have not yielded significant more biomass over the first six growing seasons.

In the fourth and fifth growing seasons, above- and below-ground carbon were measured. These data indicated considerable below-ground carbon stored in the soil and root biomass. Root turnover in perennial switchgrass is relatively slow, with only a small fraction of roots dying from one season to the next.
The overall goal of the research on switchgrass is to produce high yields with the least input costs. This will enhance the possibility of biomass ethanol and other products, becoming competitive with fossil fuel energy.

Producing Switchgrass on the Farm

Jon Walton, UT Extension Area Specialist, Biofuels
Ken Goddard, UT Extension Specialist, Biofuels
Clark Garland, Professor, UT Agricultural & Resource Economics; Chair, Biofuels Farmer Education Team

Tennessee's Biofuels Initiative provided an opportunity for farmers within a 10-county area of Vonore, Tennessee to produce switchgrass for energy under a three-year contract. Vonore is located approximately 35 miles south of Knoxville. In 2008, 16 farmers planted 723 acres of switchgrass. An additional 1,890 acres were planted in 2009 and an additional 2,400 acres are being planted in 2010. This brings the total acreage up to approximately 5,000 acres being grown by 60 farmers in approximately 320 fields.

Switchgrass is a warm-season perennial grass native to North America. The plant can reach heights up to 10 feet with an extensive root system. Once established, switchgrass well-managed for biomass should have a productive life of 10-20 years. Within the stand, switchgrass is an extremely strong competitor. However, it is not considered an invasive plant. Alamo, a lowland variety of switchgrass, was planted the first two years. In 2010, improved varieties of Alamo and Kanlow were also included in the new plantings.

Switchgrass seed is very small. When establishing switchgrass, buying quality seed is an important consideration. Switchgrass seed are normally sold on the basis of pure live seed (PLS). In calibrating

seeding equipment, take into account the percentage of pure seed and the germination rate. For biomass production, UT recommends 6 pounds of PLS per acre. Planting dates can range from mid-April to mid-June. Switchgrass is a warm-season grass and establishes and grows best under warm conditions. Switchgrass can be planted into a tilled seedbed or no-tilled. It appears no-till planting with a no-till drill in fields not bedded from past row crops is the ideal way to plant. Switchgrass should be planted when sufficient soil moisture is available for emergence of the seeds. A planting depth of ¼ inch or less is critical, with good seed coverage at that depth. This is usually easier to achieve in no-tilled soil conditions. The drill should have small seed boxes suitable for accurately metering switchgrass.

Experience with switchgrass production points toward "picking your battles" with respect to potential weed problems. In the establishment year, switchgrass does not compete well with grasses such as fescue, crabgrass, johnsongrass, etc. and broadleaf weeds. Appropriate weed control measures vary greatly according to previous cropping history and specific weed varieties. Carefully evaluate fields before and after planting and check with an Extension agent for control options. Our experience in Tennessee on weed control in switchgrass indicates grass competition is much more severe than broadleaf competition. Once switchgrass is well-established and properly managed, it is very competitive against weeds.

In a one-cut harvesting system, the switchgrass has been harvested around November 1 or the first killing frost, whichever comes first. A disc-mower conditioner should be used. Switchgrass should be cut at least 6 inches high. Switchgrass stand survival, vigor and yield consistency in later years is greatly impacted by the cutting time and height.

In the first year of production yields, fields at 18 percent moisture are estimated to run approximately 30 percent (1.8 tons) of the full yield potential. Second-year yield is normally 70 percent (4.2 tons) of full production. In the third year, yields should be at the 100 percent yield level of 6 to 7 tons. Obviously, land quality, weather conditions, stand vigor, weeds and overall management will impact yield levels for a given switchgrass field. It is difficult to establish good switchgrass stands in wet soils.

Prior to planting switchgrass for bioenergy, we recommend having a firm and satisfactory contract in place.

A UT Biofuels Initiative Update

Sam Jackson, Research Assistant Professor, UT Office of Bioenergy Programs
Damon Drinnon, Feedstock Operations Assistant, Genera Energy, LLC
Louis Buck, Commercialization Manager, Genera Energy, LLC

The University of Tennessee Biofuels Initiative (UTBI) is Tennessee's answer to the global challenge of securing sustainable, renewable, affordable energy while advancing the local economy and protecting the environment. The Biofuels Initiative is a farm-to-fuel business plan developed by the state of Tennessee, UT Institute of Agriculture and Oak Ridge National Laboratory researchers. Tennessee has made an unparalleled commitment to lead the transition to an advanced biofuels economy with a commitment to support the development of a dedicated bioenergy crop supply chain and the construction of a 250,000-gallon-per-year demonstration cellulosic ethanol facility.

One of the key elements of the integrated Biofuels Initiative is a demonstration-scale cellulosic ethanol biorefinery in East Tennessee, supplied by local biomass. For this endeavor, Genera Energy, LLC has been established. Genera Energy is a for-profit, limited-liability company formed in 2008 by the University of Tennessee Research Foundation as a vehicle to carry out the cellulosic biorefinery activities and capital projects of the UTBI. Genera Energy was specifically created to provide the commercial flexibility needed to develop collaborations and partnerships with private entities with technology or other resources to contribute to the UTBI. Genera Energy, which is managed by a Board of Directors, collaborated with DuPont Danisco Cellulosic Ethanol to construct a pilot-scale cellulosic ethanol biorefinery. The biorefinery commenced operations in December 2009 and has been producing cellulosic ethanol since that time. An official grand opening was held on January 29, 2010.

When running at full capacity, the biorefinery will produce 250,000 gallons per year of cellulosic ethanol from switchgrass.

Genera Energy, LLC and the University of Tennessee continue their focused efforts on developing integrated biomass supply chain solutions and strategic partnerships to support the bioenergy industry in Tennessee. The Biofuels Initiative takes a farm-centric approach to feedstock development, working with local farmers to develop a program that provides direct payments to farmers for switchgrass production as well as one-on-one technical assistance through UT Extension and wide-ranging research related to all aspects of the feedstock supply chain. More than 5,000 acres of switchgrass have been planted on more than 60 private farms in the region. This year's planting included not only the standard Alamo switchgrass, but also included two improved varieties of switchgrass as part of a multimillion-dollar U.S. Dept. of Energy grant. The UT Biofuels Initiative has the largest planting of switchgrass on private farms in the United States. Switchgrass produced on participating farms will be utilized in the pilot-scale biorefinery to produce ethanol as well as other products, such as green power and bio-based products. An established feedstock supply of this scale provides significant opportunity for research and development related to feedstock production, harvesting, storage, transportation, preprocessing and environmental sustainability.

The university and Genera Energy have made significant progress in these areas, integrating new and existing technologies to improve the overall efficiency and sustainability of the feedstock supply system. On the horizon, Genera Energy is finalizing plans for a Biomass Innovation Park located behind the Vonore biorefinery. Construction on the Biomass Innovation Park is expected to begin during the summer of 2010. The park will be a research, demonstration and development area focusing on purpose-grown energy crops that integrates the entire biomass supply chain in one location: harvest, handling, storage, densification, transportation, pre-processing and conversion. The facility will allow for state-of-the-art technology to be used for processing switchgrass and biomass from field form to the form of material specified by end users. This facility will serve as the example for processing in the industry, as well as a site for deploying new energy technologies.

Ultimately, the development of the cellulosic biofuels supply chain, from biomass to fuels and products, will have a significant impact on the energy future of the state and nation. These new systems, technologies and products will provide increased economic opportunities for rural economies, increased energy security for the nation and improved environmental impacts of energy production/utilization. This effort will serve as a model for commercialization for cellulosic biofuels as well as other bio-based energy and products. The University of Tennessee, Genera Energy and the state of Tennessee are leading the nation in bioenergy production, from farm fields to fuels!

TOUR D: BIOENERGY 201

Switchgrass Harvest, Storage and Cellulosic Ethanol Potential

Al Womac, Professor, UT Biosystems Engineering & Soil Science
Willie Hart, Associate Professor, UT Biosystems Engineering & Soil Science

Cellulosic ethanol (cEtOH) is a fuel ethanol made from plant matter (stems, leaves, etc.) rather than plant starches (grain). The plant matter is not a typical food source, so its use helps to address the food versus fuel debate. Switchgrass is a potential source of plant matter for cEtOH.

- U.S. renewable energy mandates for transportation fuels require 36 billion gal/year of ethanol (EtOH) (from grain) and cEtOH by year 2022.
- Of the mandate, 15 billion gal/year are grain ethanol, and its current production level is 12.9 billion gal/year.
- The remaining balance is 21 billion gal/year from cEtOH – thus, future growth is expected for cEtOH.
- The U.S. consumes ~150 billion gal/year of gasoline {equivalent to ~46,000 tanker trucks (9,000 gal/each) of gasoline PER DAY}.
- The renewable fuel mandate of 36 billion gal/year is 24 percent of annual gasoline use (150 billion gal/y). Using renewables at this rate will require raising the blend rate of 10 percent, and this falls under EPA's jurisdiction – with debate on ethanol emissions and tolerance of vehicle emission systems.
- World energy use is expected to grow by 49 percent in 2035 (from 2007 levels) – and petroleum is expected to continue as a major source of fuels.

U.S. Energy Information Administration was a source for some data in this box.

Use of switchgrass, or in fact any plant matter, to make cEtOH requires a voluminous amount of supply. A 50 million gal/year cEtOH plant would require the equivalent annual volume of switchgrass in 4 x 4 x 8 ft bales (1000 lb each) stacked 32 ft tall over a stack area of ~100 acres. Questions that come to mind are with regard to harvest capacity (mph, ton/h) of current equipment, and the impact of use of those systems and subsequent storage on cellulosic ethanol potential. In other words, will any and all switchgrass supplied under various conditions be expected to produce the same amount of cEtOH per ton of dry matter? Or, does the supply chain need to ensure some level of switchgrass quality? These questions were addressed by the research reported in this tour stop. Highlights of the "take-home-message" are below:

Mowing: Mowers were outfitted with custom shoes to raise the disk cutter height to about 8 inches. Two-cut and one-cut annual harvests were investigated to test the amount of plant matter for equipment to handle. A high-capacity, roller-type mower-conditioner performed well up to a ground speed of 10.2 mph in straight standing ~9-ft tall switchgrass in one-cut harvest at low moisture content at the end of the growing season. Through-put was as high as 61 instantaneous tons of dry matter/hour. However, problems were encountered with the same mower-conditioner (at a speed of ~4 mph) in switchgrass that was partially lodged and matted under otherwise the same switchgrass conditions. A disk mower was operated except under conditions of one-cut, low-moisture switchgrass at season end. The bulky, light material would not clear the mower curtain guard frame.

In early-season mowing (two-cut), use of the mower conditioner allowed field drying from 70 to 13 percent moisture content (wet basis) in 72 h; whereas, the disk-mowed switchgrass never dried to less than 22 percent after 190 h. Tedding just after mowing typically reduced moisture content 3 to 5 percentage points.

Raking: A PTO-driven rotary rake (merry-go-round configuration) performed well under all conditions. Though well-documented raking losses were not taken, on occasion, tire trafficking pushed mowed switchgrass

between switchgrass crowns and some losses were noted in the field.

Round Baling: A variable-chamber, belt-type round baler outfitted with twine and net wrap, and specifically with a premium windrow pickup and "silage special" package performed flawlessly at speeds up to 8.7 mph and 52 instantaneous tons of dry matter/hour in one-cut harvest at low moisture at the end of the growing season. For comparison, bales were dumped every 60 sec for twine, and every 45 sec for net wrap. High operating stresses on the baler were noted, and when stems were not well aligned with the windrow, the driveline clutch had a tendency to chatter. Though precise measures of wear rate were not taken, it appeared that switchgrass was abrasive more than hay to the sides of the bale chamber. Under some instances, when year-end baling dry friable switchgrass, buildup of residue was noted, and in some cases need to be periodically removed as much as every 5 to 10 bales to prevent interference with gate closure and external belt rubbing.

Field Chopping: A pull-type forage field chopper equipped with a pickup header was used to direct-chop switchgrass in the field. Using a low-powered tractor (~115 hp) resulted in a slow speed, but for the most part the chopper operated well. Particle sizes were widely distributed compared to the selected theoretical length of cut (3/8 inch). This came to light when handling bulk-chopped material closer to the biorefinery. The longer switchgrass stems were not fed straight into the knife drum. The manufacturer is examining the exact cause.

Storage: Covered and non-covered bales and chopped piles were examined for periods up to 18 months after placement into storage.

Cellulosic Ethanol Potential: A representative "biorefinery" process was developed using liquid ammonia fiber explosion (pre-treatment) and enzymatic hydrolysis (using enzymes to release fermentable sugars). Potential cEtOH was then calculated from the various fermentable sugars. The bottom line is that switchgrass that gets wet, and stays wet, suffers a severe loss in cEtOH potential. This was noted from samples at the ground level that were wet due to wicking. Results can be extrapolated to switchgrass that gets wet, and stays wet, due to bale-to-bale contact. Outer layers of exposed round bales allowed to dry in the field, did not suffer significant losses in cEtOH potential, at least for the very tight bales produced in this study.

