DEVELOPMENT OF THE UNIVERSITY OF ARIZONA CROP MONITORING SYSTEM

E.R. Norton and J.C. Silvertooth
University of Arizona
Tucson, AZ

Introduction

Cotton production in the desert southwest is commonly characterized by high input production practices that usually result in high yields. Among the inputs that are involved in this intensive production scenario include first and foremost water. Other inputs include pest control, fertilizer nitrogen (N), and plant growth regulators. Since cotton is very responsive to crop inputs, such as water and fertilizer N, management of these inputs is critical to achieve not only maximum agronomic but also economic yield. As the US cotton industry moves towards a more open and free market with less government support, efficient management of these inputs becomes increasingly important. Producers need to be very critical of what is put into the crop and have a relatively good assurance that a specific input is actually having a positive effect on the crop.

One method that has been proposed which can lead to more efficient management of inputs is the use of a 'feedback' approach to input management. This is contrasted by a 'scheduled' approach, which would involve the scheduling of inputs based upon a calendar or days after planting. The 'feedback' approach to input management involves the use of crop monitoring in order to ascertain the past and current status of the crop and then using that information in order to make informed management decisions.

There are three important aspects that need to be understood in order to be able to use crop monitoring in an efficient manner. The first is collection of data. Data collection must be made in a uniform and consistent manner across all management units and across years if the objective is to develop long-term trends for a given farm. The second aspect is management of collected data. Collection of crop monitoring data or plant mapping data does little good if it cannot be summarized into a form that is useful and relatively easy to manage. The third is probably the most important of the three. This involves the interpretation of the data and then utilizing the information in management decisions that hopefully will serve to increase the efficiency of the production system.

In an effort to address point number two, management and summary of collected crop monitoring data, we have developed a simple software program that can be used to manage and summarize data collected from a crop over the season. The software was developed using Microsoft Excel and is simply a tool to summarize crop monitoring data. The software does not provide any recommendations with regards to management but merely summarizes on one 8.5"x11" sheet all the data that is entered into the system.

The system consists of several pages, each of which allows for the input of different crop monitoring/input data. These pages include:

- General information page: This page allows for the input of field identifiers, variety, planting date, plant population, and acres.

- Plant mapping data entry page: This page allows for the input of plant mapping data collected for a given date. This page has the capacity for the entry of 15 individual dates of sampling over the season. In order to calculate percent fruit estimates and height to node ratios all plant mapping data must be entered. This data includes plant height, first fruiting branch, number of mainstem nodes, number of aborted or missing sites for first positions (pre-bloom), and first two positions (post first-bloom), and nodes above top white flower.

- Irrigation information page: This page allows for the input of irrigation event information including; start date, stop date, and total amount of water applied to the field (acre-ft.). Amount of water applied (acre-in.) per acre is calculated. This page has the capacity for 15 irrigation events across the season.

- Fertilizer N information page: This page allows for the input of fertilizer N event information including; date of event, form of fertilizer used, rate of fertilizer used, and rate of N applied to field.

- Petiole NO_3^--N analysis information page: This page allows for the input of petiole analysis (ppm NO_3^-N) information for 15 dates of sampling across the season.

- PIX/PGR information page: This page allows for the input of information regarding PIX or other PGR applications including application date, products used, and rate applied.

All of the information put into the preceding pages is then summarized on the summary sheet, which can be printed out. All plant mapping information i.e., fruit

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1734-1737 (1998)
National Cotton Council, Memphis TN

retention estimates (FR), height to node ratios (HNR), petiole nitrate-N values, and nodes above white flower estimates are plotted on graphs that contain long-term baselines developed for Arizona cotton. All of the plant mapping data is plotted as a function of heat units (86/55°F thresholds) accumulated after planting. All other information i.e., irrigation events, fertilizer N events, PIX/PGR events are all tabulated on the summary sheet with running totals. Irrigation, fertilization, and PIX/PGR events are identified on the FR and HNR graphs with markers so as to track these events along with plant mapping trends.

Basic requirements for the software include; a machine (at least a 486, preferably Pentium based) that is capable of operating Microsoft Excel 7.0 (version of Excel included in Office 95) or greater. The software will be available through the University of Arizona Cooperative Extension for the 1998 growing season.

