# Recent Yield and Fiber Micronaire Tendencies For Upland Cotton in Arizona

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*Abstract*

*Problems associated with increasing trends towards high micronaire values for Upland cotton (Gossypium hirsutum* L.*) have been a matter of concern for the Arizona cotton industry in recent years. The discounts on fiber value associated with high micronaire has been compounded by the fact that market prices for cotton fiber has been very low in recent years and yields have been stable at best. An evaluation of recent yield and fiber quality data from a number of locations in Arizona was evaluated in relation to trends within Arizona and across the U.S. cotton belt. Results indicate similar patterns exist in terms of stable yields (yield plateau) and increasing micronaire values between Arizona and other U.S. cotton producing states. The conclusion is presented that these patterns are at least due in part to a common genetic base for varieties that grown in Arizona and beltwide. There also appears to be some distinct relationships associated with high micronaire with region and individual farm management practices.*

## Micronaire Trends – Arizona and Beltwide

In evaluating the problems associated with high micronaire in Arizona it is important to develop a perspective in relation to beltwide trends associated with yield and micronaire for Upland in recent years. Thus, we should first consider the trends in Arizona in relation to other cotton producing regions in the U.S. and to identify any similarities in the national or regional patterns.

One of the principle components that contribute to cotton yield is individual fiber weight, which can be directly related to fiber micronaire. All other factors being equal, increasing mic will tend to increase yield as well. However, in recent years while we have experienced trends toward increasing micronaire, we have also had much discussion in Arizona about a possible "yield plateau" and the difficulties associated with achieving high yields with consistency. This has also been a common issue of critical importance in most other parts of the U.S. cotton belt. Figure 1A shows the average yields for Upland cotton in the U.S. from 1975 to 1999 with similar data for Arizona in Figure 1B. The patterns associated with overall U.S. cotton yields and those from Arizona are similar. In general, we can see that 1987 was a very good year in Arizona and beltwide, but since then yields have tended to plateau or perhaps even decline. Figure 2A shows average micronaire for the entire U.S. crop from 1975 to 1999. The trends associated with average mic on a beltwide basis are clearly increasing. In Arizona, general increases in average mic were experienced in approximately 1993 and again in 1996 in relation to long-term trends (Figure 2B). A similar trend was experienced across the entire U.S. cotton belt (Figure 2A).

In Figure 3 the overall distribution of mic values for the entire 1999 U.S. (Figure 3A) and Arizona (3B) Upland cotton crop is presented. The mic distributions in Figure 3 are clearly skewed toward higher values with a peak approaching 5.0 and rapidly declining at a mic > 4.9. In Arizona, the peak in distributions are >5.0 mic. One might conclude from these data that varieties have been bred and developed with a greater propensity toward higher mic fiber and a distinct avoidance of fiber > 4.9 as seen from the sharp decline in mic distributions above that level from the beltwide data (Figure 3A).

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After a review of this information, there appear to be similarities in the relationships associated with mic and yield between Arizona and the rest of the U.S. cotton belt. One common link between Arizona and other segments of the U.S. cotton belt are the varieties being marketed and grown. If the common Upland cotton varieties in the U.S. are being bred with higher mic tendencies (as shown in Figures 2 and 3), their production in an environment conducive to high mic (such as the lower elevations of Arizona) should be expected to result in a higher probability of producing high mic fiber. This does seem to be occurring.

## Environmental and Management Impacts on Micronaire in Arizona

When considering the micronaire characteristics of cotton fiber we commonly regard the following three basic components as being very important: 1) genetics, 2) environment, and 3) management. One very good source of information to assess the genetic or varietal influence on cotton micronaire is the data generated by the statewide variety testing program conducted by the University of Arizona (UA). This program is directed by Dr. Hal Moser (UA) in cooperation with county agents, seed company representatives, and farmer-cooperators in many locations across the state. Another good source of information of this type includes the data provided by commercial seed companies from their variety testing programs in Arizona. Micronaire in these tests will vary widely at different locations. But varieties may have a tendency to produce higher micronaire across locations in a consistent pattern with one another. From some recent analysis of this type of data in central Arizona, Dr. Moser has indicated that only about 20% of the variation in these tests for a particular year was due to genetics (or the variety). Thus, we should try to determine the manner and extent that environment and management serve to influence fiber micronaire.