Switchgrass as a Forage Crop

Gary Bates, Professor, UT Plant Sciences
Pat Keyser, Director, Center for Native Grasslands Management, UT Forestry, Wildlife and Fisheries

While there has been a great deal of media attention on the merits of switchgrass as a biofuel feedstock, many are less familiar with the potential of switchgrass as a forage crop. Switchgrass, like a number of other native warm-season grasses (NWSG), can actually produce high-quality forage. Yields of 3–6 tons per acre can be expected, depending on rainfall and soil type, as well as other environmental conditions. The nutrient content of this forage can be as high as 16-17 percent crude protein, if harvested correctly.

Characteristics that make switchgrass attractive as forage crop

► **High yields** – Switchgrass grown for forage can produce up to twice as much as tall fescue on an acre of land. Research in Tennessee has shown that, if grown exclusively for hay, 4-5 tons per acre are not uncommon. If switchgrass is planted primarily for biofuels production, there is potential to harvest the early growth through haying or grazing, then managing the remainder of the season's growth for biofuels.

► **Summer production** – Since switchgrass is a warm-season grass, it is adapted to hot, summer conditions, with peak growth during May through August. It is easier to produce hay at this time of year because of better drying conditions. Since most cattle operations in the Mid-South use tall fescue as their primary pasture grass, there is limited forage production during summer. This limited production reduces the performance of cattle, and may lead to overgrazing and weakened stands of tall fescue. Switchgrass can provide good-quality forage for

grazing animals and provide the opportunity to rest tall fescue pastures during a stressful time of the year.

Keys to using switchgrass as a hay crop

The first cutting of switchgrass should be made during mid- to late-May, when the plant is vegetative or first showing seedheads. Crude protein levels could easily range from 14–15 percent at this time of the year. A second hay harvest can be expected sometime in late July or mid-August. As with any other forage species, the more mature the crop is when harvested, the lower the nutrient content will be.

Forage harvests should leave a minimum 8-inch residual height to ensure rapid regrowth and stand persistence. Producers must realize that leaving high residual heights is very important to quick recovery of the plant because of the elevated growing point on switchgrass (often > 5 inches above the soil surface) and the minimal leaf surface area present below 8–10 inches. Removing the growing point and all leaves will result in delayed regrowth that will substantially reduce yield and, in the long run, stand vigor.

Grazing switchgrass

Because switchgrass has good nutritive value for cattle, the material could be removed through controlled grazing rather than haying. Research has shown weight gains of 1.5-2 lb/day can consistently be achieved. Because of the reasons given above under haying guidelines, it is important not to graze switchgrass too closely. Leaving a residual stand height of at least 8 inches, and preferably as high as 12 inches, is important when utilizing switchgrass for grazing. Initial entry into switchgrass in the spring should occur once the stand is 15 – 18 inches tall, or under rotational grazing, 24 inches tall. These heights typically will occur in mid-May. Stocking at lower rates or creep-grazing calves will make it possible to begin sooner. Stocking rates of 3 – 5 steers/ac will probably be best under normal circumstances, with the higher numbers needed for the rotational grazing. Regardless, grazing switchgrass will require closer management of grazing pressure than lower growing forages such as tall fescue or bermudagrass.

Economics of Switchgrass Production

Burton English, Professor, UT Agricultural & Resource Economics
James Larson, Associate Professor, UT Agricultural & Resource Economics
Daniel Mooney, Research Associate, UT Agricultural & Resource Economics
T. Edward Yu, Assistant Professor, UT Agricultural & Resource Economics

The UT Switchgrass Project was established in 2004 to generate basic knowledge about switchgrass production in Tennessee, investigate best management practices, determine least-cost sustainable production practices and develop producer recommendations. Since its inception, this project has established experiments at the Milan Research and Education Center to obtain information on varietal performance, optimal seeding and nitrogen fertilization rates, and dry-matter storage losses. This research has since expanded to evaluate production costs, farm-level production risks and storage economics. This tour stop highlights key economic findings from these efforts.

Production Costs. The cost to establish, maintain and harvest switchgrass under a five-year contract ranged from $50-75/ton (not including returns to management), depending on the yields obtained. On average, harvest represents the largest cost component (50 percent), followed by land (25 percent).

Establishment and maintenance represented only a small portion of total costs (slightly more than 10 percent each). Lower production costs ($5 to 9/ton) are projected if the stand's establishment costs can be spread over a 10-year period.

Storage Economics. Storage losses for rectangular bales exceeded that of round bales, with the majority of losses occurring within the first 150 days. A protective tarp is effective in reducing these losses. In evaluating storage surfaces for round bales, no differences were found between pallet, gravel and well-drained ground storage surfaces. Due to economies apparent in harvest, rectangular bales are cost-effective when delivered directly after harvest. However, round bales are recommended for on-farm storage, as they

more efficiently shed water and minimize losses. At biomass prices above $50/ton, a protective tarp is also recommended, as the value of storage loss would exceed the cost of the tarp and installation.

Farm-Level Risks. As with most agricultural commodities, there are risks in all aspects. Price, production costs and yield, and hence farm income, may be impacted by the following:

Switchgrass can be difficult to establish because of seed dormancy, soil moisture and temperature conditions with spring planting, and weed competition. Reseeding may increase production costs and delay revenue streams.

It takes three years for switchgrass to reach full yield potential, resulting in upfront establishment costs but a delayed and uncertain revenue stream. Producers with contracts shorter than the lifespan of a switchgrass stand may find themselves holding an asset without value if the contract is not renewed. Because the stand is a durable asset, it may be subject to technological risk in that newer, higher-yielding varieties may be developed.

Land ownership also plays a role in evaluating risks, since switchgrass is a perennial that may be under contract for a number of years and may require fewer inputs after establishment. Landowners may opt to manage the switchgrass themselves, thus impacting traditional crop producers who might not be able to spread their fixed costs over as large a crop area. Projected harvesting time for switchgrass is once in the fall after a killing freeze. The coarse and fibrous nature of switchgrass may increase equipment repair and maintenance costs. With the large amount of biomass to be harvested, machine and labor time per unit of crop area may rise at an increasing rate for each additional ton harvested; thus, machinery and labor costs will likely be higher for switchgrass than other forage-type materials.

High precipitation and limited daylight in the fall and winter months may reduce available field days for harvest and may increase harvest costs and biomass losses relative to other potential harvest periods. Once-a-year harvest will likely require storage of a substantial amount of biomass away from the plant on the farm. Precipitation and weathering may affect the quality and dry matter losses of switchgrass bales and thus the yield of ethanol. Given the potential for weathering, a processor may require that stored bales be protected from precipitation.

Large numbers of switchgrass bales under storage may be a fire hazard and present liability issues for the farmer.

As switchgrass develops into a viable alternative crop, the UT Agricultural and Resource Economics Department aims to provide effective and economical production recommendations to Tennessee producers. In addition, future research will investigate new opportunities for improving the farm economics of switchgrass for biomass.

TOUR E: NO-TILL CORN PRODUCTION

The Changing World of Insect Management in Corn

Sandy Steckel, Research Specialist II, UT Entomology and Plant Pathology
Jeff Lannom, Weakley County Director, UT Extension

Newer Bt technologies in corn are becoming commercially available and will have an impact in several ways. Bt corn hybrids, which produce toxins from the bacterium Bacillus thuringiensis, are widely planted in Tennessee. The use of Bt corn is very effective in controlling many of the caterpillar pests that often occur in Tennessee.

A refuge of non-Bt corn is required for Bt corn acres. This refuge is meant to provide a source of susceptible moths for mating with any resistant moths that might survive in Bt corn. Corn with the newer stacked technologies will quickly influence refuge acres. Currently, corn with the older single gene Bt trait planted in cotton counties requires a 50:50 refuge. This means a producer must plant at least 50 percent of corn acres to non-Bt hybrids. For producers in non-cotton counties, the refuge requirement is 80:20, meaning 20 percent planted to non-Bt hybrids. However, some newer Bt traits require only a 5 percent refuge in non-cotton counties and a 20 percent refuge in cotton counties. This is important, because the Mid-South has areas with very high corn borer pressure. The new technologies will have a big impact on refuge requirements, but perhaps the greatest impact will be in corn earworm (bollworm) control.

Some of the older technologies we will be talking about include the original Herculex Xtra and YieldGard (VT3). These traits essentially provide 100 percent control of Southwestern and European corn borers. They also provide some suppression of fall armyworm and cutworms. YieldGard and Herculex have moderate impact on corn earworm (bollworm). They cause delays in larval maturation and some mortality, but substantial kernel damage from corn earworm or fall armyworm may still occur.

The newer corn technologies include Genuity VT Triple Pro, Genuity SmartStax and Agrisure Viptera. Genuity Triple Pro has 2 Bt caterpillar toxins + 1 Bt corn rootworm toxin + Roundup Ready 2 (RR2). This technology has activity on corn borers like the older technologies but also has improved activity on corn earworms. This technology was commercially available in 2010.

Genuity SmartStax contains 8 GMO events and is essentially a cross between Genuity Triple Pro and Herculex Xtra. It has 3 Bt caterpillar traits + 3 corn rootworm traits + RR2 and Liberty Link (LL). Research at the University of Tennessee and other universities in the Mid-South has shown that it has excellent control of corn earworm and fall armyworms feeding in the ears. There was a noticeable reduction in kernel damage compared with non-Bt hybrids and the older Bt technologies. This technology was commercially available in 2010.

Agrisure Viptera has 2 Bt caterpillar toxins + RR2. University research has shown that kernel damage from corn earworm or fall armyworm is drastically reduced in Viptera corn. There is opportunity out there for Viptera to link the rootworm traits, though this will have relatively little impact in Tennessee, because corn rootworms are not a common pest. Viptera corn is not available for sale until complete deregulation. Viptera has been deregulated in the United States but not in all foreign markets, and therefore is not yet commercially available.

As impressive as these newer technologies are in controlling corn earworm feeding, UT data have not shown a yield increase when compared with currently available Bt traits. Because these technologies provide much-improved control of corn earworm, and because corn is the key host for this insect, widespread adoption may cause a landscape level reduction in corn earworm populations. This could benefit other crops where this pest also occurs, such as cotton and soybean. There are some concerns that high adoption of Bt cotton and corn throughout much of the Mid-South is putting tremendous pressure on corn earworm to develop resistance to these technologies. Further research is needed to determine what value these technologies will have to producers.

Foliar Disease Management in Corn

Scott Monfort, Associate Professor, University of Arkansas Division of Agriculture

The increase in corn demand and price has caused a dramatic increase in acreage over the last five years. With more emphasis being placed on corn production in Arkansas, management of foliar diseases, including southern rust and gray leaf spot, have become important. In most years, selection of adapted hybrids, early planting, proper fertilization, weed and insect control, and adequate irrigation have minimized the yield impact of foliar diseases. However, even with these management practices, disease outbreaks are possible (for example, the 2004 southern rust epidemic) and can cause severe yield loss under favorable environmental conditions. In these situations, fungicides are often necessary to protect the crop. One of the major limiting factors for effective control of foliar diseases in corn is a lack of information of the proper timing of fungicide applications, especially in later-planted corn. There is also only limited information available regarding the resistance of many of today's hybrids to southern rust and other important corn diseases.

A total of four disease management plots were planted from May to late June for foliar disease evaluation at select locations throughout the state in 2008 and 2009: 1.) SWREC at Hope, 2.) Jefferson County, 3.) Rowher Research Center and 4.) Jackson County (Newport Research Center). Thirty-two hybrids were evaluated at each location. Plots in the test were evaluated for incidence and severity of diseases in early August. Southern rust and northern corn leaf blight were the only two economically important diseases observed in the four locations, with southern rust being moderate to severe. There was a large variation in southern rust across the 32 hybrids evaluated. Southern rust incidence was at 100 percent, with severity ranging from 5 to 60 percent at Newport and 70 to 100 percent at Rowher. Results at all locations indicated that most of hybrids are susceptible to moderately susceptible to southern rust. The disease and yield response to fungicides of all hybrids were also evaluated to determine the economic return of fungicides when disease is present. At all locations, the use of a fungicide (Quilt @14oz) significantly reduced southern rust in a majority of the hybrids compared to the untreated. Hybrid yields were significantly impacted with the addition of a fungicide, increasing yields an average of 30 bushels per acre. At $4.50 per bushel, a fungicide increased the crop value $135 per acre, minus the fungicide and application cost.

Planting Systems Optimal for Corn Production in the Mid-South

Erick Larson, Associate Professor, Mississippi State University

Over the past decade, there has been a dramatic increase in corn acreage relative to cotton acreage in the Mid-South. This dramatic shift in crop production acres has far-reaching implications, including farm equipment, which could be affected by this shift in crop production, particularly since corn is normally grown in a crop rotation system with other crops. Mechanical limitations with cotton production/harvest dictate cotton to be typically grown in wide-row planting systems (38- to 40-inch rows). Research and commercial corn production in the U.S. Corn Belt and other regions of the world show narrow row spacing improves corn productivity by improving plant geometric spacing, which improves plant use efficiency of crucial growth processes, including light interception, and nutrient and water uptake. Thus, research in now underway to evaluate row widths and planting systems optimal for corn production in the Mid-South.

