

1999 Integrated Cotton Management Demonstration

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Abstract

An Integrated Cotton Management (ICM) Demonstration project was conducted on the Demonstration Farm at the Maricopa Agricultural Center in 1999 for the second year. In this project, all current guidelines and recommendations disseminated by the University of Arizona were integrated in a systems approach for cotton production. The Extension Specialists in agronomy, entomology, irrigation management, weed sciences, and plant pathology following the University recommendations made the management decisions. On a 52.7 acre field, 78% Bt and 22% non-Bt cotton was planted into moisture on April 9, 1999. Because of problems with cool temperatures and deep seeding, a stand of only 25,000 plants/acre was established. Weed control was achieved with one preplant application and two cultivations. The field was sprayed three times for lygus and two times for whitefly control. Approximately 38.6 acre-inches of irrigation water was applied. An average of 3005 lb/acre of seed cotton were harvested. After harvesting, a field budget was established. The variable costs per acre were \$594.96 and the total cost was \$957.96/acre. Average micronaire was 4.45, strength was 28.41 gm/Tex, length was 1.10 (1/100 in.) and grade color was 21. The price received for the cotton was 74.82¢/lb, including LPD and hail damage payments, just over 3¢/lb below the break-even price. An additional \$139/acre in PFC payments was received but not calculated into the budget. This project demonstrates the utility and compatibility of current recommendations and the potential for integration of all disciplinary guidelines in one system.

Introduction

Producing cotton during a less than favorable economic climate presents growers with new challenges to their efficiency. Every input must be scrutinized carefully for its return on investment. University of Arizona Extension faculty routinely research, develop, and validate their disciplinary-based recommendations and guidelines for cotton production. In the course of research and development, it is common scientific procedure to control all factors except for the one of interest (e.g., irrigation termination decisions, variety, or whitefly management program). While crucial to the development of this initial research-based information, validation is a separate process necessitating, at some point, a systems approach. In a systems approach, Extension faculty attempt to examine their guidelines in the context of all the interacting production practices that might be present across the region. While it is impossible to validate all UA guidelines on each acre throughout Arizona, we are fortunate to have a University Demonstration farm dedicated in part to this objective. In 1999, a group of Extension faculty responsible for the development and dissemination of cotton production and protection guidelines came together for a second year (Dittmar et al., 1999). Under the same economic constraints as our local growers, this group was challenged to produce cotton using all our University guidelines in as profitable manner as possible. Through this effort we can

validate the compatibility of our guidelines and demonstrate the integration of the multiple disciplines that contribute to cotton production in Arizona.

Field Description and Operations

The project was conducted on a 52.7 acre field that was in cotton last season at the Maricopa Agricultural Center (MAC). It was located on five benches that were dead level (benches four through eight). The length of the irrigation run was 825 ft. The soil was an alluvium soil, and the soil type was a clay loam on four of the benches. On one bench, bench 6, the soil was sandier and had characteristics similar to a sandy loam. This was the bench where the non-Bt refuge cotton was located.

The field was monitored at least once a week for plant development, weeds and/or insects depending on the time of the season. The Extension Specialists, following the University recommendations and considering the results of the field monitoring, made the decisions for field operations and applications.

The farm crew of the Maricopa Agricultural Center performed the field operations. Mainly six-row equipment was used for the field operations except harvesting, which was done with 2-row spindle pickers. All sprays were applied using a 47 ft tractor-mounted sprayer that drove in the skip rows. All applications were made broadcast, two nozzles per row, at 22 GPA. Weather data for the Heat Unit calculation were acquired using the AZMET station located at the Maricopa Agricultural Center. A summary of all of the chemical applications (pesticide and fertilizer) is given in Table 1.

Field Preparation and Planting

The field was ripped in February with a 3-shank subsoiler and disced before laser planing. On March 8, the field was treated with trifluralin herbicide (0.75 lb a.i./acre) and incorporated with the s-tine rig crosswise to the planting direction. The field was listed on March 9 and then pre-irrigated on March 17. On April 9, the field was planted into moisture and then dragged off on April 17. The cool spring conditions and slightly deep seed placement provided for poor germination and emergence conditions.

