GENETIC SHORT FIBER CONTENT OF AMERICAN UPLAND COTTON

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Ⅰ. Introduction.

Recently there has been a strong expression of interest by US cotton spinners in the short fiber content of American upland cotton. This surge of interest may be driven by intense global competition, as evidenced by the continued escalation of textile imports into the US, advances in spinning technology which benefit from lower shot fiber content, both of these and , perhaps other factors.

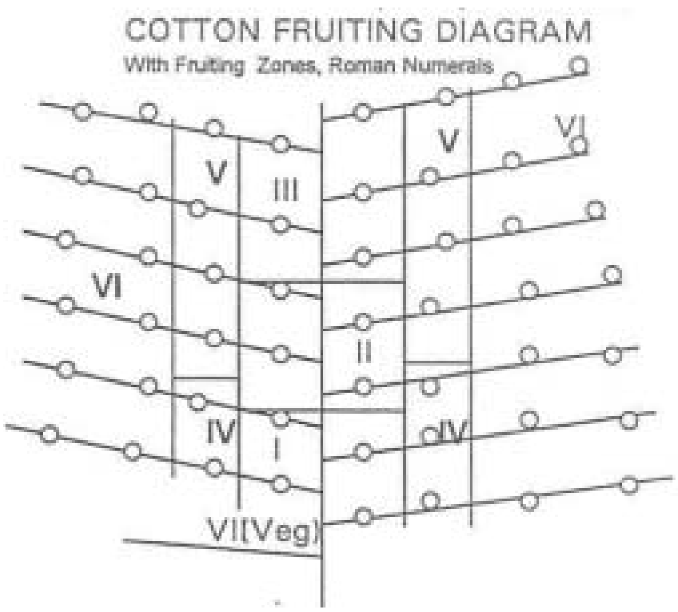
Earlier this year, the board of directors of the National Cotton Council approved a resolution urging inclusion of a short fiber content measurement in the spectrum of fiber qualities reported by the Cotton Division, AMS, USDA. The resolution reads as follows: “Endorse the importance of short fiber content as a quality factor for textile processing: and by August 1, 1999, determine a consistent and reliable common measurement for the industry and, evaluate the impact of reporting short fiber content as part of the official cotton class”

At the EFS Conference, held in Greenville, SC in 1997, Mr. Jeff Alverson of Russell Corporation raised the question as to the source of the short fibers in a bale of cotton. Specifically, he asked the question, "What of the genetic short fiber content of cotton"?

As a result of the question raised by Mr. Alverson and the National Cotton Council resolution, the research reported in this paper was developed on an attempt to address the level of variance in genetic short fiber content among some existing cotton varieties and the level of variance within individual varieties. This information seems essential to satisfying the conditions set out in the above quoted National Cotton Council resolution.

Ⅱ. Experimental Procedure.

All cotton varieties included in this study were planted in N.E. Arkansas on may 6, 1997 and hand thinned, at the 2nd true leaf stage, to a final population of 3 plants per linear foot of row. All other management practices, including soil type, irrigation amounts and timing, fertility, weed control, insect control, etc. were identical. No harvest aids or plant growth regulators were utilized are depicted of the Cotton Fruiting Diagram to the right. Seed cotton from each Fruiting of lint cleaning. The weight of lint was determined by fruiting zone.



Subsequently, all fiber samples were tested by Cotton incorporated for fiber properties including short fiber content via HVI and AFIS. The weighted average short fiber content was determines by multiplying the short fiber content of each fruiting zone by its fractional contribution to yield and totaling these products. this procedure gives a reasonable estimate of the short fiber content to be expected in a well blended sample of such cotton fiber.

Ⅲ. Results And Discussion.

Figure 1 shows the weighted average genetic short fiber content of eight currently produced varieties of American upland cotton.