TOUR F: NO-TILL SOYBEAN PRODUCTION

Conventional and Liberty Link™ Varieties

Bob Williams, Area Specialist, UT Extension

Conventional and Liberty Link™ soybean varieties provide an alternative to the Roundup Ready™ technology that has become so popular with soybean producers since the late 1990s. Interest in growing these alternative varieties has surged again in recent years due to the fluctuating cost of glyphosate and high seed cost of Roundup Ready™ varieties. Additionally, there is a perceived reduction in the value of the glyphosate trait. In areas of Tennessee that are experiencing glyphosate-resistant Palmer amaranth and horseweed, heavy reliance on conventional herbicide programs to achieve control of resistant weeds has reduced the interest in a glyphosate system. Conventional soybean seed is inexpensive, but the conventional soybean system requires careful management for effective weed control with non-glyphosate products. Conventional soybeans are primarily available as maturity group 5 varieties, and the seed from some conventional varieties can be saved by the grower to plant the next year's crop. Liberty Link™ varieties were recently introduced for commercial sale and include a limited number of maturity group 4 and maturity group 5 varieties. The Liberty Link™ trait allows producers to apply Ignite herbicide in resistant weed situations. The sources of conventional and Liberty Link™ seed will be discussed. Variety characteristics including standability, disease traits and yield will be a focus of this tour stop.

Using Row Spacing, Planting Date and Population to Optimize Soybean Yields

Angela McClure, Associate Professor, UT Plant Sciences

Soybean production in Tennessee has changed quite dramatically over the past 10 years. Producers have contributed to a more stable state average soybean yield by reducing the risk of weather-related crop failures through the planting of multiple maturity group soybeans. Additionally, producers are including more inputs to increase their yield through the use of seed insecticide and fungicide treatments and foliar fungicide applications.

The yield of different maturity group soybeans can be optimized by adjusting production practices such as row width, planting date and seeding rate. Most row widths are determined by the equipment that is available. However, as producers replace aging equipment, there is a continued need for knowledge about the row widths that are optimal for yield in the maturity groups that are planted. The increased cost of seed and seed treatments for most herbicide-tolerant varieties has made it less economical to overplant soybeans at high seeding rates or to replant soybeans where stands are thin if a lower stand is actually sufficient. A summary of optimal row spacing, planting date and seeding rates for soybean maturity groups will be presented on this tour stop.

Green Bean Syndrome

John Rupe, Professor, University of Arkansas, Division of Agriculture, Fayetteville, AR

Soybean fields in the Mid-South have been plagued for decades by a problem sometimes called green bean syndrome (GBS). With GBS, plants fail to mature, remaining green long after the rest of the field is ready to harvest. Leaves and stems of affected plants remain green and there is a proliferation of tiny, seedless pods at the nodes. There may be a few normal pods, but these usually only contain one large seed. In some cases, there is normal pod development, but the seed die in the pod and the plants stay green. GBS occurs every year to some extent, but usually only affects a few scattered plants. However, in some fields large areas can be affected, reducing yields and interfering with harvest. Unfortunately, we are not able to predict when or where these severe outbreaks will occur. In 2008, severe outbreaks of GBS were observed in a number of fields in east-central Arkansas, where the extent of damage ranged from 10 to 100 percent. A number of harvested fields were observed that had green islands – areas of the field left uncut until frost

killed the plants. These fields were observed at the end of September and were probably planted in mid to late May. In 2009, a number of late-planted fields in southwestern Arkansas had severe GBS. The damage was extensive and was observed in a number of cultivars, maturity groups and in both conventional and RoundupReady™ cultivars. There were stinkbugs in some of these fields, but heavy rainfall in September prevented insecticide applications. In these fields, GBS occurred on the well-drained parts of the fields, but not in the low spots. GBS was also reported that year in southeast Missouri, southern Illinois and southwest Tennessee.

The cause of GBS in these fields is not known, but there are several possibilities. One strong possibility is stinkbug. Stinkbugs feed on the developing soybean embryo. This feeding can directly result in seed death and saliva from the stinkbug can also cause abnormal plant growth. Field tests have shown that intensive stinkbug feeding can result in GBS. Stinkbugs have been associated with some of the affected fields, but not all. GBS has occurred in fields with severe stinkbug pressure, but has also occurred in fields that were routinely scouted for stinkbug and promptly treated with an insecticide when needed. Entomologists who examined some of these fields felt that, while stinkbugs may be involved, they may be only part of the story. Other possible causal agents are viruses and phytoplasmas. The Tobacco Ringspot Virus (TRSV) is known to cause a disease, bud blight, that has GBS-like symptoms. This virus kills the growing points in the soybean plant preventing pod formation and the plants fail to mature. TRSV is seed- and nematode-transmitted, but is not routinely isolated from plants with GBS and is unlikely to be the cause of the severe outbreaks we have seen the past few years. Another possibility is phytoplasma. Phytoplasmas are smaller relatives of bacteria that cause GBS-like symptoms, especially the bud proliferation. These pathogens are insect-transmitted and are difficult to detect. So far, phytoplasmas have not been found in affected plants. Current research is focused on finding fields with GBS and collecting information about how the crop was grown, associated pest problems and cropping history. The pattern of disease in the field is being determined on the ground and with aerial photos. We are applying molecular tools to determine if a virus or phytoplasma may be involved. Since we cannot predict when or where GBS will occur, nor can we make the disease occur in test plots, our research is centered on studying affected grower fields, when and wherever the disease occurs, so it is important that growers let their Extension agents and specialists know about outbreaks of GBS. The more fields we observe, the more we will learn about this disease and how to prevent it.

Development of Soybean Varieties for Improved Resistance to Cyst Nematode

Prakash Arelli, Supervisory Research Geneticist and Soybean Breeder, USDA-ARS Mid-South Area & UT, Jackson, TN
Lisa Fritz, Research Associate, USDA-ARS Mid-South Area & UT, Jackson, TN

The Mid-South has more acreage planted with soybean than any other crop. Soybean ranked first in cash value among row crops produced in West Tennessee in recent years. High yields are critical to soybean producer profit margin. Diseases have suppressed soybean yields; soybean cyst nematode especially has caused significant yield losses in Tennessee. An estimate of 4 percent yield loss includes $35 to $40 million annually. These losses have remained relatively stable, primarily with the use of resistant cultivars. Nearly all nematode-resistant cultivars currently available carry resistance genes from one of two sources: Peking and/or PI88788. Nematodes can adapt to resistant cultivars over time because of lack of broad-based soybean resistance. More aggressive and yield-suppressing nematode populations are also emerging in West Tennessee and continue to adapt to resistant cultivars commercially available today.

In our USDA breeding program, in cooperation with Vince Pantalone from the University of Tennessee, we are stacking up resistance genes from traditional sources, together with the resistance genes identified from the newest sources, and developing unique resistant cultivars with broad-based resistance. Combined technologies of traditional plant breeding, together with recent biotechnological methods, are

used to transfer resistance genes into elite soybeans, primarily in maturity group V. Soybean JTN-5203, developed by USDA and UT in maturity group V, has out-yielded nearly all entries in 2009 Tennessee Soybean Performance Tests and produced 67 bushels/acre. It is a conventional bean resistant to multiple nematode populations, especially to newly emerging Race 2 population in Tennessee, resistant to stem canker, frogeye leaf spot and moderately resistant to SDS. Others in maturity group IV are in developmental stages for release. Soybean JTN-5109 is the latest soybean line developed by using traditional breeding and genetic marker-assisted selection method for resistance to a synthetic nematode population, which is highly aggressive combined with no known source of resistance except an unadapted plant introduction PI 567516C. Soybean PI 567516C is from China, with greenish brown seed, a very high rate of lodging and is highly shattering combined with extremely poor yield. Nematode resistance genes from PI 567516C soybean have been combined with resistance genes from soybean Hartwig in Hartwig background. Currently, soybean Hartwig is available with broad resistance to nematode populations in Tennessee in maturity group V cultivars and resistance genes from new soybean line PI 567516C will further improve Hartwig soybean for its resistance. More are in the pipeline for release. Thus, Tennessee soybean producers will have reduced risk of economic loss by the nematodes and will benefit by having productive, adapted, high-yielding, nematode-resistant cultivars especially developed with excellent collaboration from Vince Pantalone at UT by USDA-ARS in Jackson, TN.

Development of High-Yielding Soybean Varieties for Tennessee

Vince Pantalone, Professor, UT Plant Sciences
Suzannah Mellinger, Graduate Research Assistant, UT Plant Sciences
Chris Smallwood, Graduate Research Assistant, UT Plant Sciences
Ben Wiggins, Graduate Research Assistant, UT Plant Sciences

Our University of Tennessee Soybean Breeding and Genetics Program uses modern methods of classical plant breeding coupled with DNA laboratory technologies to develop high-yielding conventional and Roundup Ready soybean varieties for producers in Tennessee and the Mid-South. For example, our Roundup Ready variety USG Allen ranked #1 for seed yield in its maturity class in the 2009 Tennessee State Variety Test, where it exceeded the commercial average by 4 bushels/acre. Based on commercial acreages of production during 2009, the extra bushels that it produced added more than $1.1 million in additional farmer revenue compared to the average soybean variety that year. During the past five years (2006 to 2010) our program has released seven commercially available Roundup Ready varieties, which are marketed through UniSouth Genetics, Inc., headquartered in Nashville, TN. Our newest variety for 2010 is USG 75T40, a top-yielding early Group V Roundup Ready soybean with extraordinary resistance to soybean cyst nematode (SCN) Race 2. Our new USG 74T59 was designed to combine SCN resistance with a drought-tolerant pedigree in a mid Group IV Roundup Ready soybean variety. During the worst drought year in decades (2007), that variety topped the tests for yield, and produced more than 8 bushels/acre above the average of all entries in the USDA Southern Regional Test. The use of resistant cultivars helps to minimize losses from SCN and helps keep producer revenues stable.

Our graduate students engage in many active research projects, from enhancing the stability of biodiesel fuel to applying genomic information for the genetic improvement of soybean. For example, a major new project underway is to reduce phytate concentration in the seed. The low-phytate trait will enhance nutrition for poultry and swine, and will protect the environment by reducing phosphorous loads in poultry manure applied to agricultural lands. Phosphorous leaches into aquifers, ground water, ponds, lakes, streams and estuaries, where it contributes to increased algal blooms, and decreased available oxygen concentration. Phosphorous levels are important to current federal regulations regarding nutrient loads and nutrient best management practices. At present, no commercial soybean varieties exist that express low phytate. Our basic and applied

research will fill this gap and help to solve a current need. We have successfully employed DNA markers to track the inheritance of two recessive genes that together govern the concentration of soybean seed phyate. New biotechnology instrumentation in our laboratory will now enable us to use single nucleotide polymorphisms (SNPs) as perfect markers that were developed as part of the actual gene sequence. This will enable our students to train in modern technology and apply their discoveries to improve the environment and the livelihood of soybean producers in Tennessee and the Mid-South region.

TOUR G: NO-TILL COTTON PRODUCTION

Managing Spider Mites

Scott Stewart, Professor, UT Entomology & Plant Pathology

Spider mites have become an increasing problem in parts of the Mid-South. As part of a regional project, an effort began in 2009 to better understand how miticides and mite infestation levels impact yield. These efforts are being continued in 2010. One component is the standardized evaluation of various miticides. Another component is investigating how the timing and intensity of spider mite infestations impact yield. Five states were involved in these tests, including Tennessee. This project is partially funded by Cotton Incorporated.

Standardized Evaluation of Miticides: Because 2009 was characterized by being unseasonably cool and wet throughout much of the Mid-South, fewer tests (4) were initiated than planned, and yield data could not be collected at all locations. Also, spider mite populations in most tests were of moderate intensity and duration, with populations at three locations crashing to negligible levels before final counts could be made. Nevertheless, when analyzed across all locations, all miticide treatments significantly reduced populations at 3-5 days after treatment, 7-9 DAT and 10+ DAT, and control across treatments was statistically similar. Mite populations were at their lowest level 7-9 DAT, but overall populations in untreated plots had also decreased during this time frame. Yield was not significantly affected by yield. However, environmental conditions were not favorable for spider mites or potential impacts on yield. Also, hard lock caused by excessive rains in September brought into question the value of yield data collected at two of three locations.

Infestation Timing and Intensity Effects: In each state, spider mites were infested onto cotton at different growth stages, and the intensity and duration of infestations were noted as well as the impact on the plant and yield. In general, spider mites significantly impacted yields where data were able to be generated (data not shown). Infestations initiated at the three-leaf stage resulted in significantly lower yields compared to the non-infested in all three of the trials that reported a yield loss. Infestations beginning at first bloom significantly reduced yields in two of the three trials reported. Additionally, infestations beginning at 200 heat units and 400 heat units beyond first bloom resulted in significant yield reductions in one of the three trials reported.

Harvest Aids for Cotton

Owen Gwathmey, Associate Professor, UT Plant Sciences
Tom Barber, Assistant Professor and Extension Cotton Agronomist, University of Arkansas

Harvest aids are chemicals that prepare the crop for mechanical harvest by removing leaves, opening mature bolls and suppressing regrowth. Selected and applied correctly, harvest aids improve harvesting efficiency and preserve lint quality.