Plant Development and Nitrogen Management

Four of the five benches or 78% of the field were planted with transgenic cotton of the variety Delta Pine 33B, and the remaining bench (22% of the area) was planted with Delta Pine 5415. The field was planted at a rate of 12.0 lb of seed per acre. Early scouting showed the plant population to be low (25,000 plants/acre) but not below the 20,000 plants/acre threshold. Therefore, it was decided not to reseed and continue the crop.

A total of 126 lb N/acre were applied to the field, split among three applications. On May 14, 44 lb N/acre were applied sidedress as ammonium sulfate. Additionally, another 41 lb N/acre were added on June 10 and again on June 23.

Starting on June 17 and ending on September 8, five representative plants out of every bench were mapped weekly for height-to-node ratio (HNR), fruit retention (FR), and nodes above the top white flower (NAWF). The HNR (Fig. 1) shows that through most of the season, the plants stayed above the baseline but never grew above the recommended mid-point. Fruit retention, however, did go below the baseline and remained there for several weeks (Fig 2). From the outset, FR was low due to unknown factors. Then, pressure from lygus early in the season contributed to squares loss and as a result, the FR continued to be below acceptable levels. Even in the later part of the season, when the FR did recover and lygus had been sprayed several times, the recovery was small.

Irrigation Management

The field was pre-irrigated on March 17-18, with approximately 8.8 in. of water using siphon tubes. The decisions for the subsequent irrigations were made using the AZSCHED irrigation scheduling software, soil sampling and neutron moisture gauge readings taken weekly. The first postplant irrigation was on May 25. Although one bench was considerably more sandy, and required irrigation more often, it was decided that a single bench should not dictate the management for the entire field and irrigation was based on a field average. Additional irrigations were applied on June 14, June 30, July 22 and August 3 and August 16. All of the irrigations ranged from 4-6 inches and were made at approximately 50% depletion of the plants available moisture (PAW).

Weed Control

On March 8 trifluralin was incorporated as a pre-emergence herbicide with an s-tine rig perpendicular to the intended planting direction at a rate of 0.75 lb a.i./acre. The weed pressure after planting was very low. The emerging weeds were controlled by two conventional cultivations with a rolling cultivator in late April and again in early June.

Pest Management

For pink bollworm (PBW) control the transgenic Bt cotton variety DeltaPine 33 B was planted on 78% of the total acreage. The remaining 22% (one bench) was planted with a non-Bt cotton variety DeltaPine 5415 to provide a refuge for resistance management. PBW pressure, termination decisions and the economic conditions were such that no added sprays were made against this pest.

Lygus adults began to enter the field in mid to late June. Nymphal levels did not increase until mid-July. Recent research (Ellsworth, this volume) confirms that chemical control is best timed when there are at least 15 total Lygus / 100 sweeps with at least four nymphs. This level was first measured on 19 July. The first full field Lygus spray followed the next day; however seven days later, Lygus were almost at threshold once again. The second spray kept levels below threshold for nine days and a third spray was made nine days after this point. This spray suppressed Lygus below threshold for another nine days. At this point, the crop was well into cut-out and irrigations had been terminated, so no further Lygus sprays were made. A summary of lygus counts is given in Fig. 3.

The Lygus control program consisted of three solo sprays or about \$49.76/acre, though the first whitefly spray (Phaser + Ovasyn) and a partial fleahopper (Vydate) spray may have had some marginal impact on the Lygus population. This amount is well above the statewide average for 1999 (\$19.98/acre), but well below the budget of much of the adjacent farm. Lygus bugs were a chronic problem this year, dominated by the presence of adults. Adhering to guidelines that specify sprays only when nymphs are present helps to contain costs and maximize profitability. Also as recommended, singular compounds were used at their highest rates to provide for maximum control of these chronic populations. Losses were most certainly experienced in this field in spite of the control program. With the limited number of effective insecticides and the chronic nature of the adult invasion to this area, the control program selected most likely maximized profits in spite of the likely yield loss.