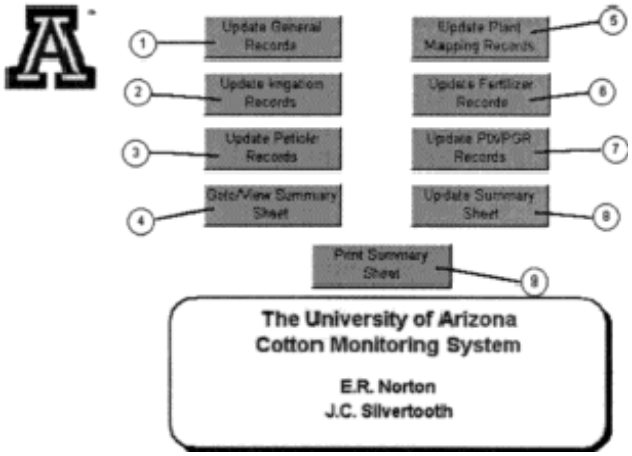


Figure 1. ① Link to page where general field information is entered and edited. ② Link to page where irrigation records are entered and updated. ③ Link to page where petiole NO_3^--N results are entered and updated. ④ Link to view updated summary sheet. ⑤ Link to page where all plant mapping data is entered and updated. ⑥ Link to page where fertilizer N records are entered and updated. ⑦ Link to page where PIX™/PGR records are entered and upated. ⑧ Link to update summary sheet including all graphs and figures. ⑨ Link to print summary sheet.

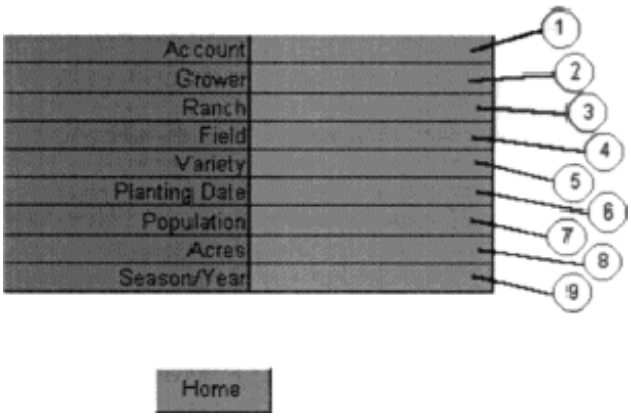


Figure 2. ① Text entry cell. Enter account for which this field pertains. ② Text entry cell. Enter Grower for which this field petains. ③ text entry cell. Enter the Ranch identifier for which this field pertains. ④ Text entry cell. Enter field identifier. ⑤ Text entry cell. Enter variety for this field. ⑥ Text entry cell (date format - mm/dd). Enter planting date for this field. ⑦ Text entry cell. Enter approximate plant population for this field. ⑧ Numeric entry cell. Enter acreage for this field. This number will be used in calculations to determine irrigation amounts. ⑨ Text entry cell. Enter the season/year for this field.

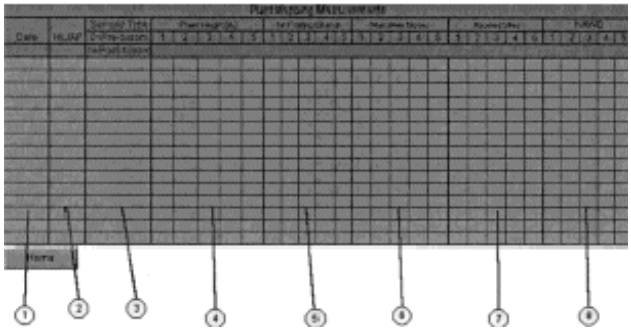


Figure 3. ① Text entry cell (date format - mm/dd). Enter date for which plant mapping sample was taken. ② Numeric entry cell. Enter heat units accumulated after planting for which plant mapping sample was taken (data can be obtained from UA cotton advisories see page 1). ③ Numeric entry cell (either 0 or 1). This cell will determine how fruit retention estimates are calculated. By entering a 0 the program will calculate fruit retention based upon the first fruiting position on each fruiting branch. Entering a 1 will have the program calculate fruit retention based upon the first two sites on each fruiting branch. UA cotton agronomy recommendations are to map first position fruit on each fruiting branch prior to first bloom. Post first bloom is done by mapping the first two positons on each fruiting branch. ④ Numeric entry cells. Enter the five plant height measurements (inches) for this sample date. ⑤ Numeric entry cells. Enter the five first fruiting branch measurements for this sample date. ⑥ Numeric entry cells. Enter the five mainstem node number measurements for this sample date. ⑦ Numeric entry cells. Enter the five aborted and missing site measurements for this sample date. ⑧ Numeric entry cells. Enter the five nodes above white bloom measurements for this sample date (post first bloom only).

