MILAN 2004 NTill FIELD DAY

THE UNIVERSITY of TENNESSEE

Milan 2004 Tour Reports

Thursday, July 22, 2004
7 a.m. – 3 p.m. CDT

Crop Variety Demonstrations
and Equipment Demonstrations

North Tract of the Milan Experiment Station

TABLE OF CONTESTS

TOUR A
AGRI-TOURISM, VALUE-ADDED AND ALTERNATIVE AGRICULTURE

Part 1. Agri-Tourism

What is the Tennessee Agri-Tourism Initiative?

Stanley Trout

With the help of the USDA's Rural Development, the Tennessee Department of Agriculture, the Tennessee Department of Tourist Development, the Tennessee Department of Economic and Community Development, the UT Agricultural Extension Service and the Tennessee Farm Bureau Federation launched a campaign to increase farm income and make a positive impact on rural communities through agri-tourism.

The aim of the Tennessee Agri-Tourism Initiative is to work with farmers, local chambers of commerce, visitor bureaus and others to build farm income through agri-tourism; expand tourist income in rural communities; and establish a sustainable, long-term program.

The process of attaining these goals was broken down into three phases: Inventory and Analyses, Training and Development, and Promotion.

An inventory of existing agri-tourism operations in Tennessee was conducted in the fall of 2003. More than 600 enterprises were identified, and operators of 210 enterprises meeting the Initiative's agri-tourism definition were successfully contacted and surveys were completed. Survey information is being used in promotional materials to learn more about agri-tourism in Tennessee and to identify topics for educational materials and workshops.

Training activities are conducted periodically for existing and prospective farmers/operators. Technical experts have been identified to assist with agri-tourism operations.

Statewide and national promotional activities are underway. Promotions focus on identifying visitor interests, origin and other demographics and capitalizing on tourist interest in agriculture, rural heritage and rural culture. Monthly statewide broadcast promotions are underway. Press releases and other promotions throughout the year will highlight each agri-tourism venue in its proper season. Various promotional outlets include use of visitor centers and press tours. Agri-tourism brochures and maps will be available in the summer of 2004 through regional state tourism offices. Visit **www.picktnproducts.org** for additional information.

Customer Service at Agri-Tourism Enterprises

Ramay Winchester

At all agri-tourism enterprises, the bottom line depends on how customers/guests are treated. We want to establish a standard of customer service where each and every customer feels like a welcomed guest. We want to introduce basic guidelines so that employees understand the vital importance of treating customers like guests. A training tape "The Guest" will remind employers everything they already know but have perhaps forgotten about customer service! The reason for this seminar: "So how do we get our guests to come back?" Well, if we've made them feel welcome, taken care of their needs and thanked them for their business, all we really need to do is — invite them back."

Marketing for the Agri-Tourism Enterprise

Megan Bruch

Marketing is very important to the success for agri-tourism enterprises. In a 2003 survey of 210 Tennessee agri-tourism operators, advertising, marketing and promotions were identified most often as the most important factor of success.

A complete marketing plan contains seven main elements. These elements include market research and analysis, marketing and financial objectives/goals, marketing strategies, marketing mix/tactics, financial analysis and marketing budget, monitoring and evaluating market response, and marketing plan checklist. Although all of these elements are important, they can be boiled down to three general marketing goals for the agri-tourism enterprise:

1. Attract customers to the enterprise.
2. Entice customers to spend money at the enterprise.
3. Create a desire in customers to return again and again to the enterprise.

Agri-tourism enterprises offer a variety of attractions — everything from corn mazes and pumpkin patches to on-farm vacations and wineries. This wide variety of activities also targets a variety of markets. Target markets for agri-tourism enterprises may include interstate travelers; local or vacationing families; traveling retirees; school, birthday, church or business groups; teenagers; and many more. Clearly identifying a target market allows an enterprise to focus its marketing efforts on the needs and desires of a specific group.

A single marketing plan that will be effective for every enterprise and every target market does not exist. A marketing plan must be developed for each particular situation. It is helpful, however, to consider some examples from existing enterprises. Some methods currently used to attract customers to agri-tourism enterprises include on-farm demonstrations, special events such as a seasonal kick-off event, coupons or discounts, and advertising. Enterprises entice customers to spend additional dollars by offering several attraction options or packages of attractions, offering farm and related products for sale, creating attractive displays, and offering refreshments for sale. Enterprises have created a desire in customers to return by making a good first impression, keeping facilities clean, training personnel to be courteous and knowledgeable, creating an expected farm ambiance, thinking of visitor needs and comfort, offering unique or new products, providing an enjoyable and memorable experience, and creating traditions.

Many strategies exist to attract customers to the enterprise, entice customers to spend their money at the enterprise and create a desire in customers to return again and again to the enterprise. It is most important to remember to develop marketing strategies based on the specific target market of an enterprise.

Presentation is posted online at http://cpa.utk.edu/pptpresentations/agri-tourism/AgriTEnterprise-milan.pdf.

Part 2. Value-Added Agriculture

Value-Added Food Opportunities

Bill Morris

The concept of adding value to raw commodities is nothing new to the agricultural community, but as an individual producer you may wonder where to start if you want to sell products at a farmer's market or have them distributed regionally or even nationally. What type of foods and receipts can I afford to add value and process according to government regulations? What agencies will regulate my specific food? Once you have decided to "process" a food and add value to your operation, you will be subject to inspection by state and federal regulatory agencies. The potential hazards your product could contain may dictate the frequency and the degree of scrutiny your operation will receive.

This session will discuss how our food systems are regulated, what facility requirements will be needed to comply with the U. S. Food and Drug Administration or USDA and what is the role of the Tennessee Department of Agriculture in the manufacturing of foods to be sold retail. We will define a step-by-step procedure for getting a product safely in a package and ready to be marketed.

Good Manufacturing Practices (GMPs) and Good Agricultural Practices (GAPs) will be discussed, along with who sets these requirements. We will define low-acid

and acidified foods and the importance of pH (acidity) in the processing and packaging of foods safely.

Other questions that will be answered include "What is a HACCP plan (*Hazard Analysis and Critical Control Point*) and do I need one?" and "Where would I find assistance in preparing such a plan?"

By the completion of this session, you will have a better understanding of the regulated food industry and what you will have to do to be in compliance.

Adding Value with Organic and Natural Market Niches

Peg Hamlett

For more than a decade, annual sales and production of organic and natural foods have grown at double-digit rates. "Organics" are consistently among the fastest growing part of the food and agriculture sector. According to the Organic Monitor, 2003, the United States is now the largest market for organic foods and beverages in the world. Produce, dairy and meat/poultry are primary categories of organic and natural product adoption. Applying an organic production system enterprise to a part or the whole of a family farm could add value to that operation.

Organic consumers are embracing all types of foods. Currently, the organic consumer is considered a niche. And, niche markets are proliferating! The adoption of the National Organic Program by the USDA and the application of the USDA seal on packaged organic products effective October 2002 enhanced the future of this industry. Several major U.S. distributors, brokers and retailers are taking advantage of the forces driving the organic industry growth. Even so, for the small, family farm, direct marketing is still one of the most favorable avenues for adding value with organic and natural market niches.

The industrialization of agriculture has contributed to the creation of a multitude of niches in markets that are largely undiscovered. People who are satisfied with products that fit industrial systems of mass production realize a bargain — getting what they want at a lower price. But what about those who are not satisfied with what mass production offers? Herein exists an opportunity where small, family farmers can look to what represents potentially profitable market niches.

All market niches are associated with specific individuals or groups of consumers. The people who are willing to pay more for fresh "organic" produce represent a niche in the fresh produce market. People who want locally grown "natural" beef make up another niche. Any form of niche marketing is about identifying and serving individuals or identifiable groups who have unique tastes and preferences for products that are different from those of the larger populations of which they are part. Marketing statistics indicate that 44.9 percent of the U.S. population purchases within the niche of "organic products."

The key to successful niche marketing is to find a market that is: (1) sufficiently different from its mass market context to allow a significant premium in price (or a significantly lower cost), (2) large enough to be served profitably, but (3) too small to accommodate methods of mass production and distribution.

Organic and natural agricultural production systems meet the standards for both sustainable agriculture and sustainable niche marketing. The sustainability concept requires that no one element is considered supreme — neither the consumer nor the producer. The economics of an organic or natural system can assist in providing the incentives and means for sustaining both resources and people.

Part 3. Alternative Agriculture

Cut-flower Production and Marketing

Pam Rye

Field grown cut flowers and herbs hold great promise as a suitable niche crop for producers in Tennessee. Favorable climatic factors, low start-up costs, and small land and machinery requirements allow for ease of entry into the market. Determining market needs and proper marketing techniques deserve detailed investigation prior to beginning a cut flower and/or herb venture

Specific points to be addressed are site preparation, crop scheduling, variety and production recommendations, post-harvest care, and marketing and merchandising techniques.

Matching Resources with Market Potential: Vegetables & Small Fruits

R. Allen Straw

Several fruit and vegetable crop enterprises may be options for traditional row-crop producers. However, these enterprises may require significant investments of capital and labor as well as management. Management and marketing are two important considerations when planning an alternative or new enterprise. In the case of fruits and vegetables, this is especially true.

For many producers, tree fruits require too much time to reach commercial production. They may also take several years to pay back the original investment. A significant amount of time, energy and money is expended to see that first dollar of positive return. Also, tree fruit crops occupy land for many years. It is very difficult for Tennessee producers to compete with West Coast production or even North Carolina. The one possibility is that of producing fruit for some sort of value added enterprise, such as pies.

Producers with existing greenhouse structures have several alternatives. When considering vegetable production, crops like tomatoes, cucumbers and peppers have been grown quite successfully. Some producers have had success with lettuce. Other vegetable production options being explored include "greens" crops. Several producers have explored strawberry production in greenhouses with less than desirable results. This enterprise may have potential in the future, but at present it is still "experimental."

The primary vegetable crops to consider are cucurbits, okra, sweet corn, sweet potatoes and tomatoes. Not all of these enterprises will make one rich. However, they all have the potential to generate positive net returns as well as offer marketing strategies.

Cucurbits include crops like cucumbers, muskmelon (cantaloupe), summer squash, watermelon, pumpkins, winter squash and gourds. Cucumbers are not likely to make a producer rich. However, they may be required to provide mixed loads of produce when shipping. The same may be said of summer squash. Plasticulture muskmelons may provide great income potential. However, the market may not be as lucrative in some parts of the state as others. Seedless watermelon production appears to offer some potential. Retail sales of watermelon make them appear to be the marketing option of choice. If winter squash can be grown and stored until after January 1, the price is usually quite attractive. However, much of the winter squash grown in the state is used for decorative purposes. Halloween is now the second most decorated season of the year. Pumpkins, gourds, ornamental corn, straw and corn stalks, as well as other decorative items, sell well during September and October.

Okra often retails for $2.00 to $3.00 a pound and is a staple of the South. Although sweet corn is grown in every county in Tennessee, there still appears to be a market for early sweet corn. Reports of $4.00 per dozen ears are not uncommon across the state. Another staple of the South is sweet potatoes. Local sales of roots can generate a significant return. Value added processing of sweet potatoes has been explored and is still an option. Tomatoes have been grown throughout the Tennessee for years. Providing vine-ripe tomatoes throughout much of the spring, summer and fall can provide steady sales. Growers in Grainger County of East Tennessee have been doing this for years.

Small fruit options focus primarily on blueberries, brambles and annual plasticulture strawberries. Blueberries are quite popular because of both their nutritional value and their antioxidant characteristics. This enterprise requires four or more years to reach commercial production. Blueberries also require significant preparation prior to planting.

Brambles include both blackberries and raspberries. Both are very perishable; however, because of their perishable nature, they often bring a nice price. The trend in blackberries is to utilize the new erect, thornless variety releases from the University of Arkansas. Black and red raspberries offer potential for Tennessee producers. There are red varieties that produce in the spring, while others produce in the fall, followed by a short crop the following spring. Fall-fruiting red varieties may not work well in the heat of West Tennessee.

Annual plasticulture strawberries offer the greatest potential returns of nearly any legal crop that can be grown in Tennessee. However, this is not an enterprise for the faint of heart. Annual production costs can range from $10,000 to almost $20,000 per acre and involve considerable risk.

Several vegetable and small fruit enterprises offer potential for Tennessee and Mid-South producers. However, two words need to be remembered: **Marketing** and **Management**.

Effect of Planting Date and Plant Density on Varieties of Differing Maturity

Chism Craig

Tennessee is on the northern edge of the Cotton Belt resulting in a potentially short growing season. The University of Tennessee currently recommends that cotton be planted from April 20 – May 10. Producers rarely plant their entire crop within the recognized short planting window due to inclement weather. Often a portion of the crop is planted outside of the recognized current "planting window." Above average heat unit accumulation and favorable harvest weather have resulted in excellent yields for late planted cotton in recent years. Therefore, many Tennessee and other Mid-south cotton producers are re-evaluating the current recommendations. Data for current planting date recommendations were obtained before widespread adoption of short-season, transgenic varieties and boll-weevil eradication. Up-to-date information is needed to determine if advances in cotton production have lengthened the planting window for Tennessee producers. In addition to planting date concerns, the cost associated with the widespread adoption of transgenic varieties has forced producers to significantly reduce their seeding rates. Reduced seeding rates along with poor emergence due to disease and weather often leave a less than optimum plant stand. New information is needed to determine the plant populations needed for optimum yields and fiber quality. In addition to yield concerns, previous research has shown differences in yield and fiber quality for varieties planted at several densities across several dates. Agronomic and economic data are needed to evaluate these new transgenic varieties when planted on a wide range of dates at several plant densities. The objective of this study is to evaluate the agronomic and economic performance of cotton varieties of differing maturities when planted at different densities and dates.

A multi-year study initiated in 2003 is being continued on upland sites at the West Tennessee Experiment Station in Jackson, Tennessee and at the Milan Experiment Station in Milan. Two cotton varieties, Paymaster PM 1218 BG/RR (determinate, early season variety) and Deltapine DP 555 BG/RR (indeterminate, full season variety) were planted on three dates and thinned to three plant population densities in each environment. Plots were arranged in a randomized complete block with four replications in a manner to allow for comparisons among varieties, plant population densities and planting dates. Data such as plant population, nodes above white flower, boll density, lint yield and fiber quality will be collected throughout the year.

Results from one year of data from the West Tennessee Experiment Station location showed that plant density did not significantly affect lint yield of either PM 1218 BG/RR or DP 555 BG/RR, regardless of planting date. Contrary to our hypothesis, lint yields improved with each planting date and fiber quality was discount free. The positive response to late planting is potentially misleading, since the heat unit accumulation for the late-May planting date was nearly the same as the late-April planting date. These data are from one year of testing only and do not support changing our current recommendations. Continued testing is needed to adequately evaluate this topic before changes to our current recommendations can be made.

Plant Population and Planting Date

Bobby Phipps

Plant population and planting date are very important factors in cotton production. Plant stand can have a big influence upon crop maturity. If the stand is thin, the plants will tend to produce more vegetative branches, which are late maturing. Normally one or two vegetative branches are normal. More than two per plant indicates the plant population is too low. In some cotton varieties an excessively high plant population has an adverse effect upon plant maturity. High populations can severely delay maturity. This was observed in Missouri in 2003. Dates of flower and days to boll opening are delayed with high plant populations. One would think that with few or no vegetative branches the crop would be early, but this is not the case.

