

# Late Season Crop Management Effects on Fiber Micronaire

J.C. Silvertooth and A. Galadima

## Abstract

*A field experiment was conducted during the 2002 and 2003 growing seasons to evaluate a central Arizona grower's method of addressing high cotton fiber micronaire based on the management and timing of agronomic inputs. In-season management and irrigation termination combined with defoliation methods has led to 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 in 2002 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 1/2 pt. surfactant in 20 gal./acre carrier and a treatment which received the conventional treatment in addition to a pre-defoliation of Accelerate and a post-defoliation of Gramoxone, consistent with the grower's methods. At the grower's location, data was collected during the 2002 and 2003 seasons. In 2002 and 2003, plant growth and development measurements taken in-season revealed that height to node ratio (HNR) and fruit retention (FR) levels tracked well and were similar for both sites and years (grower's fields and MAC study). Lint yield estimates indicated no difference between conventional defoliation and the treatment receiving additional compounds at MAC in 2002. Average yield estimates were high for the cooperator-grower fields in both the 2002 and 2003 seasons. Results of the analysis performed on final micronaire data indicated no significant difference in micronaire values between the two methods of defoliation and late season management at MAC. In addition, fiber micronaire values exceeded the premium level (>5.0) for both treatments at MAC. In contrast, the data of 2002 and 2003 obtained from the cooperator-grower gin records revealed consistent results for average fiber micronaire for all of the fields monitored in this project which were at premium levels (<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.

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 defoliant 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).

This current study was initiated in 2002 with the objective of monitoring and documenting a grower-cooperator's protocol of timing end of season operations, including his method of defoliation, in which he first applies Accelerate, then Ginstar, and lastly Gramoxone to desiccate and crack open the top late bolls so that at harvest blend of all fiber from the total boll load on the plant produces a premium fiber micronaire (Silvertooth and Galadima, 2003). The defoliation protocol employed by the grower has been successful for him, consistently. This approach ensures that the top bolls are well opened and ready to be picked into a well-mixed seedcotton during the harvest. The 2003 project was a continuation of the 2002 evaluation process of the 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 2002 experiment included an Upland cotton (var. DP 458BR) that was dry-planted and watered-up on a Casa Grande sandy loam on 4 April 2002 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 1-5. Tables 1 and 2 shows the records from MAC and Tables 3-5 present records for the cooperator-grower located at Arizona City. At the grower-cooperator location, data was collected in 2002 from two field blocks of 10 and 13 acres planted to AP9527 and AP7126 cotton varieties and in 2003 from three field blocks of 2-10 and 13 acres planted to AP9257, AG3601, and AP7126, 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 sub-samples 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, field measurements (identical to the MAC experiments) were taken at weekly intervals through the end of the season. Seedcotton was harvested from each field unit 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 at MAC in 2002. 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 in 2002 and AZ City in 2002 and 2003 (Figures 1-5). Lint yield results (Table 6) indicated no differences between the two treatments at MAC in 2002. In addition, fiber quality parameters, which included micronaire and strength, were not significantly different between the two treatments at MAC (Table 6). 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 2-5 provide information concerning heat units accumulated after planting (HUAP) at critical management points in the season. Figures 1 and 2 also illustrate the timetable for some of the late-season operations at MAC and Arizona City in 2002.

A well-mixed seedcotton harvest (from top and lower bolls) may help to lower final micronaire values, but it appears that the interactions among variety, location, and management are very important. It is particularly apparent that the timing of certain crop management operations (N inputs, IT, and defoliation) are the most critical elements. Further work was needed to better elucidate the successful methods employed by the grower-cooperator in an effort to identify a pattern and to duplicate and transport these methods to other locations. Hence in 2003, data was again collected similar to 2002, this time from three of the grower-cooperator's fields. Figures 3-5 illustrate the schedule for the 2003 late-season operations at the grower's site (Arizona City). Results obtained from the grower's gin record for 2003 are very consistent with those of 2002. Lint yields averaged about four bales per acre for varieties AP7126 and AP9257 but was lower for AG3601 (Table 7). However, fiber micronaire values were at premium levels for the three varieties and were consistent with the results obtained in 2002 (Table 7). 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 but the timing of the entire set of operations that begin started with IT of the crop. We have also observed that the grower maintained the same strict sequence in his operations for both years providing the successful results. The challenge for the future will be to apply the grower's late-season methods at other locations and realize premium fiber micronaire values. This is particularly true for locations where optimum micronaire values have been elusive.

