The Agriculture Program
THE TEXAS A&M UNIVERSITY SYSTEM

Cotton Yield Mapping and Guidance Systems on the Texas High Plains

Randy Boman, Alan Brashears, Kevin Bronson, Danny Carmichael,
John Everitt, and Wayne Keeling **

Introduction

Often referred to as the gateway to precision agriculture, yield monitors are considered an important step in identifying field variability.

A yield mapping system measures and records the amount of cotton being harvested at any point in the field, along with the position of the harvester. To produce a yield map, the harvester must be equipped with a global positioning system (GPS) receiver and a yield monitor.

Yield data are sent to an onboard computer where measured yield is matched with its appropriate field position and the data are stored in a memory card. Data on the memory card are then transferred to a computer equipped with yield mapping software to produce a yield map.

We have tested experimental and commercial yield monitors for the last five harvest seasons. They represent two basic types, weighing system and light bar system.

The weighing system, developed by the Department of Agricultural Engineering at Texas A&M University, utilizes load cells at the pivot points of the stripper basket and on the bar where the basket rests in the transport position. This system has the advantage of directly measuring the harvested cotton in the basket.

Software development to smooth signals from load cells, “zero” basket weights after each basket dump, and retrieve data have limited the development of this system. The display for this system is larger and provides information on updated yields, total basket weight, total module weight, acres harvested and longitude and latitude.

The light bar system developed by Mississippi State University and two commercial firms (AgriPlan Inc. and Micro-Trak) utilizes light bars mounted in the conveyance ducts of the cotton stripper.

Light bar systems typically employ a bar containing a light source on one side of the duct, and a receiver on the opposite side of the duct to measure the signal from the light source. It is necessary to take care when mounting the sensors and receivers so they are properly aligned.

Because most of these units are mounted on the seed cotton conveyance duct on the back of the field cleaner, mounting can be somewhat problematic.

The experimental unit from Mississippi State University has a light bar and sensor mounted in the same module, thereby simplifying mounting.

Strippers equipped with field cleaners typically have the sensors mounted to measure seed cotton after field cleaning. Strippers without field cleaners should have the sensors mounted on the conveyance duct from the header to the basket, in order to simplify mounting.

Light bar systems are calibrated by obtaining a weight of harvested cotton from either a trailer or module and then entering a correction factor into the computer.

During our initial testing of light bar systems, foreign matter in harvested cotton caused erroneous output by sensors. Modification of these sensors has reduced these errors, and daily cleaning of the sensors significantly improved the reliability of readings.

Data from light bars are accumulated and processed by a Pocket PC for commercial yield monitors. Each commercial system utilizes proprietary software developed for each particular unit.

These units typically display real-time measurement of yield rates, ground speed, and distance traveled while calculating and displaying the acres harvested, pound harvested, and the average pounds per acre harvested for a load, field, or overall total.

Yield Map Examples

Yield maps provide useful information to producers. These maps can identify areas of high and low productivity, so future inputs can be adjusted to maximize the productivity or profitability of a field.

Yield maps document both natural and man-made sources of production variability.

Natural variability is caused by weather within a growing season, and from year to year. To correct for this, a producer may need to acquire data from several years to determine consistent yield trends that can be related to soils or topography.

In comparison, man-made yield variability may be easily identified and corrected with data from a single year. Examples of man-made variability include poor irrigation water distribution, or the effects of past production practices.

The following yield maps were created at several farm locations in 2000 and 2001 using a Micro-Trak system mounted on a John Deere 7445 cotton stripper equipped with a field cleaner.

Data were processed using Micro-Trak software, and processed data were imported into a mapping software program called ArcView.

Figure 1 from the Halfway Center indicates yield variability associated with varying levels of water application under a low energy precision application (LEPA) center pivot irrigation system.

Area A had 0.75 evapotranspiration (ET) replacement applied; Area B had 0.50 ET replacement; and Area C had 0.25 ET replacement. Area A has several data points which indicate yields in excess of 750 lbs. of lint per acre

Area B has numerous data points indicating lint yields ranging from 251 to 750 lbs. of lint per acre. Area C has the lowest yield; ranging from zero to 250 lbs. of lint per acre.

Figure 1. Halfway Irrigation Treatments.