One of the most difficult decisions to make in farming is whether to replant or leave the existing crop. Seedling diseases, stunting due to cool weather, hail, insects and damage from blowing sand can turn a good crop into a disaster. Profit margins are so narrow that the correct decision must be made. Years like the last two have shown that making the correct decision can mean the difference between making a profit and taking a huge loss.

Several factors should be considered before destroying the old crop. Plant health can determine if the present stand will survive. If the plant stems are girdled due to seedling diseases, the plants are unlikely to survive. The sugars produced in the top of the plant will be unable to reach the roots, which enable them to grow. The condition of the roots is also important. Some plants, such as cotton, can have poor roots and still survive.

Stand density is critical in making a replant decision. Determine the number of plants that have a chance of surviving per foot of row. Cotton can compensate for thin plant spacing much more than one would expect. In the last two years we conducted a trial evaluating plant spacing. We compared four, two, and one plant per foot and also one plant per eighteen inches. The lint yields ranged from 1400 pounds to 1455 pounds in 2000 and from 1115 pounds to 1213 pounds in 2001. These results indicate that it would not pay to replant even when there was only one plant per eighteen inches. I have considered one per foot an adequate stand when making a replant decision. Do not interpret this data to mean that money can be saved on engineered seed technology fees by planting low seeding rates because after adverse weather a stand could be left with far fewer seed than necessary for maximum yields. Replanting could be very expensive in this case and cost far more in reduced yields than was saved on the technology fees with the low seeding rate.

A good uniform stand is more important than stand density. There need to be few large skips. If one side of a field is too thin, it can be replanted and treated as a separate field regarding timing of production operations. If the end of a field needs to be replanted, this is a serious problem. If only one end is replanted, it causes problems with timing of insecticide application, irrigation and harvest aid applications. Timing will be wrong for one part of the field.

When replanting, destruction of the old stand can be a problem. If it is left and new seed planted in the old stand, there will be the problem of two ages of crop and timing will be off for one of the crops. If the crop is replanted, the use of paraquat may be necessary to rid the field of the old stand.

Late in the season many of the preferred varieties will be in short supply. Before destroying a field, it is best to check with the seed dealer about seed supplies.

After rains it is difficult to know if more herbicide is needed and where in the seedbed the original herbicide is located. A thin stand will have poor shading, and it will be more difficult to cover the ground with a good canopy.

Yield reduction due to a late planting is a major factor to consider. We compared planting dates the last two years. In 2001, the May 3 planting produced 1104 pounds of lint. The yields dropped with each planting date to the final date of May 31, which yielded 493 pounds. This was twenty-one pounds per day-of-delay decrease in lint production. In 2002 the April 30 planting date produced 1221 pounds. The May 6 planting produced 1338 pounds, and the May 16 and May 23 planting dates produced 1369 pounds. The last planting date was May 28, which produced 1358 pounds. Very cool, wet weather occurred May 17. Stands were greatly reduced. However the May 16 and May 23 plantings did very well. Any date was satisfactory. The cost of the seed would not have been recovered if the stand had been replanted. In 2003, planting later than May 13 had major reductions in lint yield. The May 13 planting date yielded 1018 pounds, and by June 2 the yield dropped to 346 pounds. After May 13 replanting should be avoided if possible.

Replanting does not guarantee a better stand and yield will suffer due to the late date. If the crop is kept, there is no miracle cure. The crop needs to be protected from sand and thrips and given time to recover.

Our data show that two plants per foot of row are ideal. These plantings will mature the earliest of any plant density. The crop should be planted before May 13.

The Landscape and Stink Bugs in Cotton

Scott Stewart and Gene Miles

Stink bugs have become a common and important pest of Tennessee cotton during the past three to four years. The green stink bug and the brown stink bug are the most common species found in cotton. A reduction in broad-spectrum insecticide applications, resulting from the success of boll weevil eradication and the adoption of Bt cotton, has created a more stink-bug friendly environment. Stink bugs are mobile and have a wide host range. This host range includes weeds and common field crops such as corn and soybean. Consequently, the build-up and movement of stink bugs from these hosts into cotton fields is an important consideration. Recognizing these relationships, it may be possible to anticipate and/or prevent stink bug movement into cotton. An "on-farm" study is being conducted to determine whether early-maturing soybeans, planted in narrow strips around the perimeter of cotton fields, can be used as a trap crop for stink bugs. The intent is to attract and treat stink bugs in the soybean strips before they colonize cotton. Stink bugs are seed feeders and are attracted to soybeans and cotton that are setting fruit (i.e., pods and bolls, respectively). Therefore, it is important the soybean pod development precedes or at least coincides with boll development in cotton. This approach also relies on stink bugs being relatively more attracted to soybeans than to cotton. On the same date of cotton planting, several rows of Group III and Group IV soybeans were planted around two sides of a cotton field in four counties in West Tennessee. These strips will be treated with insecticide when stink bugs are present. Data are being collected to determine the relative development of both the soybeans and cotton. Stink bug counts in soybean and cotton are planned in each field, as well as in nearby fields lacking a soybean trap crop. Data on stink bug injury in cotton is also being collected. The tour stop will give a brief overview of stink bug biology and the injury caused to cotton. Data will be presented showing the potential success of using a soybean trap crop in reducing stink bug injury in cotton

Solid and Skip-Row Spacings for Cotton

C. Owen Gwathmey

Cotton producers want information about different row spacing and skip-row patterns that can help lower production costs. Agronomic and economic data are needed to evaluate these systems for Tennessee and to develop effective weed control strategies for them.

Planting in skip rows may improve net revenues by reducing per-acre costs of seed, technology fees, and other in-row expenses. Skip-row systems improve profits only if the reduction in these "front-end" costs offsets the lost revenue from the skipped rows. Under full-season conditions, cotton can compensate by growing into the skipped rows, but so will the weeds! Crop suppression of weeds increases with plant population, such as in ultra-narrow row (UNR) cotton systems where rows are spaced 10 inches apart or less. However, seed costs are much higher in UNR than in wider rows.

Research was conducted in a non-irrigated creek bottom and at irrigated and non-irrigated upland sites at the Milan Experiment Station in 2002 and 2003. A replicated factorial experiment was conducted with 40-, 30- and 10-inch row spacing treatments, each in solid and 2+1 skip-row configurations, at each site. PM 1218 BG/RR was planted at all sites in mid-May and harvested one time in late October each year. The 30- and 40-inch rows were harvested by spindle picker, while 10-inch rows were harvested by a finger-type stripper. A preliminary economic analysis was based only on planting costs (seed, tech fees, in-furrow costs) and crop value (lint yield and loan value). For this analysis, no "UNR Exception" was applied to tech fees in 10-inch rows.

In 2002, relatively thin stands were produced after planting all row widths, due to cool wet weather. Populations averaged less than 25,000 per acre in 30- and 40-inch skip rows and in 40-inch solid plantings. Lint yields were about 25% higher in 10-inch solid cotton than in wider spacings, due to higher population density (75,000/ac) in 10-inch rows. However, loan value of the stripper-harvested 10-inch rows averaged $0.47/lb, while the spindle picked cotton averaged $0.50/lb. Crop value in all row spacings and configurations were similar in 2002 after subtracting seed and tech fees.

In 2003, several combinations of row spacing and configuration produced similar yields and crop value after seed costs and tech fees were considered. Across test sites, lint yields in skip-row cotton increased relative to solid planting as row spacing decreased from 40 to 10 inches. Seed costs and tech fees reduced crop value of 10-inch solid planting relative to 10-inch skip row, 30-inch solid and skip, and 40-inch solid planting. Lint yields were lower in 40-inch skip row relative to 40-inch solid and 30-

inch cotton, despite larger bolls and more bolls/plant. This difference was associated with lower canopy light interception and fewer bolls/acre in 40-inch skip rows. Crop value of 40-inch skip row cotton was also lower than 40-inch solid and 30-inch plantings, despite lower seed and tech fees. Lower weed interference and earlier maturity were observed in 10-inch rows and in solid plantings.

Results so far suggest that yields and net revenues from 10- and 30-inch 2+1 skip-row cotton were similar to 30- and 40-inch solid plantings. However, yield compensation was inadequate in 40-inch 2+1 skip rows, and yield compensation delayed maturity slightly. Weeds also grew larger in 30- and 40-inch skip-rows. High seed and tech fees, smaller bolls, and fewer bolls/plant negated the yield advantage of 10-inch solid plantings. To complete this study, data are needed from years with more typical weather patterns for Tennessee.

This research is supported in part by Cotton Incorporated Project 03-340TN.

Weed Management Systems for Cotton

Bob Hayes and Chris Main

Weed management systems for cotton should prevent weed interference, be economical and sustainable, reduce weed seed bank in soil, prevent weed resistance, and neither injure cotton nor reduce quality, lint or seed yield. To be successful, weed management systems require advance planning and timely execution. A few days delay in an application may mean reduced control, higher rates and greater herbicide costs.

The components of a weed management system for no-tillage cotton may include the following:

1. Early preplant burn down with or without residual herbicide(s)
2. At-planting burn down with or without residual herbicide(s)
3. Postemergence with or without residual herbicide(s)
4. Post-directed herbicide(s) with or without residual herbicide(s)
5. Layby herbicide(s)
6. Pre-harvest herbicide(s)

Our most consistent and effective early preplant burn down program has included glyphosate plus Clarity, especially where glyphosate-resistant (GR) horseweed is present. Valor can be added to extend the preemergence control, but cost is increased. Where this program has been followed by an at-planting burn down (Gramoxone Max or Ignite) with a residual herbicide (Cotoran, Karmex, Caparol, etc), excellent control has been achieved. Prowl can also be included with the at-planting application for additional control at little extra cost.

Timely postemergence application of glyphosate alone or tank mixed with Dual Magnum (available as package mixture trade named Sequence) to improve grass and nutsedge control or Staple to improve morning glory control are critical to prevent early weed competition and establish a height differential for subsequent post-directed or hooded sprayer application. Glyphosate should be applied before the cotton reaches 5-true leaves. Envoke can be applied postemergence overtop after cotton reaches 5-true leaves for improved morning glory control. Envoke does not control Palmer amaranth (pigweed).

Post-directed application of herbicides can be made to cotton once a height differential between cotton and weeds is achieved. Cotoran plus MSMA may be post-directed in cotton at least 3 inches tall and will provide contact and residual control of many weed species. After cotton reaches 6 inches, Caparol, Karmex, Layby Pro, Goal, Suprend and Cobra may be used. Any of these products can be applied with glyphosate in RR cotton, but spray must be directed to the base of the cotton plant. Expect some glyphosate antagonism, especially on grasses, with some tank mixtures. Aim, Gramoxone Max, Ignite, and Glyphosate may be used under hooded sprayers in any cotton varieties.

Layby herbicides for cotton include Caparol, Cotoran, Karmex, Layby Pro and Valor. Layby applications differ from normal post-directed application in that cotton should be >12 inches tall and generally higher application rates are used.

Special consideration should be given to situations where glyphosate-resistant horseweed is present. Where early preplant applications are made, horseweed emerging in late March and April, has presented problems since few options exist for horseweed control within three weeks of cotton planting. Likewise, pigweeds, especially Palmer amaranth, are frequently present in fields during mid- to late-season. Glyphosate is one of the most effective herbicides for pigweeds, but it must contact the weed in sufficient dosage to kill it. Dense infestation and crop canopy may prevent coverage. Weeds emerging after an application of glyphosate survive because it has no preemergence activity. Dual plus glyphosate (Sequence) can provide some residual activity on pigweeds. While there is no consistent, complete pigweed control program, Caparol, Goal or Valor have been beneficial in providing some

residual control. Pre-harvest treatments of glyphosate may be beneficial in desiccating weeds and preventing viable seed production, thus reducing the weed seed bank in the soil.

It is no secret that glyphosate is weak on morning glory. Cotoran is the most effective preemergence herbicide, while Staple and Envoke are the most effective postemergence herbicides. Goal, Aim, Cobra and Valor are effective post-directed herbicides. Ignite is very active on morning glory but can only be used in Liberty Link cotton or with a hooded sprayer.

Roundup Ready® Flex cotton is scheduled for release in 2006 and will allow postemergence applications beyond the fifth true leaf. While this will provide a greater application window, a systems approach may be necessary to prevent weed resistance. The advantage of integrating multiple sites-of-action herbicides in the weed management program is a ward against the development of weed resistance and weed shifts.

No-till acres in West Tennessee are down approximately 25 percent. We recognize that pre-plant tillage may be a viable option for pre-plant weed control on land not subject to erosion, but there are still advantages to no-tillage: moisture conservation, trafficability especially during planting and early season operation. In-crop cultivation may be an option in conventional tilled fields not subject to erosion. However, hooded sprayers and residual herbicides provide both initial and residual weed control. Integrated weed management systems should employ the most effective and economical tools available to achieve optimum weed control.

TOUR C
SOYBEAN PRODUCTION TOPICS

Comparing Soybean Planting Dates, Populations and Early Maturity Groups

Bob Williams and Greg Allen

The major limitation to profitable soybean production in Tennessee is drought.

In most years, rainfall in April through June, coupled with stored soil moisture from winter, provide adequate water for vegetative growth. After June, rainfall is sporadic and coupled with high temperatures. Crop moisture demands exceed that provided by rainfall. Soil moisture is quickly depleted and temporary/long term deficits occur. This often happens during the critical pod set and seed fill periods.

These sporadic moisture deficits have resulted in up to 58 percent yield losses compared to irrigated soybeans according to University of Arkansas researchers. University of Tennessee research from the West Tennessee Experiment Station verified average daily moisture use over a 111-day growing period was 0.17 inches per day with a peak use of 0.34 inches per day. Approximately 18-19 inches of rainfall were needed to produce 32.5 bushels or roughly 1.8 bushel per inch of water. The normal July-August rainfall represents less than 50 percent of the soybean plant demands during that time.

Planting a determinate Maturity Group MGV variety from mid-May through June and harvesting mid-October through November results in a 150+-day growing season, with flowering starting some 60 days after germination or in mid-July through August. This period of flowering and pod setting/filling, with high water availability requirements coincides with historically low rainfall months.

Early season production systems employ the use of indeterminant, early MG varieties (primarily MGIII and MGIV) to initiate earlier flower/pod fill time frames to minimize the risk of drought or moisture stress in July/August. Planting MGV varieties early will not effectively reduce time to flowering, pod fill and maturity. Therefore, to effectively spread risk from July/August droughts, select proven varieties from earlier maturity groups.

Extension conducted Standardized Variety plot yield comparisons of the various maturity groups. Compiled from 5,116 plots at 291 locations from 1997-2003, they resulted in an average yield of 41.2 bu/Acre for MGIV compared to 39.8 bu/Acre for MGV varieties. From 2000-2003 the averages were 47.4 bu/Acre for MGIII, 43.5 bu/Acre for MGIV and 43.1 bu/Acre for MGV.

For the past four years, the Milan Experiment Station has conducted a series of trials comparing MG III, IV and V at various plant populations (100, 150, 200 and 250,000 seed/Acre) at three planting dates (mid-April, mid-May and mid-June). This effort is being conducted to determine the most effective planting combinations to optimize yield, reduce risk and limit seeding cost.

Tour stop discussion will include an in-depth look at the results of the multi-year study and provide greater detail of cultural practices to employ with plantings of earlier MG varieties.

