SOME PERSPECTIVES FROM 50 YEARS OF COTTON BREEDING

Fred Bourland
University of Arkansas – NEREC
Keiser, AR

Abstract

My cotton breeding career began as a graduate student in 1970. In that year, I learned many of the mundane operations of cotton breeding such as planting plots, making crosses, picking boll samples, ginning the samples and delinting seed. I have continued to perform these operations now for 50 years. I have experienced numerous long hours/days of tedium and sweat, but those have been accompanied by many exciting moments and changes. Some of these changes categorized into five groups include:

1. Extra-plant factors:
    - Technological factors - Computers and computer-related technology have greatly increased efficiency of data collection and analyses, word processing, generation of label and forms, duplicating paper and files, and communication.
    - Legislative factors – Both the Plant Variety Protection Act of 1970 and Cotton Incorporated (founded in 1970) have had pivotal roles in the development of varieties. However, restrictions in state funding of agricultural research, reductions in state-funded cotton breeding positions, and increases in government regulations have hinder breeding activities.
2. Cotton plant structure:
    - Plant genetics – The cotton plant maintains the same karyotype, but transgenes and molecular markers are now often used.
    - Plant development – The plant has the same vertical and horizonal flowering intervals, but varieties have fewer vegetative branches and are earlier maturing.
    - Morphological traits (mainly for combating insect pests) have proliferated and declined.
    - Plant management – Precision of management has increased due to plant-to-stand practice (thinning done only in research plots), increased irrigation capacity, advent and frequent use of plant growth regulators, and employment of techniques to monitor plant development.
3. Cotton pests:
    - Diseases – Today's cotton plants encounter less seedling disease, Verticillium wilt, and bolls rots but more nematode problems than in 1970.
    - Insects – Boll weevils have now essentially been eradicated in the US and boll/bud worm complex are mostly controlled by transgenes, but the importance of tarnished plant bug as pest has greatly increased.
    - Weeds – Herbicides were still new innovations in 1970, but now management systems are dictated by transgenes and herbicides which has resulted in less grass problems but more resistant broadleaf weeds.
4. Cotton yields: US yields have doubled since 1970, but have experienced two and possible three yield plateaus.
    - The first plateau in ~1965 to ~1982 was attributed to technology drags associated with changes in multiple management inputs.
    - The second plateau in ~1988-2000 was initially due to insect control problems (boll weevil and insecticide resistance in boll/bud worm complex), then followed by genetic drag associated with introduction of transgenes.
    - A possible third plateau beginning in ~2005 may be associated with genetic drag associated with new transgenes and/or climatic limitations on further yield increases.
5. Cotton fiber quality: Since 1970, substantial increases in fiber length (almost 10% longer) and fiber strength (almost 20% stronger), but no trend in micronaire have occurred. The advent of HVI and AFIS testing procedures have been vital to these improvements. Also, the long-established negative relationship between yield and fiber quality has been neutralized in several new varieties.

Management of cotton production has made monumental changes. The adaptation of short-season varieties has enhanced earlier maturity of cotton. Improvement in seed quality and seedling disease has allowed plant-to-stand to

become a standard operation, and has permitted growers to obtain more optimum plant densities. Expanded irrigation capacity has increased yield and yield stability. The advent and use of plant height regulators have resulted in shorter and more uniform plant heights. Boll openers have facilitated once-over harvest. Transgenes have become a crucial part of insect and weed control. Increased size of planting and harvest equipment has led to larger farm size.

Since 1970, substantial increases in yield have been experienced, but the factors associated with the yield increase are not well-documented. What is the future of US cotton breeding? I envision a bright future, but I expect only incremental improvements to occur in cotton breeding until major management system changes are made.