Commercial defoliants have herbicidal or hormonal modes of action. Herbicidal defoliants injure the plant, causing it to produce ethylene, which promotes defoliation (leaf shed). Active ingredients may include tribufos or carfentrazone. At rates too high for the temperature, these defoliants can kill leaves. This causes desiccation or "stuck leaves," increasing leaf trash in harvested lint. Hormonal defoliants increase ethylene production in the plant, promoting defoliation. Active ingredients of hormonal materials may include thidiazuron or dimethipin. Vegetative regrowth is suppressed by auxin inhibition by products containing thidiazuron or cyclanilide. Regrowth suppression is useful when harvest is delayed, when a late flush of soil nitrogen occurs or when late rains occur in a drought year.

Ethephon generates the ethylene hormone in the plant. It is mainly used to open bolls, but also aids defoliation at high-use rates. Ethephon needs temperatures >60 degrees F to work well. Ethephon products are sold as premixtures with other materials such as cyclanilide or urea sufate. It is also a common tank-mix partner with defoliants.

Desiccation is the rapid drying of plant tissue, due to cell membrane disruption. Typically, desiccated

leaves do not shed, adding to leaf trash in the harvested lint. Harvest-aid products designed to desiccate cotton may contain paraquat or sodium chlorate. Desiccants are mainly used in stripper cotton to reduce moisture. They offer relatively poor boll opening and regrowth control, and can cause problems in tank mixtures. Cost-effective use of harvest aids involves using various modes of action to match the weather and crop conditions. A common scenario involves early-maturing, drought-stressed cotton typically found on hill ground. Drought stress toughens the leaf cuticle, causing harvest-aid uptake problems. Drought can also shorten the stalk and the boll load, lowering yield potential and harvest-aid budget. Hot weather at time of harvest-aid application has the potential to stick leaves. In this case, we want to avoid herbicidal-type materials, and use hormonal modes of action. An example tank mixture might include thidiazuron SC at 1.6 to 2.4 oz/A, plus ethephon at 16 to 24 oz/ac, and a nonionic surfactant at 0.25% v/v.

Another scenario involves late cotton with rank growth, typical on irrigated bottom ground. A thick canopy leads to spray coverage problems. However, the high boll load promises a high yield potential and a more ample budget. Late maturity can lead to unfavorable weather at time of harvest-aid application. In this case, a two-step approach is appropriate. Example: 1st application might include ethephon+cyclanilide premixture at 22 to 30 oz/A, plus tribufos at 6 to 8 oz/A. An example follow-by application, 7-14 days later, might include a tank mixture of carfentrazone at 0.5 to 1.0 oz/A + COC, and ethephon at 12 to 20 oz/A.

A different scenario often occurs after early freeze or frost. A light frost (brief period of 30-32°F) turns leaves, but a hard freeze (sustained <30°F) can lock bolls shut. Harvest-aid chemicals don't work well in cold weather, so it's important to wait until day temperatures rise to 55-60°F. An example tank-mixture after light frost might include carfentrazone at 0.75 to 1.0 oz/A + COC; plus ethephon at 36 to 42 oz/A. After a hard freeze, carfentrazone at 1 oz/A + COC may be appropriate, or maybe no harvest-aid application at all. We always need to set aside an ample budget for harvest-aid chemicals and application. We want to read the label and use multiple, complementary modes of action suitable for the weather and crop conditions. Most of all, we need to be patient and have realistic expectations.

Additional information:

Cotton Harvest Aids. University of Tennessee Extension W225. Available at: http://www.utextension.utk.edu/fieldCrops/cotton/PDF%20files/W225.pdf

Cotton Defoliants. University of Arkansas Cooperative Extension MP-44. Available at: http://www.uaex.edu/Other_Areas/publications/PDF/MP44/I2_Cotton.pdf http://www.uaex.edu/Other_Areas/publications/PDF/MP44/I3_Cotton.pdf

Cotton Response to Nitrogen Fertilization and Plant Growth Regulation

Chris Main, Assistant Professor, UT Plant Sciences
Matthew Wiggins, Graduate Research Assistant, UT Plant Sciences

Cotton is a perennial plant that is grown commercially as an annual plant in most production regions of the world. This unique aspect of cotton production requires management techniques that are different from many other field crops. Nitrogen fertilization, while essential to achieve high yields, can negatively impact cotton growth and development as well as decrease yield potential. High rates of nitrogen fertilization will produce a crop that has more vegetative biomass and extend the length of time it takes the crop to mature and become ready for harvest. To help offset the impacts of excessive growth, plant growth regulating products can be utilized to maintain a compact plant, keeping bolls in the optimum harvesting zone for mechanical pickers. This tour stop will investigate optimum nitrogen rates for cotton production, along with proper use of plant growth-regulating compounds for maintaining proper plant size.

What Was Once Old Is Now New Again

Brock Waggoner, Associate Professor, UT Plant Sciences
Bob Hayes, AgResearch Center Director, UT West Tennessee Research and Education Center
Larry Steckel, Associate Professor, UT Plant Sciences

Over-the-top applications of glyphosate in cotton during the growing season have been a great technological achievement in cotton production. When Roundup Ready® cotton was first introduced in 1997, glyphosate went from being a great burndown herbicide to being more widely used than the next top 10 herbicides. In the Mid-South, until just a few years ago, a seed dealer would be hard-pressed to find a customer who wanted any crop that was not Roundup Ready®. Since glyphosate-resistant horseweed (*Conyza canadensis*) was confirmed in Tennessee in 2001, weed control started becoming more challenging for Tennessee growers. Though horseweed is still an issue in no-till cotton production, most cotton growers have learned to manage it. The real 'game changer' in weed management has been the widespread proliferation of glyphosate-resistant Palmer amaranth (*Amaranthus palmeri)*. This weed has forced many growers to migrate from a completely glyphosate-based system to an Ignite-based system. This tour stop will highlight some of these weed management changes in cotton brought on by glyphosate-resistant horseweed and Palmer amaranth. The strengths and weaknesses of each system will be discussed in this new era of glyphosate-resistant weeds.

TOUR H: BEEF CATTLE PRODUCTION IN TENNESSEE

Using Commodity (by-product) Feeds in Beef Rations

Clyde Lane Jr., Professor, UT Animal Science

Many different food/distilling industries have byproducts that can be fed to beef cattle. These commodity or by-products can be an economical way for producers to reduce their feed costs if they have to purchase feed. Many producers consider these types of feed something new; however, they have been extensively used by commercial feed companies as a component of their feed for a long time. It is just recently that many of these commodity feeds have been readily available to individual producers. Some of the feeds included in this list include cottonseeds, hominy, bakery waste, soyhulls, citrus pulp, rice bran, wheat mids, brewers grains, corn gluten feeds, cottonseed meal, soybean meal, cottonseed hulls and rice hulls. Since there are many common advantages and disadvantages for these feeds, only three will be discussed in this tour stop.

The three feeds to be discussed are soyhulls, corn gluten and distiller's grains. Soyhulls are a byproduct of the soybean oil industry. The soyhulls serve as both an energy and a protein source. They work well when fed alone or when mixed with other feeds. They are generally available in pelleted form. An average analysis is 80 percent TDN, 14 percent crude protein and 14 percent starch. The protein, calcium and phosphorus are adequate for most beef animals and are nearly balanced for their requirements. The lower starch level reduces acidosis and improves performance of animals on forage-based diets.

Corn gluten is a byproduct of the wet corn milling process where starch and nutritive sweeteners are produced. Distiller's grains are a product of the ethanol distilling process. Since corn gluten and distiller's grains are so similar in nutritive value and have some of the same feeding problems, they will be discussed together.

Both of these feeds have acceptable protein content (16–25 percent TDN). They are both quite palatable to animals. The problem with both feeds is that they have high sulfur content and a poor calcium-to-phosphorus ratio (too much phosphorus for the amount of calcium present). Adding additional calcium to the diet can correct the calcium-to-phosphorus ratio. The high sulfur content is the reason for limiting the amount of these feeds to 15 to 40 percent of the diet. The high sulfur content ties up the copper, zinc and selenium. The correct mineral mixture can be used to provide the extra amounts of these minerals needed by the animals. Since there is a limit on how much of these minerals can be added (too much can be toxic), producers should work with their mineral dealers to select the best mineral to add to the feed mixture. When deciding whether to use these commodity or byproduct feeds, the costs need to be carefully evaluated. In addition to the actual cost of the feed, be sure to add in the cost of transportation, wastage and spoilage, any special equipment needed for storage and feeding, plus the extra costs for minerals associated with their use. If a wet product is being considered, be sure to make calculations on a dry basis to get an accurate cost evaluation.

Commodity or by-product feeds make a good addition to the feeding program for many producers. It is important to understand the limitations of each feed and develop a feeding program that will minimize the negative effects.

Managing Genetic Defects

F. David Kirkpatrick, Professor, UT Animal Science

The advent of national genetic evaluation by a number of different purebred beef breeds has provided the industry a means to identify genetically superior animals in a number of traits within a breed. This has provided the opportunity to identify and use a certain few sires within a breed in an attempt to fix a desired phenotype and performance in desired traits. It is not unusual to see a particular sire that excels genetically in a particular combination of traits appear in several generations of a pedigree on both sides of an individual. Also, with the additional means of multiplying a given set of genetics by artificial insemination and embryo transfer, a particular sire's

genetics or bloodline can become very concentrated in a breed.

The concept of mating individuals within a line and trying to maintain a substantial degree of relationship to an outstanding individual within that line is called linebreeding. This concept has a tendency to fix a number of genes from that superior individual that influence superior performance in certain traits, as well as other genes affecting other traits from that superior individual. This enhances the opportunity for an increase in inbreeding and the likelihood of discovering a genetic abnormality affected by a recessive genetic defect.

Recessive genetic defects occur in all breeds and species, even humans. Recessive genetic defects in cattle are inherited congenital abnormalities. Animals that inherit a single defective or mutated gene from one parent and a normal copy of the gene from the other parent are heterozygotes and are not affected from the condition, but they are carriers of the mutated gene and will, on the average, pass it on to half of their progeny. The only way a recessive genetic defect can be expressed is when the individual possesses both of the recessive mutated genes in its genetic makeup (homozygous recessive). It has to inherit one recessive gene from each carrier parent.

Animals that do not possess a copy of the mutated gene are called homozygous normal and do not differ phenotypically from the animals that possess one normal and one mutated gene (heterozygotes). Phenotypic selection against the recessive gene is ineffective, since there is no measurable difference between the homozygotes and heterozygotes. It is similar to selecting against the red gene in coat color in cattle. Both the homozygous black cattle and heterozygous black (red gene carriers) are black and not distinguishable. However, when two black animals produce a red calf, we can determine that both parents are heterozygotes (red gene carriers).

In the past, proving suspected carrier bulls free of a recessive gene for a trait were required to be mated to a number of known carriers (those females that had produced an individual possessing the trait) or use of sire-daughter matings to determine if a defect arose from any of the matings. If a defective animal was produced, the bull was deemed a carrier for that recessive trait. This type of procedure consumed both time and expense to determine the genetic status of a bull.

Fortunately, advances in molecular genetics have provided new tools for the rapid identification of specific mutations that cause defects. DNA-based diagnostic tests are newly available tools to identify carriers and manage various genetic defects. These technologies have led to the identification of genetic mutations that cause a number of different genetic defects in various breeds.

Genetic defects in the Angus breed have recently caused a tremendous amount of concern, since a very popular bull (GAR Precision 1680) has been identified as a carrier for both the AM (curly calf syndrome) and NH (hydrocephalus) genes. This popular bull, who excelled in carcass marbling as well as birth, weaning and yearling weight, was born in 1990. He has sired many offspring as well as popular AI sons and grandsons that appear in numerous pedigrees. In addition, many composite breeds (Gelbvieh Balancer, Simm-Angus, Chiangus and others) have used his genetics in their developmental programs.

With the new DNA tests available, breeding programs can be managed toward eliminating or reducing the frequency of these recessive genes. Within the Angus breed, known AM carriers are denoted in the pedigree as AMC and animals proven free of the gene are denoted as AMF. Also, known NH carriers are signified by NHC and those free of the NH gene are reported as NHF. The majority of Angus AI sires have been DNA tested for both recessive genes and the results are posted on the Angus homepage (www.angus.org). Several other breeds list known carriers of various genetic defects on their homepages. Not all animals need to be tested. Only those that have ancestors in their pedigree that are known or possible carriers would be necessary to eliminate the chance of the occurrence of one of these defects. Because of the mode of inheritance, it is also important to understand that an individual who has a carrier in his/her pedigree may him/herself not be a carrier. Sound selection decisions and breeding programs can be implemented to eliminate the occurrence of either one of these defects. Commercial producers who use Angus bulls in their crossbreeding programs

have a low probability of producing or losing calves from either one of these lethal genetic defects, even if the bull they are using has a carrier in his pedigree. However, if a commercial producer saved heifers for replacements from the bull that had a carrier in his pedigree, the producer needs to be sure that the next bull purchased is not a carrier for either genetic defect. The surest and simplest procedure to eliminate the risk of having either one of these genetic defects is to use only bulls that are proven to be free of both genes (NHF & AMF). The elimination of this condition can be very manageable if proper records are maintained in a commercial cow-calf program.

Genetic defects are not new to the industry. All breeds contain some genetic defects, and it is extremely rare that they are observed. However, closer matings (both bulls and cows that have common ancestors in their pedigree) increase the likelihood of occurrences. One of the early mutations experienced in the cattle industry was the polledness condition, which indicates that not all mutations are bad. In the 1950s, we experienced dwarf calves and eliminated them by selecting against those identified carriers. With the genetic molecular technology available today, and the ability to easily identify carriers, these recent occurring abnormalities can also be eliminated in a more rapid fashion.