New Soybean Cultivars

Vince Pantalone and Prakash Arelli

The new conventional maturity 5.0 soybean cultivar *5002T* was developed by the Tennessee Agricultural Experiment Station for its *high yield* throughout broad geographical regions of the southern USA. This cultivar has recently been approved to replace Manokin and to become the new *high yield check variety* in the USDA Southern Uniform Testing Program, conducted throughout the South. Certified seeds of 5002T will be available to farmers for planting in 2005.

5002T was developed by the University of Tennessee Soybean Breeding Program and resulted from a superb pedigree — the cross Holladay x Manokin. 5002T typically produces about 4 Bu/A higher yields than Manokin. 5002T has white flowers, tawny pubescence, tan podwall and a determinate growth habit. 5002T is resistant to *stem canker* and is tolerant to *sudden death syndrome*, but it is susceptible to *soybean cyst nematode (SCN)*.

Research is needed to aggressively target SCN resistance development in Tennessee and the Mid-South region. The Mid-South has more acreage planted with soybean than any other row crop. Soybean ranked first in cash value among crops produced in Tennessee in 2003 and in recent years. High yields are critical to soybean producer profit margins. Diseases have suppressed soybean yields; SCN especially has caused significant yield losses. Current cultivars trace their resistance mostly to Peking and/or PI 88788. SCN can quickly adapt to resistant cultivars because of the limited genetic base of resistance. Additionally, more yield suppressing and aggressive nematode populations recently identified in West Tennessee have adapted to the resistant sources commercially available today. Nevertheless, resistant cultivars are economical and environmentally safe. We are targeting our research to stack resistance genes from traditional sources of SCN resistance together with novel genes from unique and new sources. Combined technologies of classical breeding and recent biotechnology methods will be used to transfer SCN resistance genes into high yielding Tennessee soybeans that are being developed for the Mid-South.

Proposed Seed Labeling and Traceability Regulations for 2005

Angela Thompson and Tim Smith

The European Union (EU) has continued to block the import of specific corn hybrids that are genetically modified or classified as 'GMO's.' Roundup Ready® soybeans have always been exempt from import restrictions. Certain corn hybrids with specific *Bacillus thuringiensis* (Bt) events have received clearance in recent years, but new events have not. Just recently, the EU voted against allowing import of any hybrids containing the NK-603 event, which is "Roundup Ready 2" corn.

In 2001, genetic event traceability and food labeling regulations were developed by the EU, but most were not put into effect or enforced. In 2003, the EU discussed an agreement to lift the current GMO ban, replacing it with proposed traceability and food labeling regulations on all GMO crops. April 18, 2004 was the deadline for the Traceability and Food Labeling regulations to go into effect for genetically modified crops exported to the European Union countries. According to latest information, these regulations were put into effect, but discussion about enforcement is ongoing.

Proposed regulations fall into two categories: 1.) Food labeling which would allow less GMO crop into food products sold in the EU unless labeled as a GMO food and 2.) Tracking of genetically modified seed grown in the U.S. and imported into EU countries. Food labeling would involve labeling food products sold in EU countries that contain more than 0.9 percent genetically modified crop content (syrup, meal, etc.) of approved GM events. Any food product containing more than 0.5 percent of non-approved GM events (Roundup Ready corn, certain newer *Bt* corn) would also be labeled. Traceability requirements for tracking GMO seed from farmer's field to European ports appear to be complicated, and could require producers to provide copies of seed tags/labels at point of sale or transfer to grain handling facilities. The latest updates regarding these regulations will be discussed along with possible impacts on producers in 2005.

TOUR D
PEST MANAGEMENT IN SOYBEANS

Stinkbugs and Soybean Aphid: An Old and New Pest in Beans

Ken Goddard and Steve Burgess

This tour stop concentrates on two potentially damaging pests that occur in soybean. Stink bugs, primarily the green and brown stink bug, are often the most important insect pests of soybean. These insects cause injury by feeding on developing seed within pods. This injury can reduce yields and reduce seed quality, resulting in significant economic loss. In contrast to stink bugs, the soybean aphid is a new potential pest in Tennessee. The soybean aphid, also known as the Chinese aphid, was accidentally introduced into the northern Soybean Belt. It was first discovered in the United States in 2000. It is the only aphid that will successfully colonize and reproduce on soybeans, and it has become a significant pest in Illinois, Wisconsin, Iowa, Ohio, Michigan, Minnesota and other Mid-western states. This insect was first documented in Middle and West Tennessee in 2003, including specimens collected at the Milan Experiment Station. It is unclear whether this pest will continually survive and become an economic problem in Tennessee. A survey, sponsored by the Tennessee Soybean Promotion Board, is being performed in 2004 to determine the extent and level of aphid infestations across the state. This survey will also document the occurrence of stink bugs. This tour stop will review various stink bug management considerations including sampling, treatment thresholds and insecticide options. A discussion of soybean aphid biology and injury potential, as well as the results from the soybean aphid survey, will be presented.

Reducing Risk of Soybean Yield Loss—Soybean Cyst Nematode Resistance and Cultural Practices

Pat Donald and Kerrick Hartman

Soybean cyst nematode (SCN) is an economic pest of soybean reducing yield often with little indication of its presence. An estimated 143 million bushel loss was attributed to SCN in 2002. Higher estimated loss occurred in prior years. Management strategies can reduce the risk of yield loss. Currently, the most effective strategy is management of the nematode during the crop production period through use of SCN resistant varieties in combination with rotation to crops that are not hosts for the nematode.

Cultural management: Changing cultural management of soybean production may have an impact on SCN management. No-tillage practices have been adopted with differing reports on the effect of this cultural practice on reproduction of SCN. We are looking at the long- and short-term ramifications on SCN reproduction as related to different tillage regimes. Our studies indicate that the highest SCN reproduction occurred in no-tillage plots when they were tilled. Changes in tillage practices have also changed the composition of problem weeds present in production fields. Some of these weeds are known hosts of SCN and research in Indiana and Ohio have found that SCN reproduces on some of these winter annual weeds during the non-crop production period. Reproduction by SCN during the non-crop period would negate the effects of some of the management practices used during the crop production period. We have been examining plant roots in middle and west Tennessee for indications of successful reproduction during the non-production period and have not found presence of SCN reproduction prior to the typical soybean planting time frame.

Soybean resistance: In addition to cultural practices, the use of SCN resistant varieties rounds out the most cost effective management strategies. Development of SCN resistant varieties begins with planned crosses using parents with desirable traits including nematode resistance and other traits such as good yield and regional adaptation. Individual plants are selected that have the desired characteristics in a process that may take eight to 10 years. To determine the SCN resistance potential within soybean varieties, plants are tested against population(s) of SCN. The seed is inoculated with a pre-determined, quantifiable level of eggs, juveniles or cysts of a described SCN population. The plants are grown under controlled conditions until mature females are present on the roots. Evidence of SCN reproduction is cysts present on the test

plant roots. The cysts are counted and the variety is categorized as resistant or susceptible based on the number of cysts recovered from the roots. The variety may be tested individually against several populations of the nematode typical of the proposed market when multiple resistance is deemed necessary or economically important.

Controlling Frogeye Leaf Spot in Soybeans

Melvin Newman and Bruce Steelman

In 2003 two strobilurin fungicides, pyraclostrobin (Headline) and azoxystrobin (Quadris), were compared to thiophanate-methyl (Topsin-M) for control of Frogeye Leaf Spot (FLS) caused by *Cercospora sojina*. Under heavy FLS disease pressure, all fungicide treatments increased yield and seed size. Disease ratings for FLS and defoliation were significantly reduced with the strobilurin fungicides. There was no significant difference in yield among any of the fungicide rates or number of applications. However, FLS ratings were significantly lower for higher rates of fungicides and for multiple applications of the strobilurin fungicides. Seed weights were also higher for multiple applications and higher fungicide rates. (See details in Table 1 below).

Soybean Rust Update

Soybean rust caused by the fungus *Phakopsora pachyrhizi,* has been reported in several countries and has spread rapidly, causing severe damage in South Africa and Brazil within the last two to three years. Damage can range from 10 percent to 80 percent. Soybean rust attacks the leaves and causes them to drop early, which inhibits pod setting and reduces yields. Soybean rust spores can be carried for hundreds of miles in one season and could enter the United States at any time. There have been no reports of soybean rust in the contiguous 48 states at the time of writing (6/1/04). There are no known resistant varieties, and prospects are not good for resistant varieties anytime in the near future. There are many hosts for soybean rust, but the most widespread host is Kudzu. Soybean rust might even over winter on Kudzu in the southern part of the United States where temperatures are above freezing in the winter. The University of Tennessee and the state Department of Agriculture have begun the process of clearing several more fungicides with the EPA for use on soybean rust should it be found in the United States. At this time, only Quadris (azoxystrobin), Bravo and Echo (chlorothalonil) and Topsin-M are cleared for use on soybeans for rust control. When soybean rust is identified in this area, producers will need to react very quickly and spray their soybeans with a recommended fungicide. Application equipment and fungicides may be in short supply when this happens.

ASA will present a series of seven soybean rust education meetings this summer. The one in Memphis is scheduled for July 23, 2004, from 10:00 a.m. - 2:00 p.m. at the Agricenter International, Inc., 777 Walnut Grove Rd., Memphis, TN.

Check www.SoyGrowers.com/rust and www.utcrops.com for updates and more information on soybean diseases.

Table 1

Location: MILAN EXPERIMENT STATION

University of Tennessee

Soybean Foliar Fungicide Test

Variety: Delta King 5465RR

Investigator: Dr. Melvin Newman

Description				**Yield**	**FLS**	**Defoliation (percent)**	**Anthracnose**	**Seed Wt.**
Rating Unit				**Bu/A**	**Rating 0-10**		**Rating 0-10**	**grams/100 seeds**
Rating Date				**10/24/03**	**9/19/03**	**10/7/03**	**10/21/03**	**11/6/03**
Treatment Name	**Rate**	**Rate Unit**	**Appli. Stages**					
Headline	6	fl oz/a	R3	53	3	13	3	15
Quadris	9	fl oz/a	R3	52	2	38	4	14
Quadris	6	fl oz/a	R3	51	1	50	3	14
Quadris	6	fl oz/a	R5					
Headline	6	fl oz/a	R3	50	1	8	2	14
Headline	6	fl oz/a	R5					
Headline	9	fl oz/a	R3	50	2	10	3	15
Quadris	6	fl oz/a	R3	48	4	68	5	14
Topsin M	0.5	lb/a	R3	46	3	80	5	13
Topsin M	0.5	lb/a	R5					
Topsin M	0.5	lb/a	R3	46	5	86	5	13
Topsin M	1	lb/a	R3	45	5	75	5	14
Check			-	34	9	100	8	12
LSD (P=.05)				5.35	1	17.4	0.9	0.8

NOTES:

1. Disease ratings were made on a scale of 0-10, where 0=no disease and 10=most disease possible.
2. FLS=Frogeye Leaf Spot.
3. Plots were under pivot irrigation at MES.
4. DISCLAIMER STATEMENT: All ratings and yields are averages of three replications per location. The actual value for each replication is not shown here but is available upon request. Actual field reactions may differ significantly from year-to-year and from field-to-field due to varying environmental conditions.
5. All spray applications made with 20 gal. water/A, hollow cone nozzles (TX12).
6. Application dates: R3 (early pod set, ¼" pods) on 8/7/03, R5 (pod 1" long) on 8/20/03.
7. Seed weight is the weight of 100 seeds in grams.

Weed Management in Forages

Greg Breeden, Neil Rhodes and Scott McElroy

Introduction

Weeds often become troublesome in forages because they find room to grow. This can be attributed to low seeding rate, poor internal drainage of the soil, droughty soils, low pH and/or poor fertility status, or overgrazing. Regardless of the type of forage, the first and most effective weed management input should be management of the crop for maximum competition. Even with a producer's best efforts in cultural care, there will be a need for an effective herbicide program. The best herbicide program for use in forages involves applying the proper herbicide when the weeds are most susceptible to achieve the highest level of control. Herbicide choice and application timing is dependent on the target weed types (grass or broadleaf weeds) and their life cycle (annual, biennial or perennial).

Weed Types and Life Cycles

To develop the best herbicide program, knowledge on the weed types and life cycles (or knowing when to expect them) is very beneficial in making decisions on herbicide choice and application timing. Weeds in pastures can be divided into two main types: broadleaf weeds (Ex. henbit, deadnettle and chickweed) and grass weeds (Ex. crabgrass, dallisgrass and johnsongrass). Within each type certain weeds may have one of four different life cycles: summer annual, winter annual, biennial and perennial. **Summer annuals** - plants that germinate from seed in the spring, flower and produce seed in the mid to late summer and die in the fall. **Winter annuals** - plants that germinate from seed mostly in the late summer through winter, flower and produce seed in the late winter to spring and die in the late spring to early summer. **Biennials** - plants that complete their life cycle over two growing seasons. They germinate and produce a vegetative rosette the first year. The second year, the plants bolt, flower, produce seed and die. **Perennials** - plants that produce a vegetative structure (taproot, tuber, bulb, rhizome, etc.) that allows them to live for more than two years. Most perennials also reproduce from seed.

This information allows us to categorize our treatment options into one of three application timings. Those are late winter to early spring, fall and late spring to summer applications. March to early April is when the late winter to early spring application would be made. Buttercups, thistles, horseweed, and plantains are examples of weeds that can be controlled during this time. For many broadleaf weeds, we most often make an herbicide application in late winter or early spring. However, these broadleaf weeds can be just as effectively controlled in the fall with an application in November to December. In fact, better control or more timely control of newly emerged, fall-germinating winter annual weeds like henbit, deadnettle and chickweed can be achieved. The other application window is during the warm summer months. This time period is when the summer annual broadleaves like cocklebur and pigweeds are adequately controlled. Some of the harder to control broadleaf weeds are targeted during this time, such as tall ironweed and horsenettle.

In some cases knowing when to apply is more important than what to apply. An example of this is buttercup. Excellent control (99 percent) can be achieved with a properly timed application of 2,4-D at 2 pints/Ac in March. If this application is not made until late April, control will decrease to around 70 percent. Further, if applications are made too late, the weeds will produce seed, thus requiring future control actions. Later applications also increase the risk of drift damage to cotton and other susceptible crops.

Fence Rows and Property Border Areas: Management of Problem Perennial Weeds

Darren Robinson and David Lockwood

Fencerows and property border areas that are left undisturbed favor the development of perennial plants. In areas, where the site is frequently disturbed with practices such as tillage or cultivation, annual weeds will dominate. In areas free of disturbance, annual plants will be replaced by perennial plants. Among the perennial plants that can potentially develop, certain species are more competitive and as a result, their presence is more dominant or more frequent. Allowed to grow and reproduce their presence will encroach un-managed areas. A plant becomes a weed when this plant interferes with the intended use or aesthetics of an area that is under management. The resulting weedy perennials can be native or non-native to an area. Regardless of their area of origin, these plants that dominate are unwanted plants or weeds. In undisturbed sites the perennial weeds that dominate will be invasive or the most aggressive in growth and reproduction or spread.

As a result, several of these invasive weedy plants may be the most difficult to control. Short-term control may be achievable. However, the ideal approach to limiting unwanted perennial vegetation is to adopt a management approach that ideally leads to eradication rather than the need for repeated short-term control procedures.