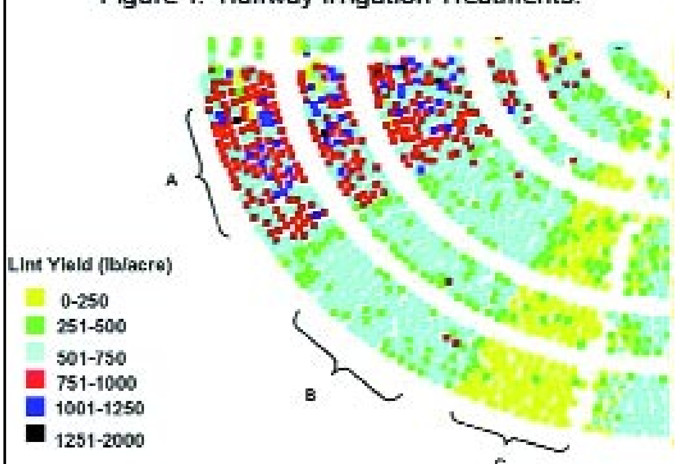


Figure 2 from the Helms Farm near Halfway shows yield variability under a LEPA center pivot system. Varying irrigation levels were used, as shown in areas A, B, and C.

Area A produced the highest yield; Area B yield was intermediate; and Area C produced the lowest yield.

A variety test shown in Area D was conducted under four spans of the pivot, and produced yields ranging from 1143 to 1391 lbs. per acre.

Figure 2. Helms Farm Irrigation Treatments and Variety Test.

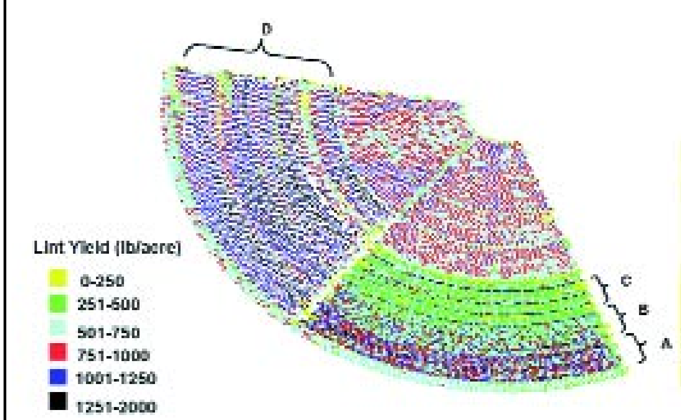


Figure 3 from the Western Peanut Growers Research Farm near Denver City shows an area of high LEPA irrigation output in Area A.

Area B indicates a region of poor production due to erosion. Turn rows are noted by arrows labeled Area C.

Figure 3. Western Peanut Growers Research Farm Pivot.

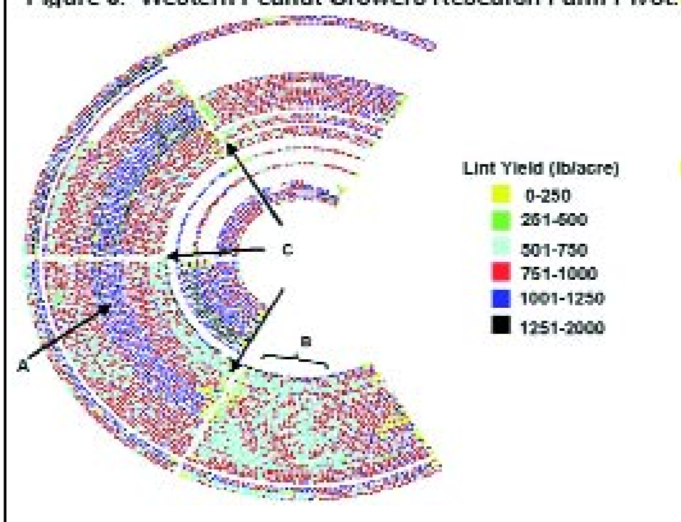


Figure 4 from the Lamesa AG-CARES facility (2000 and 2001) indicates yields under the LEPA pivot in 2000 were generally low to medium, due to dry conditions.

Area A produced higher yields than the surrounding region due to differences in topography.

Runoff from a single high-intensity rainfall event was likely the cause of higher yields in this area.

A yield increase due to a cotton-following-peanuts rotation is seen in Area B; which produced higher lint yields than other regions of the field.

Figure 5 from the Lamesa AG-CARES facility shows higher yields due to better growing conditions in 2001.

A variety test conducted under four spans of the pivot (Area A) produced lint yields ranging from 769 to 1089 lbs. per acre.

Area B indicates low yielding dryland corners. Dryland yield in the southeast corner was higher than yields in the northeast corner.

A region of perennial weed infestation in this field is seen in Area C.

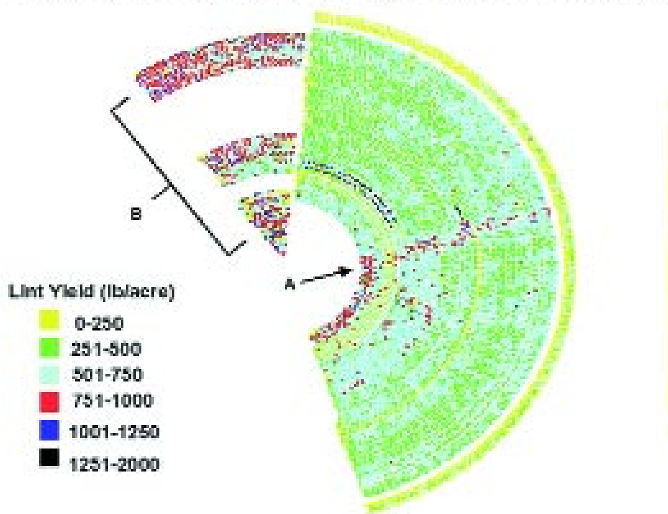


Figure 4. AG-CARES 2000 Precision Agriculture Area.