Replacement Beef Heifer Selection and Development

Justin Rhinehart, Assistant Professor, UT Animal Science

Selection and development of beef heifers, to replace culled cows or increase herd numbers, impacts the economics of a cow-calf operation through genetics and longevity. Improved genetics can enhance growth performance and carcass value, while eventual longevity of the heifer as a mature cow is influenced by reproductive success during the first breeding season. The first decision to be made regarding replacement females is whether to keep weaned heifers and develop them to breeding or market all heifers and purchase bred females (cows or heifers) that have been bred to fit a specific calving season. Several factors impacting this decision include economics, available resources, experience, genetic improvement and convenience. The financial concerns of developing replacement heifers are related to diverting cash flow and resources. If immediate revenue is required to maintain normal production capacity, selling weaned heifers and purchasing bred replacements later should be considered. Furthermore, consider purchasing replacements if higher returns can be generated by an alternative use for the proceeds from market cow and feeder calf sales.

If the decision is made to retain replacements, several pre-breeding practices should be followed to make sure they breed early, calve easily and rebreed in the subsequent breeding season. Nutritional management from weaning to the first breeding season is extremely important. A good rule of thumb is to have the heifers weighing 65-70 percent of their expected mature body weight by the start of the breeding season. This should ensure that the heifers have reached puberty and will have a greater opportunity to be bred successfully.

At least one month prior to the breeding season, the heifers should be given a reproductive tract score, pelvic area measurement and pre-breeding vaccinations (including booster). A reproductive tract score will estimate each individual heifer's sexual maturity and make sure they are ready to breed. Pelvic area measurements will identify heifers that could have calving difficulties even when bred to a proven low-birthweight sire. Pre-breeding vaccinations, especially those including protection against "vibrio" and "lepto," should insure proper health and reduce the instance of pregnancy wastage.

After a defined breeding season, the replacement heifers should be palpated to determine pregnancy status. The most ideal scenario would be to ultrasound 30 days after the bull is removed. Identifying open heifers as early as possible will result in more marketing options for open heifers and eliminate wasting feed resources on heifers that will not produce a calf. The next best option would be to have a veterinarian manually diagnose pregnancy as early after the breeding season as they are comfortable. After spending this much time and labor on developing replacements, it will be important to maintain the same diligence from breeding to calving and

rebreeding. The heifers should calve at approximately 85-90 percent of their predicted mature weight, with a body condition score of 6. Watch the heifers closely as they calve and provide assistance when needed. Supplemental nutrition will likely be required until they are confirmed pregnant in the subsequent breeding season.

Preconditioning Beef Calves to Improve Marketability and Improve Returns

Emmit L. Rawls, Professor, UT Agricultural & Resource Economics

Buyers of Tennessee feeder cattle are demanding calves that will go on feed or grass and perform efficiently and profitably for their customers. Preconditioned calves have been weaned at least 45 days, taught how to eat and drink from a trough, castrated, dehorned and properly vaccinated for bovine respiratory diseases (BED). Preconditioned calves are worth more to buyers because they gain faster, have reduced sickness and death loss, and have a lower cost of gain than non-preconditioned calves. In recent years, buyers have started paying more for preconditioned calves when they can be offered in truckload lots of 48,000 to 50,000 pounds. Cattle feeders do not have sufficient skilled labor to manage bawling calves, which are more likely to get sick and require management attention. Furthermore, calves that have to be treated in the feedlot will have poorer feedlot performance, produce lower-valued carcasses and will be less profitable than preconditioned calves. The key is to properly precondition calves and offer them in a competitive market in truckloads to capture the value that has been added.

Calves also need to be weaned using a low-stress method such as fence-line weaning, where the calves and mothers can touch noses. Having calves accustomed to eating dry feed prior to weaning, combined with a low-stress method, can result in a transition with little to no loss in performance. A two-step method where calves are fitted with plastic anti-nursing devices, then turned back with the cows for a week, can be used if a fence-line arrangement is not possible, and offers similar results.

The time of the year when calves are weaned and marketed can also have a dramatic impact on the returns achieved from preconditioning. Research by Howard and Rawls over the past 14 years revealed that 60-day post-weaning periods where calves were fed 2 percent of bodyweight were more profitable than 45-day periods. Furthermore, spring calves weaned in November and December and marketed in January and February were much more profitable than marketing in the fall. The most profitable opportunity for fall-born calves was to wean in June and market in August.

TOUR I: NO-TILL WEED CONTROL

Herbicide Mode of Action

Eric Walker, Assistant Professor, UT Martin Plant Science
Philip Shelby, UT Extension Director, Gibson County

Weed identification, proper herbicide application timing for maximum weed control and herbicide mode of action will be the topics of this tour stop. Smaller, younger weeds are easier to control with herbicides than larger, older weeds, because most weeds become more tolerant to herbicides as they increase in size. Also, specific herbicides control specific weed species and do not control others. Therefore, correct identification of small, young weeds and a basic understanding of herbicide mode of action are essential for effective weed control. At this tour stop, various crop and weed species were planted in field plots, then treated with different herbicides. Speakers will teach guests how to correctly identify small, young weeds and illustrate strengths and weaknesses of commonly used herbicides based on crop safety, weed control and plant injury symptoms caused by the herbicides.

Weed Control Technologies

Tom Mueller, Professor, UT Plant Sciences
Kelly Barnett, Graduate Research Assistant, UT Plant Sciences
Richard Buntin, CCA, UT Extension Director, Crockett County

Glyphosate-resistant (GR) weeds such as palmer amaranth, horseweed and giant ragweed have become more problematic to control as they continue to spread throughout the state. The introduction of new weed control technologies may provide new options to control GR weed species. This tour stop will focus on the weed control technologies that are currently available in soybean, as well as future technologies that will be available in the next couple of years. In addition, grain sorghum varieties with ALS-resistant and ACCase-resistance will be discussed.

Field studies were conducted to evaluate programs with pre-emergence (PRE) plus postemergence (POST) herbicide applications in Roundup Ready soybean. However, the increased presence of glyphosate-resistant weeds is making it more difficult to control these species with glyphosate alone. Roundup Ready soybeans have provided growers with the opportunity to control weeds since 1996, and these varieties are currently used by more than 90 percent of soybean growers in the U.S. Glyphosate-resistant weeds are making it difficult for growers to manage weeds with glyphosate alone, so the objective of this study was to determine the best weed control programs for effectively controlling glyphosate-resistant weeds in Roundup Ready soybean.

Liberty Link soybeans provide growers with the opportunity to use an alternate herbicide mode of action in their weed control program. Ignite, the non-selective herbicide used on Liberty Link crops, can provide excellent control of many weeds, including glyphosate-resistant Palmer Amaranth. The objective of this study was to evaluate the efficacy of Ignite alone and in combination with other herbicides. Using other herbicides in addition to Ignite can provide better control of some weed species and particularly can increase efficacy on larger Palmer Amaranth. Additionally, using other herbicides with Ignite will help preserve the technology and prolong the development of resistance to this herbicide. Varieties of soybean with resistance to dicamba and glyphosate will be available in 2014. This technology will provide growers with an additional option for managing difficult-to-control weeds, such as glyphosate-resistant Palmer Amaranth. This study demonstrates the dicamba-resistant soybean technology and evaluates the efficacy of a dicamba (Clarity) + glyphosate applied PRE followed with an early POST application of glyphosate when compared with a dicamba + glyphosate POST only application. New weed control technologies in grain sorghum will also be available in the near future. By 2012, ALS-resistant grain sorghum (Inzen Z) and ACCase-resistant grain sorghum (Inzen AII) will be released commercially. By 2013, varieties with these combined traits (Inzen ZAII) will be commercially available. The ALS-resistant variety, Inzen Z, will allow the ALS

herbicide (Zest) to be applied for over-the-top grass control in grain sorghum. The ACCase-resistant variety, Inzen AII, will allow the ACCase herbicide Assure II (quizalofop) to be applied for over-the-top grass control in grain sorghum. Studies were conducted to evaluate the efficacy of PRE plus POST herbicide programs that can be used to control grasses in the Inzen Z and Inzen AII grain sorghum varieties.

Grass Pasture and Hay Weed Control Strategies

Neil Rhodes, Professor, UT Extension
Will Phillips, Graduate Research Assistant, UT Extension

Weather patterns over the past three years have presented numerous challenges to cattle producers in terms of implementing weed control strategies in pastures and hay fields. The extended drought of 2007-2008 in most of the region resulted in loss of grass due to overgrazing and the lack of success in re-seeding due to low soil moisture. This extended dry period was followed in 2009 by ample-to-surplus rainfall. Fortunately, the 2009 rains allowed producers to make considerable headway in restoring valuable grass stands. However, these same rains have led to the release of heavy weed pressure in 2010 arising from previously dormant weed seed in the soil profile. This has put a premium on the proper implementation of sound weed control strategies. Weed control strategies for pasture and hay vary, but most of the basic components are the same: promotion of grass competition through maintenance of proper soil pH and fertility; managed grazing rather than overgrazing of pastures; timely clipping of pastures; correct, timely identification of weed pests; and the timely implementation of the correct control measure, which is usually a herbicide.

Fortunately, a number of new herbicides and new labels for existing herbicides have entered the marketplace and greatly improved weed control options for pasture and hay. This has been particularly true for bermudagrass. While broadleaf weeds can be troublesome, the greatest weed challenges over the years in bermudagrass have been summer annual and warm-season perennial grasses. A new label granted earlier this year now allows the use of Prowl H2O (pendimethalin) in established, dormant bermudagrass for preemergence control of many annual grasses and small-seeded broadleaves such as crabgrass, foxtails, barnyardgrass, pigweeds and lambsquarters. Prowl H20 must be applied before weed seed germination, and it must receive rainfall for activation. Producers with persistent crabgrass problems should consider Prowl H2O, as there are no effective, labeled postemergence options for crabgrass. Prowl is not registered for use in cool-season forage grasses such as tall fescue and orchardgrass.
Rhizome and seedling johnsongrass can be controlled in forage bermudagrass with either Outrider (sulfosulfuron, also sold under the trade name of Maverick) or Pastora. Outrider/Maverick should be applied postemergence to actively growing johnsongrass. The herbicide also controls nutsedge, but it is weak on most summer annual grasses and broadleaves. Pastora, a premix of the active ingredients in Accent (nicosulfuron) and Cimarron (metsulfuron), was cleared for postemergence use in forage bermudagrass in April of this year. The herbicide provides broadspectrum control of many grasses and broadleaves, including seedling and rhizome johnsongrass, broadleaf signalgrass, barnyardgrass, foxtails, fall panicum, pigweeds, cocklebur, sicklepod and many other broadleaves. It does not control crabgrass nor nutsedge. Pastora causes some temporary discoloration and growth reduction of bermudagrass. This can be reduced by using no more than 1 oz/A, and by making applications sooner, rather than later, following a hay harvest. Outrider/Maverick and Pastora are not registered for use in cool-season forage grasses.

Numerous, highly effective broadleaf herbicides are available for use in bermudagrass and cool-season grasses such as tall fescue and orchardgrass. Milestone (aminopyralid), ForeFront (aminopyralid + 2,4-D) and Chaparral (aminopyralid + metsulfuron) are effective on most annual broadleaves and several perennial broadleaves such as horsenettle and tall ironweed. Chaparral provides better control of spotted spurge, goldenrod, brambles and buckbrush than Milestone or ForeFront, but it causes noticeable stunting in tall fescue due to the metsulfuron component.

We are in our third year of research with a new broadleaf herbicide from DuPont coded DPX MAT-28. The active ingredient is aminocyclopyrachlor, which is similar in chemistry to aminopyralid. A trade name has not been announced. The herbicide has performed well in our trials across the state, and registration in forage bermudagrass and cool-season grasses is expected in time for the 2013 use season.

For more information on weed control strategies in grass pastures and hay, please stop by your local UT Extension office and pick up a copy of Publication 1580, *2010 Weed Control Manual for Tennessee*. The publication can also be accessed on-line at weeds.utk.edu.

Always read the label thoroughly before purchasing and applying a herbicide. Be sure to read and follow all instructions and precautions such as rates, waiting times before grazing or hay harvest, crop rotation and use of treated hay.

TOUR J: IRRIGATION

Choosing Corn and Soybean Varieties Best-Suited for Irrigation in Tennessee

Fred L. Allen, Professor and Coordinator, UT Plant Sciences
Richard D. Johnson, Research Associate, UT Plant Sciences

During most growing seasons in Tennessee, inadequate moisture is the major limiting factor to maximum yields for all row crops. The UT Agronomic Variety Testing Program has been conducting corn and soybean variety tests with and without irrigation at the Research and Education Center at Milan since 2002. In normal rainfall years, the average yield difference between irrigated vs. non-irrigated tests has ranged from about 70 to 80 bu/a across all maturity groups of corn hybrids (110-120 DAP), and about 10 to 15 bu/a across all maturity groups of soybeans (MG 3-5). In years when there is moisture stress during the seed-filling period, all varieties respond to irrigation. However, there is variation among both corn and soybean varieties in how well they respond to irrigation. For producers who have irrigation systems, it is important to study irrigated variety trial data in order to choose the ones for their operation with the record of responding best to supplemental water. This presentation will focus on this topic.

