Late Season Crop Management Effects on Fiber Micronaire

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Abstract

A field experiment was conducted during the 2002 growing season to evaluate a central Arizona grower's method of addressing cotton fiber micronaire based on the management and timing of his agronomic inputs. The success of his inseason management, irrigation termination decision combined with his method of defoliation has led to a consistent production of premium fiber micronaire in recent years. Steps to accomplish crop defoliation and the subsequent mixing of seed cotton from the top (younger) and lower (older) bolls achieved at harvest are intended to keep the micronaire at premium levels and further prevent discounts on the crop. A companion study was conducted at the University of Arizona Maricopa Agricultural Center (MAC-1,175 ft. elevation) in an effort to duplicate the grower's late season crop management operations. This study consisted of two treatments, a control (conventional) which received an application of 10 oz. Ginstar combined with ½ pt. surfactant in 20 gal./acre carrier and a treatment which received the conventional treatment in addition to a pre-defoliation Accelerate and a post-defoliation Gramoxone applications consistent with the grower's methods. Plant growth and development measurements taken inseason revealed that height to node ratio (HNR) and fruit retention (FR) levels estimates were similar for both sites (grower fields and MAC study). Lint yield estimates indicated no difference between the conventional defoliation and the treatment receiving additional compounds at MAC. Results of the analyses performed on final micronaire data also indicated no significant difference in micronaire values between the two methods of defoliation and late season management at MAC. Fiber micronaire values exceeded the premium level (>5.0) for both treatments at MAC. However, results obtained from the cooperator-grower gin records revealed that average fiber micronaire for all of the fields monitored in this project were at premium level (<5.0).

Introduction

Discounts associated with high fiber micronaire have been extremely costly to Arizona cotton producers in the Arizona cotton industry in recent years. Recent studies have shown that there are a clear set of interactions associated with the environment, genetics (varieties), and crop management factors in relation to final fiber micronaire readings. In an effort to further delineate the relationship among these factors, numerous experiments have been conducted in the lower elevations of Arizona in recent years (below 2,000 ft. elevation). These studies have shown a strong influence associated with late season management (particularly irrigation termination) and fiber micronaire readings. Also, from survey work associated with these same projects, a clear relationship was also revealed for some growers that have a distinct tendency to produce cotton below the discount range in terms of fiber micronaire (<5.0).

In survey work done with growers that have a distinct tendency to produce micronaire below the discount range, some growers obviously have some late season management techniques that seem to be very conducive to producing a crop with high yield and favorable micronaire. One grower in the Eloy/Arizona City of Pinal County offered to cooperate with us on a project to evaluate late season management techniques associated with defoliation and harvest preparation. Several fields were selected for close monitoring in the Eloy/Arizona City area during the 2002 growing season. A companion study was established at the University of Arizona Maricopa Agricultural Center (MAC) in an attempt to duplicate and mirror the late season treatments that were being applied in the Arizona City case for further evaluation. Particular treatments that were of interest in relation to the grower's experience included a pre-termination application of Accelerate followed by standard defoliation procedures and then a subsequent application of a mixture of Gramoxone and Ginstar.

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Extensive cotton defoliation work has been conducted in Arizona in recent years. A series of projects began in 1987 with a single field experiment that was conducted in the Yuma Valley to compare several defoliation treatments on a field of Pima cotton (Silvertooth and Howell, 1988). That experiment was followed by a series of at least four similar experiments each year from 1988 (Silvertooth et al., 1989), 1989 (Silvertooth et al. 1990) and 1990 (Silvertooth et al., 1991) in an effort to expand locations, and treatment comparisons. Some treatment consistencies were identified from the 1987, 1988, and 1989 experiences, which were then used for the 1990, 1991 (Silvertooth et al., 1992), and 1992 (Silvertooth et al., 1993) experimental projects. Nelson and his associates have also conducted a number of experiments concerning defoliation factors and refinement (Nelson and Hart, 1991a; Nelson and Hart, 1991b; and Nelson and Silvertooth, 1991). Common treatments resulting from this earlier work include Dropp + DEF and Dropp + Accelerate combinations, with increasing rates as temperature conditions cool. The 1994 and 1995 experiments represent an extension of this general project, and particularly the 1993 experiments, in terms of evaluating some new combination treatments and attempting to refine recommendations and guidelines (Silvertooth and Norton, 1995). One defoliation study of interest conducted by Nelson and Hart (1995) showed boll opener treatments and the use of combination of defoliants had no significant effect on lint yield or fiber properties.