Due in part to the inconsistency of the stand density, whiteflies were decidedly aggregated in the northern portions of each bench. These areas had slower canopy closure, larger bare ground skips, and notably water-stressed plants. These conditions fostered large populations of whiteflies that developed sooner and faster than on the south side of each bench (Fig. 4). This knowledge impacted our whitefly control decisions. Had distributions been east to west, it would have been possible to spot treat as thresholds were reached. But because the distribution was within the rows, sprays were delayed until the north side exceeded the five adults per leaf level (>57% infested with three or more adults). This first occurred on 2 August when there were over 8.1 adults per leaf there. Nymphal densities were still well below the action levels for use of IGRs (40% disks infested with large nymphs) (Ellsworth et al. 1996b) (Fig. 5). These facts coupled with the apparent late development of whitefly populations in general (i.e., August) and the expected early termination, a Stage II non-pyrethroid combination was

selected (Table 1; Ellsworth et al. 1996a). Our hope was that this would serve to lower adult numbers with some nymphal suppression while serving to dampen the differences between two sides of the benches.

The Phaser-endosulfan + Ovasyn application kept populations below the adult threshold for 17 days, though the differential between the north and south sides remained. Nymphal densities (Fig. 5) were still fairly low (< 0.5 / disk); however, a sample taken four days later revealed a huge increase in adults and large nymph levels. The levels were far in excess of what would be normally recommended for use of IGRs; however, the control period required was going to be at least 30 days (i.e., until green-leaf drop). Furthermore, the equivalent adulticidal program using conventional materials (e.g., pyrethroid combinations) would require at least two sprays at a cost in excess of (\$40/acre). Thus, Applaud (ca. \$23/acre) was used which works more quickly in killing nymphs and costs less than Knack. Adult levels (Fig. 4) were excessive through the post-spray period and stickiness was apparent on the lowest leaves prior to the IGR spray. Nymphs, however, declined quickly and the IGR performed extremely well until defoliation. The total whitefly control program for this field was around \$44/acre using one conventional insecticidal combination and one IGR. This illustrates the need for flexibility in designing control measures while still using the recommended sampling and threshold guidelines. Normally, an IGR would be used first to maximize the utility and cost-effectiveness of natural controls. In this case, however, three conventional sprays were already required for other pests, limiting the efficacy of natural controls, and a large differential in whitefly populations was present in our field.

Defoliation and Harvest

The field was defoliated on September 16, 1999 with 8 oz. Ginstar/acre. Harvest took place the week of October 30 through November 3, 1999. The yield data showed quite a variation throughout the field, with the benches on the west end yielding higher than those in the east. Similar to last year's yield data, the center bench, which had a higher sand content, yielded the lowest. Seed cotton yields ranged from 3560 to 2560 lb/acre. The average lint yield for the field was 2.1 bales/acre.

Budget

A simplified budget analysis was done to assess the economic aspects of the demonstration project. Costs for field operations, overhead, management, etc., were included. Costs for the variable inputs, i.e., water, herbicides, insecticides, etc. were all adjusted for this year's inputs. A summary of the inputs and their associated cost is found in Table 2.

As compared to last year, the water cost was considerably lower in 1999. Water costs were \$238/acre in 1998 as compared with only \$109/acre in 1999. However, insecticide costs were higher this year due to increased lygus pressures.

Table 3 shows the return for the yield with various scenarios of cotton prices. At the far right of the table is the Break Even price and Lower Limit price. The Break-Even price takes into account all of the costs, fixed and variable. The Lower Limit price only covers the variable costs. For last season, the variable costs would have been covered by a \$0.35 per lb lint return. However, to cover total costs would have required a \$0.79 per lb of lint return price. The estimated price received including a loan deficiency payment (LDP) and hail insurance payment was \$0.7482 per lb of lint. Therefore, variable costs were covered but total costs were not. Additionally, two PFC payments of approximately \$69.82/acre each were received but not used in calculated the budget.

Acknowledgments

The authors would like to thank AgrEvo, Valent, Monsanto, DeltaPine, DuPont, and the personnel at the Maricopa Agricultural Center for their support.

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Table 1. Chemical and fertilizer applications made to the demonstration project.