## **Acknowledgements**

The authors wish to thank the grower that cooperated on this project, Mr. Jim Shedd. The financial support provided by the Arizona Cotton Growers Association and Cotton Inc., the Arizona Cotton Research and Protection Council, the Anderson Clayton Company, and Handwerker-Winburne is greatly appreciated. We appreciate all of the valuable cooperation and technical assistance provided by the staff at MAC. Also, we wish to thank all of the research assistants with the UA Agronomy program for their hard work and the valuable technical assistance provided.

## **References**

- Gomez, K. A. and A. G. Gomez. 1984. Statistical Procedures for Agricultural Research. (2<sup>nd</sup> 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: p. 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. Univ. of Arizona, Series P-87: p. 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. Univ. of Arizona, Series P-87: p. 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. Univ. of Arizona, Series P-99: p. 63-66.
- SAS Institute. 1996. SAS/STAT: Procedures. Release 6.03 ed. SAS Inst., Cary, NC.
- Silvertooth, J. C. and A. Galadima. 2003. Late season crop management effects on fiber micronaire, 2002. Cotton, A College of Agriculture Report. Univ. of Arizona, Series P-134: p. 79-84.
- Silvertooth, J. C. and A. Galadima. 2002. Evaluation of irrigation termination effects on fiber micronaire and yield of Upland cotton, 2001-2002. Cotton, A College of Agriculture Report, Univ. of Arizona, Series P-130: p. 17-41.
- 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. Cotton, A College of Agriculture Report, Univ. of Arizona, Series P-125: p. 13-24.
- Silvertooth, J. C. and D. R. Howell. 1988. Defoliation of Pima cotton. Cotton, A College of Agricultural Report. Univ. of Arizona, Series P-72: p.117-120.
- Silvertooth, J. C., D. R. Howell, S. W. Stedman, G. Thacker, and S. S. Winans. 1989. Defoliation of Pima cotton. Cotton, A College of Agriculture Report. Univ. of Arizona, Series P-77: p. 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. Univ. of Arizona, Series P-81: p. 20-22.
- Silvertooth, J. C., and E. R. Norton. 1995. Cotton defoliation evaluations, 1994. Cotton, A College of Agriculture Report. Univ. of Arizona, Series P-99: p. 34-39.
- Silvertooth, J. C., and E. R. Norton. 1996. Evaluation of irrigation termination management on yield of upland cotton, 1995. Cotton, A College of Agriculture Report, Univ. of Arizona, Series P-103: p. 40-45.
- Silvertooth, J. C., and E. R. Norton. 1997. Evaluation of irrigation termination management on yield of upland cotton, 1996. Cotton, A College of Agriculture Report, Univ. of Arizona, Series P-108: p. 218-224.
- 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. Cotton, A College of Agriculture Report, Univ. of Arizona , Series P-77: p. 69-72.
- 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. Univ. of Arizona, Series P-87: p. 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. Univ. of Arizona, Series P-91: p. 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. Univ. of Arizona, Series P-94: p. 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. Univ. of Arizona, Series P-96: p. 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. Cotton, A College of Agriculture Report, Univ. of Arizona, Series P-81: p. 6-12.

- 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. Cotton, A College of Agriculture Report, Univ. of Arizona, Series P-87: p. 1-14.
- 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. Cotton, A College of Agriculture Report, Univ. of Arizona, Series P-91: p. 252-273.
- 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. Cotton, A College of Agriculture Report, Univ. of Arizona, Series P-94: p. 27-39.

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

Variety	DP 458BR	Heat Units (HU)	
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.

Application Date*	Treatment		HUAP
	1	2	
20 September	Conventional	Conventional + Accelerate + Gramoxone	4033
2 October	10oz Ginstar + ½ pint surfactant	1½ pint Accelerate + 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	4014 (HUAP)

Table 4. Listing for agronomic input dates for cooperator-grower (Mr. Jim Shedd), Arizona City, AZ, 2003.

Variety	AG3601	AP7126	AP9257
Planting Date and HU accumulated after 1 January at planting	10 April (692)	11 April (706)	9 April (677)
Termination Date and HUAP	5 September (3400)	5 September (3386)	5 September (3415)
Harvest Date and HUAP	24 October (4465)	24 October (4451)	24 October (4480)

Table 5. Listing for defoliation exercise (application) dates for cooperator-grower (Mr. Jim Shedd), Arizona City, 2003.