There is evidence from earlier studies conducted in Arizona that irrigation termination (IT) management (Silvertooth et al., 1989; Silvertooth et al., 1990; Silvertooth et al., 1991; Silvertooth et al., 1992; and Silvertooth et al., 1993; Silvertooth et al., 1994; Silvertooth and Norton, 1996; Silvertooth and Norton, 1997) has a significant effect on yield and quality. There is also some evidence to suggest that the combination of IT and/or defoliation management can have a significant impact on fiber micronaire. Recent studies in Arizona have revealed a significant reduction in fiber micronaire as a function of early IT management (Silvertooth et al., 2001; Silvertooth and Galadima, 2002).

The current study was initiated to mimic and document a grower-cooperator's protocol of timing some of his season-end operations and of course his method of defoliation, in which he first applies the Accelerate, then the Ginstar, and lastly Gramoxone to desiccate and crack open the top late bolls so that a resultant harvest produces a premium fiber micronaire. The defoliation protocol ensures that the top bolls are ready to be picked into a well-mixed seedcotton during the harvest. The objective of this project was to evaluate late season management factors associated with defoliation and harvest preparation in relation to final fiber micronaire measurements.

Materials and Methods

A field experiment was conducted in 2002 at MAC to evaluate a cooperator-grower's (Mr. Jim Shedd) in-season and late-season crop management operations that include defoliation procedures and to evaluate their impact on fiber micronaire.

The experiment included an Upland cotton (var. DP 458BR) that was dry-planted and watered-up on a Casa Grande sandy loam on 4 April at MAC (1,175 ft. elevation). The experiment involved two treatments and was structured in a randomized complete block design with four replications. Plots were six, 40 inch rows wide and extended the full length of the irrigation run (600 ft.). Date and rates of all agronomic inputs are shown in Tables 1-3. Tables 1 and 2 shows the records from MAC and Table 3 presents records for the cooperator-grower located at Arizona City. At the grower-cooperator location, data was collected from two field blocks of 10 and 13 acres planted to AP9527 and AP7126 cotton varieties, respectively.

All pest control and irrigation management practices at MAC were carried out on an as-needed basis. Basic plant measurements were collected from both locations. Crop measurements included plant height, number of mainstem nodes, node of the first fruiting branch, number of aborted or missing fruit, and the number of nodes above the top white flower (NAWF) on 14-day intervals. This information was collected to track crop growth and development over the season. Lint yields were obtained at MAC for each treatment by harvesting the entire center four rows of each plot with a four row mechanical picker. Seedcotton subsamples were collected for ginning, from which lint turnout estimates were made. Lint yield and fiber micronaire data were subjected to analysis of variance according to procedures outlined by Gomez and Gomez (1984) and the SAS Institute (1996) to determine if significant differences in yield and micronaire due to defoliation treatments were observed. At Arizona City, seedcotton was harvested from each field block into separate modules that were later sent to the gin and then to the USDA Cotton Classing Office in Phoenix for HVI analysis. Data from the gin and classing office were obtained from which average yield and micronaire values were determined.

Results and Conclusions

Basic plant measurements did not reveal differences between the conventional defoliation treatment and the treatment receiving a pre-defoliation Accelerate and post-defoliation Gramoxone applications. Fruit retention (FR) and the height to node ratio (HNR) levels tracked within the thresholds and the normal range for Upland cotton for the entire season at both MAC and AZ City (Figures 1 and 2). Lint yield results (Table 4) indicated no differences between the two treatments at MAC. In addition, fiber quality parameters, which included micronaire and strength, were not significantly different between the two treatments at MAC (Table 4). Our inability to achieve a premium micronaire (<5.0) at MAC was clearly a function of not matching the exact timing of the critical operations such as irrigation termination, defoliation, and late season crop management steps that were employed by the grower. In addition, each operation at MAC had to follow what the grower had previously carried out creating the time lag. Tables 3 and 5 provide information concerning heat units accumulated after planting (HUAP) at critical management points in the season. Figures 1 and 2 illustrate the timetable for some of the late-season operations at MAC and Arizona City.