TOUR K: INTEGRATING AUTO-GUIDANCE INTO YOUR FARMING SYSTEM

An Overview and Demonstration of Auto-Guidance

John Wilkerson, Professor, UT Biosystems Engineering & Soil Science
Phillip Allen, Research Associate, UT Biosystems Engineering & Soil Science

Auto-guidance has the potential to assist Tennessee producers in many ways. Reduced fatigue, accurate input placement and the opportunity to mismatch row-crop equipment are a few of the potential benefits. Knowing the right questions to ask a dealer when adopting a new technology like auto-guidance will help ensure you get what you expect and what will work best on your farm. All auto-guidance systems are made up of a tractor control system that physically controls the equipment, a display that provides user-interface and a high-accuracy GPS that will require external correction information. Several manufacturers sell full auto-guidance systems that include all of the necessary components. There are options even within manufacturers when selecting components. The user or dealer also has the flexibility to mix components across manufacturers to build a system tailored for specific applications or that will incorporate existing equipment. For example, the system demonstrated at the 2010 No-Till Field Day integrates a monitor that staff were familiar with from their cotton picker, a GPS from previous mapping applications, a cellular system that communicates correction data from TDOT and a new equipment controller. Important things to keep in mind when considering an auto-guidance system include:

- If you have spotty performance from GPS systems due to obstacles around your fields, auto-guidance may not work well. Auto-guidance relies on GPS to determine your position/speed in the field.
- The accuracy of your auto-guidance will be dictated by the accuracy of your GPS unit and the calibration performed by the dealer who installs the system.
- Compatibility with existing equipment could be important, because it can allow for easy data transfer between monitors, equipment and your computer.
- A strong relationship with a good dealer can be important when technical support is necessary.

An Overview of Current Auto-Guidance Technology

John Fulton, Assistant Professor, and Daniel Mullenix, Biosystems Engineering, Auburn University

The adoption of auto-guidance technology continues to grow across the U.S. Farmers who have adopted auto-guidance have recognized tremendous benefits to their operation. These have included minimizing overlap; increasing field efficiency; reduced guessing of the next adjacent pass location; and improved, overall application or planting accuracy. These benefits have directly resulted in improved profitability through input savings and reduced in-field time. Another benefit that farmers or machine operators have highlighted during recent surveys in Alabama has been reduced fatigue over long days and the ability to work accurately at night, thereby allowing them to extend the work day during critical field operation times. The technology also allows operators to make calls or conduct business while the tractor or machine drives itself. In most cases, farmers have indicated they will never revert back to manual guidance of machines after adopting auto-guidance, since it provides these benefits to their operation and for any operator.

A recent trend in the Southeast and across the U.S. is the increased adoption of Real-Time Kinematic (RTK; inch-level accuracy) based auto-guidance systems. This trend can be attributed to the lower upfront capital costs for RTK auto-guidance, making it more feasible for farmers. One of the primary cost reductions is the availability of **Real-time Networks (RTN)** such as Continuously Operating Reference Stations (CORS), currently available in several states. Overall, the price reduction can be about 40 to 50

percent, depending upon the system. The existence of RTNs has eliminated the need for a farmer to invest and then manage his or her own base station. Another benefit of RTNs for users is that longer baselines (distance between base station and rover unit on machinery) are possible; however, a connection to the Internet is required. Radios have been the main communication for traditional on-farm base stations, providing around a 2- to 10-mile range, depending upon the terrain, trees and other obstacles. With RTNs, a modem or mobile phone with a data plan can be used to communicate between the network server and auto-guidance system. Research conducted at Auburn University shows no accuracy degradation up to 20 miles, as stated by RTK auto-guidance manufacturers, and the range could be 25-30 miles but depends on the operating conditions. Therefore, RTNs have provided farmers cost reductions in purchasing RTK auto-guidance systems, increased baseline distances and eliminating the need to manage a base station. Of note, farmers need to be aware that many private and possibly some public RTNs require an annual subscription fee, so make sure to ask providers for pricing options for your RTK auto-guidance technology. CORS is currently free to users in states across the U.S. and managed by DOT. Check with the DOT or others to determine if CORS is a viable option in your area. Along with RTNs, there are other new advancements in auto-guidance systems, especially GPS receiver technology that farmers need to consider during purchases or upgrades. The following is a brief list with comments:

GNSS or Global Navigation Satellite System: describes the ability to use navigation satellites over just the United States GPS satellites. GLONASS, the Russian navigation system, is the only operational satellite navigation system besides GPS, but it can be used by new receivers and guidance systems. GNSS receivers become advantageous when working near treelines or other obstacles around or within fields. Consequently, the auto-guidance will remain engaged when satellites become blocked by trees. Auburn studies have shown an increase in operation within these environments, which benefits farmers.

Terrain Compensation Module or TCM: simply, the TCM corrects position measurements as equipment operates in rolling terrain. Since most GPS/GNSS receivers are mounted on top of the cab or the highest point on equipment, the effect of roll and pitch must be accounted for, so the calculated GPS/GNSS positions are centered at the ground. Some TCMs can also correct for yaw as well, which can be important when operating on steep slopes or soil conditions where traction can be an issue. For some farmers in the Southern U.S., it would be preferred to have a TCM that compensates for roll, pitch and yaw, since the combination of steep slopes and operating over or around terraces can be common.

In summary, one should consider 1) GPS versus GNSS, 2) personal base station versus RTN options, 3) whether the receiver can receive the new L2C and L5 satellite signal, which increases reliability, 4) capabilities of the TCM technology to correct for roll, pitch and/or yaw, and 5) the auto-guidance and receiver can be updated when the manufacturer releases new firmware. Feel free to visit www.alabamaprecisionagonline.com to read further about these topics and more. Auto-guidance systems will continue to evolve with new options and technologies to improve performance.

Options to Consider When Selecting Auto-Guidance Equipment

Rob Freeland , Professor, UT Biosystems Engineering & Soil Science

Many GPS equipment options are available for providing automated guidance and control during row-crop production. As a rule, costs increase for those options supplying greater accuracy, precision, functionality and reliability. For some operations, the lower-cost options simply are not suitable.

Rapid technology advancements are also rendering older guidance equipment and controllers obsolete. Older equipment lacks support, as the underlying technology on which it depends becomes no longer supported or unusable when mixed with modern components.

Consideration must also be given to the equipment's interconnectivity and upgrade capability. There are pros and cons of using equipment fixed to

a single vendor's proprietary standards, as opposed to operating equipment supporting industry-wide standards.

This tour stop will present the numerous options available to producers when considering purchasing new or upgrading their auto-guidance and controller equipment. Options discussed will be: 1) DGPS vs. RTK, 2) single-based station vs. CORS network vs. dealer network, 3) U.S. only satellites vs. multiple constellation, and 4) proprietary vs. industry-standard connectivity.

Auto-Guidance and Planter/Boom Control

Mike Buschermohle, Professor, UT Biosystems Engineering & Soil Science
Brandon Jernigan, Graduate Assistant, UT Biosystems Engineering & Soil Science

Auto-guidance systems and automatic section control for planters and sprayers are precision agriculture technologies that are being adopted by producers because of their potential to save labor and or input costs. Auto-guidance is the next step beyond light bars, because these systems can automatically steer your equipment from planting to harvest. This technology utilizes RTK-GPS to deliver pinpoint accuracy, which saves you input costs by reducing skips and overlaps; it eliminates guesswork of row and swath spacing; it reduces operator fatigue, which allows you to work longer days when needed and it allows you the ability to work in low light conditions. Auto section control technology utilizes the Global Navigation Satellite System (GNSS) and coverage maps to automatically turn on and off sections or individual rows of planters or sections and even individual nozzles on spray booms based on predefined field boundaries, no-spray or no-plant zones, and previously applied areas. Automatic section control helps reduce costly over-planting and over-spraying on end rows, point rows, terraces and waterways – saving you money and valuable time. Today, most manufacturers provide this technology as an option on new planters or sprayers. However, some older planters can be retrofitted with this technology.

Planting and spraying are two important farming operations. While these are often thought of as separate operations, row crop production has to be thought of as a complete system. Making changes to one part of this system often leads to the necessity to make changes to other parts of the system. For example, replacing your 12-row planter with an 18- or 24-row unit can reduce your planting time in the field; however, increasing the width of your planter can lead to higher seed costs because of more double-planted acres in your fields and equipment problems due to operating current machinery on mismatched rows. This tour stop will discuss how you can integrate precision agriculture technologies, such as auto-guidance and automatic section control on planters and sprayers, to help make changes to your current row crop production system to make it more profitable and efficient.

"Economics of Auto-Guidance and Planter Control"

Margarita Velandia, Assistant Professor, UT Agricultural & Resource Economics

In the context of Precision Agricultural (PA) technologies, Automatic Section Control (ASC) Technology for planters provides control over planting operations such that sections or rows on the planter are turned off in areas of the field that had been previously planted or areas that have been marked not to plant. Potential benefits of this technology are lower seed costs due to reduction in double-planted acres, and improved yield potential in these double-planted areas at harvest time. Reduced cost (i.e., seed savings) and additional revenue (i.e., improved yield) will vary based on field shape and size. A study was conducted in West Tennessee to identify proportion variation of double-planted areas based on field geometry (i.e., field shape and size). Information on 28 cotton fields, totaling 1122 acres, was collected between April and June of 2010. Additional cost and reduced revenue due to double-planting was compared to a base case scenario where the use of an ASC technology for planter is assumed. An economic evaluation of potential economic losses that could be avoided by

using an ASC technology for planters was conducted using a partial budgeting analysis.

About 14 acres of the total 1122 in the study would be double-planted without ASC. The additional cost due to double-planting for all the 28 fields was about $1,437. The reduced revenue for the 1122 acres was between $825 and $2,477, for a 10 and 30 percent reduced yield assumption, respectively. The total reduced net profit due to double-planting was between $2,263 and $3,914 for all the 1122 acres. Fields were classified based on level of reduced profit and shape. Preliminary results suggest that reduced net profits increase with the irregularity of the field shape. Very irregular field shapes will result in higher net profit losses due to double-planting when compared to more regular field shapes. Therefore, potential economic benefits from adopting an ASC technology increased as the proportion of fields with irregular shapes on farm operations increased.

TOUR L: NO-TILL DISEASE CONTROL

Is This the Year for Soybean Rust?

Melvin A. Newman, Professor, UT Entomology & Plant Pathology

In 2009, soybean rust, caused by the fungus *Phakopsora pachyrhizi,* was first found in Shelby County on **September 4,** with other counties becoming positive in the next few days and weeks. By December, we were able to confirm soybean rust in 44 counties across Tennessee with the likelihood of nearly all counties having some rust. This was the earliest (about 4-6 weeks), most severe and widest spread rust infestation across the state since its discovery in November of 2004. By November 23rd, rust had been found in **16 states and more than 576 counties** in the U.S. and in three states and municipalities in Mexico. The extremely rainy weather during much of the growing season was conducive for rust development. During a soybean rust tour at the University of Florida, researchers reported increased severity and earliness over the years and that the soybean rust may be adapting to our hosts and climate. Alabama, Mississippi, Georgia and Arkansas were four states to the south of Tennessee that were completely covered with soybean rust with some reported damage to yield in some unsprayed fields. It was estimated that Tennessee did receive some minor damage (about 0.01 percent yield loss to the state). Rust was fairly heavy in Tennessee counties closest to the Mississippi and Alabama borders. Although most producers sprayed for other late-season diseases, there was very little actual spraying for soybean rust.

Fortunately, soybean rust spores cannot survive freezing temperatures and must be carried by air currents from warmer climates each year. As a result, the current-year surviving spores must now be blown in from Mexico, south Florida, Texas or other warmer areas. Temperature, wind direction and moisture must also be favorable for rust spores to arrive in Tennessee and be viable for infection. In most cases, soybeans must be in the reproductive stages for infection to occur and spread. However, it is possible for rain storms and hurricanes to spread rust spores over a large area of the country. Once viable spores arrive in Tennessee, it may take up to three or four weeks before any infection can be identified in the field. Of course, this is the time to spray a fungicide for control, before infection reaches 10 percent in the lower canopy. Under favorable disease conditions, spraying fungicides on soybeans with more than 10 percent infection may not give adequate control. Once rust spores reach Tennessee, there must be an extended period of adequate free moisture and humidity with temperatures about 65 to 83 degree F for maximum infection to occur. Without these conditions, it seems that soybean rust will be slow to get started. UT Extension plant pathologists and soybean specialists will continue to monitor conditions and rust spore movement all during the growing season and alert producers if necessary.

To assist producers, we will again deploy spore traps and monitor several sentinel plots across the state. Leaf samples from these sentinel plots are examined each week for possible rust infection. Once any infection is discovered, recommendations will be quickly made to producers and Extension agents for possible fungicide spraying. At that time, specific recommendations will be made as to which fungicide or combination of fungicides should be used, along with the best timing of application. The Tennessee Soybean Rust Hot Line telephone # is: **1-877-875-2326**. As changes in rust movement occur in the South, they will reported at this number. Also, updated information, maps and commentaries on the most recent rust finds can be found at the following website: **http://sbr.ipmpipe.org**.