The data in Figure 1 describe the percentage of the crop classed with Group 5 micronaire (3.5-4.9, below the discount range) in 1998 and 1999 for eight areas in Arizona. From these data we can see that high micronaire is less of a problem at higher elevations ($\geq$ 2,000 ft.), as seen from the Marana. Generally, as you move into lower elevations (e.g. Lower Colorado River Valley), the tendency for higher micronaire increases. However, an important exception to this trend is the data for Wellton-Mohawk (Yuma County). Based on elevation and environmental considerations (e.g. high night temperatures), the Yuma area should be considered a high micronaire environment. However, as shown in Figure 4 Yuma actually has a higher percentage of Group 5 micronaire than many central Arizona locations. When a similar set of varieties are considered among three locations in the Lower Colorado River Valley (Figure 5), we see that the Parker and Mohave Valleys tend to produce higher micronaire values than the Yuma area. These observations support the conclusion that there is a significant contribution from management in the formation of fiber micronaire. One important factor to consider in contrasting Yuma with other areas in Arizona is the dominance of the vegetable industry and the impacts on cotton crop management. Cotton fields are commonly planted earlier and also terminated and defoliated quite aggressively in an effort to accommodate the planting of vegetable crops in the fall.

The fact that crop management can have a significant impact on fiber micronaire is further illustrated in Figure 6 which shows the percentage of the crop classed with various micronaire groupings among certain growers (Growers A – N on the x – axis) in the same central Arizona area. The lighter, upper portions of the bars represent the discount ranges of micronaire ($\geq$ 5.0). Some growers clearly do not have a high micronaire problem while others using the same general set of varieties do. The data are not shown, but it is important to add that the growers with a minimal amount of high micronaire cotton also have very good yields. Thus, management is a very important factor in determining fiber micronaire.

## Management Factors Associated with Fiber Micronaire

It is apparent that a distinct trend exists with increasing micronaire values for Arizona cotton since 1993. At the same time, lint yields have experienced somewhat of a plateau. A similar trend with respect to both micronaire and yield exists for the entire U.S. cotton belt. The three most dominant factors associated with fiber micronaire include 1) genetics, 2) environment (climate), and 3) management. In general, the management objectives I would describe in achieving optimum yields and micronaire are the same as those for realizing early maturity (earliness). There are several selected crop management practices that can have a significant impact on fiber micronaire that are worthy of review and consideration.

The timing of the final irrigation (i.e. irrigation termination) can impact yield and fiber micronaire. At the end of the first fruiting cycle (Figure 7), when the nodes above the top (first position) white flower (NAWF) are 5 or less, the decision needs to be made as to whether the bolls from the first fruiting cycle will be sufficient for the crop to harvest or if a second fruiting cycle (top-crop) will be attempted. If the second fruiting cycle is attempted, an extra six to eight weeks of production time may be needed to realize the full development and maturation of the top-crop. If a sufficient boll load is set through the second fruiting cycle the grower benefits from additional yield. Additionally, fiber in the upper portions of the plant is often has lower micronaire than bolls on the lower portion of the plant. Thus, as the fiber from both portions of the plant is blended, more optimal average micronaire values can be realized.

However, if a substantial boll load is not developed from the top-crop, the additional production time serves to fully mature all the existing bolls from the first fruiting cycle, which includes bringing the micronaire values closer (higher) to their maximum potential. This may be a contributing factor to many of the high micronaire problems recently encountered in Arizona.

The data in Figure 8 illustrates this trend from a study that was conducted with DP NuCotn 33B at Maricopa, AZ comparing three dates of final irrigation. For this experiment, planting was on 9 April and the end of the first fruiting cycle (cut-out) occurred in the first week of August. The treatments consisted of irrigation termination (IT) on 7 August, 20 August, and 17 September. The first IT date (7 August) provided soil moisture on this sandy loam soil sufficient only to mature the blooms that were set the first week of August. The second IT date (20 August) provided one additional irrigation that could be considered as "insurance" to mature the existing fruit load. The final IT date (17 September) was intended to support growth through the top-crop and these plots had also received the 20 August irrigation and some rainfall in late August and early September. Each treatment was defoliated approximately 25-30 days after the final irrigation. For more details on this study see the article on page 34 of the 1998 UA Cotton Report, Series P-112.