A well-mixed seedcotton harvest (from top and lower bolls) may help to lower final micronaire values, but it appears that the interaction among seed type, location, and management particularly timing of operations (N inputs, irrigation termination, and defoliation) is the most critical element (Figures 1 and 2). Further work needs to be done to better elucidate the successful methods employed by the grower-cooperator so that it can be duplicated and transported to other locations. However, it is clear that the success associated with his approach is not a simple matter of making an Accelerate application prior to IT and defoliation.

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References

Gomez, K.A. and A.G. Gomez. 1984. Statistical Procedures for Agricultural Research. (2nd ed.) John Wiley & Sons. New York.

Nelson, J. M. and G Hart. 1991a Defoliation research on Pima cotton at the Maricopa Agricultural Center in 1990. Cotton, A College of Agriculture Report. University of Arizona, Series P-87:33-35.

Nelson, J. M. and G Hart. 1991b. Effect of plant nitrogen on effectiveness of defoliations for short season cotton production. Cotton, A College of Agriculture Report. University of Arizona, Series P-87:39-41.

Nelson, J. M. and J.C. Silvertooth. 1991. Defoliation research on Pima cotton at the Marana Agricultural Center in 1990. Cotton, A College of Agriculture Report. University of Arizona, Series P-87:36-38.

Nelson, J. M. and G Hart. 1995. Effect of Combinations of Accelerate and other defoliants on Defoliation and Yield of Pima and Upland Cotton. Cotton, A College of Agriculture Report. University of Arizona, Series P-99:63-66.

SAS Institute. 1996. SAS/STAT: Procedures. Release 6.03 ed. SAS Inst., Cary, NC.

Silvertooth, J.C. and A. Galadima. 2002. Evaluation of irrigation termination effects on fiber micronaire and yield of Upland cotton, 2001-2002. p. 17-41. Cotton, Univ. of Arizona Rep. P-130.

Silvertooth, J.C., A. Galadima, E.R. Norton, and H. Moser. 2001. Evaluation of irrigation termination effects on fiber micronaire and yield of Upland cotton, 2000. p. 13-24. Cotton, Univ. of Arizona Rep. P-125.

Silvertooth, J. C. and D. R. Howell. 1988. Defoliation of Pima cotton. Cotton, A College of Agricultural Report. University of Arizona, Series P-72:117-120.

Silvertooth, J. C., D. R. Howell, S. W. Stedman, G. Thacker, and S. S. Winans. 1989. Defoliation of Pima cotton, A College of Agriculture Report. University of Arizona, Series P-77:77-81.

Silvertooth, J. C., D. R. Howell, S. W. Stedman, G. Thacker, and S. S. Winans. 1990. Defoliation of Pima cotton, 1989. A College of Agriculture Report. University of Arizona, Series P-81:20-22.

Silvertooth, J. C., and E. R. Norton. 1995. Cotton defoliation evaluations, 1994. Cotton, A College of Agriculture Report. University of Arizona, Series P-99:34-39.

Silvertooth, J.C., and E.R. Norton. 1996. Evaluation of irrigation termination management on yield of upland cotton, 1995. p. 40-45. Cotton, Univ. of Arizona Rep. P-103.

Silvertooth, J.C., and E.R. Norton. 1997. Evaluation of irrigation termination management on yield of upland cotton, 1996. p. 218-224. Cotton, Univ. of Arizona Rep. P-108.

Silvertooth J. C., J. E. Malcuit, D. R. Howell and P. Else. 1989. Effect of date of planting on the lint yield of several cotton varieties planted at four locations in Arizona, 1988. p. 69-72. Cotton, Univ. of Arizona Rep. P-77.

Silvertooth, J. C., S. H. Husman, G. Thacker, D. R. Howell and S. S. Winans. 1991. Defoliation of Pima cotton, 1990. Cotton, A College of Agriculture Report. University of Arizona, Series P-87:18-32.