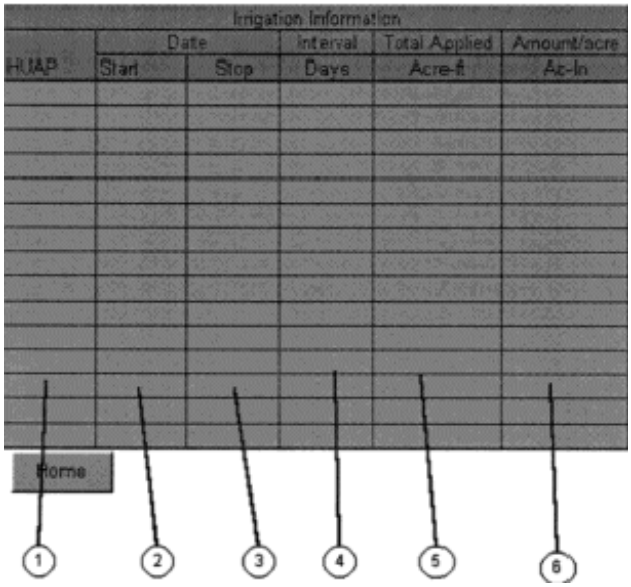


Figure 4. ① Numeric entry cell. Enter heat units accumulated since planting for this irrigation events. This data is used to plot the irrigation event on the fruit retention graph (data can be obtained from cotton advisories see page 1). ② Text entry cell (date format - mm/dd). Enter date for which irrigation event began. ③ Text entry cell (date format - mm/dd). Enter date for which irrigation event ended. ④ No data entry - calculation cell. This cell calculates the irrigation interval between the current and the one event previous. ⑤ Numeric entry cells. Enter the amount of irrigation water applied (acre-feet). ⑥ No data entry - calculation cell. This cell calculates the amount of water applied in acre-inches.

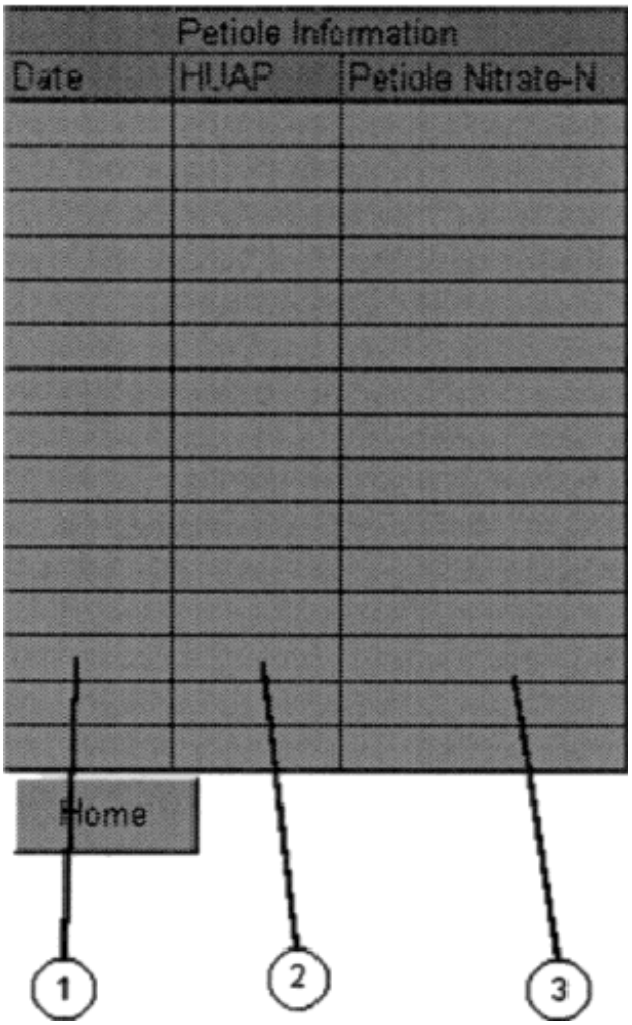


Figure 5. ① Text entry cell (date format - mm/dd). Enter date for which petiole sample was taken. ② Numeric entry cell. Enter heat units accumulated since planting for the date this petiole sample was collected (data can be obrained from cotton advisories see page 1). ③ Numeric entry cell. Enter value for petiole NO_3^--N analysis.