A complete management plan for limiting unwanted invasive plant develop would consider the following:

- Limiting unwanted plant introduction into an area
- Limiting the conditions that favor their development
- Physical removal options
- Choice of the right herbicide or combination of herbicides applied at the correct amounts and at the right times, or when the most complete long-term control can be achieved
- Limiting re-development by stabilizing the site with desired vegetation or physical barriers such as mulch or the use of residual herbicide options where appropriate.

Over the past ten years, a great deal of effort has been put into the study of control and management options for invasive perennial weeds. The bulk of this work has indicated that the best approach is to consider management options that would ideally lead to long-term control or eradication. Then, once the site is free of unwanted invasive plants, the site should be re-established with a desired vegetation or ground cover to minimize re-development of unwanted perennials.

In terms of gaining long-term control, the most economical approach for most species comes down to the effective use of herbicide options focusing on herbicide choice, application method and application timing.

Focus should be placed on selecting the best herbicide option that will give the most broad-spectrum control applied when the unwanted plants are in their most sensitive stage of growth. Then stabilize the site with desired vegetation or barrier that will limit re-development of unwanted invasive perennial plants.

New Herbicides: What They Do and What They Don't

Tom Mueller, Andy Kendig and Todd Willian

Heard great things about a new herbicide? Did it sound better than sliced bread, or did it sound just like an ad for a new and improved dish detergent?

New herbicides usually bring desirable new traits: excellent control of a formerly troublesome weed, residual weed control, improved crop safety or ease of use. On the other hand, a new herbicide may not be that new. One of the best parts of a field day is to see things for yourself. At this stop you will see several new herbicides sprayed on a selection of crops and weeds. On an informal guided tour you can see Ignite, Envoke, Suprend, Sequence, Roundup, Steadfast and others sprayed on several common and troublesome mid-South weeds. Also, several crops will be planted and treated with these herbicides to give you an idea of what drift or tank-contamination issues may occur.

Three weed scientists will be manning this stop. Please feel free to ask them questions. In addition to guiding the tours, they are willing to visit with attendees about weed control issues between the tours.

Ignite is a new name for Liberty from Bayer, which you may be familiar with from Liberty Link corn. Ignite is associated with the new Liberty Link cotton. Unlike Roundup Ready cotton, Ignite can be sprayed over the top of cotton after the 4-leaf stage without any concern for fruit formation. Ignite is somewhat like glyphosate as it is non-selective. However, compared to glyphosate, it is stronger on some broadleaf weeds (morningglory in particular) but weaker on grasses and pigweed species.

Envoke is a new ALS-type herbicide from Syngenta for postemergence use in cotton. It is somewhat similar to Staple in that it controls broadleaf weeds, may be used over-the-top, and is an ALS inhibitor. Envoke has strong activity on morningglories, sicklepod and nutsedge. Envoke is somewhat weaker on prickly sida (teaweed), and velvetleaf (wild cotton). Envoke also does not control ALS-resistant weeds (some Palmer amaranth and cocklebur are ALS resistant) and grass is only suppressed. Envoke causes somewhat more yellowing on cotton than Staple, and growers may want to consider partially directed applications if they plan to spray Envoke over-the-top.

Suprend is another Syngenta herbicide that is a mixture of Envoke and Caparol and is intended for postemergence directed application to cotton. Caparol has somewhat limited postemergence activity on morningglory, sicklepod and nutsedge, while Envoke has somewhat limited residual activity. The combination is intended to combine the strengths of the two herbicides.

Sequence is another Syngenta herbicide. It is a mixture of Dual Magnum and glyphosate (also known as Touchdown IQ). This herbicide is intended to provide residual activity to glyphosate when it is used postemergence. Sequence may be used over-the-top of Roundup Ready crops or used for burndown. Some researchers report improved Palmer amaranth activity when a sequence-type treatment is used instead of glyphosate alone.

Steadfast is a new DuPont product that is based on Basis Gold. Basis Gold contained nicosulfuron (Accent), rimsulfuron (Matrix) and atrazine. Steadfast also contains nicosulfuron (Accent) and rimsulfuron (Matrix). Also, it is highly recommended that atrazine be added to Steadfast whenever possible. Steadfast contains a higher rate of nicosulfuron (Accent) and consequently provides slightly better Johnsongrass and annual grass control. Also, by leaving the atrazine out, Steadfast can be used postemergence on up to 20" tall corn (atrazine tank mixes limit Steadfast to 12"). After corn is 12" tall, another popular tank mixture has been Callisto, which like atrazine, provides postemergence and residual control of many broadleaf weeds.

Palmer Pigweed Control in Corn and Soybeans

Larry Steckel and Jerry Parker

Palmer amaranth (Amaranthus palmeri S. Wats.) is a member of the pigweed family (Amaranthacea). Palmer is one of nine species in this family that can commonly be found as weeds in row crops. It has the most rapid growth rate and is the most competitive of the pigweeds. Published reports have found yield loss from Palmer competition to row crops ranging from 30 percent to 70 percent. Palmer is native to the southwest United States (New Mexico to California) and Mexico. Over the last 40 years it has spread and now can found as far north as Missouri, Illinois, Kansas and throughout much of the Mississippi Delta and many southeastern states. Palmer is now among the most competitive and prevalent annual weeds in cotton, corn and soybean production here in Tennessee.

Early identification can be key when trying to manage this weed in row crops. Unfortunately, many of the Amaranthus species are difficult to tell apart, and often the pigweeds have simply been lumped together and incorrectly identified as redroot or smooth pigweed. Seedling Palmer can be identified from other typically weedy pigweeds in Tennessee by the lack of hair on the stems or leaves. Later, Palmer will mature into individual plants that have either male or female flowers. Both of these characteristics separate it from other pigweeds commonly found in Tennessee like smooth and redroot pigweed. It also has very long petioles that are as long or longer than the leaf. This distinguishes it from other pigweeds that are hairless or sparsely hairy like the waterhemps, slender and spiny amaranth, which have very short petioles.

Why have the pigweeds, particularly Palmer, become such a problem weed. For many years, soil-applied herbicides were widely used and followed up with a cultivation treatment. This kept the pigweed population pretty much in check. However, recently there has been a shift away from soil-applied and preplant incorporated herbicides to more post applied herbicides that have little or no soil residual activity. Unlike many other weeds, Palmer can germinate from March through August in Tennessee. This makes it almost impossible to time herbicide applications post emergence and receive season long control. Adoption of reduced tillage practices also favored the germination and growth of the small-seeded weeds such as Palmer pigweed. Additionally, herbicide resistance has been documented in this pigweed species. To date there are confirmed biotypes of Palmer resistant to the triazines like Atrazine and Princep, ALS inhibitors like Sceptor and Steadfast and dintiroanilines like Treflan and Prowl.

Once a field has a problem how can it be managed? Since Palmer can emerge over a long period of time, relying just on a pre-applied herbicide or a single post-applied herbicide will likely not provide consistent control. Palmer can best be managed when a pre-applied herbicide is followed by a post or when a post-applied herbicide is followed by another post that contains some type of residual product to control pigweeds.

Herbicides that are in many premixes such as Dual II Magnum, Cinch, Degree, Harness, Fultime, and Frontier all will provide residual control of pigweed in corn. Atrazine will provide both residual control and burndown small emerged pigweed. The plant growth regulator herbicides like Distinct, Clarity and 2,4-D are other options in corn. Callisto is a new post-applied herbicide for corn with very good activity on pigweed.

In soybeans Dual, Prowl, Frontier, and Spartan will all provide residual control of Palmer. Glyphosate is a very good control option for pigweed postemergence. The diphenyl ethers like Reflex, Blazer and Cobra will also control pigweeds post if they are 4 inches or smaller. Treflan is still a very good option in conventional-till soybeans. In both corn and soybeans put in with tillage, cultivation is still a good weed management tool for pigweed. Palmer amaranth can be successfully managed if a comprehensive weed control plan that utilizes several different control options is in place.

Bermudagrass for Beef Cattle

Warren Gill

Bermudagrass attracts the interest of beef producers, not only because of its high yield potential, but also because of its seasonal production pattern. Because bermudagrass flourishes during hot weather, when cool-season grasses are not as productive, it would appear to be a natural pasture crop to fill the summer slump period of cool-season grass pastures. While quantity is certainly important, quality should be considered in determining whether and where bermudagrass fits into a livestock-forage enterprise.

In all forage crops, quality tends to decrease with advancing maturity. As warm-season grasses such as bermudagrass mature, fiber concentrations increase and contribute to a decline in digestibility. Higher growth temperatures also hasten maturity and increase lignification (thickening of cell walls), which reduces digestibility. However, the forage quality of bermudagrass hay cut at 28-day intervals compares favorably with that of timothy, orchardgrass and tall fescue hay cut at comparable stages of maturity.

Frequency of cut and nitrogen fertility influence both protein content and the digestibility of the dry matter. Higher levels of nitrate fertilization have occasionally resulted in toxic levels of nitrate in bermudagrass.

Although bermudagrass hay is not preferred for high-producing dairy cows, it can be used for growing replacement heifers, feeding dry dairy cows, horses and all classes of beef animals. Studies using bermudagrass for growing steers indicate highest quality and more rapid production gains during May and June rather than in July and August. Gains of 1.5 to 2.0 pounds per day are not uncommon during the earlier period, but performance of less than a 1.0-pound gain per day has been measured during July and August. While animal performance decreases during the hot summer, carrying capacity or production per acre has been shown to improve. Carrying capacity may increase as much as 20 percent during July over the June period.

Bermudagrass appears to fit best in the beef program when it is desirable to increase stocking rate in exchange for individual animal performance. This may be in a fall-calving herd where a summer pasture is needed for heavy stocking. A heavily stocked bermudagrass pasture can supply most of the nutritional requirements for maintaining dry beef cows. With a spring-calving herd, cows could also be concentrated on bermudagrass after the breeding season.

If higher rates of animal performance are required on a bermudagrass base, it is possible to improve performance by supplementation. Some consideration should be given to the feedstuffs utilized, with more emphasis on low-starch supplements (soyhulls, corn-gluten feed or distiller's grains, for example).

Another consideration would be mineral supplementation. For example, sulfur levels are sometimes high in Tennessee-produced bermudagrass, so minerals known to be affected by sulfur (copper and selenium) may need to be provided at a higher concentration in free-choice minerals. Also, consider avoiding excessive levels of sulfur fertilization.

Prepared by Warren Gill (Portions adapted from "Bermudagrass: a Summer Forage in Kentucky" by D. C. Ditsch, W. O. Thom, G. D. Lacefield and L. W. Murdoch)

Utilization of Bermudagrass and Other Forages with Horses

Doyle Meadows

All horses should be fed high quality forages every day. A modern feeding program for horses would maximize the use of forages (hay or pasture) to meet nutritional needs with supplements of mixed grains as needed. Feeding adequate quantities of hay would not only be more cost effective than feeding larger amounts of grain but also would be a safer and healthier feeding program. Many horse owners today are incorrectly more concerned about the grain portion of the horse's diet than the forage. Forage and forage intake should be the primary consideration when feeding horses.

Forages for horses include pastures and hay. Pastures and hays are generally divided into two categories, legumes and grasses. Examples of legumes are alfalfa, clo-

ver and lespedeza. Bermuda, timothy, orchard, fescue and bluegrass are examples of grasses. Pastures and hay can be either grasses or legumes or combinations of the two. The majority of Tennessee pastures are fescue or fescue and clover mix. However, there is an increase in bermudagrass production in Tennessee.

Bermudagrass hay is excellent forage for all classes of horses. It is very palatable for horses and is typically of better quality than most grass hays due to the better management practiced by hay farmers. Bermudagrass nutritional data can reach that of alfalfa if the crop is properly fertilized and watered. Although bermudagrass is an excellent source of hay for horses, some people feel that extremely fine-stemmed bermudagrass hay causes impaction colic. For this reason, some horse owners have stopped feeding bermudagrass hay or have used alternative grass forages.

Legumes are higher in protein than grasses and tend to have slightly higher energy values. The energy content of legumes is generally no higher than one megacalorie of digestible energy per pound. The protein content of a typical quality legume hay is about 15 percent crude protein, with a range of 10 percent to 20 percent protein on "as fed" basis. Legumes also contain high levels of calcium and moderate phosphorus levels.

Grazing horses will eat up to 2.5 – 3 percent of their body weight in forage daily. All stalled horses should get at least 1.25 percent of their body weight in hay each day. Horses can be maintained on good quality forage; but working horses, lactating mares and young growing horses will need to be supplemented with a mixed-grain diet.

Bermudagrass and Goats

An Peischel

The goat is an extremely agile, gregarious and opportunistic creature. It is the ability of management, through innovation and creativity, to successfully use those characteristics for the enhancement of lands. The management goal encompasses the use of all ecosystems – biological and environmental – with success centering around flexibility of management plans and the ability to re-plan. To accomplish this, biodiversity must be maintained and the physiology of plants and soils understood along with the ability of man to make environmental, economical and socially sound decisions. Goats, under control are being used to enhance land productivity and encourage the production of vegetation.

The use of goats in vegetative management can take many diverse avenues including but not limited to noxious weed abatement, poisonous/toxic plant eradication and enhanced vegetation production by eliminating competition from unwanted species.

Diet Preference Differences
(percent of diet)

Plant	Horse	Cattle	Sheep	Goat
Grass	90	70	60	20
Weeds (forbs)	4	20	30	20
Browse (woody)	6	10	10	60

Genetic heritability of foraging by livestock is important in browse and pasture operations. The different species graze at different times during a 24-hour period, each species selects different plants and plant parts as do the age groups within that species, they require different amounts of water, and each species has a unique mineral requirement.

With the intensive use of portable, solar powered electric fencing, creativity in fencing allows: 1) maximum utilization of forage, allowing plants to rest before re-grazing; 2) allocation of forage based upon quality or physical condition of the goats; 3) ability to manage plant species and 4) maintain a healthy environment for vegetation and livestock – a symbiotic relationship.

The next time you think about weed (forb) and browse (woody) species in a bermudagrass pasture or hay field think of goats – herbicide and pesticide usage can be minimized, there is no heavy metal input, no chemical costs and goats are in high demand.

(Prepared by: An Peischel, Small Ruminant Extension Specialist for Tennessee State University and the University of Tennessee).

TOUR G
BERMUDAGRASS PRODUCTION

Successful Bermudagrass Establishment

Gary Bates

Bermudagrass is becoming a more important forage crop for Tennessee and the mid-to upper-South. It can be excellent quality that is easier to produce for hay than many cool-season crops. To establish bermudagrass successfully, pay attention to the following details:

1. Select the right variety. Many varieties of bermudagrass are grown in the southeastern United States. Understanding the differences between varieties and knowing the important criteria for selecting a variety can be the difference between bermudagrass being profitable or being a complete failure. Here are the important characteristics to consider in bermudagrass varieties:

- Cold Tolerance — Some varieties of bermudagrass have very little cold tolerance. These varieties may be totally killed during their first winter. Other varieties may suffer enough winterkill to hurt the stand and limit production the next year. Be sure to select only varieties that are able to survive our winters. Do not be the first person to try a new bermudagrass variety in your area.
- Yield — There are significant yield differences among varieties. After cold tolerance, yield potential is probably the next most important factor.
- Planting Method — Seeded varieties are generally easier to plant than the vegetative-type varieties. Seeded types generally do not have as good cold tolerance as the good vegetative types.
- Cost — If only a few acres are desired, seeded types are probably the most economical and easiest varieties to deal with. If more than 10 acres is desired, the vegetatively propagated varieties, particularly the ones spread by clippings, become more economical.