Silvertooth, J. C., S. H. Husman, S. W. Stedman, P. W. Brown, and D. R. Howell. 1992. Defoliation of Pima cotton, 1991. Cotton, A College of Agriculture Report. University of Arizona, Series P-91:289-301.

Silvertooth, J. C., S. H. Husman, P. W. Brown, and J. Burnett. 1993. Cotton defoliation evaluations, 1992. Cotton, A College of Agriculture Report. University of Arizona, Series P-94:44-55.

Silvertooth, J. C., S. W. Stedman, R. E. Cluff, and E. R. Norton. 1994. Cotton defoliation evaluations, 1993. Cotton, A College of Agriculture Report. University of Arizona, Series P-96:49-56.

Silvertooth J. C., T. F. Watson, L. I. Terry, and J. E. Malcuit. 1990. Evaluation of date of planting and irrigation termination in the yield of Upland and Pima cotton. p. 6-12. Cotton, Univ. of Arizona Rep. P-81.

Silvertooth J. C., T. F. Watson, L. I. Terry, and J. E. Malcuit. 1991. Evaluation of date of planting and irrigation termination in the yield of Upland and Pima cotton. p. 1-14. Cotton, Univ. of Arizona Rep. P-87.

Silvertooth J. C., T. F. Watson, J. E. Malcuit, and P. W. Brown. 1992. Evaluation of date of planting and irrigation termination in the yield of Upland and Pima cotton. p. 252-273. Cotton, Univ. of Arizona Rep. P-91.

Silvertooth J. C., T. F. Watson, J. E. Malcuit, and P. W. Brown. 1993. Evaluation of date of planting and irrigation termination in the yield of Upland and Pima cotton. p. 27-39. Cotton, Univ. of Arizona Rep. P-94.

Table 1. Agronomic information for the Defoliation and Micronaire study, MAC, AZ, 2002.

		Heat Units (HU)
Variety	DP 458BR	
Planting Date	2 April	547 (since Jan. 1)
Termination Date	14 August	3057 HUAP (HU after planting)
Harvest Date	26 November	

Table 2. Treatments for the Defoliation and Micronaire study, MAC, AZ, 2002.

	Treatment		
	1	2	
Application Date*	Conventional	Conventional + Accelerate + Gramoxone	HUAP
20 September	0	1½ pint Accelerate + ½ pint surfactant /acre	4033
2 October	10oz Ginstar + ½ pint surfactant	10oz Ginstar + ½ pint surfactant /acre	4289
24 October	0	1½ pint Accelerate + ½ pint surfactant + 14 oz Gramoxone /acre	4634

*Each application carried out using 20 gal./acre carrier

Table 3. Listing for all dates for the Cooperator-Grower (Mr. Jim Shedd) Arizona City, 2002.

Varieties (AP7126 and AP9257)	Date	HU
Planting Date	20 April	854 since Jan. 1
Irrigation Termination Date	9 September	3326 (HUAP)
1½ pint Accelerate + ½ pint surfactant Application Date	20 September	3589 (HUAP)
Defoliant – 10oz Ginstar + ½ pint surfactant Application Date	27 September	3750 (HUAP)
12 oz Gramoxone + 1½ pint Accelerate + ½ pint surfactant Application Date	4 October	3861 (HUAP)
Harvest Date	13 October	

Table 4. Lint yield and micronaire results of the micronaire evaluation study, MAC, AZ, 2002.

Treatment	Lint Yield (lbs. lint/acre)	Micronaire	Fiber Strength
1	1699	5.3	31.5
2	1749	5.3	31.1
LSD	NS	NS	NS
OSL	0.5145	0.9999	0.4743
C.V. (%)	5.5	2.4	2.5

Table 5. Lint yield and micronaire results of the micronaire evaluation study for Jim Shedd, AZ City, 2002.