As shown in Figure 8, the trends indicated an increase in fiber micronaire with later IT. Yields were good for all treatments, but also tended to increase with later IT. This is certainly not offered as an absolute antidote to the recent problems Arizona has experienced with high micronaire and associated discounts. But, these trends may be important in relation to the impact that management can have on fiber micronaire.

## Summary

We can evaluate the results of this project in terms of the three principle components that we believe contribute to yield and fiber micronaire: 1) genetics, 2) environment, and 3) management. From the information presented it appears that Arizona is not alone in terms of a plateau of Upland cotton lint yields over the past 10 years and increasing micronaire trends in that similar patterns exist between Arizona and the rest of the U.S. cotton belt. Thus, there is a definite question relative to variety or genetic contribution to this effect. There are also some distinct patterns associated with regional location in Arizona and the trends toward high micronaire. Also, it is very clear from the data analyzed that there appears to be some rather strong relationships between fiber micronaire and farm management. It is not clear, however, at this point as to exactly what the most important management factors are.

Based on the facts that cotton varieties are currently being developed for commercial use and distribution across the entire U.S. cotton belt and Arizona is a relatively small market on a beltwide basis, it is not likely, at least in the short-term, to consider the development of special "local' varieties with lower micronaire tendencies for use in the mid- to low-range elevations in Arizona. Thus, it is increasingly important to gain a better understanding of the causes associated with high micronaire and how we might better manage a crop in relation to that. We obviously have a lot to learn in an effort to understand how crop management effects fiber micronaire.

## Acknowledgements

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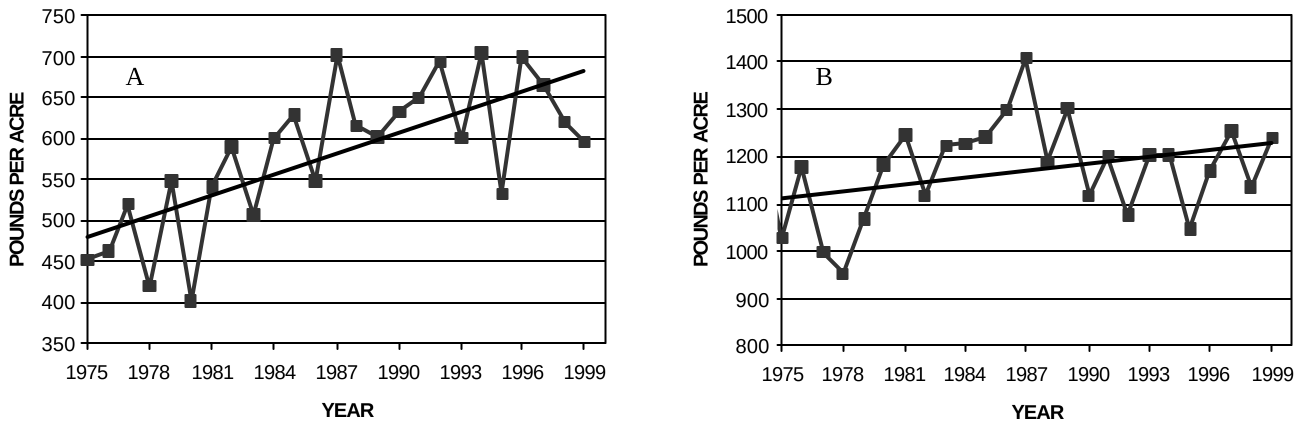


Figure 1. US (A) and Arizona (B) yield trends.