2. Plant at the proper time. Moisture is important for bermudagrass establishment. Plant between mid-May and late-June. Later plantings can be successful, but there is a greater chance of failure.

3. Proper fertility at planting. Make sure that pH, potash and phosphate are adequate at planting. Soil testing is the only sure way to know soil fertility status. Apply approximately 30 pounds of nitrogen per acre at planting.

4. Minimize weed pressure. Don't allow weeds to get above the bermudagrass and cause competition problems. There are limited opportunities for herbicide applications during the establishment year. Clipping will be one of the better options for minimizing weed pressure during the first year.

Bermudagrass Weed Control

Ron Blair

Controlling weeds in Bermudagrass is a key component to producing high quality forage that can attract the quality conscious horse market and insure consistent forage for cattle.

Producers need to balance cost of weed control with specific markets and weed pressure. Producers should be mindful that there are abundant herbicides labeled for lawns that should not be used on hay or pasture land.

A weed control program should include a fertility program by soil test and timely clipping, mowing, or grazing schedule.

A chemical program may be divided into a dormant spray program from November through March and a growing phase from May through September. Applications of any herbicide should be avoided during a transition time, i.e. spring green up and fall stockpiling.

Growers must read and follow label directions for grazing and haying restrictions. Certain herbicides will kill all existing clovers and/or fescue and retard growth of desirable species. Some of the new chemistry is very rate specific, which must be taken into consideration before spraying.

Current recommendations for weed control include Gramazone Max (dormant), Roundup (dormant), 2, 4-D, Plateau, Cimarron 60DF, Grazon, Banvel, and Redeem. Application rates and weed response are in Publication 1580, 2004 Weed Control Manual for Tennessee, available at your local Extension Office or on the web.

Bermudagrass Fertilization

Philip Shelby

Cutting hay on a 28-day schedule and developing a sound fertilization program are the two most important factors in optimizing yield and quality while minimizing risk and cost.

Soil testing should be the first step in developing a sound fertilization program. Lime, phosphorus (P) and potassium (K) should be applied according to soil test recommendations to create and maintain a pH of 6.0 - 6.5 and bring soil test values for P & K into the high range.

(P) is necessary for many plant processes and high forage yields. (P) does not readily leach from the soil, which means it can be applied at any time of the year and may be applied all at one time.

Maintaining (K) levels is essential for maintaining thick healthy stands and winter hardiness. (K) is subject to leaching, especially in sandy soils and may be better utilized in a split application. Additionally, bermudagrass is a Aluxury consumer@of (K) which means it may take up more (K) than is needed for plant growth if excess is available. (P & K) may be applied in either the fall or spring in one application but is probably best split into two applications during the growing season. Split applications of (K) applied with nitrogen (N) fertilization throughout the growing season will likely improve nutrient efficiency of both (K & N).

(N) stimulates forage growth (yield) and increases crude protein. The amount of (N) used should be dependant on the amount of forage desired. Additionally, (N) rates should take into consideration any yield limitations such as soil type, moisture availability and temperatures. Hybrid Bermudagrass is capable of producing between 5 and 8 tons of hay per acre annually in Tennessee. That does not mean that all soil types are capable of producing even the 5-ton per acre yield. It is important to adjust (N) rates based of the production potential of a given soil and the available moisture prior to the (N) application. Many university studies have shown linear yield increases in response to increased (N) rates. The University of Tennessee recommends no more than 400 lb/ac (N) annually for hybrid bermudagrass hay production and no more than 300 lb/ac (N) for common bermudagrass hay production. If the higher rates of (N) are used, then also apply the higher rates of (P & K). A soil test will show if a soil is testing in the low, medium, high or very high category for (P & K). 400 lb/ac (N) rate applied annually would require 120, 80 and 40 lb/ac (P) respectively for low-, medium- and high-testing soils. The same (N) rate would require 240, 160 and 80 lb/ac (K) respectively for low, medium and high testing soils. Conversely, if the low rate of 120 lb/ac (N) were applied annually it would require 60, 40 and 20 lb/ac (P) respectively for low, medium and high testing soils. Additionally, if the same (N) rate were applied it would require 120, 80 and 40 lb/ac (K) respectively for the low, medium and high testing soils. Using the high rate of (N) may not always be advisable. Using high rates of nitrogen can create concerns with toxic nitrate levels during periods of drought for both pasture and hay production. Under drought conditions bermudagrass can take up excess nitrate nitrogen that has not been converted into protein. Ruminants die of asphyxiation resulting from accumulation of nitrite, which interferes with oxygen transport in the blood stream. Additionally, (N) applications should not extend beyond mid-September to avoid delays in hardening of bermudagrass, which would increase the risk of winter injury.

Secondary elements such as calcium (Ca), magnesium (Mg) and sulfur (S) should not be a problem in Tennessee if liming with dolomitic limestone. The dolomitic limestone should take care of the calcium and magnesium requirements. Sulfur is not recommended unless on extremely sandy soils or when tissue tests indicate sulfur deficiency. Sulfur levels in Tennessee have been shown to be at high enough levels to be antagonistic with copper availability in forages.

Annual soil testing is an essential tool in monitoring pH and soil fertility. Bermudagrass is a heavy user of nutrients, which must be replaced to maintain soil fertility. A 6-ton hay yield will remove 300 lb/ac (N), 84 lb/ac (P), 252 lb/ac (K), 36 lb/ac (Ca), 27 lb/ac (Mg), and 27 lb/ac (S).

Fertilization recommendations

Establishment: Incorporate 30lb/ac (N) plus all recommended P, K and lime as indicated by soil test as part of seedbed preparation at planting or sprigging. Apply an additional 30lb/ac N one month later. Splitting the nitrogen will result in better nutrient utilization and will help limit weed growth (competition). Establishment recommendations are the same for common and hybrid.

Common & Hybrid Pasture Maintenance: 60-180 lb/ac (N) is recommended annually for common bermudagrass pastures and 120-180 lb/ac (N) annually for hybrid/improved bermudagrass pastures. Apply half the N on May 1 and the other half July 1. If the higher rates of N are used, then use the higher recommended rates of (P & K).

Common Bermudagrass Hay Maintenance: 120-300 lb/ac (N) is recommended annually. Top dress 60 to 75 lb/ac (N) beginning May 1 and again after each cutting when conditions favor regrowth. If moisture conditions are

favorable, bermudagrass hay should be cut every 28 to 30 days. Four cuttings are often possible. If the higher rates of (N) are used then also apply the higher rates of (P & K).

Hybrid/Improved Bermudagrass Hay Maintenance; 120-400 lb/ac (N) is recommended annually. Apply 60 to 100 lb/ac (N) beginning May 1 and again after each cutting when conditions favor regrowth. If moisture conditions are favorable, bermudagrass hay should be cut every 28 to 30 days. Four cuttings are often possible. If the higher rates of (N) are used, then also apply the higher rates of (P & K).

The How and Why of Quality Bermudagrass Hay

Richard Joost

Cattlemen and hay growers alike desire to produce the largest amount of high quality hay possible during the growing season in order to meet animal needs during periods of low pasture availability. The production of high quality hay is a balancing act for the producer. The desire to harvest the most hay possible leads to decisions to fertilize heavily and wait for a large accumulation of growth before harvest. Forage quality relates mainly to the degree of digestibility of the fiber contained in the plant material. As bermudagrass matures, the cell walls develop secondary thickening consisting largely of lignin. Lignin is essentially the material that makes up wood and is not very readily broken down by the microbes in the rumen.

Various fiber analyses have been developed to explain changes in forage quality. The detergent fiber system uses varying strengths of reagents to correlate fiber content with predicted animal performance. Over time these values have been proven very accurate. The neutral detergent fiber (NDF) analysis removes all the soluble cell components leaving the cell constituents lignin, cellulose and hemicellulose as a residue. This NDF residue is well correlated to intake, because it is a good measure of the "fill" capacity of the forage. Treatment with the acid detergent fiber (ADF) reagent removes the more soluble hemicellulose leaving a residue of lignin and cellulose. This ADF residue is well correlated with digestibility. Crude protein is a measure of the nitrogen content of the forage. High protein bermudagrass provides more useable nutrients to livestock. Young leafy forage is always higher in nitrogen content and thus protein since most of the protein is contained in the leaves.

Nitrogen fertilization stimulates vegetative growth and has the tendency of producing higher yields of leafier, less fibrous bermudagrass forage. Bermudagrass utilizes approximately 45 lb N/ton of forage produced. To produce the highest yield of the best quality forage, we recommend cutting the first harvest when the crop reaches a height of 15 - 18 inches. Additional cuttings should be made every four weeks after the first harvest until late September. An N application of 60-70 lb/a following each harvest except the last will help stimulate vegetative regrowth and optimize forage quality.

TOUR H
NO-TILL EQUIPMENT AND CROP VARIETY DEMONSTRATIONS

William Hart and Joe Sarten

Equipment Demos

Strip-Till Dream Machine
Sunflower - White
9412 Drill
Tri County Equipment
8 row 30" Kinze planter
3500 with interplant

Crop Variety Demos

Delta & Pine Land Co
Dow AgroSciences
Dyna Gro Seed
FFR
Monsanto
Pioneer Hi-Bred International Inc.
Stoneville Seed
USG
Vigoro Seeds/Royster-Clark, Inc.

TOUR I
MANAGING IRRIGATION FOR MAXIMUM CROP PRODUCTIVITY

Irrigation Scheduling and Soil Moisture Sensors

Brian Leib and John Buchanan

The first version of **MOIST** (**M**anagement of **I**rrigation **S**ystems in **T**ennessee) for center pivot irrigated row crops is now available for download from the Internet as an Excel spreadsheet (http://bioengr.ag.utk.edu/weather/). MOIST is designed to help you decide when to irrigate and how much water to apply in order to obtain maximum yield without wasting water. Initially, you will have to enter your soil water holding capacity, soil depth, crop type, planting date, expected harvest date, and irrigation system application rate for MOIST to start a water balance and estimate your crop water use rate on a weekly basis. MOIST calculates crop water use from historic weather data at different locations in Tennessee and adjusts these estimates by your crop's stage of growth. Also, an automated weather station located in Haywood County has been linked to the Internet so you can obtain real-time weather and crop water-use information (http: //bioengr.ag.utk.edu/weather/). As the growing season progresses, you will need to enter the amount of rainfall received and the amount of irrigation applied in order for MOIST to estimate the present soil moisture status of your crop based on a balance between water leaving and water entering the soil profile. MOIST allows you to implement your own soil moisture management goals that will keep you from stressing your crop while maintaining enough storage space to capture and utilize rainfall.

MOIST represents a water-balance method of estimating soil water content. Another method is to directly measure soil moisture with sensors. The neutron probe, tensiometers and resistance sensors (watermarks) are fairly common to irrigation scheduling. However, there are many new instruments coming to the market that measure the capacitance/dielectric constant of the soil. These include EnviroScan, AquaTel, AquaFlex, Moisture Point, and others. Much of our research has shown that these sensors can be effectively used in irrigation scheduling, even if the sensors do not produce the exact same measurements. One goal of this session is to inform you of the different sensor characteristics and costs so you can make an informed decision when purchasing this type of irrigation scheduling tool. Placement of sensors, interpretation of the readings and actual readings from a nearby plot will also be discussed.

Economics of Irrigation

Chuck Danehower and Tim Campbell

Producers in Tennessee in an effort to increase their farm profitability are exploring the feasibility of irrigation on their farms. Irrigation is a management tool that can help reduce risk, and enhance yields. In Tennessee, approximately 3 percent of the cotton acres were irrigated in 2003 (Boll Weevil Eradication Program information). A lesser acreage of corn and soybeans were also irrigated.

Irrigation is useful as a tool to enhance yields. In the surrounding states of Arkansas and Missouri, irrigated crops have had increased yields over non-irrigated crops the last five years as follows: Cotton - 229 lb with a minimum of 138 lb and a maximum of 365 lb; Corn - 52 bu with a minimum of 42 bu and a maximum of 64 bu; Soybeans - 17 bu with a minimum of 10 bu and a maximum of 28 bu. These numbers are based on averages with some producers not experiencing these increases and other producers having a greater yield increase. On the average, these yield increases can be useful in determining the feasibility of irrigation.

One of the first steps in determining the feasibility of an irrigation system is to obtain a cost estimate for the system and water source as well as acres irrigated. Most irrigation systems have a useful life of over fifteen years; however, they generally have to be paid back over five to ten years with seven years being the most common. Although in the long run an irrigation system may be profitable, it is important to examine the short-run cash flow implications. If the system cannot generate enough additional revenue to cover the annual loan or lease payments, the producer must be able to cover the difference until the system is paid off. Use realistic prices along with the estimated yield increase when determining feasibility.

It is unlikely that the prices for 2003 and 2004 will remain for the life of that system.

Other considerations include increased costs of production from seed, fertilizer, chemicals, fuel, and labor. These increased costs as well as the costs to run the system need to be included when examining the payback of a system. The after-tax benefits of purchasing or leasing an irrigation system should also be considered. Producers purchasing an irrigation system would generate tax benefits in the way of depreciation and/or a Section 179 Deduction (increased to $100,000 for 2003, 2004, 2005) and an interest write off. If leased, the lease payment would be a tax-deductible expense.

Landowners and the producers renting the farmland are increasingly examining ways to irrigate it. The most common method has been to split the irrigation payment in the same proportion as the crop is shared, although other equitable splits also exist and are occurring. When both parties increase their net income, it is a win-win situation. It is important to structure your written lease detailing how this arrangement will work and what will happen if the lease is terminated.

Irrigation can be a profitable investment for producers and landowners, but it is one that needs to be evaluated on a farm-by-farm basis. For assistance in evaluating irrigation on your farm, contact your local UT Extension office.

Corn and Soybean Variety Response to Irrigation

Fred Allen and Richard Johnson

The University of Tennessee state variety tests for corn and soybeans have been conducted concurrently with and without irrigation at the Milan and Middle Tennessee Experiment Stations since 2002. The plot size is two rows, 30 ft. in length, replicated three times in a randomized complete block design. The row spacing in the corn tests during 2002 and 2003 was 30 inches at both locations. Also the row spacing was 30 inches for the soybean tests at the Middle Tennessee location for both years and the Milan irrigated test in 2003. The irrigated and non-irrigated soybean tests in 2002 and the non-irrigated soybean tests in 2003 at Milan were drilled in 7.5-inch rows. The irrigation units at the Middle Tennessee station are center-pivot systems, and the unit at the Milan station is a lateral traveling system. At both stations irrigation was initiated when the corn reached approximately the three-leaf stage and when the soybeans were near the V3 stage of development. Irrigation continued until the corn had reached the soft dough stage and the soybeans had reached pod fill. Irrigation was used to supplement the natural rainfall such that the experiments received about 1.5 inches of water per week.

The data presented in the table below are from the 2002 and 2003 growing seasons. Raccoons destroyed the non-irrigated corn plots at the Middle Tennessee location in 2002, thus we do not have comparisons for that location on corn in 2002. The 2002 growing season was typified by being hot and dry for most of May through July with some rains occurring in August and September. The 2003 season was unique in that rainfall occurred throughout the growing season in very favorable amounts and with favorable timing. In 2002 and 2003 there were 95 corn hybrids combined representing early, medium, and full season maturities. For soybeans there were 176 varieties in 2002 and 187 in 2003 that represented Roundup Ready (RR) maturity groups (MG) 3, 4, and 5 as well as non-RR conventional MG 5 varieties.