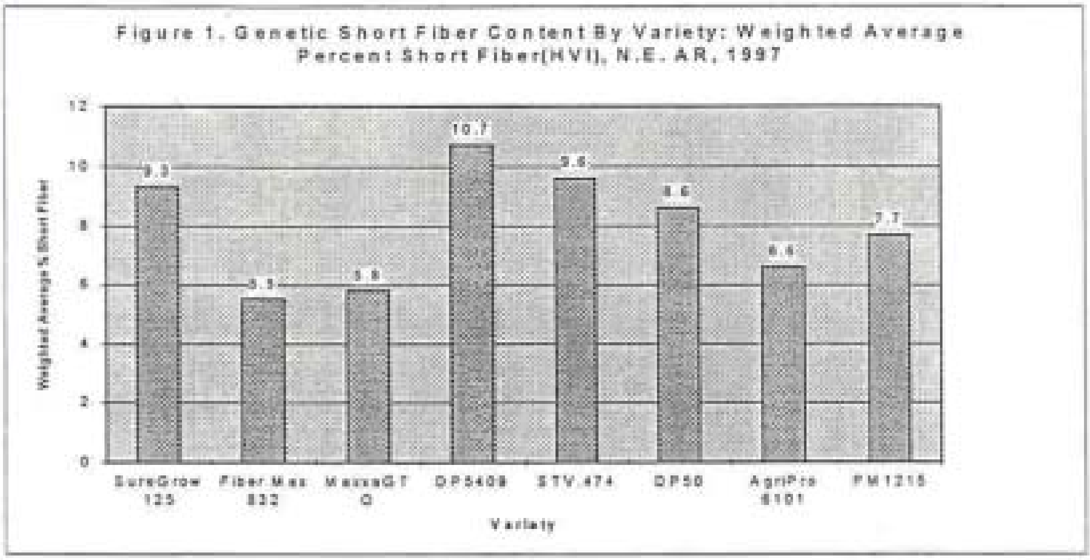


Figure 1. Genetic Short Fiber Content By Variety: Weighted Average Percent Short Fiber(HVI), N.E. AR, 1997

Of the eight varieties shown in Figure 1, half of them had a genetic short fiber content greater than 8 percent and half of them had a genetic short fiber content lower than eight percent. One of the newest varieties, FiberMax 832, had the lowest genetic short fiber content, i.e. 5.5 percent DeltaPine 5490,a relatively with the lowest genetic level of short fiber. These findings constitute strong evidence that genetic shirt fiber content could be improved by applying selection pressure for it, that is, the genes which result in a lower short fiber content do exist in the American upland cotton genome.

It is noteworthy that the oldest variety included in this study, Deltapine 50. did not have the highest genetic short fiber content. In fact, three of the more recent varietal releases, DeltaPine 5490, Stoneville 474 and SureGrow 125 had higher genetic short fiber content levels than breeding of these varieties. This is easily understood, since the current market places no value on lower short fiber content and has not identified this quality factor as important. Implementation of the above quoted National Cotton council resolution will, perhaps, result in market forces which will stimulate the breeding of new varieties with improved short fiber content levels.

As outlined above, the lint from seven different locations on the cotton plant (Fruiting Zones) was maintained separate and the short fiber content from each of these Fruiting Zones determined. Figures 2,3 and 4 show these data for three of the varieties, Suregrow 125 a very popular rainbelt variety, Acala Maxxa GTO the latest production variety from the San Joaquin Valley of California and FiberMax 832, a new variety of Australian origin, which has been introduced into the u.s. rainbelt for the 1998 production season by AgrEvo Cotton seed International (ACSI).

These data clearly show a high level of variation in genetic short fiber content among Fruiting Zones. SureGrow 125, which had the highest weighted average genetic short fiber content (9.3%), also had the lowest level of variation (2.2%) of the three varieties shown. It is uniformly high in genetic short fiber content.

Figure 2. SureGrow 125: Genetic Short Fiber Content By Fruiting Zone, N. E. AR, 1997 (Range = 2.2%)

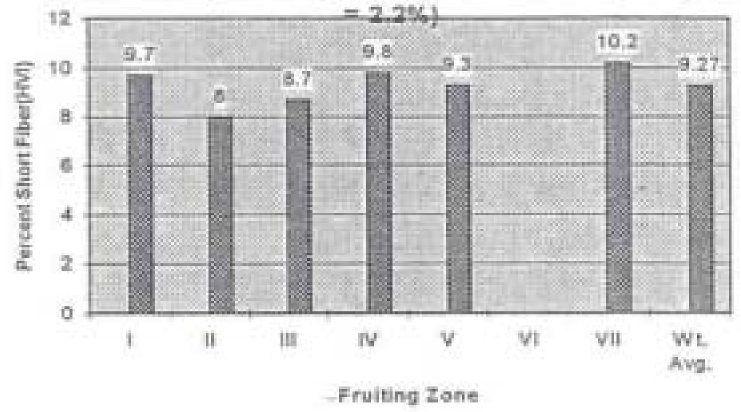


Figure 3. FiberMax 832: Genetic Short Fiber Content By Fruiting Zone, N.E. AR, 1997 (Range= 6.2%)