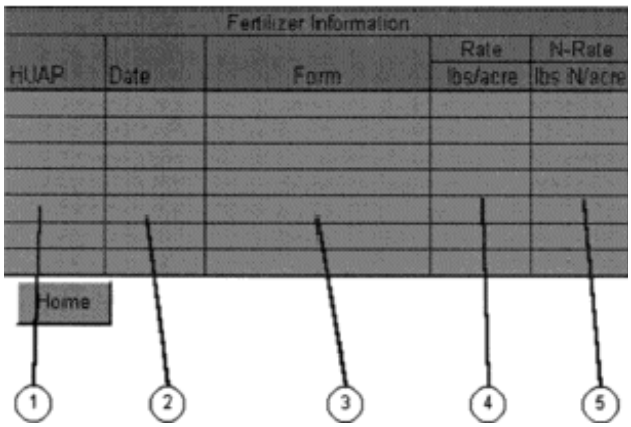


Figure 6. ① Numeric entry cell. Enter heat units accumulated since planting for this fertilization event. This data is used to plot the fertilization event on the fruit retention graph (data can be obtained from cotton advisories see page 1). ② Text entry cell (date format - mm/dd). Enter date for which fertilization event occured. ③ Text entry cell. Enter the form of fertilizer N used for this event. ④ Numeric entry cell. Enter the rate at which fertilizer was applied (lbs/acre). ⑤ Numeric entry cell. Enter the rate at which fertilizer N was applied (lbs N/acre).

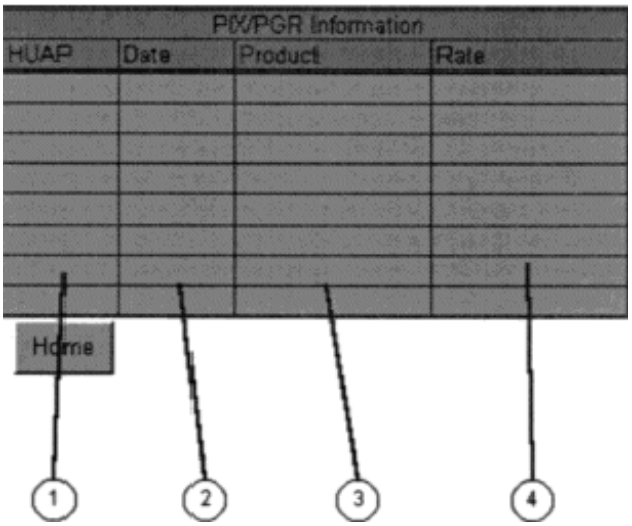
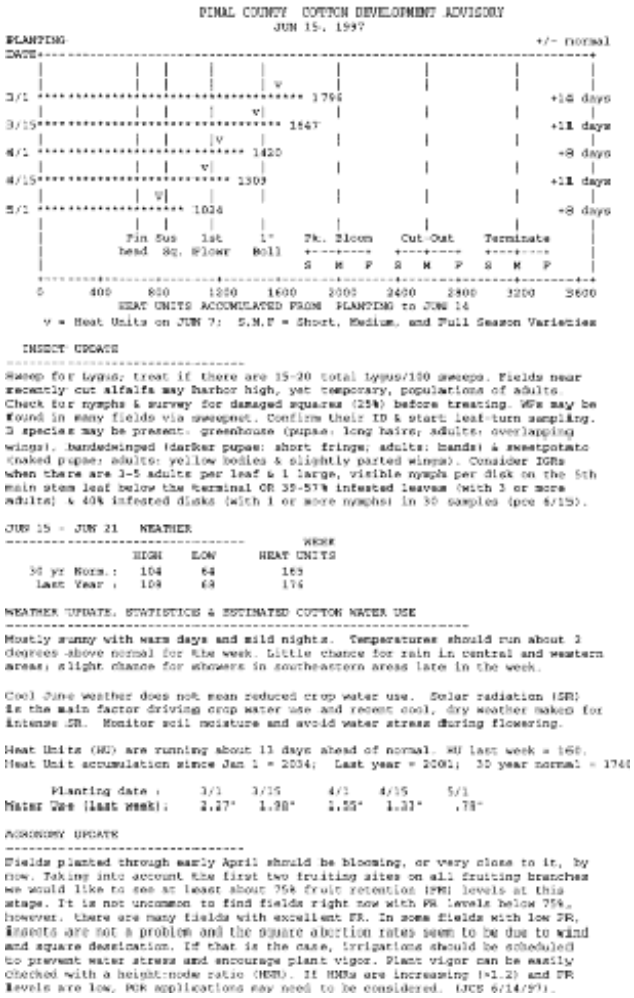


