

BREAKING THE YIELD-FIBER QUALITY BARRIER

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Abstract

Lint yield and fiber quality were evaluated on all new conventional strains developed from 1995 to 2000. Few strong associations were detected for lint yield versus fiber length, strength or micronaire. Positive and consistent correlation existed for lint yield and lint percent, as well as, lint percent and micronaire. For each year's new strains, the top five high yielding (HY) lines were compared with the top five high yielding plus improved fiber quality (IQ). The HY lines generally yielded higher than the IQ lines. However, several lines were identified that had both high yield and high fiber quality. The introduction of diverse genetic backgrounds as parents appears to have contributed to the more recent increases in both lint yield and fiber quality. Within these germplasm pools, success in breeding for both high yield and improved quality is certainly attainable when both fiber and yield selection criteria are utilized.

Introduction

In the past decade, several top yielding new varieties tended to have lower fiber quality, especially in terms of higher micronaire and shorter fiber. This has suggested that, as in many crops, an inverse relationship exists between yield and quality. However, very recent releases of high yielding, improved fiber varieties, has shown that this relationship is either weak or nonexistent. The release of DP 491 has shown that high yielding, well adapted varieties with outstanding quality are certainly possible. This study was conducted to evaluate the relationships of high yield and improved fiber quality. Recent experiences in breeding for simultaneous increases in yield and fiber quality will be described.

Materials and Methods

Yield and fiber data was collected from the newly developed strains for the years 1995 through 2000. The lines were developed in the Delta and Pine Land Midsouth Cotton Research program located at Scott, MS. The data collected were strain means from Stage 1 (first year) tests grown at two locations near Scott, MS. Data was converted to percent of the check variety. The check varieties used were DP 5409 in 1995; ST 474 in 1996 – 1999; and SG 747 in 2000. Correlations were made between lint yield, lint percent and fiber traits.

Two groups were identified within each year of testing. The first group selected was the top five high yielding (HY) lines. Strains with extremely high micronaire or extremely short fiber were not included in this group. The second group was the top five yielding lines with improved fiber quality (IQ). Improved fiber quality criteria included a combination of lower micronaire, longer fiber and higher strength than the check variety. The two groups were compared for yield and fiber traits.

Results and Discussion

Correlation coefficients for lint yield versus lint percent, micronaire, and fiber length and strength are presented in Table 1. With few exceptions, no large associations existed between lint yield and the fiber traits. A significant and strong association was indicated in 1996 only, for lint yield and micronaire. However, lint yield had significant and sometimes strong associations with lint percent (LP).

Because lint percent was such an important contributor to lint yield, correlations were calculated between lint percent and the fiber traits. Significant and sometimes strong correlations existed between lint percent and micronaire. These suggest that concentration on lint percent for yield increases will tend to give higher micronaires. There were no strong and consistent associations lint percent with fiber length and strength.

The top five high yield (HY) lines had a slight yield improvement over the improved quality (IQ) group in 1995 (Figure 1). The HY group had a substantial increase over IQ group and the check variety in 1996. This was specifically related to strains developed from crosses of PM H1215 x Deltapine Midsouth lines. In 1997, yields were unexplainably depressed relative to the check. However, one of the IQ lines eventually resulted in the variety DP 491.

In 1998, the HY group had yield increases over the check (Figure 2). This was not the case with the IQ group. In 1999 and 2000, substantial increase over the check occurred with the IQ group, and more so with the HY group. In 2000, the HY group

outyielded the check by 25% to 35%. Although the IQ group yielded generally lower than the HY group, it still outyielded the check by 17% to 29%. These results indicate that lint yields in recent years have improved for the IQ lines, as well as, the HY lines. Although the HY lines were generally better yielding than the IQ lines, some IQ lines were in the HY group.

One of the HY lines in 1998 was 99X35, which has a proven outstanding yield and has completed Stage 5 testing. Two HY lines from the 1999 source are 01X06 and 01X37, which have proven performance records in 2000 and 2001. Seven of the 10 lines from 2000 were advanced to 2001 Stage 2 tests at three locations (Table 2). Three HY lines and three IQ lines confirmed their high performance. Fiber quality confirmed improvements (with one exception 02X16) over the ST 474 check.

Fiber Quality Distribution

Fiber trait distributions of the HY and IQ groups are presented in Figures 3, 4 and 5. Micronaire and fiber length was generally lower for the IQ group but not in all instances. Fiber strengths tended to be similar for both groups, with the exception where the 1999 IQ group was clearly higher in strength (Figure 5).