Variety	AP3601	AP7126	AP9257
	HUAP	HUAP	HUAP
1½ pint Accelerate + ½ pint surfactant Application Date - 28 September	3936	3922	3951
Defoliant – 10oz Ginstar + ½ pint surfactant Application Date – 4 October	4079	4065	4094
1 pint Gramoxone + 1½ pint Accelerate + ½ pint surfactant Application Date – 15 October	4307	4393	4322
Harvest Date – 24 October	4465	4451	4480

Table 6. 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 7. Lint yield and micronaire results of the micronaire evaluation study for Jim Shedd, AZ City, 2002 and 2003.

Variety	Average Lint Yield (lbs. lint/acre)	Average Micronaire	Average Fiber Strength
2002			
AP7126	1827	4.8	30.1
AP9257	2320	4.9	31.2
2003			
AG3601	1296	4.5	33.3
AP7126	2016	4.8	29.1
AP9257	1824	4.7	29.1

Figure 1. Mr. Jim Shedd, AZ City, 2002

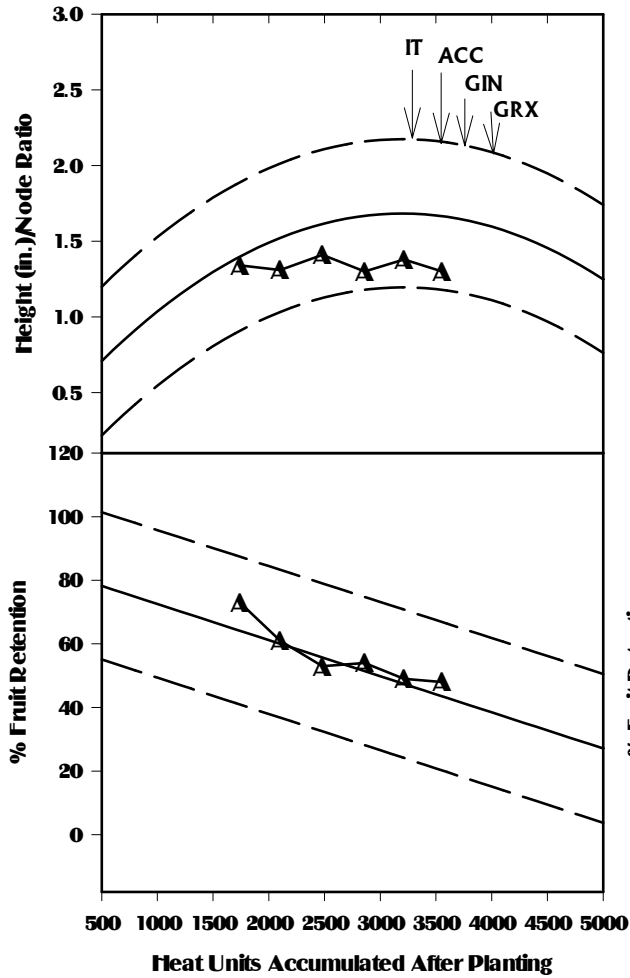
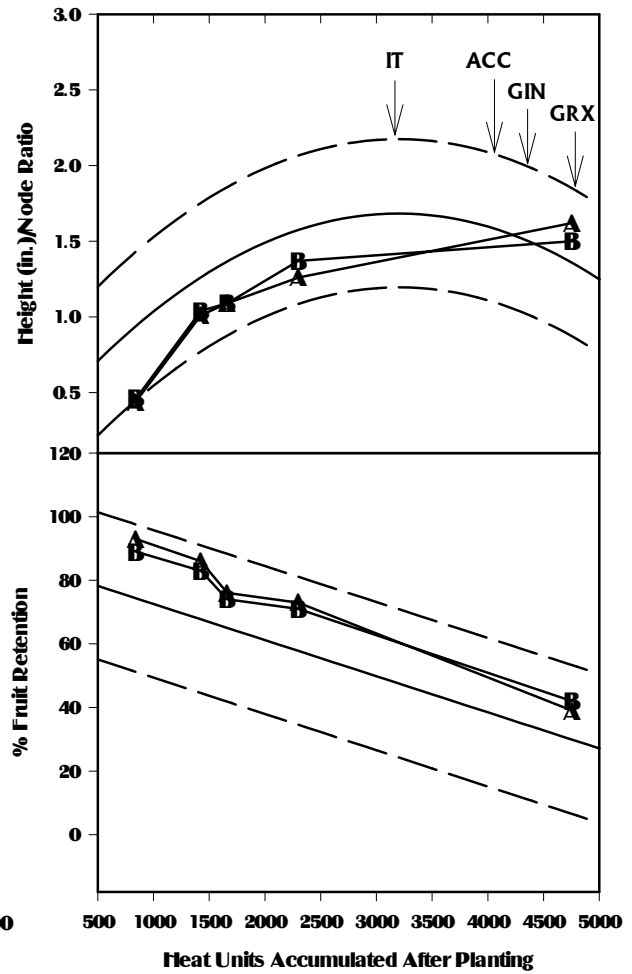
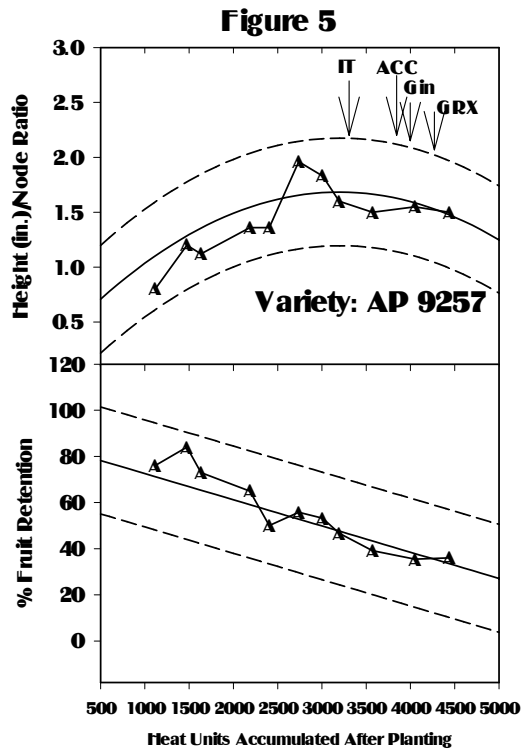
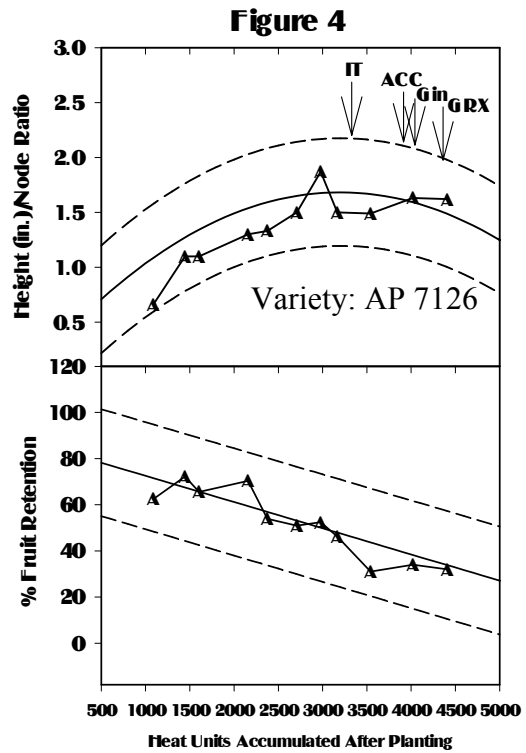
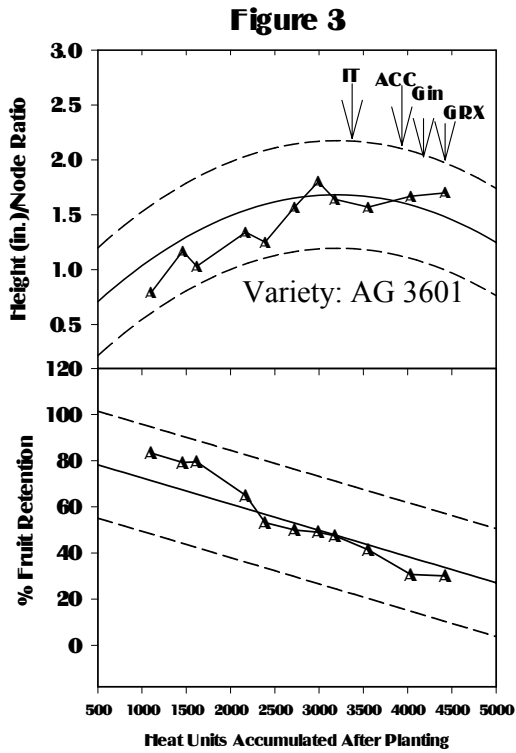


Figure 2. Defoliation and Mic MAC, 2002



Figures 1 & 2. Height to node ratio and fruit retention curves for Mr. Jim Shedd, AZ City and Defoliation and Micronaire Study, MAC respectively showing dates of defoliation treatments, 2002. (IT=Irrigation Termination; ACC=Accelerate; Gin=Ginstar; GRX=Gramoxone)





Figures 3-5. Height to node ratio and fruit retention curves for Mr. Jim Shedd, AZ City, showing dates of defoliation treatment, 2003.