Figure 7. ① Numeric entry cell. Enter heat units accumulated since planting for this PIX/PGR event. This data is used to plot the PIX/PGR event on the height to node ratio graph (data can be obtained from cotton advisories see page 1). ② Text entry cell (date format - mm/dd). Enter date for which PIX/PGR event occured. ③ Text entry cell. Enter the product used for this event. ④ Text entry cell. Enter the rate which PIX/PGR was applied.



PINAL COUNTY COTTON DEVELOPMENT ADVISORY
JUN 15, 1997

PLANTING DATE — +/- normal

3/1 ********** 1796 +16 days
3/15 ********** 1647 +11 days
4/1 ********** 1420 +8 days
4/15 ********** 1309 +11 days
5/1 ********** 1024 +8 days

Pin Sus head Sq. Flower 1st Boll 1" Bloom | Pk. Bloom S M P | Cut-Out S M P | Terminate S M P

0 400 800 1200 1600 2000 2400 2800 3200 3600
HEAT UNITS ACCUMULATED FROM PLANTING to JUN 14

V = Heat Units on JUN 7: S,M,F = Short, Medium, and Full Season Varieties

INSECT UPDATE

Sweep for Lygus; treat if there are 15-20 total Lygus/100 sweeps. Fields near recently cut alfalfa may harbor high, yet temporary, populations of adults. Check for nymphs & survey for damaged squares (25%) before treating. WFs may be found in many fields via sweepnet. Confirm their ID & start leaf-turn sampling. 3 species may be present: greenhouse (pupae: long hairs; adults: overlapping wings), bandedwinged (darker pupae: short fringe; adults: bands) & sweetpotato (naked pupae; adults: yellow bodies & slightly parted wings). Consider IGRs when there are 3-5 adults per leaf & 1 large, visible nymph per disk on the 5th main stem leaf below the terminal OR 35-57% infested leaves (with 3 or more adults) & 40% infested disks (with 1 or more nymphs) in 30 samples (pce 6/15).

JUN 15 - JUN 21 WEATHER

	HIGH	LOW	HEAT UNITS
30 yr Norm.:	104	64	169
Last Year :	104	69	174

WEATHER UPDATE, STATISTICS & ESTIMATED COTTON WATER USE

Mostly sunny with warm days and mild nights. Temperatures should run about 3 degrees above normal for the week. Little chance for rain in central and western areas; slight chance for showers in southeastern areas late in the week.

Cool June weather does not mean reduced crop water use. Solar radiation (SR) is the main factor driving crop water use and recent cool, dry weather makes for intense SR. Monitor soil moisture and avoid water stress during flowering.

Heat Units (HU) are running about 13 days ahead of normal. HU last week = 168. Heat Unit accumulation since Jan 1 = 2034; Last year = 2001; 30 year normal = 1744

Planting date :	3/1	3/15	4/1	4/15	5/1
Water Use (last week):	2.27"	1.98"	1.55"	1.21"	.78"

AGRONOMY UPDATE

Fields planted through early April should be blooming, or very close to it, by now. Taking into account the first two fruiting sites on all fruiting branches we would like to see at least about 75% fruit retention (FR%) levels at this stage. It is not uncommon to find fields right now with FR% levels below 75%, however. There are many fields with excellent FR. In some fields with low FR, insects are not a problem and the square abortion rates seem to be due to wind and square desiccation. If that is the case, irrigations should be scheduled to prevent water stress and encourage plant vigor. Plant vigor can be easily checked with a height:node ratio (HNR). If HNRs are increasing (>1.2) and FR levels are low, PGR applications may need to be considered. (JCS 6/14/97).

Figure 8. Example of UA cotton advisory for Pinal County for the week of 15 June 1997.