Date	Chemical/fertilizer	Active Ingredient/Nitrogen applied (lb/acre)	Purpose
3/08	Trifluralin	0.75	Weed Control
5/15	Ammonium Sulfate	44	Fertilizer
6/10	Ammonium Sulfate	41	Fertilizer
6/24	Ammonium Sulfate	41	Fertilizer
7/01	Vydate C-LV	1.0 (a.i.)	½ the field - Fleahoppers
7/20	Orthene	1.0 (a.i.)	Lygus
7/27	Orthene	1.0 (a.i.)	Lygus
8/05	Phaser + Ovasyn	0.75 + 0.25 (a.i.)	Whitefly
8/14	Vydate C-LV	1.0 (a.i.)	Lygus
8/29	Applaud	0.5 lb	Whitefly
9/16	Ginstar	8 oz	Defoliant

Table 2. Budget for the demonstration project for the 1999 season.

Variable Costs				
Input	Description	Amount Applied (lb, gal./acre)	Cost (\$/lb,gal)	Total Cost (\$/acre)
Fertilizer	Ammonium Sulfate	126 lb N (600 lb fertilizer)	165/ton	49.50
Herbicide	Trifluralin	0.23 gal	14.50/gal	3.33
Insecticides	Vydate	51 oz	55.49/gal	22.11
	Orthene	2.22 lb	9.01/lb	20.02
	Phaser	0.25 gal	23.96/gal	5.99
	Ovasyn	0.167gal	30.00/gal	5.00
	Applaud	0.5 lb	46.00/lb	23.00
	Scouting Fee			25.00
Defoliant	Ginstar	0.0625 gal	163/gal	10.18
Irrigation		3.22 acre-ft	34/acre-ft	109.00
	Water Assessment			25.00
Seed	DP 33 Bt (78%)	6.8 lb	1.00/lb	6.79
	DP 5415 (22%)	1.7 lb	1.00/lb	1.70
	License Fee			32.00
Wages		14.74 hours/acre	12.12/hour	178.64
Ginning Fee		3005 lb- seed cotton	0.02/lb	60.70
Assoc. Fee, Classing Fee				18.00
Total Variable Costs				595.96
Fixed Costs				
Equipment				134.00
Property Taxes				23.00
Maintenance				71.00
Land + Operations				48.00
Management				86.00
Total Fixed Costs				362.00
TOTAL COSTS				957.96

Table 3. Profit (\$/acre) and yield data for the ICM Demonstration Project for 1999. The “Break Even Price” covers all costs and the “Lower Limit Price” covers the variable costs. Negative numbers are shown in parentheses ().

Bales/acre*	Price of cotton lint (\$/lb)								Break-Even Price (\$/lb)	Lower Limit Price (\$/lb)
	0.50	0.55	0.60	0.65	0.70	0.7482	0.75	0.80		
	Profit (\$/acre)**									
1.5	(451)	(413)	(376)	(338)	(301)	(265)	(263)	(226)	1.11	0.49
2.0	(326)	(276)	(226)	(176)	(126)	(78)	(76)	(26)	0.83	0.37
2.1	(301)	(248)	(196)	(143)	(91)	(40)	(38)	14	0.79	0.35
2.5	(201)	(138)	(76)	(13)	49	109	112	174	0.67	0.30
3.0	(76)	0	74	149	224	297	299	374	0.56	0.25
3.5	49	137	224	312	399	378	487	574	0.48	0.21

*Using a lint turn out of 34.91% and a seed turnout of 48.87% (from gin data).

** Assuming a price of \$160/ton for seed and a ginning cost of \$2.02/100 lb of seed cotton. The \$0.7482/lb of lint was the best estimate for the price received (not including premiums or deductions for quality) and the 2.1 bales/acre yield was an average from the entire field. These figures do not include PFC payments of approximately \$139/acre.