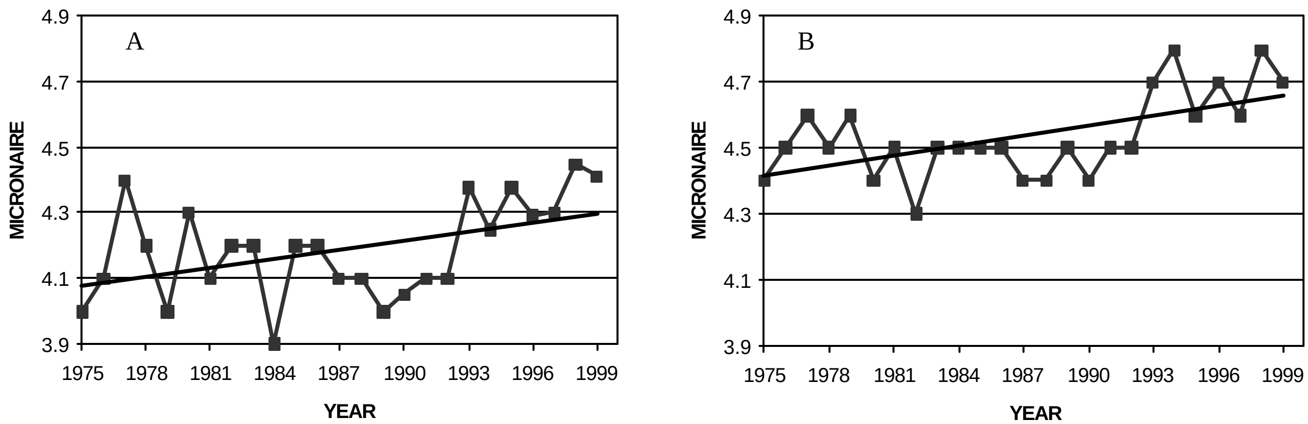


Figure 2. US (A) and Arizona (B) micronaire trends.

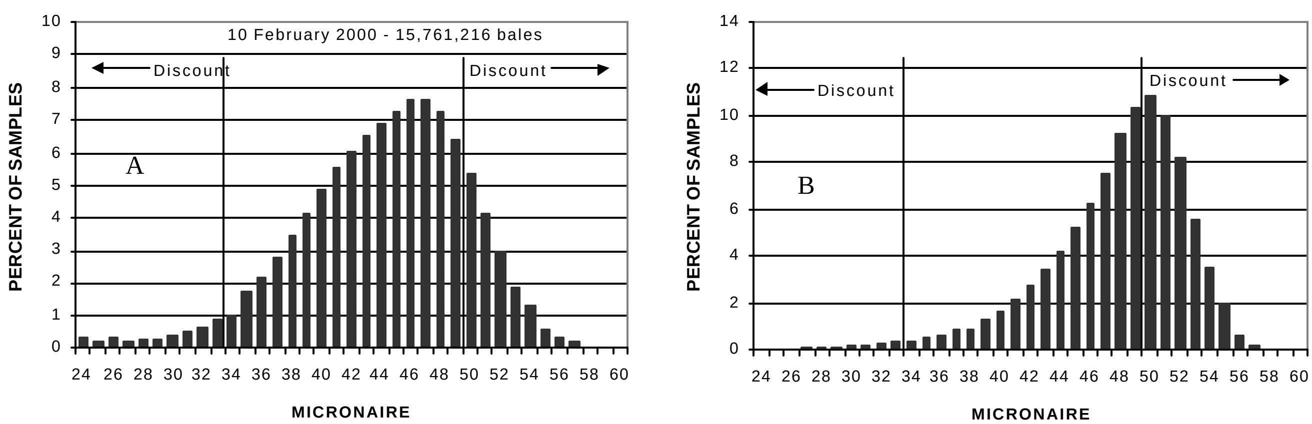


Figure 3. Percent of samples in micronaire categories for US (A) and Arizona (B), 1999 crop.