Using the 1999 and 2000 groups, yield was plotted with fiber length and micronaire (Figures 6 and 7). No associations existed between these lint yield versus micronaire, and with lint yield versus fiber length.

Genetic Background

The general genetic backgrounds of these lines presented in Table 3. Starting in 1998, the introduction of Chinese, Pee Dee, and Australian parents began appearing in the top performing strains. That introduction appears to have contributed to the increase noted in lint yield and fiber quality.

Conclusions

Associations between lint yield and key fiber traits varied depending on year and group of genotypes. Few strong associations existed which would prohibit successful selection for yield and quality traits.

Lint yield increases brought about through increases in lint percent could present problems with micronaire because of the two positive associations (lint yield versus lint percent and lint percent versus micronaire).

Selection for only high yield gave generally higher yields than when selection also included fiber traits. However, many exceptions existed whereby high yield and high fiber quality were combined.

Introduction of diverse genetic backgrounds as parents appears to have contributed to the more recent increases in both lint yield and fiber quality.

Success in breeding for both high yield and improved quality is certainly attainable when both fiber and yield selection criteria are utilized.

Table 1. Correlation of lint yield with fiber traits

Lint Yield vs:	1995	1996	1997	1998	1999	2000
Lint Percent	0.31**	0.74**	0.28**	0.60**	0.32**	0.51**
Micronaire	-0.17*	0.54**	0.10	0.23*	0.12	0.02
Fiber Length	0.07	0.09	-0.14	-0.05	0.13	0.31**
Fiber Strength	-0.13	-0.24**	0.18	0.04	-0.16*	-0.18
Lint Percent vs:						
Micronaire	0.10	0.42**	0.21*	0.24*	0.48**	0.38**
Fiber Length	-0.16*	-0.02	-0.09	-0.24*	-0.05	-0.06
Fiber Strength	0.02	-0.29**	-0.26**	0.13	0.05	-0.13
Number of Strains	175	219	111	108	167	76

*,** significant at 5 and 1 percent, respectively.

Table 2. Mean yield and fiber quality of 2001 Stage 2 tests at three locations.

Group	Entry	Lint yield	Lint Percent	Micronaire	Length	Strength
HY	02X06	1478	42.5	4.6	1.17	30.1
HY	02X07	1444	41.6	4.4	1.15	30.9
HY	02X09	1420	43.8	4.5	1.15	29.9
IQ	02X04	1414	40.2	4.5	1.14	31.3
IQ	02X12	1383	39.9	4.4	1.20	34.4
IQ	02X16	1337	38.6	4.7	1.17	30.9
HY/IQ	02X01	1272	40.2	4.0	1.24	31.5
	ST 474	1238	40.1	4.7	1.11	31.0
	Mean	1290	39.2	4.5	1.15	31.2

Table 3. Germplasm sources for the top 5 entries.

Year	High Yield Group	Improved Quality Group
1995	High Plains HQ	-
1996	1200 series (MAR)	1200 series (MAR)
1997	1200 series (MAR), Stripper	1200 series (MAR), Stripper
1998	Chinese, Pee Dee	1200series (MAR), Pee Dee
1999	Chinese, Pee Dee, MAR	Chinese, Pee Dee, Australian
2000	Chinese, Pee Dee, Stripper	Chinese, Pee Dee, Stripper, Australian

Yield (% of check)

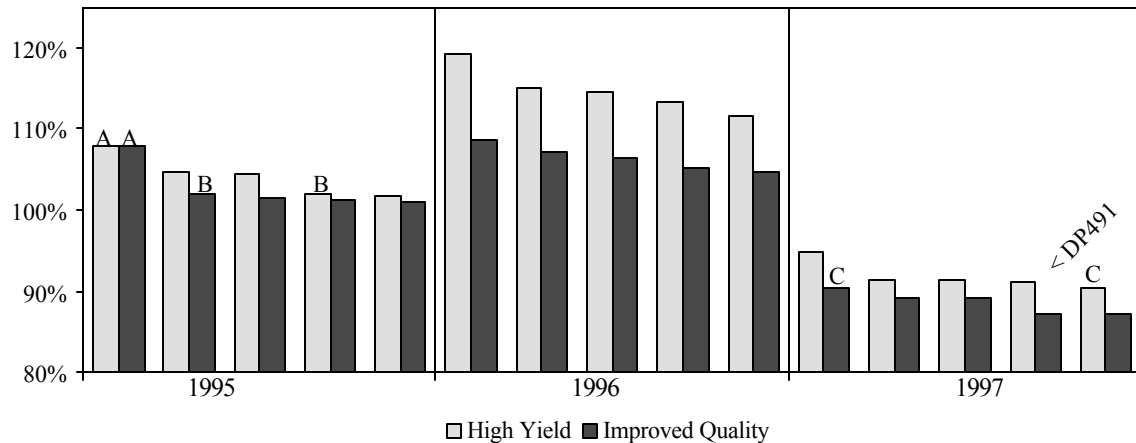


Figure 1. Percent yield against the check of the top 5 high yielding entries versus the top 5 with improved quality from 1995 to 1997.