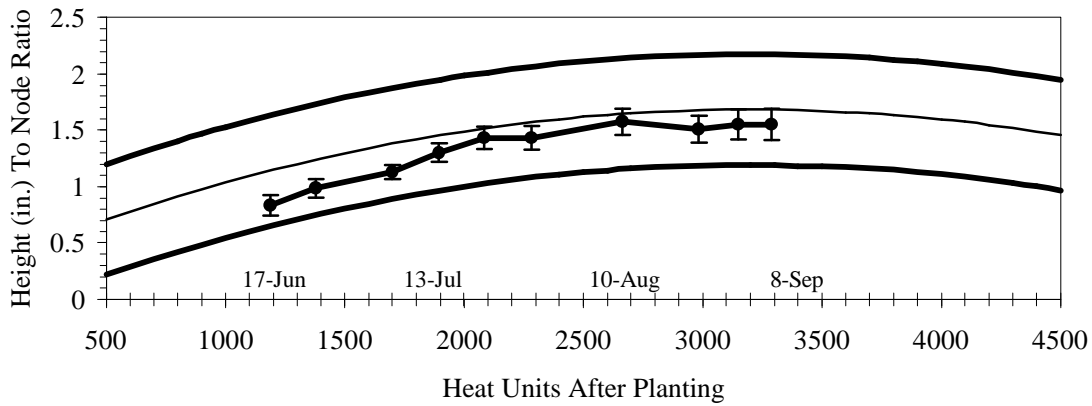


Figure 1. Height to node ratios for the ICM Demonstration Project field in 1999. The line represents the average for the five benches with the standard deviation shown for each day a set of measurements was taken.

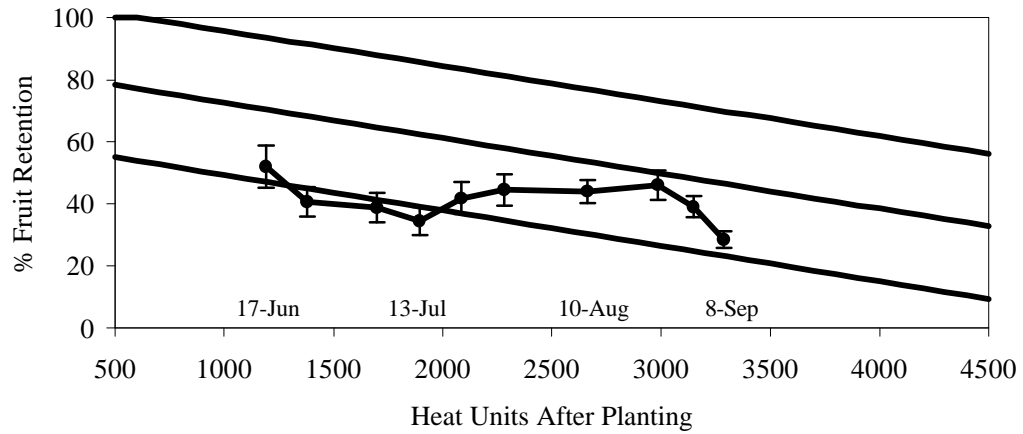


Figure 2. Percent fruit retention for the ICM Demonstration Project field in 1999. The line represents the average for the five benches with the standard deviation shown for each day a set of measurements was taken.

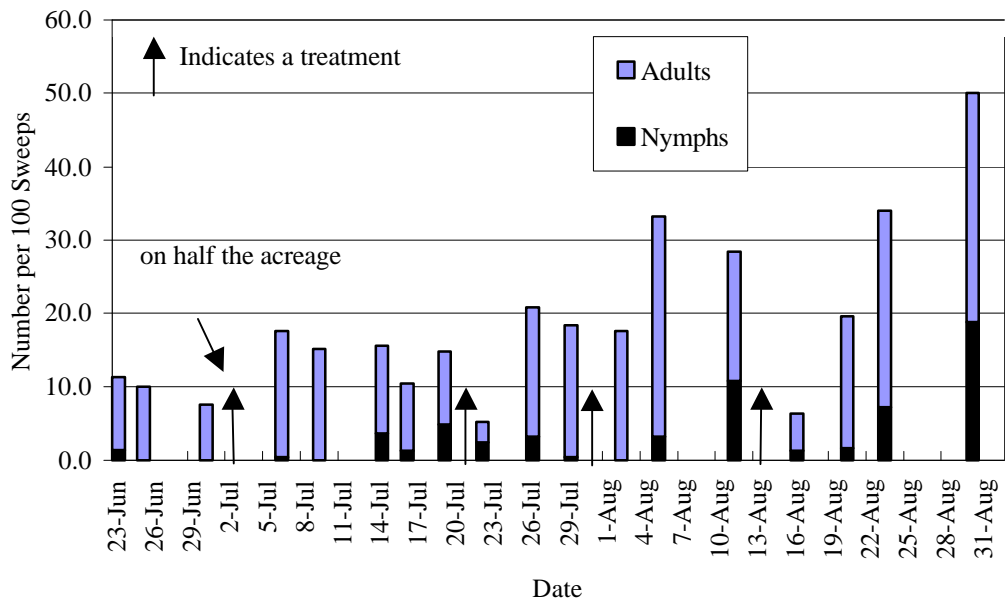


Figure 3. Lygus adult and nymph counts from sweeps in the ICM Demonstration Project field for 1999. The values are the average of 250 sweeps taken in the five benches (i.e., two sweeps of 25 taken in each bench).