Variety	Average Lint Yield (lbs. lint/acre)	Average Micronaire	Average Fiber Strength
AP7126	1827	4.8	30.1
AP9257	2320	4.9	31.2

Figure 1. Mr. Jim Shedd, AZ City

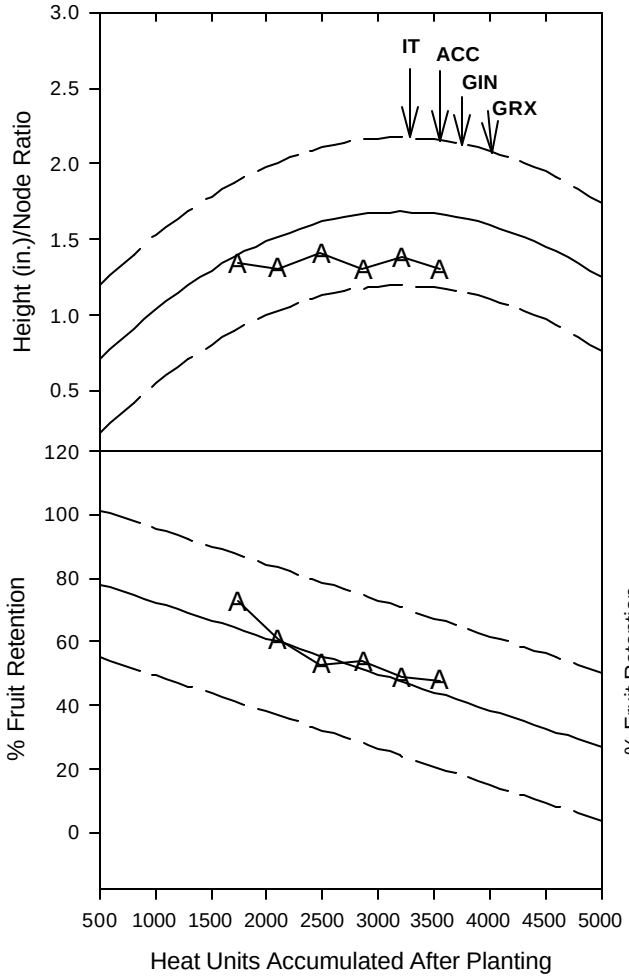
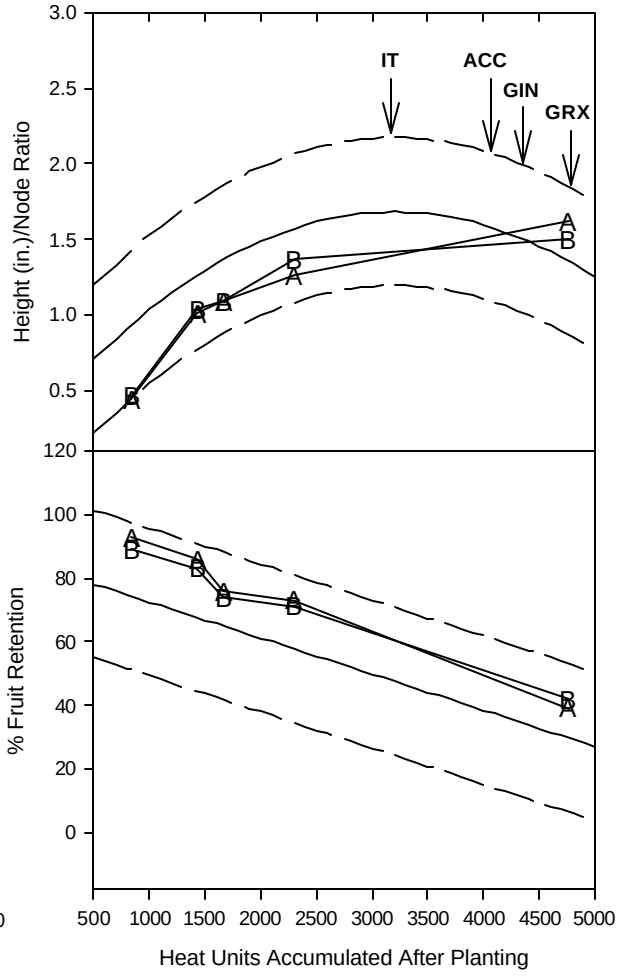


Figure 2. Defoliation and Mic Study, MAC



Figures 1 & 2. Height to node ratio and Fruit retention curves for Jim Shedd, AZ City and Defoliation and Micronaire Study, MAC showing dates of defoliation treatments respectively.
(IT=Irrigation Termination; ACC=Accelerate; Gin=Ginstar; GRX=Gramoxone)