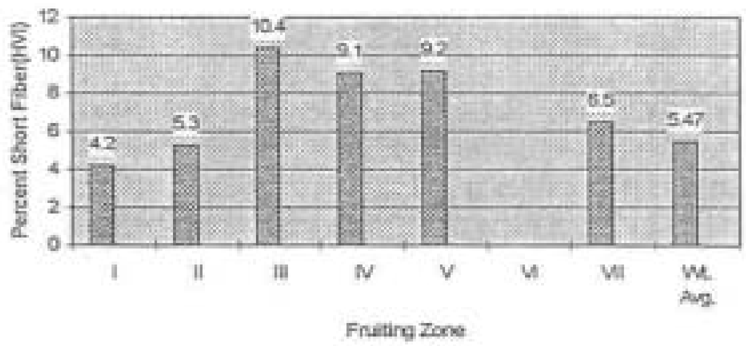
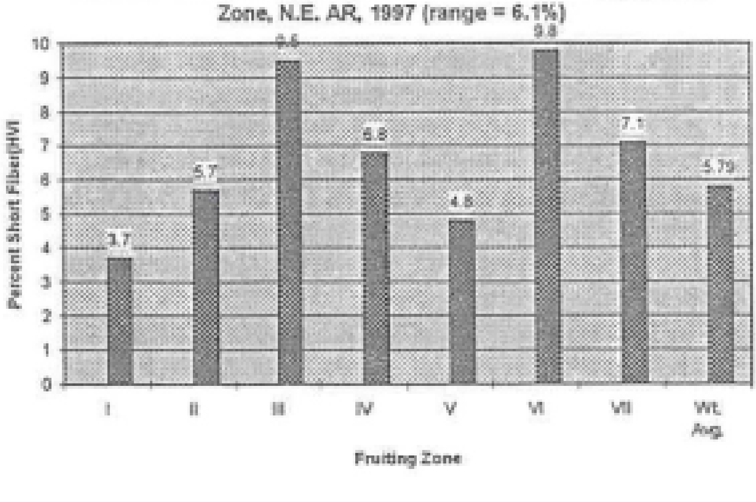
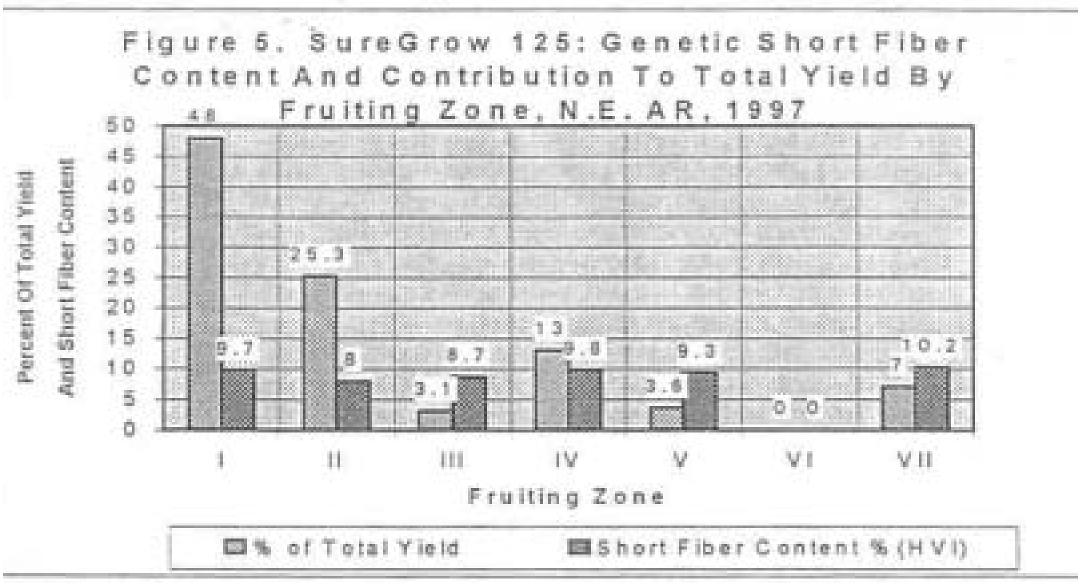