Lint Yield (% of check)

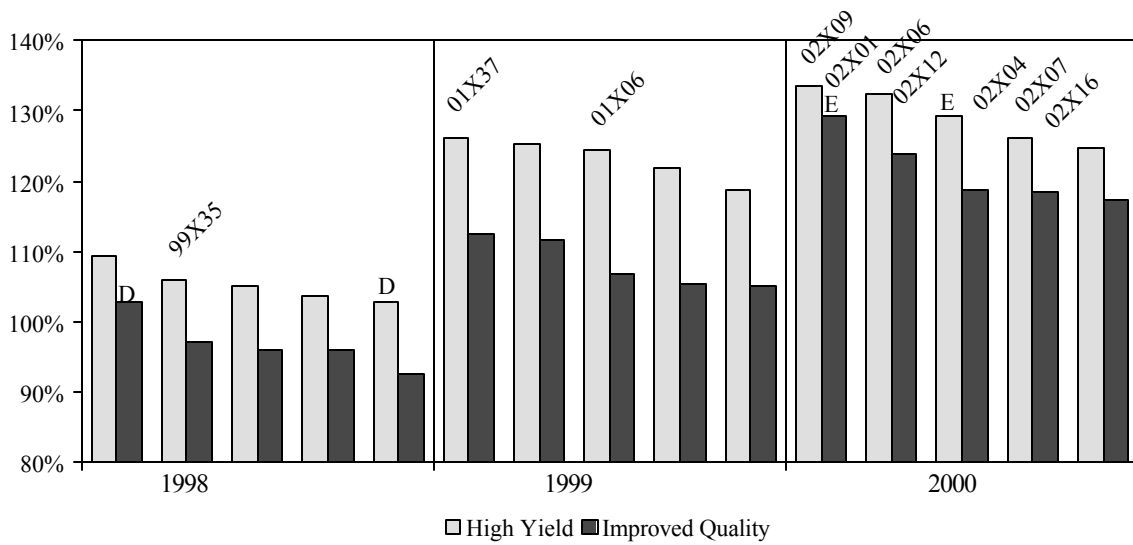


Figure 2. Percent yield against the check of the top 5 high yielding entries versus the top 5 with improved quality from 1998 to 2000.

Micronaire (% of check)

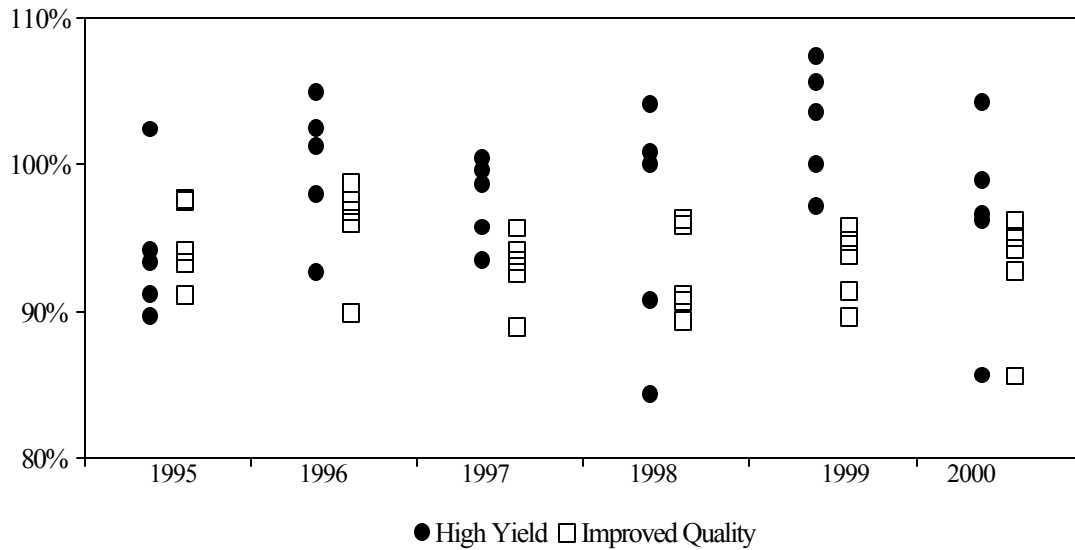


Figure 3. Micronaire as a percent of the check for the top 5 high yielding versus the top 5 improve quality strains.