Irrigation resulted in large differences in yield for both corn and soybeans in 2002 at both locations. The average difference in yields of the 95 corn hybrids at the Milan station was 76 bu/ac, and the average difference in yields of the 176 soybean varieties was 15 bu/ac. Similarly the average difference in the yields of the 161 soybean varieties at the Middle Tennessee location was 17 bu/ac. With a price scenario of corn selling for $2.75 per bushel and soybeans at $6.50 per bushel, the difference in income with irrigation would have been about $210 per acre for corn and $105 for soybeans during the dry year. Even during the very favorable moisture year of 2003, irrigation resulted in 10 and 40 bu/ac average increases in corn yields across 95 hybrids at the Middle Tennessee and Milan locations, respectively. With the same price scenario given above for corn, the difference in income per acre for irrigation would have been $27.50 and $110, respectively. On the other hand, the irrigation did not result in significant differences in soybean yields at either location in 2003. In fact, numerically the average yield of the 187 soybean varieties at Middle Tennessee was 1 bu/ac less in the irrigated test. There were no consistent differences among the different maturity groups of soybeans in how they responded to irrigation, nor were there consistent differences among the early, medium or full season corn hybrids across the two years. Responses were more dependent on the amount and timing of rainfall events during the different seasons. The economics of the different irrigation systems will be discussed in another presentation.

See Table 1 on the following page.

Table 1
Average Yields (bu/a) of (n) Corn Hybrids and Soybean Varieties from Irrigated (Irr.) vs Non-Irrigated (Non-Irr.) Tests at Middle TN and Milan Experiment Stations in 2002 and 2003.

	Middle TN						Milan					
	2002			2003			2002			2003		
Crop	Irr.	Non-Irr.	Diff.	Irr.	Non-Irr.	Diff.	Irr.	Non-Irr.	Diff.	Irr.	Non-Irr.	Diff.
Corn	--	--	--	178 (95)	168	10	175 (95)	99	76	218 (95)	178	40
Soybeans	43 (161)	26	17	58 (187)	59	-1	63 (176)	48	15	61 (187)	59	2

TOUR J
MANAGING AGRICULTURAL LAND FOR WATERFOWL

Tennessee Partners Project

Tim Willis

The Tennessee Partners Project (TPP) is a cooperative effort between private landowners, Tennessee Wildlife Resources Agency (TWRA), USDA Natural Resources Conservation Service (NRCS), Ducks Unlimited (DU), USDI U.S. Fish and Wildlife Service (FWS), Tennessee Department of Agriculture (TDA), and the University of Tennessee Agricultural Extension Service (UTAES). The purpose of the TPP is to assist with enhancement, restoration and management of wetland habitat for waterfowl and other wildlife on private lands.

Since more than 70 percent of North America's remaining wetlands exist on private lands, efforts like the TPP provide an effective and cost-efficient means of providing habitat for migrating and wintering waterfowl, shorebirds and other wildlife.

Participating landowners agree to manage the project consistent with a 10-year "Wetland Habitat Development Agreement," which the landowner signs with DU. The landowner agrees to impound shallow water on his/her property immediately following harvest of crops until March 1, annually. In return, landowners receive technical assistance (i.e., survey and design, management recommendations) and water control structures (WCS) at no cost.

TPP partners developed additional cost-share assistance for new dike construction activities. Landowners can receive 75 percent cost-share (maximum of $2,000) assistance for new dike construction projects completed after January 1, 2003. Since 1993, approximately 10,000 acres have been developed through the TPP and over 31,000 acres have received technical assistance.

Woods and Water: A Good Combination for Waterfowl

Sam Jackson

The proper management of bottomland hardwood stands can significantly enhance the variety and numbers of wildlife on your property. This presentation will focus on one aspect of bottomland hardwood management, specifically Green Tree Reservoir (GTR) management for waterfowl. A GTR is a bottomland hardwood forest that is temporarily flooded during the winter months to provide food-rich habitat and secure nesting areas to waterfowl. Wood ducks and mallards are two species particularly attracted to this type of habitat. Flooding these forested areas provides hard mast and insects to ducks at a time of year when food supply is critical.

Areas typically managed for GTRs are bordered by levees on all sides with some type of water control structure used to control water levels during flooding. A permit is usually required before constructing a water impoundment like this. You should contact your local Natural Resources Conservation Service office or the Tennessee Valley Authority to determine what permits are needed in your area. After your levee system has been constructed, you can make plans to begin flooding your bottomland areas. In late October or early November, water is diverted or pumped into the levee and gradually raised to a depth not exceeding 18 inches where it is held until late February before being slowly drained off the site. The area being flooded should contain a high proportion of mast-producing tree species such as cherrybark and other water-adapted oaks. Other species, such as ash, blackgum, sweetgum, maple, and elm will also produce seeds and fruits used by waterfowl, particularly later in the winter. The water does not cause significant problems for trees because they are dormant during the flooding period. However, it is very important to drain the water before trees begin to develop swollen buds in the spring. If water is held too late, it can damage or kill trees as they come out of dormancy.

A concern of GTR management is the long-term effect flooding can have on the standing timber. Studies have shown that flooding occurring during the same time period each year over 20 or more consecutive years will alter the species composition of the site. A stand will begin to shift to more water-adapted species such

as cypress, and contain less of the more economically valuable and more beneficial mast producing trees, such as oaks. One way to remedy this problem is to alter the flooding regime so that an area is only flooded every other year or two out of three years. These types of regimes give sites a break from flooding and help maintain their normal species composition.

Management during the time of year when these bottomland stands are not flooded is also very important. Harvesting, planting or improvement of the forest can promote the growth or establishment of desired species and can remove undesirable species. Small openings in the forest can be created to allow for open water areas when the site is flooded. These areas can be left alone or be planted with a variety of grain species. No matter what dry-season management is employed, it is important to leave a variety of mast producing species on the site to ensure good mast production each year. Some species are highly variable in mast production, so a broad range of species will help make some type of mast available each year. Nesting sites are also important, whether they are natural cavities in trees or wood duck nesting boxes that are built for the site, and are needed to attract large numbers of waterfowl.

Green Tree Reservoirs are a great way to attract waterfowl to your property. When properly conducted and managed, GTRs are a valuable asset to wildlife management.

Winter Flooding Crop Fields for Waterfowl Management

Billy Minser

Flooding crop fields in winter to attract waterfowl and other wildlife is a management tool that has been used for several years. Ducks and geese are attracted to waste grain and weed seeds, while shorebirds, wading birds and mammals visit flooded fields in search of fish and/or vertebrates. Landowners are interested in this management practice because flooding fields in winter provides a place to hunt (or lease). In addition, there is evidence that flooding crop fields is actually cost-effective for the producer by providing increased weed control and decreased sedimentation rates. While wildlife benefits from flooding crop fields are obvious, the effects of winter flooding on agricultural interest need to be evaluated. Several questions were addressed by the following study including the impact of winter crop flooding on crop production, pest weeds, soil fertility and erosion.

In 1994 - 1999 the University of Tennessee's Department of Forestry, Wildlife and Fisheries implemented a study designed to answer these questions. The study was conducted at the West Tennessee Experiment Station's wetland study units in Jackson, Tennessee. At the wetland study units, low-level terraces and water-control structures allow crop fields to be flooded and drained. A low-level terrace was built around each of nine four-acre soybean fields, and a water-control structure was installed at the low end of each field so water could be held or drained from the field. Results of the study are as follows:

1. Winter flooding did not affect crop production in the seasons following flooding. Crop yields did not differ among flooded and non-flooded fields.
2. Fields where water was held until April 1 (just before planting season) had significantly fewer spring weeds than fields drained February 1 and fields that were not experimentally flooded.
3. Winter flooding had no effect on soil fertility. No differences were found in flooded or non-flooded fields before, during or after the study.
4. There were no short-term differences in sedimentation or soil loss rates between flooded or non-flooded fields. It is reasonable to assume, however, that over several years, soil would be retained, or even added, in fields surrounded with terraces on the down-slope side.
5. Even though fields were not managed specifically to attract wetland birds, 57 bird species were observed using the study fields during winter. Bird use of the 36-acre wetland complex increased by 332 percent during the length of the study. Bird groups observed included waterfowl (ducks and geese), wading birds and shorebirds, gulls and terns, and various upland birds (e.g. songbirds, blackbirds and doves). More than 15,460 birds were counted using the complex while the six fields were flooded during the winters of 1996 - 1999.

This study supports the conclusion that flooding harvested crop fields in winter is a suitable technique to provide habitat for waterfowl and other water birds. In addition, winter flooding of harvested fields at the Jackson Experiment Station had no effects on soil fertility or crop yield.

Recommendations. A low level terrace can be built around a relatively flat crop field with a water-control structure placed at the lowest end of the field. The terrace should be capable of holding 2 - 18 inches of water over most of the field. The terrace can be designed so that row

cropping can be conducted directly on the terrace. Design of the terrace and size of the water-control structure should be determined with help of the Tennessee Partner Project biologist. Water for flooding may be rainwater runoff draining naturally through the field or it may be pumped from a nearby creek or well. Flooding should be initiated when ducks begin migrating through – between mid-November and early December.

Field crops offering the most energy for waterfowl include corn, milo and soybeans. However, some grains deteriorate faster than others when flooded. After 90 days of flooding, 86 percent of soybeans, 50 percent of corn and 42 percent of milo is deteriorated (Waterfowl Management Handbook, USFWS). Because milo and corn last longer and produce high energy, they are recommended over soybeans. To prevent excessive seed deterioration, fields should not be flooded well in advance of waterfowl arriving. In addition, fields should be flooded gradually (over a period of 2-3 weeks), not all at once. Gradual flooding provides food over a longer period and helps ensure the food supply does not deteriorate before the season is over. Preferably, more than one field should be flooded to provide a different crop or to make food available over a longer period. Flooding large acreages (or more fields) will attract more waterfowl and other wetland-associated birds. Leaving some of the crop unharvested will provide more food and also attract additional waterfowl.

Manipulating and flooding wetland weed fields, called moist-soil management, complements flooding crop fields for waterfowl. Many weeds stimulated in moist-soil management regimes (e.g., smart-weeds, fall panicum, barnyardgrass, various sedges, pigweed and duck potato) are excellent waterfowl foods and are cheaper to produce than special plantings for waterfowl. In fact, some weed seeds are higher in energy and/or protein and more nutritionally complete than grain crops. Because of the wide diversity of weeds and associated invertebrates, moist soil management can produce more pounds of food per acre than harvested crop fields. Invertebrates are needed by ducks for reproductive conditioning and are more abundant in moist-soil fields than harvested crop fields.

Managing fields normally too wet for row cropping as moist-soil weed fields, in combination with adjacent flooded crop fields, provides quality habitat for migrating and wintering waterfowl and should attract a wider array and number of wet-land associated birds than flooded crop fields alone. Managing moist soil fields is accomplished through various flooding and draining schedules, along with discing, prescribed fire and/or herbicides to produce the desired combination of weeds. For technical assistance and cost-share opportunities, contact the Tennessee Partners Project Biologist, Natural Resources Conservation Service Project, 235 Oil Well Road, Jackson, TN 38305, (731) 668-0700, ext 107.

Native Warm-Season Grasses as Vegetative Buffer Strips for Water Quality and Wildlife Protection

Forbes Walker and Neal Eash

In early 2001, a number of native warm-season grass strips were established around many of the fields and experimental plots at the Milan No-Till Experiment Station. The two main purposes of these strips are to act as **vegetative buffers** to protect environmentally sensitive features such as rivers and streams and to provide **habitat** for wildlife. The warm-season grass and sedge species used in these strips included Switchgrass (*Panicum virgatum*), Broom sedge (*Carex scoparia*), Big Bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), and Eastern Gamagrass (*Tripsacum dactyloides*).

Management is important for native-warm season grass to function well as vegetative buffers and provide habitat for wildlife. Soil testing and occasional fertilization may be necessary at establishment. Undesirable weeds, including cool-season grasses such as tall fescue (*Festuca arundinacia*) should be controlled. Once the vegetative buffer has established occasional mowing or harvesting for hay will encourage growth. Attention should be paid to the nesting and breeding habits of the bird and animal species prior to mowing or harvesting. Trees should be harvested when they reach maturity. After major storm events, the strips should be inspected and**,** if necessary**,** repaired to prevent concentrated flow within the filter strip. Gullies should be filled in and sediment buildup that might disrupt flow should be removed.

As with other conservation measures, vegetative buffer strips are not stand-alone practices but part of a whole farm conservation system. By creating a **physical barrier** between agricultural fields and nearby surface water, well-managed buffers will protect and improve water quality. The rate and amount of water movement from agricultural fields will be slowed and reduced. Sediments, some nutrients, pesticides and microorganisms will be trapped in the buffer reducing the amount of runoff reaching surface waters. Buffer strips established on stream or riverbanks will improve bank stabilization.

The effectiveness of vegetative buffers will depend on slope angle and length, soil erodibility, and the nutrients, pesticides and other potential pollutants in the runoff from the area upslope of the buffer. In general, buffer strips are most suitable on fields with 4 percent to 8 percent slopes. They are much less effective on slopes greater than 10 percent. Ideally the watershed area being filtered should not be more than 50 times the filter strip area. Strips at least 35 feet wide have been shown to reduce phosphorus loading from 50 percent to 90 percent under research conditions. Buffer strips wider than 35 feet will reduce runoff even more but can be impractical in small fields. In fields where buffer strips more than 35 feet wide are impractical, buffer strips narrower than 35 feet are better than no strips.

A major potential cost of buffers is the removal of land from agricultural production. But, loss of land may not be costly since many field edges are low yielding because of shade, compaction or wildlife damage. Some establishment costs (seed, fencing) can be recovered through USDA programs such as the Conservation Reserve Program (CRP), the Environmental Quality Incentives Program (EQIP), Wildlife Habitat Incentives Program (WHIP), Wetlands Reserve Program (WRP), Stewardship Incentives Program (SIP), and Emergency Watershed Protection Program (EWP). The Farm Security and Rural Investment Act of 2002 (Farm Bill) significantly increased funding for many of these programs.

Native Warm-Season Grasses Benefit Wildlife

Craig Harper and Ed Harsson

Native warm-season grasses (nwsg) and associated forbs offer suitable habitat for a variety of farm wildlife species. Wildlife use nwsg for nesting, brood rearing, foraging, loafing, escape and thermal cover, depending on how the stand is managed. Sparse stands (1 to 5 grass bunches per m5) growing in association with wildlife-friendly forbs (e.g., partridge pea, ragweed, beggar's-lice, and blackberry) provide excellent habitat for nesting and brood-rearing birds. An open structure at ground level allows young quail and wild turkeys to travel through the field while the forbs provide cover similar to an umbrella canopy. Deer and rabbits forage on the forbs and birds glean seed from the "weeds" in fall and winter. Nwsg fields may resemble over-grown fallow fields, but are very productive for wildlife. Dense nwsg stands (>10 grass bunches per m5) are important sources of escape and thermal cover for both birds and mammals. Deer commonly use these fields for hiding fawns and for bedding and loafing in the middle of the day. Nwsg are best managed with prescribed fire. Burning in late winter stimulates new plant growth and consumes leaf litter and other debris. This facilitates travel by young wildlife later in the growing season and allows seed in the seedbank to germinate. Burning sections on a 2- or 3-year rotation is recommended because ground-nesting birds use the dead grass material for building nests. Firebreaks are used to delineate sections within a field and control which area(s) is burned. Thus, habitat for nesting and brood rearing can be provided in the same area. Firebreaks should be planted to wildlife friendly mixtures for an additional food source.