Using NDVI to Measure Nematode Damage

Charles Overstreet, Professor and Specialist, LSU Agricultural Center

Nematodes are big problems for many of the crops such as cotton and soybeans that are grown in the southern United States. The major nematode pests of cotton include the reniform and southern root-knot nematodes, while soybeans have these same two plus the soybean cyst nematode. Symptoms can range

from very subtle or not even visible to devastating. Oftentimes, fields can suffer considerable losses without producers even being aware that damage has occurred. Unfortunately, many producers find out that nematodes are a problem when yields begin declining over time. Reniform nematode can often be associated with declining yields, since it can be so widespread and difficult to recognize within a field.

During the last several years, we have been looking in Louisiana at developing site-specific application of nematicides to manage some of our nematode problems in cotton. Many of our soils are quite variable in soil texture, often ranging from a sandy loam or silt loam to clay within the same field. Nematode problems are often most severe in the lightest soils (especially with southern root-knot nematode), but can still be severe in heavier soils when reniform is involved. Although nematode populations are useful, soil texture and profile may be more important in determining where nematode damage occurs. A great method to understand where damage may be occurring in these variable fields is plant growth and development. The use of NDVI (normalized difference vegetation index) measures how plants are developing within a field. Areas that are damaged by nematodes usually don't grow as well and will show up with a lower NDVI score (range of 0-1). Most NDVI maps are broken down into several categories, with different colors assigned to each one. Areas of a field that are growing poorly will be readily distinguishable from healthy areas. Always "ground truth" these fields to verify that the differences you are observing are real. The images obtained from fields with extremely vigorous cotton would make normal cotton appear as the worst areas in a field. Areas that have been identified as growing poorly should also be verified as being caused by nematodes, since drainage, fertility or other causes could be involved. Our best results from NDVI have occurred from early June to mid-July in Louisiana cotton. The use of NDVI collected later in the season has not been as effective in differentiating differences in areas where nematodes are causing problems.

We are also using NDVI imagery to help us pinpoint the best areas within a field for site-specific application of nematicides. We apply a fumigant such as Telone II in 12- to 16-row strips repeated several times in the field. We try to make sure that we have applied these strips through the various soil zones within a field. The NDVI imagery can be used to compare the treated rows with the untreated rows in the field to determine where the response to the nematicide is occurring. This allows a producer to apply nematicides only where needed in a field. The NDVI imagery is much better at identifying differences than just "eyeballing" the field. Big differences are easy to determine, but slight differences are much more difficult to distinguish.

Measuring Yield Loss to Soybean Cyst Nematode When Plants Look Healthy

Pat Donald, Research Plant Pathologist, Crop Genetics Research Unit, Jackson, TN

Plant parasitic nematodes have been called the "unseen enemy" since the time when now-banned toxic nontarget nematicides were used to "kill" plant parasitic nematodes. When soybean cyst nematode was first detected in 1956 in Tennessee, plants in infested fields were stunted, yellowed and even died. Now, yield loss still occurs, but the plants are not chlorotic or greatly stunted. The crop may look good until harvest. However, in increasing number of fields, soybean cyst nematode levels are rising to the point of getting a producer's attention, despite the producer planting soybean cyst nematode-resistant varieties. Several factors can be attributed to the healthier-looking plants in the presence of soybean cyst nematode. These include increased no-tillage acreage and varieties with improved root health genetics. Our study reports on plant measurements that were taken during the growing season to determine if there were plant indications of stress from soybean cyst nematode. Fewer numbers of flowers have already been documented as a cause of yield loss from soybean cyst nematode. Measurements included NDVI (normalized difference vegetation index), height and grain yield. Soybean cyst nematode levels were measured at planting and at harvest.

The impact of tillage on soybean cyst nematode reproduction has been inconsistent in the literature. We see a rise in soybean cyst nematode reproduction when the soil goes from a no-till situation to a tilled situation. We do not see this increase when we go from

a tilled system to a no-till system. Our study included measurements with no-till and conventional tillage and application of two levels of poultry litter (3 and 6 tons/A). Soybean cyst nematode reproduction was higher on average in the tilled plots than in the no-tillage plots. Soybean cyst nematode reproduction was highest on average in the conventional till/ conventional fertilizer followed by the poultry litter plots, and the lowest was the no-till plots with conventional fertilizer. However, there were few significant differences between treatments. Yield followed the pattern of the highest grain yield present in poultry litter plots, followed by the no-till plots with conventional fertilizer and finally by the conventional till plots with conventional fertilizer. Significant differences were found in the yield data.

NDVI measurements were first used in 1973 to identify the presence of vegetation in the landscape and their condition. The index measures reflected red and infra-red spectra wavelengths and uses a ratio of these values. These wavelengths give different values for plants vs. soil providing the opportunity to measure plant stand and canopy closure as well as photosynthetic capacity of plant canopies. Mathematically, NDVI reflectance data range from 0 to 1.0. Soil values were in the range of 0.1-0.2 and plant values ranged from 0.28 to ≥ 0.89 in our study. Values peaked in late July and decreased throughout the remaining collection period. NDVI, plant height and yield were highly correlated in our study. One of the observations in areas where soybean cyst nematode levels are high is that canopies do not close at the same rate as where the nematodes are absent or less prevalent. In 2008, we saw a correlation of higher soybean cyst nematode population density at planting with lower NDVI a month after planting.

Charcoal Rot and Phomopsis – Its Effect on Yield and Seed Quality

Alemu Mengistu, Research Plant Pathologist, Crop Genetics Research Unit, USDA-ARS, Jackson, TN

Charcoal rot of soybean caused by *Macrophomina phaseolina* is a disease of economic significance. Charcoal rot has been reported in the north-central states and southern regions of the United States, as well as in tropical and subtropical regions of the world. When severe, this disease reduces yield and seed quality. Being stress-related, the disease severely damages fields that are non-irrigated or rain-fed. The effect of charcoal rot and its yield impact are complicated by the compounding effects of stress on soybean. The current e**stimate** of soybean **yield** loss **due to charcoal rot** is based on anecdotal evidence rather than an objective assessment. By using moderate susceptible line (AG-3905) and a very susceptible one (DK-3964), both MG III genotypes, and resistant (DT97-4290) and susceptible (Egyptian) all late MG IV genotypes, we found out that yield loss due to charcoal rot ranged from 6 to 33 percent in irrigated plots and infection was negatively correlated. The yield loss between resistant and susceptible varieties in non-irrigated (rain-fed) environment was inconsistent because of the confounding effect of drought with that of charcoal rot. Thus, yield loss due to charcoal rot is better determined in an irrigated rather than in a non-irrigated environment.

Soybean seeds are also infected by pod and stem blight and by Phomopsis seed decay caused by *Diaporthe phaseolorum* var. *sojae* and *Phomopsis longicolla,* respectively. However, *P. longicolla* is the principal cause of *Phomopsis* seed decay and the most aggressive and endemic seed pathogen in soybean production areas worldwide. Periods of high humidity, frequent precipitation and warm temperatures during pod development favor latent infection of pods by *P. longicolla*. When these conditions persist during seed development and maturation, pod infection can lead to seed infection and decay. Seed infection is even more pronounced when harvesting is delayed beyond harvest maturity. When soybean accessions were evaluated for their reaction to *P. longicolla,* by delaying harvest and under irrigation environment, none of the 60 lines evaluated were resistant. However, six were moderately resistant and these were accessions PI 594478, Delmar, SS93-6012, SS93-6181, PI 594603A and PI 594712. The use of irrigation and delayed harvesting will allow identifying soybean lines with potential resistance to weathering conditions.

TOUR M - NO-TILL CROP DEMONSTRATIONS

The No-Till Crop Variety Demonstrations will have various varieties of corn, cotton and soybean technology on display. Participants may interact with representatives from the various companies represented.

Monsanto

Pioneer Hi-Bred

Terral Seed, Inc.

UniSouth Genetics

TOUR N: STORED GRAIN

Updates and Use of Grain Bags

Russ Patrick, Professor, UT Entomology & Plant Pathology
Kathy Flanders, Associate Professor, Entomology Department, Auburn University

This tour focuses on stored grain uses of grain bags and grain bins. The pros and cons will be presented so producers can make decisions whether to use bags in their production practices. Bags have been around in Tennessee for several years now and most producers have been satisfied with their use. Each storage method has positive and negative features, and it is important for farmers to know which system best fits their use.

TOUR O: NUTRIENT MANAGEMENT

Alternative Fertilizers for Forage

Shawn Hawkins, Assistant Professor, UT Biosystems Engineering and Soil Science
Forbes Walker, Associate Professor, UT Biosystems Engineering and Soil Science

The recent record high prices and market volatility of chemical fertilizers have driven many beef and hay producers to consider alternative fertilizers. However, there is very little applied research that assesses the effectiveness of alternative fertilizers for hay and forage production in comparison with chemical fertilizers.

Replicated plot studies are being conducted at two University of Tennessee Research and Education Centers (Plateau and Greeneville) to evaluate the yield and forage quality response of fescue grass stands to two alternative fertilizers available in Tennessee: Nashville Metro Exceptional Quality (EQ) biosolids and broiler litter. The EQ biosolids product, which is 4 percent nitrogen and 3 percent phosphorus as P_2O_5, will be available throughout Tennessee at select farmer cooperatives in a bulk dry pellet form that can be blended and spread with chemical fertilizers. Broiler litter, which typically tests at 3 percent nitrogen, 3 percent phosphorus as P_2O_5 and 3 percent potassium as K_2O, is available locally in Tennessee near poultry processing plants in Union City, Shelbyville, Chattanooga, Morristown and in north central Tennessee near Albany, KY. Both the EQ biosolids and broiler litter may be available at lower cost than chemical fertilizer and could help beef and hay producers lower production expenses.

The performance of these alternative fertilizers is being assessed in a study that includes four replicates of nine treatments: two application rates of broiler litter (2 and 4 tons/acre), four application rates of the EQ biosolids (0.75, 1, 1.5 and 3 tons/acre), chemical fertilizer applied at UT Extension-recommended rates based on soil tests (60 lbs/acre of nitrogen with supplemental phosphate and potassium as required), chemical fertilizer applied at a standard beef producer practice (300 lbs of a 19-19-19 blended fertilizer) and a control with no fertilizer addition. Several important points have been established from the first year of this two-year study:

- Nitrogen availability for spring-applied biosolids and litter is 50 percent.
- Moderate (1.5 tons/acre of biosolids, 2 tons/acre of litter) and high (3 tons/acre of biosolids, 4 tons/acre of litter) rates of the alternative organic fertilizers:
    - ° significantly improve spring hay yield and overall forage quality; forage yield and quality are equivalent to or better what can be obtained with chemical fertilizers.
    - ° residual nitrogen from moderate to high rates of spring-applied biosolids and litter improve fall fescue hay crop yields; results equivalent to fall- applied chemical fertilizers (60 lbs/acre of nitrogen) can be expected.
- Litter and biosolids provide plant available micronutrients that grass forages may readily uptake in the spring (e.g., copper and zinc).
- Long-term or high application rates of litter may produce forages with high potassium concentrations that can contribute to grass tetany.

Managing P and K Fertility in "High" Testing Fields

Hugh Savoy, Associate Professor, UT Biosystems Engineering & Soil Science
Frank Yin, Assistant Professor, UT Plant Sciences

By definition, a soil testing "high" in P and K will produce at or near 100 percent of its potential yield for the crop without the addition of additional P and K. Amounts added are primarily to maintain present soil test levels. Because of rising costs for P and K fertilizers and low probability of realizing additional yield (much less profitable yield), most states in the southern United States had, by the turn of this century, stopped recommending P and K for row crops to be grown on high-testing soils. Tennessee joined that group in the spring of 2008 when fertilizer prices reached an all-time high.

In row crops, most recent P and K rate studies have been with cotton and soybeans. These data verify that

levels set as "high" in those crops are correct. In fact, the high soil test level for K on soils to be cropped with cotton was adjusted upward from 161 to 281 Mehlich 1 extractable K in 2004 based on long-term studies conducted by Dr. Donald Howard.

Because no recent calibration data exist for corn production in Tennessee, research plots were established in the spring of 2009 to verify that corn is not responding to additional P and K applied to soils testing at or greater than 161 pounds of K or 31 pounds of P per acre by the Mehlich 1 soil test. A second objective of the study is to determine how long the sites could be cropped before a profitable yield response to P or K was realized and additional P or K fertility needed for profitable production.

One site was located at the Highland Rim Research and Education Center near Springfield, TN and one at Milan Research and Education Center. After the second year of the study, the plots will go into a standard corn/soybean rotation. Measurements taken from the plots yearly include mehlich 1 soil test level of P and K, P and K content of the first fully mature leaf prior to tasseling, P and K content of harvested grain (removal) and grain yield.

Data being presented are from 2009 plots. 2010 plots are in view of the presentation tent and participants may view these for an objective visual assessment of P and K effects on corn plant growth at high soil test levels of those nutrients.