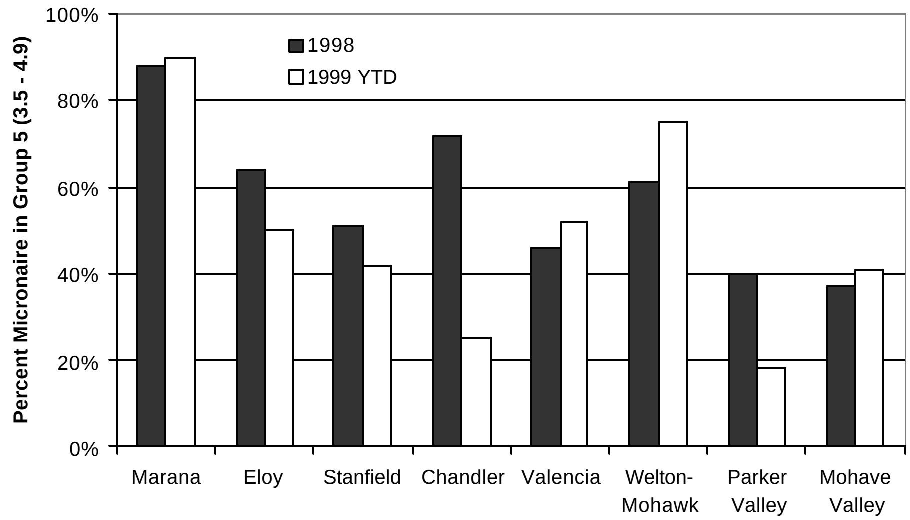


Figure 4. Percentage of the Arizona crop by selected locations in 1998 and 1999 classed in micronaire groupings.

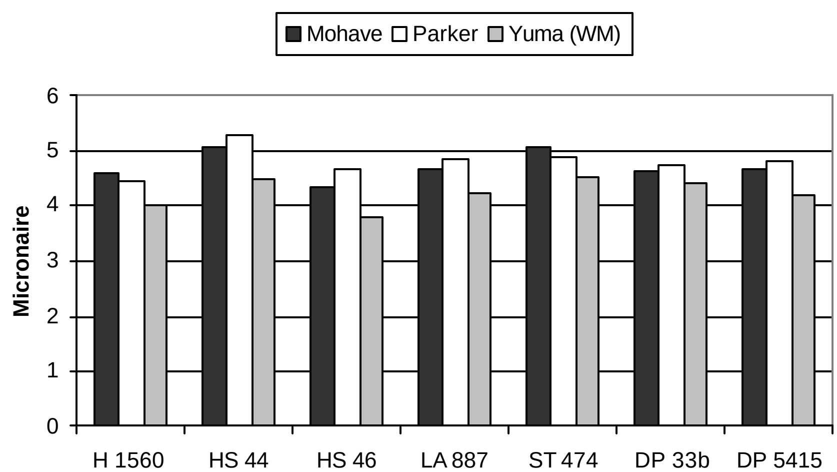


Figure 5. Micronaire trends for several varieties in three Lower Colorado River Valley locations, 1999.

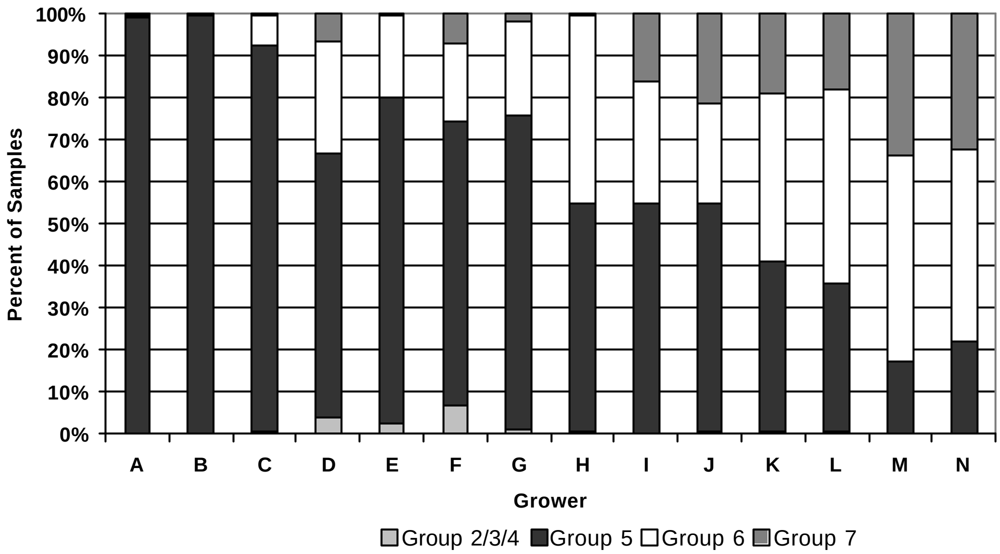


Figure 6. Distribution of micronaire values among several growers in a central Arizona area, 1999. [**NOTE:** Data used in Figures 4-6 courtesy of the Anderson-Clayton Company.]