In Tennessee, changing land-use practices have had a detrimental effect on several wildlife species dependent upon early successional habitats. As escalating costs and reduced profit margins have forced producers to adopt "clean" farming practices, available wildlife habitat for these species has diminished. Small family farms of yesteryear that once supported row crops have converted fields to tall fescue, drastically reducing food and cover available for wildlife. Although other factors have contributed, loss of native grassland and other scrub/shrub habitats has precipitated a 70 percent decline in bobwhite quail populations in the last 30 years. Several other wildlife species associated with early successional habitats have suffered significant population declines as well. Henslow's sparrow and grasshopper sparrow populations have declined over 65 percent. Many other species, including field sparrows, prairie warblers, rabbits, and woodcock are also experiencing long-term declines. Establishing field borders, buffers, and terraces with nwsg and converting fields of tall fescue to nwsg will improve habitat quality considerably and may help reverse some rather severe population declines of wildlife associated with loss of early successional habitats.

Native Grass Management

Mark Gudlin and David Howell

Native warm-season grasses, particularly when an adequate component of legumes and native forbs is maintained, provide superior nesting and/or brood-rearing habitat for a multitude of wildlife species such as bobwhite quail, cottontail rabbits, and grass and shrubland songbirds. However, periodic management is required to keep native grass stands in optimum condition for wildlife. Practices such as strip-discing, strip-herbiciding, prescribed burning and legume interseeding are particularly effective when implemented on approximately one-third of your native grass stand each year.

These management practices are now required on Conservation Reserve Program (CRP) grasslands enrolled in 2003 or after and are cost-shared by USDA. They are also optional on CRP lands enrolled prior to 2003. An additional incentive payment through Quail Unlimited (along with free seed for legume interseedings) is now available in selected West Tennessee counties to further defray the cost of implementation and increase the wildlife value of native grass stands enrolled prior to 2003. Quail Unlimited and TWRA seek to improve populations of bobwhite quail and other declining wildlife through the establishment and proper management of native grasses and forbs.

In addition to CRP, there are several other conservation programs that can help landowners establish and manage native grasses for wildlife and even other uses such as hay.

Native Grasses Complement a Forage System

Greg Brann and Jimmy May

Predominate forages in Tennessee are tall fescue and other cool-season grasses and legumes. Cool-season forages produce forage most of the year; however, there is a summer slump when livestock don't perform well or may even lose weight. Native warm-season grasses fill this void well. The native grasses discussed here are Eastern gamagrass, Switchgrass, Big bluestem, Indiangrass and Little bluestem. Attributes of native grasses are drought tolerance, time of hay harvest and high production relative to fertilizer inputs. Livestock gains are typically double those of tall fescue in the summer months. Another plus is cool-season forages are allowed to recover while grazing or cutting hay on native grass fields. The grazing season can be further extended by planting different species of native grasses. In order of maturity from earliest to latest, the species are Eastern gamagrass and Switchgrass, Big bluestem, Indiangrass and Little bluestem. Native grasses as part of a cool-season grazing system can add 70 pounds per head.

Grazing management is critical to maintaining a productive stand. Maintaining grasses between 6 and 18 inches in height results in the best production and forage quality. Allowing them to rest 30 to 45 days between cutting or grazing also improves production and longevity. Average forage quality is 8 percent to 15 percent crude protein and 45 percent to 55 percent TDN with the quality being highest during the first of the growing season. Typical yield is 3 to 6 tons per acre per year. Comparing native grasses to bermudagrass, natives are less expensive to fertilize, wildlife friendly, and more sensitive to grazing pressure.

In conclusion native grasses add diversity to the forage system. They can also spread out production, lower risk, increase pounds of gain 70 pounds per head, lower fertilizer requirements, improve drought tolerance, improve hay cutting time and provide tremendous wildlife cover.

USDA Buffer Opportunities

Mike Hansbrough and Mike Zeman

The USDA National Conservation Buffer Initiative, which has a national goal of two million miles, is an effort to encourage farmers, ranchers and other landowners to use conservation buffers more extensively for a variety of conservation purposes. This effort increases upland wildlife habitat and solves multiple resources concerns by helping landowners install buffer practices offered in one of the many federal farm bill programs. USDA's farm bill program, such as the Environmental Quality Incentives Program (EQIP), Wildlife Habitat Incentives Program (WHIP), Conservation Reserve Program (CRP) and other programs all have opportunities for landowners to enroll buffers in Tennessee.

Environmental Quality Incentives Program (EQIP)

Some buffer opportunities in providing upland wildlife habitat with other multiple resource benefits could be attained through USDA's EQIP program. This federal program for privately owned farmland is intended to maximize environmental benefits in a cost-effective manner. The purposes of the program are achieved through implementation of a farm conservation plan. Five to ten year contracts are made with producers, with most practices cost-shared at 50 percent to 75 percent. These farm plans may include structural, vegetative and land management practices like conservation buffers. Landowners can actively use buffers for other purposes like haying within this program. Wildlife benefits may be gained by landowners if beneficial grasses and grass/legume mixtures are used in a variety of practices, including field borders, riparian forest buffers, terraces, filter strips and cropland conversion to pasture. Currently, EQIP is providing over $9 million for conservation in Tennessee.

Wildlife Habitat Incentives Program (WHIP)

The Wildlife Habitat Incentives Program (WHIP) is a USDA conservation program initiated in 1998. This program provides technical assistance and cost-share (75 percent) to many (often non-traditional USDA customers) landowners specifically for improving wildlife habitat. Many states, like Tennessee in the Southeast, structured WHIP to benefit bobwhite quail. Tennessee landowners can apply to install a variety of buffer practices like filter strips, field borders and riparian forest buffers within this program to develop and improve fish and wildlife habitat on private land.

Conservation Reserve Program (CRP)

In recent years, CRP has been very successful in generating landowner interest and participation in buffer practices by offering a continuous signup with financial incentives on some buffer practices. The CRP continu-

ous signup program makes it easy to establish buffers by allowing landowners to enroll eligible land into CRP buffers at any time without having to submit a competitive offer. Filter Strips and Riparian Forest Buffers are some of the most common CRP buffers used by Tennessee landowners and offer excellent wildlife benefits. Other buffers like Contour Grass Strips are also available. Efforts to educate Tennessee landowners on the benefits of wildlife friendly cover types have been successful as acres planted in wildlife friendly buffers has increased significantly over the last several years. Native grass buffer habitat increased from zero in 1999 to over 361 miles of buffers in the last three years. Since 2002, native grasses have also been the most common cover type selected for CRP filter strips and the general signup in the western Tennessee area. Landowner selection of wildlife friendly cover types like native grasses on land enrolled in USDA programs will be key to restoration of local and regional wildlife populations like the bobwhite quail.

Sorting Out the Differences in Bt Technologies

Gary Lentz and Ed Burns

Transgenic crops have become very important across the United States in the management of both insect and weed pests. These transgenic crops contain either insect resistance or herbicide tolerance or contain both. Crops containing insect resistance derive their resistance from the incorporation of genetic material from the soil bacterium, *Bacillus thuringiensis* (referred to as Bt), which was found over one hundred years ago to be toxic to selected caterpillar species. Genetic material from Bt is incorporated in the genome of crop plants through genetic engineering, and the crops are frequently referred to as genetically modified crops or organisms, thus the abbreviation GMO.

Through gene splicing or genetic engineering, the Bt gene has been incorporated into cotton, corn, soybean, potato and tomato crops making these crops resistant to selected insect species. Originally, the genes were active only against caterpillar species, but now include activity against some of the beetle species. The activity of the Bt gene is related to three factors, the *Cry protein*, the *event* and the *promoter.*

So far, about 60 different *Cry-proteins* have been identified to provide insecticidal properties toward a number of beetles, caterpillars and mosquitoes. In corn hybrids, the following Cry proteins have been incorporated to provide resistance to insects: Cry 3 Bb1, Cry 1 Ab, Cry 1F and Cry 34/35 Ab1. When eaten by the target insect, the Bt protein is broken down by the digestive enzymes in the larva's alkaline intestine generating a shorter protein, a delta endotoxin that binds to the wall of the intestine. This causes paralysis of the insect gut and leads to death by starvation.

The insertion or physical act of placing the Bt gene into a plant's genetic material is called an *event*. Each event is unique in where and how much delta endotoxin is expressed in the plant tissue. Successful registered events include MON 810, MON 863 and Bt-11 and each of these give the Bt hybrid its own unique insect control properties. The *promoter*, a genetic switch, tells the Bt gene when, where and how much delta endotoxin to produce. The combination of these factors gives each corn hybrid its own genetic profile.

Bt corn hybrids have been evaluated over the last several years at the Milan Experiment Station, the West Tennessee Experiment Station, the Ames Plantation and the Highland Rim Experiment Station for efficacy against target species, primarily the European corn borer and the southwestern corn borer, and for yield potential. Results of these studies and the current status of the Bt corn hybrid research and development will be discussed at this tour stop.

Late Season Insect Control and Comparing Seed Insecticide Treatments for '05

David Qualls, Dean Northcutt and Angela Thompson

Field corn, particularly late May and June planted non-Bt corn, may come under attack late in the season from insects like southwestern and European corn borer, corn earworm and stink bug. Insect pressure may be greater in late-planted corn as moths and adult bugs are attracted to these greener fields instead of maturing corn. A well-timed application of insecticide in a field with above threshold insect populations may reduce damage to ears from earworm, stalk injury from borers and possibly improve yields. Moth-trap catches from over-wintering southwestern corn borers have been higher than in previous years, and a heavy second generation is possible in Tennessee. Management practices for minimizing damage due to southwestern corn borer will be discussed as well as results from late season insecticide work conducted in 2003.

Farmers are utilizing more seed insecticide treatments for insect control in corn. Seed treatments like Poncho® and Cruiser® protect the seed from pests like wireworm and seed corn maggot and protect the seedling plant from flea beetle, chinch bug and southern corn leaf beetle. Results from previous work indicate the effect on yield varies with conditions in the field. Seed treatments do not always yield a greater return when soil pests are low. Seed treatment results from 2003 and 2004 will be discussed and information provided on where to include seed insecticide treatments in production programs.

Bt Refuge Management Strategies

Rob Ihrig and Mike Hughes

Corn with a Bt gene for corn borer protection is a product of biotechnology that helps corn growers protect their crops from corn borers and other insect pests. This allows corn growers to produce higher yields and better quality grain in an environmentally friendly way.

As a condition of growing Bt corn, growers of borer-resistant corn must implement an Insect Resistant Management (IRM) program to preserve the many benefits of this technology.

Environmental Protection Agency (EPA) regulations require growers to plant a refuge. A refuge is a field, block or strip of corn that does not contain a Bt trait for controlling corn borers. Refuges are designed to produce corn borers that are susceptible to Bt corn borer resistant hybrids. When susceptible corn borer moths emerging from the refuge mate with any potentially resistant moths from the Bt corn, the resulting offspring will be susceptible to the corn containing the Bt corn borer resistant trait.

Growers planting Bt corn borer-resistant hybrids must implement an IRM program on their own farms meeting specific requirements on refuge size, refuge distance and insecticide usage. Growers who do not follow IRM requirements risk losing access to Bt corn borer resistant hybrids for at least one year.

Grain Moisture and Harvest Efficiency

Jeff Lannom and Bob Shumake

Deciding when to begin corn harvest is often a trade-off for producers who may have several hundred acres to harvest before frost, limited equipment, and limited or no drying facilities to handle high moisture grain. Some growers start harvesting when corn moisture drops below 20 percent, particularly when drying equipment is accessible, in order to finish harvest before grain drops much below 15 percent. The trade-off is that grain handlers discount prices farmers receive for grain with a moisture content above 15 percent. Harvesting early ensures that corn is removed from the field before significant grain is lost due to lodging, but grain moisture is high. Waiting to harvest until grain is closer to 15 percent may mean substantial losses as stalks may break from weathering, disease or corn borer damage. Fieldwork was conducted to determine how much grain was lost as moisture decreased and whether harvesting at higher moisture was beneficial and cost effective.

Test strips were harvested in the fall of 2003 in grower's fields in Dyer and Weakley counties and at the Milan Experiment Station and the West Tennessee Agricultural Experiment Station. Using producer or experiment station

equipment, corn was harvested at >23 percent, 19 – 22 percent,15 – 17 percent and below 15 percent. Combines were adjusted as needed to minimize grain loss behind the machine. Ear loss was estimated before harvest (pre harvest loss) in an area equal to 1/100th of an acre. Post harvest loss was measured by counting kernels in an area one header width wide and one foot deep. Return per acre was calculated using an average price of $2.27/bu and standard discounts used by two river port elevators for high moisture grain.

Harvesting at grain moisture above 21 percent did not provide a financial benefit at any of the locations due to high moisture discounts. The Dyer and Weakley county fields had ideal harvest conditions, little insect pressure and corn stood well with little lodging at even the lowest moisture. Average returns were better for grain harvested closer to 15 percent because of the smaller discount. In contrast, corn lodging and yield losses increased as grain moisture decreased at both the Milan and West Tennessee Experiment stations. The Bt hybrid at Milan lodged after storms hit it hard and at the West Tennessee Experiment Station, early season corn borer injury probably weakened the stalks and more corn lodged over time. At both Milan and the West Tennessee Experiment Stations, the higher yields when corn was harvested at 16-19 percent moisture appeared to offset any discounts for higher moisture grain.

Variable Rate Lime

Don Tyler, Mike Essington and Hugh Savoy

Lime recommendations are based on a number of assumptions, but the application of lime must be viewed as a long-term (five to six years or longer) investment. Presently, many acres of land are rented or leased by producers who make assumptions about the economics of liming that differ from those made in the past. Specifically, producers would like to make management decisions that are based on the ability to place agrichemicals where they are needed. Variable-rate lime application is a commercially available management tool that allows producers a mechanism to more efficiently and effectively correct soil acidity problems. Variable rate applications are based on an intensive soil sampling program that allows for the identification of areas in a field that require the correction of soil acidity problems. The customary soil sampling protocol, which attempts to sample the smallest reasonable area and minimize sample analysis costs, leads to a field average rate. Usually, the field average rate will result in the under application of lime in very acid areas and the over application in less or non-acid areas (as the average includes areas of potentially higher and lower soil acidity). In other words, the true soil acidity (pH) variability across each sampling area is not known. Compared to field average management, variable rate lime applications have the potential to better correct soil acidity problems in the field because the applicator has increased knowledge of soil acidity variability as a function of location. A grid or stratified sampling for soil acidity in fields is a mechanism that allows producers to precisely determine the soil variability across smaller field areas and apply chemicals as needed. However, with the change in management practice from field average to variable rate, it became evident that a reevaluation of lime recommendations relative to application rate and sampling procedure was needed. We began a study of variable-rate liming on a 25-acre field of double-cropped wheat and soybeans in the spring of 2003. The field was initially sampled in 12.5-acre blocks and results showed no additional lime was needed in the field. When the field was sampled on a grid of 50 ft wide by 100 feet long, over half of the field was shown to need lime and over one-third needed two tons per acre or more. The recommended rates of lime across the field ranged from one to 4.5 tons per acre. Areas requiring each of the rates of lime were alternated with two treatments: no lime and the recommended rate for that individual area. The lime was spread using a commercial applicator supplied and programmed by a local lime distributor. Wheat and soybean yields are being yield monitored to compare crop response to lime application, rate and subsequent change in pH, exchangeable aluminum, and manganese. These data will assist in refining our lime recommendations to better reflect expected crop response to lime at different soil acidity levels and to better inform producers on the economics of lime application in different management scenarios.