Fiber Length (% of check)

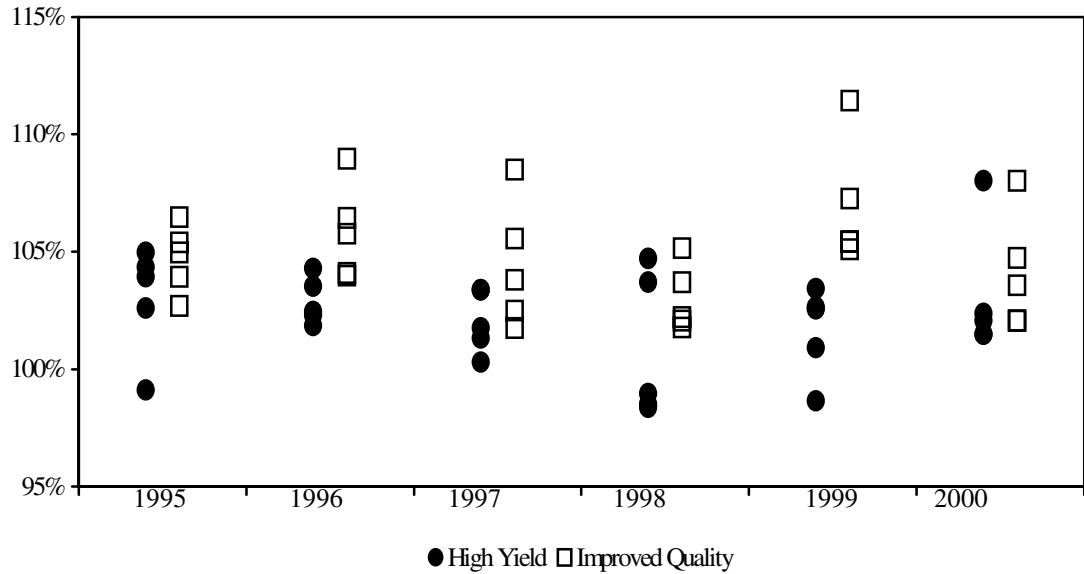


Figure 4. Fiber length as a percent of the check for the top 5 high yielding versus the top 5 improve quality strains.

Fiber strength (% of check)

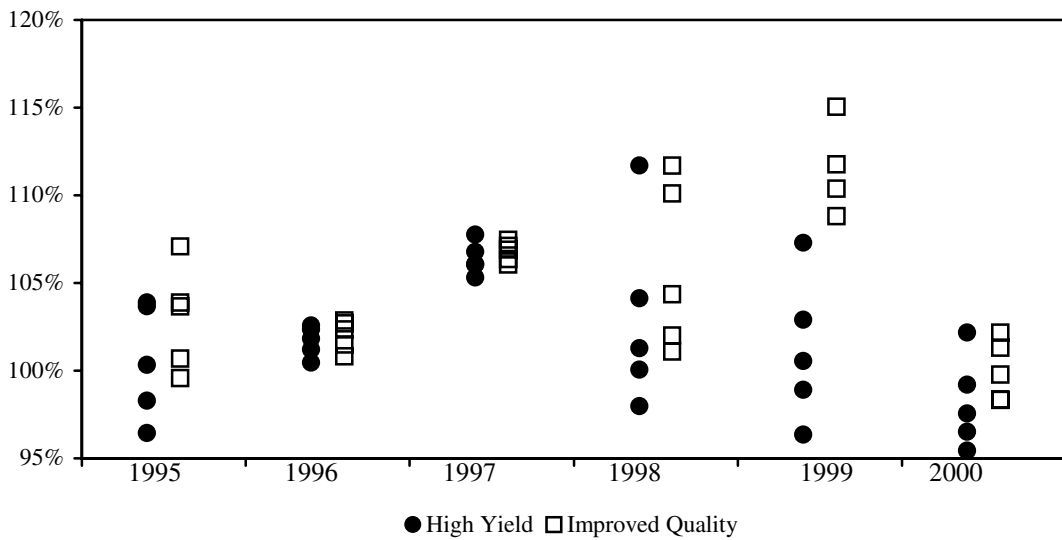


Figure 5. Fiber strength as a percent of the check for the top 5 high yielding versus the top 5 improve quality strains.