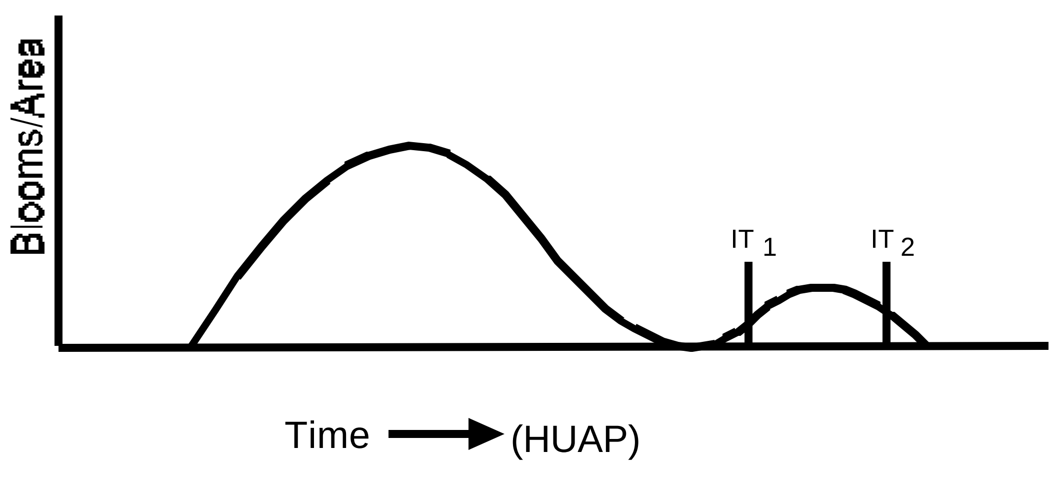


Figure 7. General cotton fruiting cycle with two hypothetical irrigation termination (IT) points.

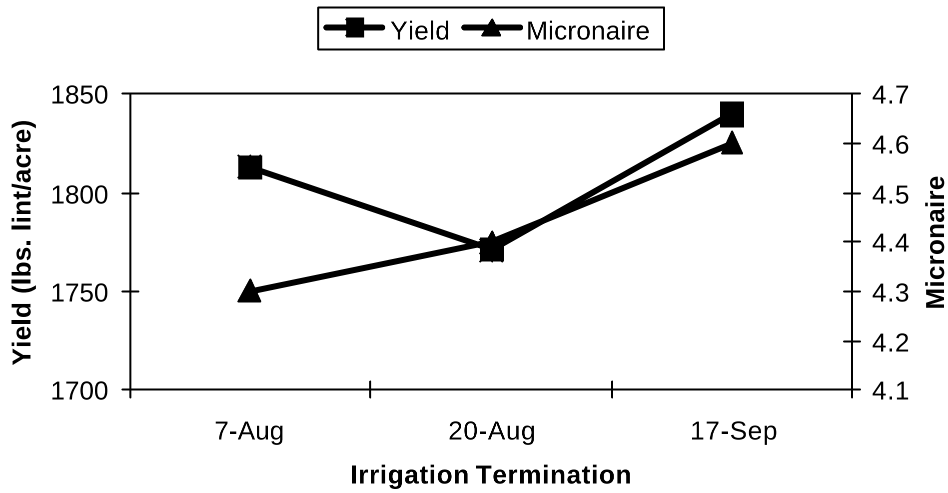


Figure 8. Irrigation termination treatment effects on yield and micronaire, Maricopa, AZ, 1997. [Variety = DP 33b, date of planting = 9 April, and cut-out was evident on 4 August 1997]