**YIELD STUDY REPORT**

**Allen B. Helms, Jr.**
**Helms Farms**
**Clarkedale, AR**

## Abstract

Thank you Mr. Chairman. It goes without saying that cotton producers, as well as the entire industry, are experiencing severe economic stress due to the lack of profitability. The American Cotton Producers have placed a high priority on matters that impact producer profitability, including reducing the cost of production.

While there are many factors that make up the cost of production, increasing yield per acre is one of the most direct ways of lowering the overall costs. Producer leadership has become increasingly concerned about the recent trends in U.S. cotton yields. Average yields across the Cotton Belt reached a high of 702 pounds per acre in 1987, but since then have leveled off, indicating that we may have reached a "yield plateau" or otherwise characterized as yield stagnation. That concern led the ACP to the formation of a Blue Ribbon Committee of public and private cotton scientists from several disciplines. Their task was to review current data to determine if there was yield stagnation and, if so, how it should be addressed. The committee's findings are the basis of a published report and my comments this morning.

Based on all data reviewed, the committee determined that clearly a significant problem exists with current cotton yields. The problem is best characterized by stagnant yields, which have become increasingly variable and highly unstable in recent years. While these descriptions appear to be contradictory, the stagnation references the slowdown in year-to-year trend increases while the instability refers to the wide swings in yields between years. Both are symptomatic of a serious problem.

A quick look at the data shows that cotton yields have increased about 6 pounds per acre per year or about 1.3 percent annually over the past 39 years. However, breaking the data out over several time periods shows that from 1970 through 1985, the rate of change in cotton yields rose at an increasing level. However, from 1985 through 1998, the rate of change in cotton yields declined, and from 1992 through 1998, the annual change was negative. In addition, the year-to-year variation in yields has increased dramatically. Yields were almost 4 times more variable in the 1980's and '90's compared to the 60's and 70's. There were more low yielding years than high yielding years in the recent period. This translates into increased risk for the grower.

The action and interaction of three basic components -- environment, management and variety -- determine yield. The environment includes many factors such as weather, soil and pests for which the grower has little influence. Highest yields are possible only when a productive variety is grown in a favorable environment under proper management. Many of the most critical environmental factors are out of the control of the producer and some of them, such as the weather and severe pest infestation, act in a random manner. Weather factors may account for as much as 70 percent of the year-to-year variation in yield. Other environmental factors, however, may be changing systematically and contributing to recent trends in cotton yields. Further research is needed to evaluate the impact of environmental factors on yields of current and prospective varieties of cotton. Management is also a critical factor that was not within the scope of this study.

In studies prior to 1985, designed to estimate the improvements in varieties due to breeding efforts, yields increased at a rate of about 8 to 9 pounds per acre per year in the Southeast, Mid-South and California. A recent study conducted in the Mid-South, however, indicated that the genetic rate of gain among the most recent varieties have slowed to about 1 pound per acre per year since the early 1980s.

Increased yield potential of new varieties often will not follow a continuous unbroken path over time toward higher yield. Instead, progress can be uneven, characterized by periods of rapid increases followed by a lull. Also, as the existing genetic variation for yield is exploited, increases in yield can become more difficult to attain over time and come at a greater cost.

The yield of a variety is determined by its yield components -- boll set and retention, lint percent and seed weight and count. The yield potential of recently developed varieties appears to have resulted in an increased number of seed per acre and a decreased weight of fiber per seed. Number of seeds may not be the most important factor. More research is needed regarding weight of fiber per seed versus number of seeds per acre.

The introduction of transgenic technology to cotton breeding has provided significant benefits to the industry. The impact of transgenic cotton varieties on yield trends is unclear. Genetic trait improvements may in fact lead to higher net yields. On the other hand, since the emphasis has been on input traits and because these traits have been backcrossed into existing commercial varieties, there has been little, if any, positive or negative contribution to the overall genetic yield potential of the transgenic varieties. Emphasis should be given to genetic enhancement of output traits such as yield and quality.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:11-12 (2000)
National Cotton Council, Memphis TN

Improvement through breeding in any crop species requires genetic diversity, yet diversity in cotton has narrowed in recent years. Many successful varieties share common parents and grandparents. DES 56, a variety released by the state of Mississippi, and Deltapine 90, a variety released by a private company, are two of the most common parents or grandparents of current popular varieties. While this speaks well of the strong inherit genetic qualities of these varieties, it confirms the narrow gene base for most of the current varieties either in release or development. Both public and private breeders need genetically diverse germplasm to sustain long-term gains in yield.

Adequate resources should be devoted to the Germplasm Laboratory housed at Texas A&M University that has as its purpose evaluation, cataloging and maintaining viable seed from a wealth of cotton germplasm collected from around the world.

A significant shift in cotton breeding has taken place in current times. The USDA Agricultural Research Service has de-emphasized its commitment to cotton germplasm enhancement such that it maintains only a few cotton-breeding positions. The same is true with the State Agricultural Experiment Stations. There are over twice as many private industry breeders as those in the public sector. Whether this shift in breeding is good or bad is not the principal question. Concerns do arise about the concentration of the private cotton breeding industry and the lack of availability of new germplasm to all breeders. There is a role for public cotton breeding in the further development of long-term issues such as genetic diversity and to encourage the development of structural genomic tools to speed breeding.

Much of the reduced emphasis on public cotton breeding is due to the lack of state and federal funding. Faced with the task of funding more research on stagnant budgets, USDA and Experiment Station directors have had little choice but to reduce funds allocated for conventional breeding. It is imperative that new funding should be provided for long-term support of conventional public breeding programs and for the continued development of biotechnology in crop improvement. Growers should emphasize to all involved parties, public and private, the critical need to economically improve cotton yields and that appropriate resources should follow this request.

In closing, our report points to serious long-term yield problems for the U.S. cotton industry. Likewise, solutions to these problems will take time. These issues need to be addressed by the public and private cotton breeding sectors. Research funding needs to be directed at understanding the environmental, management and genetic factors limiting yield increase. USDA and Experiment Station administrators must properly allocate existing resources or find new resources to begin the process. Also, private industry funds and private company research budgets should carefully consider how these recommendations can be incorporated into existing and future plans. Either through conventional or genetically enhanced technologies, current varieties must be changed or new varieties developed that have the ability to better adapt to environmental stress and have the genetic potential through improved yield factors, to take varieties to new levels of sustainable, more stable, yield improvement.

It is the goal of this report to be part of the impetus for achieving this goal. Copies of this report are available at the Council's Membership Information or by contacting the Memphis office. They have also been broadly distributed to the private and public research, breeding organizations and funding groups.

Thank you for the opportunity to present these remarks.