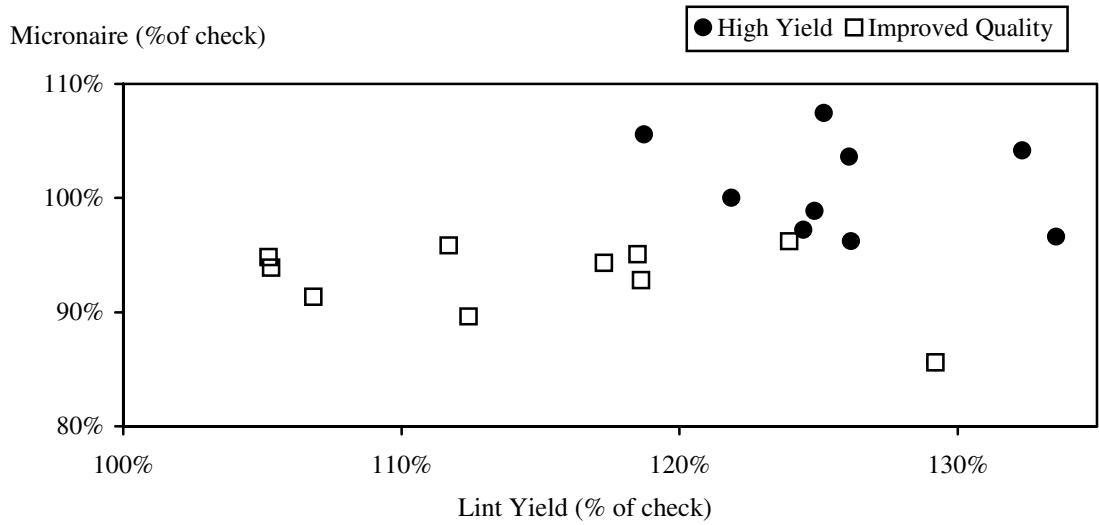


Figure 6. Lint yield and micronaire of high yield vs. improved quality strains (1999 and 2000).

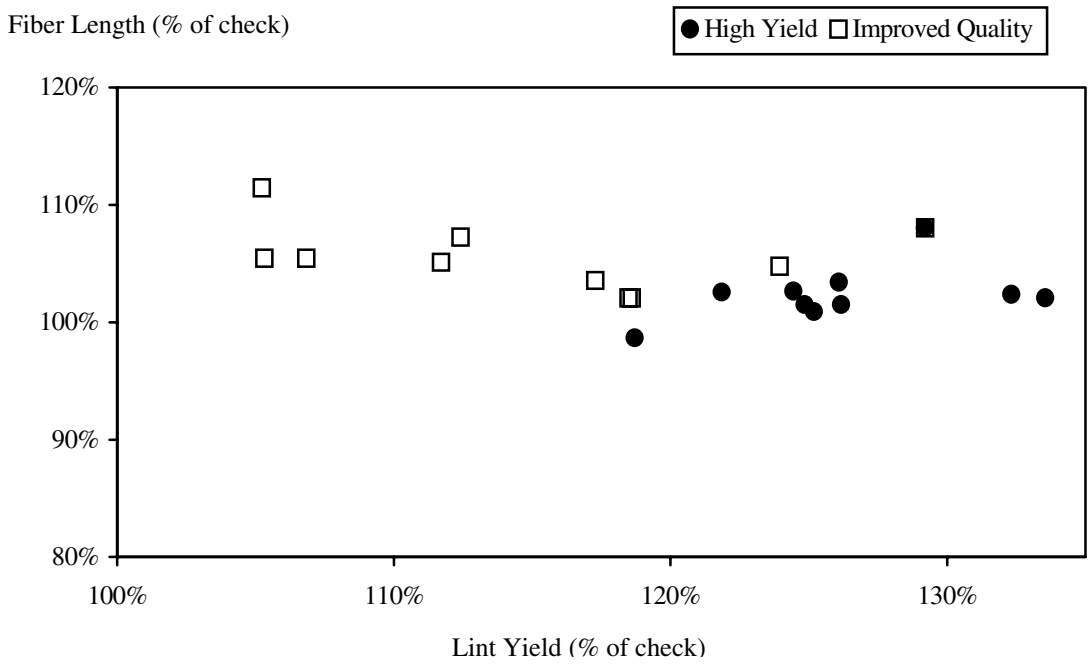


Figure 7. Lint yield and fiber length of high yield vs. improved quality strains (1999 and 2000).