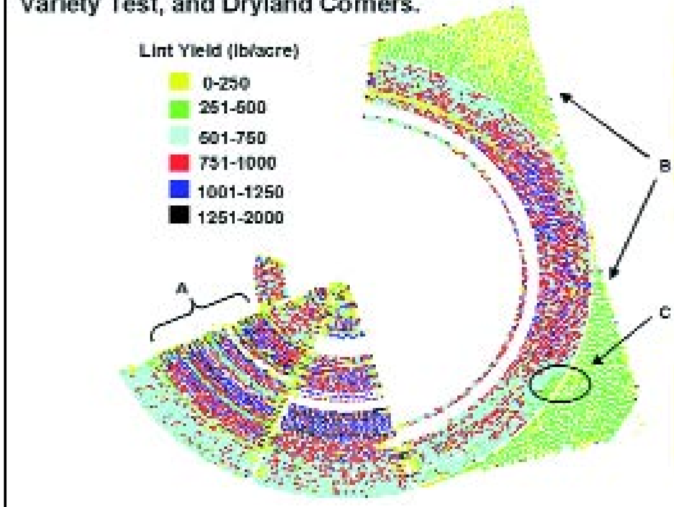


Figure 5. AG-CARES 2001 Precision Agriculture Area, Variety Test, and Dryland Corners.

Cotton strippers such as the one shown at right are equipped with GPS units (white-capped object on top of cab) and sensors, which gather yield data as lint is harvested from the field.

The combination of data from GPS units and sensors allows researchers to construct color-coded yield maps of a field.

These maps show pounds of lint harvested per acre, keyed to specific locations in the field.

Guidance Systems

The cost of yield monitors limits their acceptance and use by producers, but this cost should drop over time.

Use of whole systems, or system components, in other precision farming applications should also boost producer acceptance and help reduce system costs.

The GPS receiver we purchased for the yield monitoring system can also be used with a guidance system on tractors, sprayers, and fertilizer applicators.

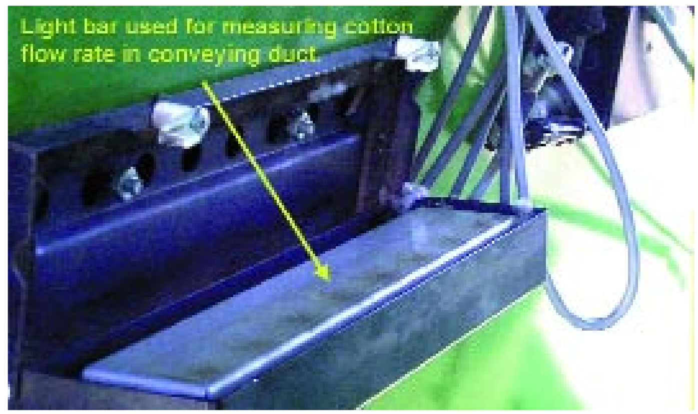
When properly installed and operated, guidance systems provide several benefits.

They can improve the accuracy and efficiency of sprayers and fertilizer equipment beyond that of current foam marker systems.

Guidance systems can also improve our ability to generate straight rows with no wide or narrow middles. They also allow us to operate equipment at higher ground speeds with less operator fatigue and eye strain.

These systems also permit us to download data and validate application areas for future reference.

White-capped GPS unit mounted on top of harvester.



Light-bar sensors gather data during cotton harvest.

Notes: **
Randy Boman is an Extension cotton agronomist
Alan Brashears is a USDA-ARS agricultural engineer
Kevin Bronson is an Experiment Station soil fertility scientist
Danny Carmichael is AG-CARES site manager
John Everitt is an Experiment Station research associate
Wayne Keeling is an Experiment Station systems agronomist

http://precisionagriculture.tamu.edu
Electronic document preparation by Andrew Huff. Original editing and layout by Tim McAlavy.

Texas A&M University Agricultural Research & Extension Center
Lubbock - Halfway - Pecos

Texas Agricultural Experiment Station
THE TEXAS A&M UNIVERSITY SYSTEM
Route 3, Box 219
Lubbock, TX 79403-9803

Texas Cooperative EXTENSION
The Texas A&M University System
Route 3, Box 213AA
Lubbock, TX 79403

(806) 746-6101