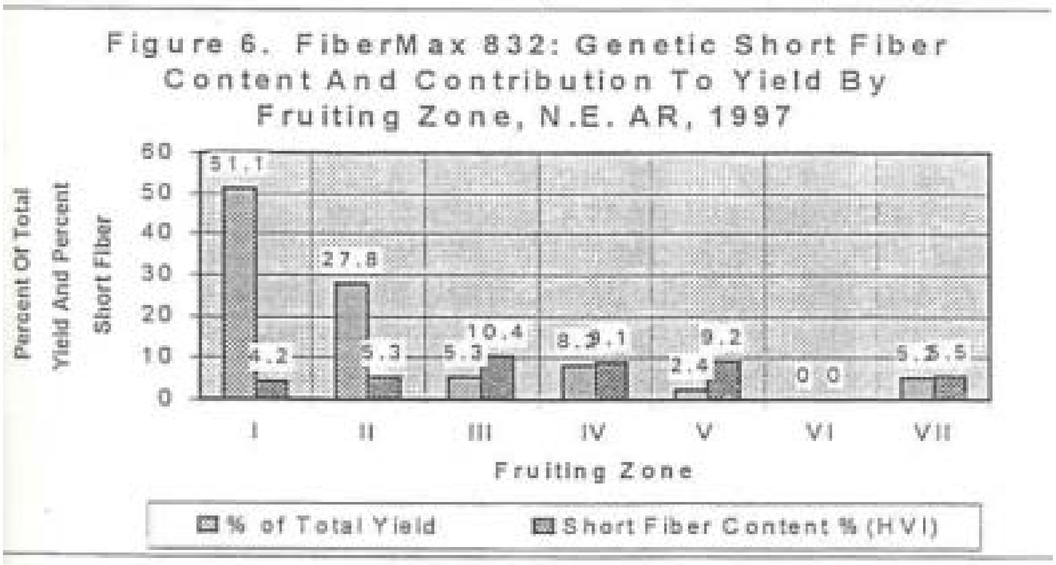
Figure 4. Maxxa GTO: Genetic Short Fiber Content By Fruiting Zone, N.E. AR, 1997 (range = 6.1%)



The other two varieties, FiberMax 832 and Maxxa GTO, had the lowest weighted average genetic short fiber content but the highest level of variation among Fruiting Zones. i.e. a little over6 percent. These data clearly show that the short fiber content is profoundly influenced by forces fiber than just the presence of the appropriate genes. This is true because all the fiber, and other somatic cells, from the same plant have the same genes. Thus, it seems likely that the regulation of expression of genes involved in initiation and elongation of cotton fiber cells is intimately related to the genetic short fiber content of lint from bolls from specific locations on the plant. since bolls, seed and fiber from different locations on the plant develop at different times during the growing season, it is reasonable to suggest that these differences are due to different environmental conditions which occurred during fiber development of individual bolls and closely associated groups of bolls such as those in the same Fruiting Zone. Cotton Bolls are initiation in an arithmetic progression, i.e., there approximately three days difference in the time of boll initiation of the same position boll from fruiting branch to fruiting branch and about six days difference in the time of boll initiation from position on the same fruiting branch.

Figures 5,6 and 7 suggest that other genetic and management factors may influence genetic short fiber content. These figures show the genetic short fiber content and the fractional contribution to total lint yield by Fruiting Zone. In the case of SureGrow 125, a little more than 73percent of it's yield was produced in Fruiting Zones I and Ⅱ, i.e., the first eight 1st position bolls. These two Fruiting Zones had 9.7 and 8 percent short fiber, respectively.





Acala Maxxa GTO produced almost 66 percent of it's yield in these same fruiting positions which had short fiber contents of 3.7 and 5.7 percent respectively. Fibermax 832 produced nearly 79 percent of it's yield In Fruiting Zones ¥°and¥± which had short fiber contents of 4.2 and 5.3 percent respectively.