Variable Rate Plant Population and Nitrogen

John Wilkerson and Henry Moody

It is well known that optimizing nitrogen application rate is important for maximizing yield and profitability in both cotton and corn. In cotton, yield reduction can result from under- or over-application, and profit reductions result in either case. Over-application of nitrogen can also lead to rank growth, which may necessitate extra mepiquat chloride applications. According to University of Tennessee estimates, a nitrogen cost of $26 per acre and a plant growth regulator cost of $13 per acre can be expected for cotton. In corn, under-application of nitrogen can reduce yield. Over-application is wasteful and can reduce profits. UT budgets predict for corn a nitrogen fertilizer cost of $43 per acre.

Seed prices have increased over the years and now account for a significant portion of the cost of production. In fact, according to University of Tennessee estimates seed costs can exceed $45 per acre for cotton and $30 per acre for corn.

Prior research has documented substantial variations in yield potential within typical West Tennessee fields. Site-specific, yield-potential-based management of nitrogen and seed may improve profitability through both yield increases and material savings. This research project will provide the information needed to develop and verify site-specific nitrogen application and seeding rate recommendations for corn and cotton.

This project is ongoing at the Milan Experiment Station. A 120-acre production field was divided into strips, and a corn/cotton rotation was established. The field was managed conventionally with no site-specific treatments during the first year. Subsequent crops have been seeded with planters equipped with commercially available variable rate control technology that allows automatic control of seeding rates. A controller for automatic application of various nitrogen rates was developed in-house and installed on a liquid nitrogen application rig. This equipment was used to establish 192 plots, 40 ft. x 90 ft. in size, with various nitrogen/seeding-rate combinations. The experiment was designed such that each nitrogen/seeding-rate combination occurs within the three general soil types present in the field (Routon, Grenada, and Lexington). Yield maps are generated during corn and cotton harvests each year and resulting data will allow determination of optimum seeding and nitrogen application rates for the soil types involved. After optimum rates have been determined, strip tests are planned to facilitate comparisons between site-specific and conventional nitrogen application and seeding management practices.

Will Precision Farming Be Profitable on Your Farm?

Jim Larson and Roland Roberts

Purchasing precision farming equipment such as a cotton yield monitor for your farm can be a risky decision. The risk stems from the uncertain benefits provided by the yield-monitoring system and the associated ownership costs. CYMIDA (Cotton Yield Monitor Investment Decision Aid) is an interactive, user-friendly computer program designed to help cotton producers evaluate the yield gain required to pay for a cotton yield monitoring system.

The program provides default values that can be changed to fit your farm situation. Your investment analysis can be customized by inputting information about how many acres of cotton and other crops you grow, harvester size, computer requirements, and so forth. Also included in CYMIDA are 11 variable-rate technology input decisions that can be evaluated. The software calculates the yield gain required to cover the cost of owning a cotton yield monitoring system. The required yield gain changes depending on how the yield monitoring information is used. For example, the information can be used with grid soil sampling information to develop maps for variable-rate application of lime and/or fertilizer.

The best way to show how CYMIDA works is to go through a hypothetical investment analysis. Suppose your farm has 1,300 cotton acres and that you own two 4-row harvesters. Now suppose you would like to evaluate the lint-yield gain associated with using the yield-monitoring information for variable-rate application of nitrogen, phosphorus, potassium, and lime, with application costs of $2.00, $1.90, $1.00, and $0.90/acre more than uniform rate application costs, respectively. Also, you expect to incur a 10 percent reduction in the application rate for each input on 100% of your cotton acreage by using variable rate technology (VRT).

The estimated annual ownership cost for two yield monitors, computer and mapping software is $6,171. Spreading this cost over the 1,300 cotton acres for this farm, yields an annual ownership cost of $4.75/acre. The yield gain required to pay for the information system when ownership costs are not allocated to a specific VRT decision is 8 lb/acre. For instance, you may find that differences in yields on a yield map were caused by a faulty fertilizer application by a custom applicator. If you decided to change custom applicators, the yield gain that you would need to pay for the system is 8 lb/acre. The increase in cost associated with owning the yield monitoring system and using the resulting information to variable-rate apply all the chosen inputs (N, P, K, and lime) is $9.37/acre. The yield gain required to cover the cost of the system is 15 lb/acre.

You can download a FREE copy of CYMIDA at http://economics.ag.utk.edu/cymida.html or http://www.cottoninc.com. Funding to develop CYMIDA was provided by Jeanne Reeves, Production Economist at Cotton Incorporated, and the Tennessee Agricultural Experiment Station. If you have questions about CYMIDA, please contact the University of Tennessee's Department of Agricultural Economics at (865) 974-3716 or e-mail Dr. James Larson at jlarson2@utk.edu or Dr. Roland Roberts at rrobert3@utk.edu.

Extension Programs in Precision Ag Technologies

Mike Buschermohle and Tim Prather

Agribusinesses and researchers have been able to develop precision agriculture equipment to measure yields, vary the application of fertilizers and pesticides, and measure plant and soil properties by taking advantage of recent technologies such as the global positioning system (GPS), plant health and soil sensing technologies, application control technologies, and geographical information systems (GIS) software. With these new precision agriculture technologies, producers now have the ability to manage specific variations within the field as management zones rather than treating entire fields as single units. Inputs such as seed, fertilizers and pesticides can be variably applied within a field to optimize production at each location within the field. Since over-application and under-application of agrochemicals are both minimized, precision agriculture has the potential for maximizing profitability and minimizing negative environmental impacts.

Precision agriculture distinguishes itself from traditional agriculture through its increased level of management. Its adoption requires a four-step process to develop the necessary management skills and pertinent information databases that are necessary to make informed decisions.

1. The initial step in this process is spatial measurement of those factors that limit or otherwise affect crop production. This can include soil fertility, soil type, soil depth, slope, cropping history and other factors.
2. These variability data can then be used to develop a management plan for the variable application of inputs such as seed, fertilizers and herbicides.
3. Based on this management plan, inputs are then applied in precision field operations. The management plans may be modified during the cropping season as new data becomes available or as conditions change.
4. Finally, the effectiveness of the precision agriculture system is evaluated with respect to economics and environmental impacts. This evaluation becomes a part of the data collection process for the next cropping season. Effective information management requires more than record-keeping analysis tools or a GIS. It requires an entrepreneurial attitude toward education and experimentation.

Ultimately, the success of precision agriculture depends largely on how well and how quickly the needed knowledge and new technologies can be developed and transferred to producers. History shows that most of the benefits of any new agricultural technology go to the early adopters. Those who lag have often been forced out of farming. Precision farming is expected to follow this same pattern. Producers who begin to accumulate data and experience today will be ready to use improved precision agriculture technology as it matures in the future.

Storing Wheat in Tennessee: Results of Insect Control and Storage Problems

Russ Patrick and Doug Johnson

Storing wheat in most areas is difficult due to the time of year the commodity is stored. Temperatures in Tennessee in July are quite high, preventing producers from reducing the grain mass temperatures during summer storage enough to control insects. However, proper aeration and the use of new grain protectants have proven that significant reduction in insect infestations in farm grain bins can be achieved. Results of an ongoing study using those methods provided better moisture control and reduction of insect pests in wheat. Although the insects were reduced significantly, it is impossible to control all of the insects during all of the storage period. These pests were reduced to the level that they were not detected in the bins used during the study.

Timber Marketing

Larry Tankersley

A first step in marketing is producing what the market demands. Plan for the future, and "Don't cut yourself out of business." Thoughtful silviculture is important!! **Quality sawlogs** are the most valuable. Those are the best species: red oak, white oak, yellow-poplar, with minimal defects. Defects are knots, and other wood qualities that reduce demand.

Quality sawlogs are produced from trees that grew/grow in dense stands, which encourages natural pruning. The density of these stands is managed to encourage pruning while maintaining space for the trees to grow. Forests will develop this way, if they are protected, for a long time — up to 80 years. With thoughtful tending this time can be reduced.

Maturity is defined by the product we are growing. A simple definition is when value is being added more slowly than a new stand would be adding value. Another answer is when the trees are big enough. A grade one log has a 13-inch diameter inside the bark at the top of the first log. That is 17 feet up. Smaller diameters also contain less "number 1" wood, commanding less money than if we waited a few more years.

Finding the right buyer is most important in good timber marketing. Local markets as we mentioned may be limited requiring us to consider a bigger pool. Timber buyers with the capacity to merchandise your wood are preferable to folks who can only sell one product or deliver to only one location. A lot of bad forestry is the result of picking over the woods as market opportunities fluctuate. If you only remove the white oak logs in a sale, all you have left may be the lower valued products which may never be marketable, and they will be taking up space where you might grow some more white oak. With a buyer who can use all of your trees, you can make more money. Those tops get used, there is less waste, and the forest is poised to grow a new crop of high-quality trees for the wood market of the future.

Knowing the volume of the timber for sale is important for ensuring that you get full value. A stand and stock table showing the species, number of trees by size, and volume is important information for you and the buyer. Marking the trees for sale ensures that only the ones you mean to sell are cut. Also marking allows you to measure and grade the trees so that you know what you are selling.

A sale contract or other bill of sale is required by Tennessee law. A contract is very helpful in conducting the sale. Everyone should be aware of what the contract says.

Important provisions:

Responsible parties, who are the buyer and seller.
Consideration, payment, 631(b), lump sum,
What is sold? Designated trees
Duration of the contract.
Written and signed, witnessed, notarized, recorded?

Special provisions: BMP compliance, performance bond, tops, wet weather, hunting season.

Selling timber. The transaction can be a 50/50 split cutting contract with a logger who cuts and delivers the logs and brings you your split or a silent auction using sealed bids. Timber of modest value can be treated more casually, but high-value timber should be handled like any valuable real estate: prepared and exposed to as wide an array of buyers as possible. Employing a consulting forester to work on your behalf is highly recommended.

Acceptable Methods of Harvesting Tennessee Timber

David Mercker

Traditional methods of harvesting privately owned timber in Tennessee have left many stands with undesirable, slow-growing trees. The practices of high-grading (harvesting the most desirable trees only) and diameter-limit-cutting (harvesting only trees that have reached a predetermined diameter such as 16 inches and larger) are still common but are no longer viewed by most professional foresters as acceptable. Both methods eventually lead to forest stands with a high composition of poor quality timber, or timber of undesirable species, particularly if these practices are repeated through generations.

Three methods of harvesting timber that are viewed as acceptable include: clearcutting, group selection and single tree selection. Each method has advantages and disadvantages, depending primarily on landowner objectives, size of forest ownership, and traits of the forest and its surrounding.

The clearcutting method essentially removes all commercial trees in one operation. It is particularly favorable in forest stands having very poor composition due to previous mismanagement or in stands that have reached or surpassed economic maturity. Clearcutting allows a forest to regenerate to desirable, vigorously growing seedlings for the future. One obvious disadvantage is aesthetics.

The group selection method could be likened to small clearcuts. Here trees are removed and new age classes are established in small groups. The width of the groups is commonly approximately twice the height of the surrounding mature trees. Smaller groups provide suitable environment for shade-tolerant regeneration (e.g. sugar maple) and larger openings provide conditions suitable for more shade-intolerant regeneration (e.g. oaks).

The single tree selection method removes individual trees from all size classes more or less uniformly throughout the forest stand. This method is desirable for many landowners because it leaves a visually appealing forest stand. Caution must be taken not to remove only the desirable species and leave undesirables. Doing so is high-grading. Also, this method requires careful logging in order to protect the residual trees.

This presentation addresses three common methods of harvesting timber applicable to forest lands in Tennessee. Though a timber harvest is typically short in duration, the impact of having done it incorrectly can last for decades. Landowners will discover methods of doing it right — methods that not only produce income, but also improve the condition of the forest for the future.

Forestry Best Management Practices (BMPs) and Stream Crossings

Wayne Clatterbuck

Stream crossings probably are the greatest risk to water quality during harvesting operations. Streams are the lowest point on the landscape where water drains. Roads and skid trails provide a conduit for runoff to enter the stream. With stream crossings, stream banks are often altered with the potential to slough off, soil is rutted or compacted, runoff from the road is concentrated at the crossing, and vegetation is removed — all increasing the chance of sediment entering the stream.

A few general guidelines for stream crossings include:

1. Avoid crossing streams, if possible. Access the timber from the other side of the stream.
2. If streams are crossed, cross at right angles where channels are straight. Do not interfere with stream flow.
3. Approaches should climb away from streams. If possible, approaches should be graveled to provide stability and reduce erosion. Dips and turnouts should be installed to turn water off the road above the crossing. These structures will allow silt to fall out above streamside management zones (SMZs) and prevent it from entering streams.
4. Choose narrow places with low banks to cross the stream. Deeply cut channels and those in soft, muddy soil should be avoided.

Stream crossings should be “red flag” areas during harvest planning. Recent BMP surveys in Tennessee indicate that about two-thirds of the sampled harvest operations avoided crossing streams completely. However, most of the potential water quality threats statewide were still associated with stream crossings.

In reality, some streams must be crossed during harvesting operations, but utmost care should be taken to ensure that the crossing is not a detriment to water quality. Low-water fords, portable bridges and log or pole fords are options for crossing small streams.

The streams with **low water fords** must have a solid rock or gravel bottom so that no muddy water will result from the crossing. Locate fords where stream banks are

low. Logs cannot be dragged/skidded across the stream bottom according to Tennessee BMP guidelines.

Bridges vary in expense and design**.** Portable bridges that can be carried from site to site are commercially available and are excellent temporary options for narrow stream crossings. Metal grating is another alternative. Log or timber bridges can be constructed from low-grade lumber and logs from the site. However, safety and load (weight) concerns should be considered. The ability to maintain traction on the bridge surface and the safety of the bridge approach is critical when the surface is wet or frozen.

Log or pole fords may be used by placing a pyramid of poles in the streambed. Green or small diameter tops, limbs, and brush should not be used for this purpose. The crossing surface can be improved by use of secured decking or panels. Old gas line pipes could also be used to allow the flow of water through the crossing structure. Logs, poles and pipes must be removed immediately after use to prevent clogging with debris and obstructing stream flow.

PVC (polyvinyl chloride) or HDPE (high-density polyethylene) **pipe bundles** can be used to build temporary stream crossings. Pipes are cabled together and layered like an accordion on top of geotextile fabric set in the streambed. Operators can place wood mats, wood panels or other materials over the pipes to add stability and traction. Water flows through the pipes while vehicles travel over them. HDPE pipes are recommended over PVC pipes because they tolerate the cold better and do not need protection from sunlight. Pipe bundles can be used in areas that are less than 10 feet wide and 4 feet deep.

Do not use fill material over these temporary crossings. Wood planking, decking, mats or panels; geotextile fabric; expandable metal grates; or even pallets are acceptable alternatives. All temporary stream-crossing materials should be removed from the stream channel after use.

Stream crossings should be avoided, if possible, during harvest operations. However, if stream crossings are necessary, care should be taken to ensure that sediment does not enter the stream. Using BMPs in your stream approaches and spending some time and effort in using temporary crossing structures will ensure that your stream crossing is not a water quality problem.

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