Potential Use of Fluidized Gas Desulfurization (FGD) Gypsum in Agriculture

Fred Rhoton, Research Soil Scientist, USDA-ARS National Sedimentation Laboratory, Oxford, MS
Michael Essington, Professor, UT Biosystems Engineering & Soil Science

The success of conservation tillage management systems imposed on highly erodible soils is, in large part, dependent upon practices that stabilize the soil surface, improve infiltration and soil water contents, ameliorate acidity problems and provide an adequate supply of essential plant nutrients. The application of lime and fertilizer amendments to the soil surface in no-till systems can be less than adequate, in this regard, due to the excess time required for slowly soluble agricultural lime to dissolve and stabilize soil physical properties to the extent that water and nutrients can more rapidly move into and down the soil profile. As an alternative to agricultural lime, we used fluidized gas desulfurization (FGD) gypsum, a byproduct of coal-fired power plants, due to its high calcium and sulfur contents, and its much greater solubility than lime. We applied FGD gypsum to no-till cotton on a highly erodible silt loam soil at rates of 0, 1, 2 and 3 tons/acre for three years, and monitored changes in soil properties with changes in amendment rate, depth and time. The data showed that within one year of initial application, significant increases were recorded for sulfur and calcium contents at depth, which led to substantial increases in soil stability and decreases in exchangeable aluminum in the subsoil. Plant uptake of sulfur increased significantly during the study period, which contributed to a yield increase of 300 lbs/acre at the gypsum rate of 2 tons/acre compared to the 0 rate. No yield responses were recorded at the other gypsum amendment rates. The results indicate that FGD gypsum can increase yields of no-till cotton by increasing infiltration rates and soil water contents, and by providing a readily available source of sulfur, a limiting nutrient in many cotton soils.

Using the UT Nitrogen Rate and Fertilizer Cost Calculators in Corn Production Systems

Tammy McKinley, Extension Specialist, UT Agricultural & Resource Economics
Debbie Joines, Manager, UT Soil, Plant and Pest Center

Did you feel the squeeze back in winter 2008? Nope, we're not talking about that hug you got after the football Vols won the Outback Bowl 21-17. We're talking about the record high fertilizer prices that put the squeeze on your bottom line. Did you stop and wonder which fertilizer product might provide the nutrients you need at the lowest cost? Or did you consider backing off the amount of nitrogen you apply? Better yet, do you ever worry prices may spike up

again and leave you at a loss as to how to best manage your fertilization program? Well, if the answer to any of these questions is "YES", then you need to learn about two economic decision tools offered by UT Extension & UT AgResearch.

The Corn Nitrogen Rate Calculator is an interactive, computerized decision aid designed to help growers obtain a profit-maximizing nitrogen rate recommendation. The calculator reports the profit-maximizing nitrogen rate, and allows users to adjust corn and nitrogen prices with easy point and click operation. Data used in developing the calculator are from corn nitrogen response trials conducted in West and Middle Tennessee. The calculator can currently be used to predict a profitable nitrogen rate for productive non-irrigated and irrigated fields. Response functions for less productive soils and for corn planted after specific rotational crops will be included as we accumulate the data. (http://utcrops.com)

The **Fertilizer Cost Calculator** is an Excel-based calculator that helps you evaluate the cost of applying varying levels of fertilizer and using various products. Along with a current soil test, this calculator may be used as a tool to evaluate estimated costs per acre for fertilizer application. It allows you to enter the price per ton of each product and amount of each nutrient to be applied. It will then calculate the total pounds of each product needed and the total costs per acre for application. (http://economics.ag.utk.edu/fertilizer.html)

After listening to this talk, producers will be aware of the information these tools provide, how to use them on their computers and how they can benefit their bottom line. Always remember that information from a current soil test should also be consulted whenever evaluating fertilization levels for your farm or contemplating any changes in your management practices. Then, next time high fertilizer prices roll back around, you'll be able to sit down and enjoy that game a bit more, knowing you have the these tools to assist you in developing an effective fertilizer management strategy that minimizes the impact on your bottom line.

TOUR P: FORESTRY

Using and Protecting Wood around the Farm

Adam Taylor, Assistant Professor, UT Forestry, Wildlife & Fisheries

Wood is an affordable, versatile and attractive material that has many uses around the home and farm. With proper design, the use of appropriate materials and a little maintenance, wood products will provide good service for many years.

Wood finds many uses around the farm, indoors and out. It can provide the structural framework of barns and fences and is used in many applications where the appearance is important (molding, millwork, etc.) It can also be an important source of fuel (firewood) or animal bedding (shavings and sawdust). Depending on the use, different types of wood and protective measures will be needed.

When using wood for structural applications, there are a couple of primary considerations: whether the wood can do the job, and if it will it keep doing the job over the long term. Depending on the load requirements for a given piece of wood, many wood species from many sources can do the job. However, if the structure is covered by a building code, then grade-stamped lumber will almost certainly be required. All structural lumber sold at building supply stores is grade-stamped, but lumber cut on a portable sawmill is not. It is possible to have 'home-cut' lumber graded but it will be prohibitively expensive – stick with the lumber from a store.

The proper longevity of the piece of wood will depend on whether it is exposed to getting wet and whether the wood is durable. All wood used outside or in contact with the ground must be protected. There are two options: use naturally protected wood such as cedar or white oak heartwood or use preservative-protected ('treated') wood. There are no effective do-it-yourself options for preservative protection of wood – you must buy the finished product. Dip or brush-on treatments will not provide the needed protection. Wood plastic composites are also rot-resistant, but these products have few structural applications. The most critical part of maintaining a wooden structure is making sure the un-protected wood components stay dry. Find and fix leaks before they cause rot. Termites can also cause significant damage – there should be regular inspection for these hard-to-detect insects.

Paints and stains can be used to change or maintain the desired appearance of wood. While such coatings can slow the wetting of wood, they are no substitute for proper wood preservative treatments. Wood is a useful fuel and, for many landowners, is free for the taking. All wood species can be burned; the most important thing is that the wood be properly dried before use. Firewood must be cut-to-length and split before proper drying can take place – a process that takes a few months. Painted or treated wood should not be burned.

There is some concern that some woods (e.g., black walnut) can be harmful to horses; however, most species can be used as an effective, low-cost, biodegradable bedding material.

Certifying Family Forests with American Tree Farm

David Mercker, Extension Forestry Specialist, UT Forestry, Wildlife & Fisheries

Most consumers are vaguely familiar with the concept of an objective third party certifying products to assure a high standard, or consistency, in product quality. The certification label that is affixed to electrical appliances by the Underwriters Laboratory, thereby assuring that appliances meet or exceed standards of quality and safety, is an example (Maser and Smith 2001). Certification has evolved in a number of industrial sectors including automobiles, chemicals, footwear, apparel and fisheries (Sasser 2001). *Forest certification* is a relatively new development and deals not with the product, but with the practice of forestry, growth of the product, harvesting of the product and ecological impacts associated with harvesting of the product (Klingberg 2003). Forest certification is gaining widespread attention by a variety of stakeholders including environmentalists, policy makers, professional foresters, social activists, loggers and the general public (Mater 1999, Viana and others 1996).

The situation for forest certification in the United States is somewhat unique when compared to the global picture, because such a large percentage of the total forest area in the U.S. is under nonindustrial private forest (NIPF) ownership. NIPF forests have traditionally filled an important position in U.S. wood production, a role that has become even more crucial with the decline in timber harvesting on public lands. Many of the major retail outlets of wood and paper products have announced policies that recognize and give preference to certified wood products (Rana and others 2003). Some companies, in order to satisfy the minimum content guidelines required for paper and other wood products, are requiring a greater percentage of certified wood in their inventory (American Tree Farm System 2005). These policies are in turn changing the wood procurement policies of the solidwood and pulpwood processing facilities. As a result of these concerns, stakeholders are beginning to debate the necessity of implementing forest certification on NIPFs. This ownership group is particularly important in Tennessee, where it comprises 79 percent of the state's 14.4 million acres. Moreover, these forests contribute more than 84 percent of the state's annual hardwood removal volume (Schweitzer 2000).

The American Tree Farm System (ATF) is one source for family forests to become certified. Since 1941, the ATF has recognized private landowners who excel in forest management. This presentation addresses the following: overview of the American tree farm system, explanation and benefits of forest certification, and the process of certifying family forests.

The High Cost of High-Grading

Larry Tankersley, Extension Forester, UT Forestry, Wildlife & Fisheries

What is high-grading? A timber harvest that removes the trees of commercial value, leaving small trees, as well as large ones of poor quality and of low-value species. High-grading reduces the value of the woods by removing the largest, most valuable trees and increasing the composition of the poor quality and traditionally low-value species, e.g., red maple, beech, elm.

How does it occur? High-grading occurs when landowners sell infrequently, are unaware of the consequences of how the trees are removed and have immediate needs for income. High-grading is also common where we have poor markets for smaller and lower-quality trees but good markets for high-quality trees. Communication is also confused when terms like selective cutting are used to imply good management while removing the best trees.

Since trees in most wood lots are the same age, cutting the biggest trees does not leave young ones to grow. Rather, these cuttings take out the fastest-growing trees, leaving slow-growing, less-vigorous trees of the same age as those removed.

Why is it a big deal? In most cases, high-grading results in a greater harvest volume and value from the first cutting, compared to forests managed silviculturally. However, neither the harvest volume or timber quality is sustained over the long run. After a high-grade harvest, the forest provides:

- less total volume because of slow-growing trees and irregular spacing between them,
- less volume from large trees of the more valuable size classes (16" +, veneer),
- more volume from poor-quality trees and low-value species,
- fewer opportunities to return for another harvest.

How do you tell if your place has been high-graded? High-grading is highly variable. In some instances it is really not that bad, with a lot of pretty good trees left after the cut. In other instances, there is often not much left to work with – all the "good" trees are gone. High-graded woods have:

- few "good" trees remaining
- more "poor" trees remaining
- patchy distribution, dense clumps, wide openings
- lots of area in skid trails

What to do? Hire a competent forester to:

- develop a plan
- mark trees to remove/keep
- require good skidding
- mark trails

- include penalties in sale contract
- regularly inspect the logging job and communicate with the crew

Restoration strategies

If your forest has been high-graded, you need to improve the growing stock by favoring better species and encouraging good spacing. How we do this will depend on the extent of the high-grading. The extent of the high-grading will depend on the number of desired stems left after the harvest. Where more than 50 good trees per acre are left, you are in pretty good shape and can do a bit of improvement cutting and let the trees grow. Where you have 20–50 good trees remaining, you should consider some type of regeneration cut in the near future, merchandising or deadening larger residual trees and releasing desirable seedlings and sprouts. Where you have 5–20 good trees per acre left, you are definitely looking to regenerate the stand, even supplemental planting. Where fewer than 5 good trees per acre are left, you may be out of the timber business or looking to regenerate or plant.

Partial Cutting in Hardwood Forests: What to Leave and What to Cut

Wayne K. Clatterbuck, Professor, UT Forestry, Wildlife & Fisheries

Conflict often occurs in determining which trees to cut. Often the best, most valuable trees are cut with little regard to leaving the inferior, poorer-growing trees to replace them. Designating tree classes is an excellent method of determining harvesting priority. Tree classes serve as the basis for planning harvest and improvement cutting as well as developing tree-marking rules. The four tree classes are (1) preferred growing stock, (2) reserve growing stock, (3) cutting stock trees and (4) cull stock trees.

Preferred Growing Stock trees (leave trees) are the future crop trees that will be grown until the end of the rotation. These trees are in good condition, of desirable species, growing at an acceptable rate, in the dominant or co-dominant crown class, of good grade or with the potential to develop into a high-quality tree and can be left indefinitely without the risk of dying. These are the best trees in the stand that are increasing in value quickly.

Reserve Growing Stock trees (storage trees) are in good condition, but do not qualify for preferred growing stock. Generally, these trees are not growing as well as preferred growing stock and are of poorer grade without the potential to increase in grade. Reserve growing stock can be left for one or more cutting cycles with little risk to merchantability or survival. However, these trees are not the ones left for the final harvest.

Cutting Stock trees (cut trees) are those that must be cut during the next cutting cycle because they are in poor condition and will not survive for future cutting cycles. These trees are usually of an inferior species for the site or of poor form or grade that will not increase in value.

Cull Stock trees are incapable of meeting the desired product goals. Most of these trees are taking growing space that would be better suited for the more desirable trees. Cull trees can be recognized as two types: (1) sound cull trees that will never make sawlogs, but contain usable fiber and (2) unsound cull stock trees that do not contain merchantable fiber. After designating the class of each tree, marking priority for trees to cut or leave is as follows:

- All cutting stock trees and cull stock trees are cut except in those instances where those trees may be providing visual or wildlife values.
- None of the preferred growing stock trees are cut except in special circumstances such as a species being universally killed by insects or disease, two preferred trees are growing side by side, each affecting the growth of the other or unusual market prices or conditions.
- Reserve growing stock trees may be cut or left according to the intensity of the harvest to be made. Often, when cutting stock and cull stock trees only are offered for sale, they are not valuable enough to entice timber buyers. Thus the sale is sweetened somewhat with a few, more valuable, reserve growing stock trees.

There is no one “right way” to mark timber. In some situations, no reserve growing stock trees would be marked. In other situations, most or perhaps all are marked. Intensity will depend on the objectives and

desires of the landowner, the present condition of the stand and markets.

Because of the lack of markets in the past for poor-grade material, most timber harvests only took the best trees and left the inferior trees. This "high-grading" has left a poor quality forest in many areas with little potential for the remaining trees to increase in value. Now with markets for lower-quality trees in most areas of Tennessee, the use of tree classes as a cutting priority allows one to provide the best growing conditions to those trees that will continue to increase in value: the fast-growing, desirable species, higher-grade trees.

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