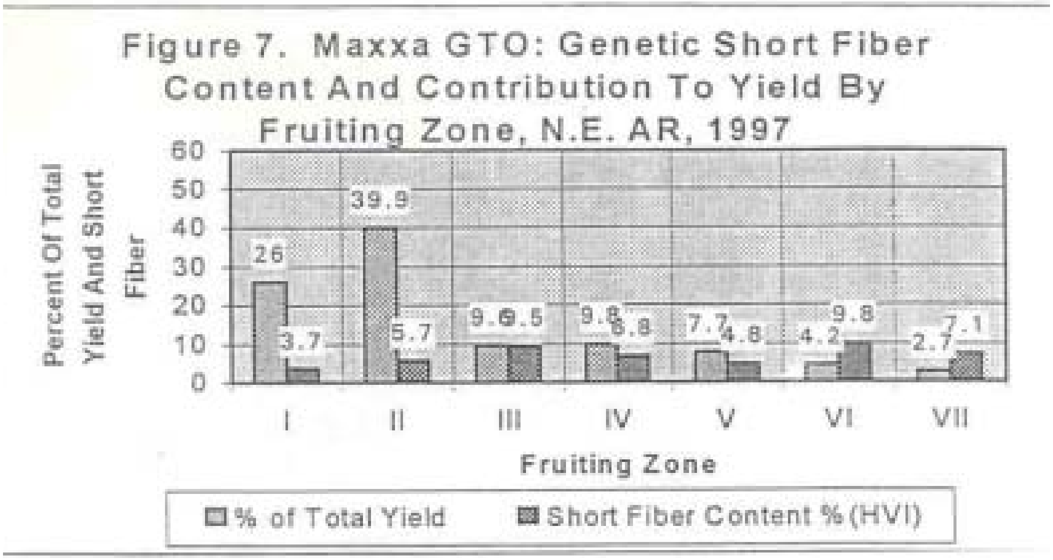


Figure 7. Maxxa GTO: Genetic Short Fiber Content And Contribution To Yield By Fruiting Zone, N.E. AR, 1997

Any genetic of management factor which influences the location of yield on cotton plants could have a significant impact on the genetic short fiber content. figure 8 illustrates how the plant population level can modify the percent of yield in Fruiting Zones ¥°and ¥± for the variety DeltaPine 50. Not all varieties react in the same way, i.e., as the plant population increases from one to four plants per foot of row, the percent of total yield in Fruiting Zones Ⅰ and Ⅱ increases dramatically. Thus, a simple production practice which cotton producers can control to impact on the weighted average genetic short fiber content. Please note that, in the experiments described in this paper concerning genetic short fiber content, plant population levels for all varieties were controlled at three plants per foot of row.

Both HVI and AFIS measurements of short fiber content were made on all samples by fruiting zone. Figure 9 shows the results of least squared regression analyses of the relationship between these two determinations of short fiber content.

Figure 8. Percent Of Total Lint Yield In Fruiting Zones I & II At Different Plant Population Levels, DP50

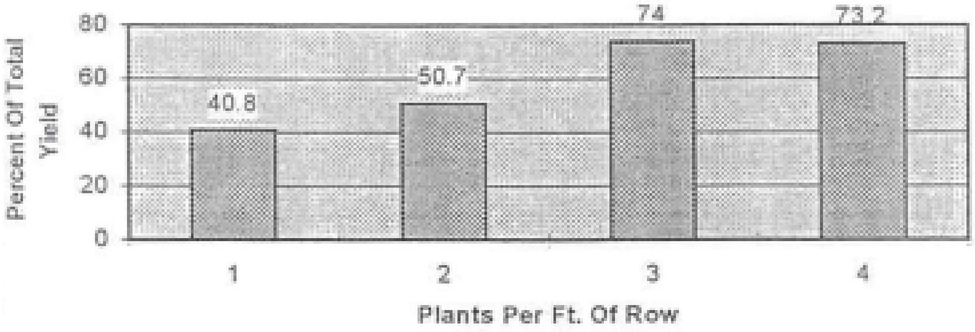
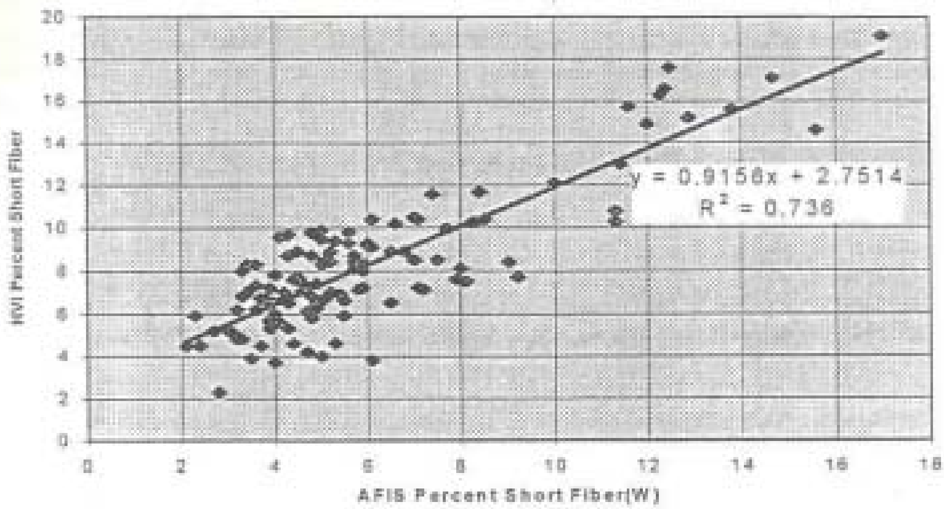