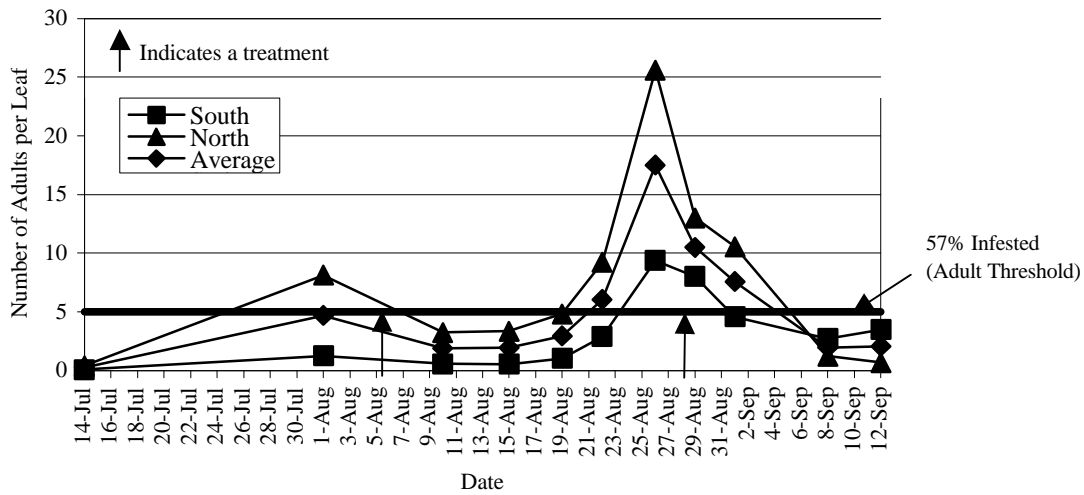


Figure 4. Whitefly adult counts for the ICM Demonstration Project field for 1999. The values shown are for the South end of the field, the North end and the average. Thirty leaf turns per bench were taken.

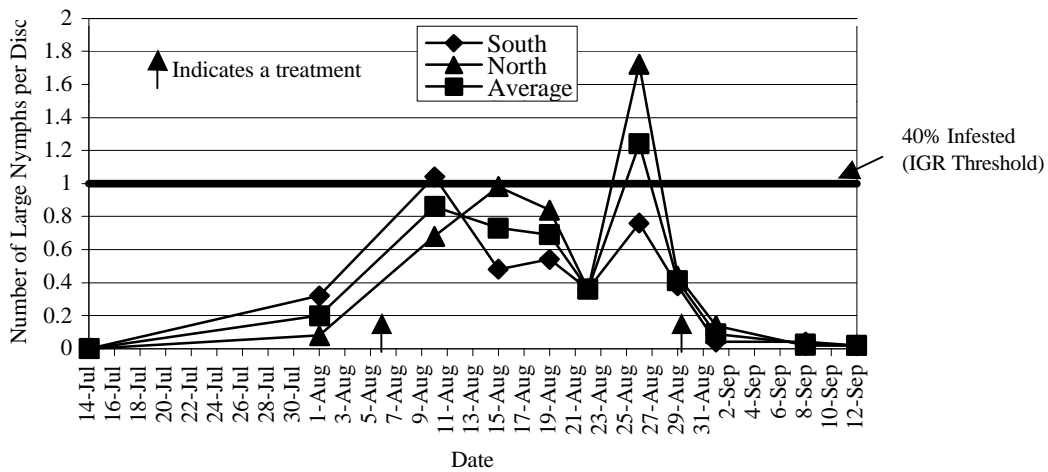


Figure 5. Whitefly nymph counts for the ICM Demonstration Project field in 1999. Values shown are for the South end, North end, and average for the field. Thirty discs per bench were taken.