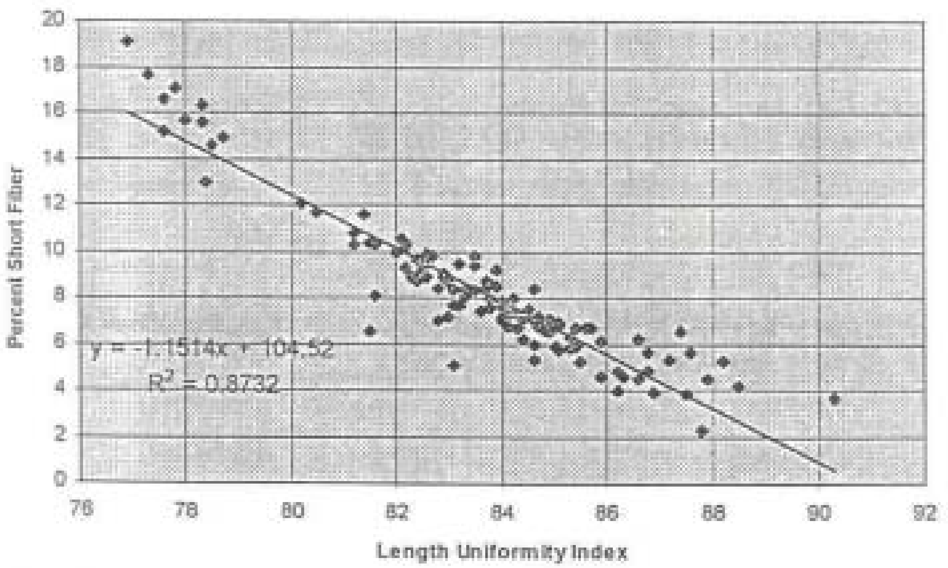
Figure 9. Change in HVI Percent Short Fiber Content With Change in AFIS Percent Short Fiber Content(W), 115 Observations, N.E. AR, 1997



HVI short fiber values followed AFIS(W) values rather closely. The coefficient of determination was 0.74. HVI short fiber content values were about 2% higher than AFIS values.

HVI short fiber content values correlated very closely with length uniformity index values. In this case, the coefficient of determination was 0.87. The results of this regression analyses are shown in Figure 10.

Figure 10. Change In HVI Percent Short Fiber Content With Change In Length Uniformity Index, 115 Observations, N.E. AR, 1997



IV. Summary.

1. Variation in the weighted average genetic short fiber content among commercial cotton varieties indicates that significant improvements in this characteristic could be made via plant breeding.

2. Genetic short fiber content varies significantly among boll locations on the cotton plant. This finding emphasizes the point that one should not expect to make highly repeatable measurements of a fiber property which has a high level of natural variance.

3. Variation in short fiber content among bolls in plants, which have the same genetic constitution, represents strong evidence that short fiber content level is influences to a significant extent by environmental events involve in the regulation and control of " fiber gene" expression.

4. HVI short fiber content measurements are well correlated with AFIS (weight) short

fiber content measurements. In addition, HVI short fiber content is highly correlated with length uniformity index values, at least when the fiver samples are evaluated by Fruiting Zone.

5. Crop management practices such as plant population levels. which influence where the bolls are located on the plant, may have a significant impact on the weighted average genetic short fiber content.

6. No matter how much "non-genetic" short fiber is crated, or by whom created, it is always better to begin at a lower inherent, genetic level.

7. If improved genetic short fiber content is desirable, proper incentives should be provided to move the plant breeding/production industry in that direction.