

SEED SELECTION: A BREEDER'S PERSPECTIVE

O. Lloyd May
University of Georgia
Tifton, GA

Abstract

Cultivar selection is a key component of profitable cotton production because the chosen cultivar must have the genetic potential to produce economically sustainable yields. Cultivar selection has become an increasingly complex decision as genetically engineered "transgenic" cultivars have become available and some old favorite conventional cultivars have been phased out. Making cultivar selection even more difficult is that the necessary trial data to select cultivars has not always been available to growers, and products have been offered for sale without much or any public testing. The purpose of this presentation is to examine grower concerns about how Roundup Ready™ cultivars are tested in the public sector, assess validity of Official State Cultivar Trial data for purposes of cultivar selection, and emphasize how to get the most out of such data.

Introduction

Genetically engineered cultivars that are tolerant of topical applications of the herbicides Roundup Ultra® or Buctril® (BXN) and the bollworm/budworm resistant cultivars (Bollgarde®) have made cotton production easier, and in many cases have reduced production costs. Grower acceptance of these transgenic products reached 60% of U.S. plantings in 1999 (USDA-AMS, 1999). However, the choice of cultivar has become a difficult decision with the plethora of Bollgarde and Roundup Ready or stacked (Bt/RR) cultivars from which to choose. Additionally, some growers have questioned the validity of State Cultivar Trial data for purposes of choosing transgenic cultivars. A key question then is the need for systems-type trials to evaluate transgenic cultivar performance, including crop tolerance to herbicides, in the intended production system.

Discussion

Historically, cultivars have been offered for sale after one or more years of public testing in Official State Cultivar Trials. In fact, it was not unusual prior to the advent of transgenic cultivars for a cultivar to earn significant market share before attaining recommended status by State Cooperative Extension Services. While many transgenic cultivars have been tested in Official State Cultivar Trials, several have been offered for sale without public testing, and have garnered significant market share. Concurrently with the near exponential gain in

market share for transgenic cultivars, some growers have reported fruiting abnormalities with Roundup Ready cultivars, and have thus questioned the validity of Official Cultivar Trial data because crop tolerance to Roundup Ultra is not evaluated. In response to grower concern about testing Roundup Ready cultivars in State Trials, systems-type trials were conducted in 1998 and 1999 at Florence, SC (May et al., 2000). The objective was to compare yields of Roundup Ready cultivars in three herbicide systems. The herbicide treatments were applied by E.C. Murdock, Clemson University Extension Weed Specialist, and funds to conduct the trials were supplied by a grant from the South Carolina Cotton Board. All of the commercially available Roundup Ready cultivars entered into the 1998 and 1999 South Carolina Official Cultivar Trials were included in our systems trials. Herbicide systems were defined as follows. One herbicide system was dubbed "standard cultivar trial" because it employed herbicides typically used in Official Cultivar Trials. The standard cultivar trial herbicide system included only soil-applied herbicides (Prowl®, Cotoran, Staple®, Cotton-Pro®, and MSMA; ca. \$52/acre herbicide cost) and served as the control in the experiment. The remaining two systems consisted of "Roundup plus residual", soil applied herbicides plus Roundup Ultra applied topically at 2-leaf stage (ca. \$41/acre herbicide costs), and "Roundup only", a herbicide system that employed only Roundup Ultra (ca. \$21/acre herbicide costs), but no soil applied herbicides. The experiments were replicated four times in 1998 and 1999 with a treatment design that allowed the combined and individual effects of cultivar and herbicide system on lint yield to be evaluated. We found that the rank of Roundup Ready cultivar yields was the same regardless of herbicide system. Thus, the best yielding Roundup Ready cultivar could be chosen on the basis of performance in any of the three herbicide systems, suggesting that performance of Roundup Ready cultivars in Official State Trials is valid for purposes of cultivar selection. In fact, averaged over cultivars, the Roundup only herbicide system produced significantly higher yields than the standard cultivar system. A few caveats are in order, however. First, results of these trials do not refute grower problems with fruit shed or yield loss associated with the production of Roundup Ready cultivars. We hypothesize on the basis of our findings and evaluation of grower complaints about fruit shed in Roundup Ready cultivars, that the key to the finding that the Roundup only system produced the highest yields may be the prevailing environmental conditions at the time Roundup Ultra is applied. Perusal of the weather data in 1998 and 1999 preceding, during, or after application of Roundup Ultra suggested little if any environmental stress, thus allowing the intended expression of the gene that softens Roundup Ready cultivars from applications of Roundup Ultra. We will follow up on this research with plant mapping and yield component studies in 2000 at the University of Georgia.

Another issue with cultivar selection is that of yield stability, a cultivar trait that can be estimated from Official State Cultivar Trials. Yield volatility exacerbates already substantial economic risks associated with cotton production. Yield stability has become more of an issue in recent years as year-to-year yield volatility has seemingly increased. Cultivar yield stability can be estimated without resorting to complex statistical analysis of Official Cultivar Trial data, by examining the yield rank of cultivars in the same trial from previous years. As an example, the Table below was abstracted from the 1998 South Carolina Cotton Cultivar Trial performance bulletin available on-line at (<http://cropweb.clemson.edu/Cotton/cotton.htm>). Cultivars C and D have been trialed for four years and allow the best estimate of yield stability, with Cultivar C showing the least change in its yield rank over the four years; thus, we would conclude that it has the best yield stability of the four cultivars (Table 1). Cultivar A is a newer entry, having been trialed for only two years, but might be a choice to try on a smaller portion of the farm acreage, given its limited testing. Cultivars B and D illustrate the yield volatility that seems to have become more prevalent in the last 10 years. Although Cultivars B and D performed well in 1998, they also exhibit yield volatility in previous years, suggesting that they have less yield stability than Cultivars A and C. Therefore, Cultivars B and D might not be good choices for large acreages of individual operations. These data illustrate the type of information that can be gleaned from Official Cultivar Trials that might be helpful in choosing cultivars for a farm. This same type of analysis can be performed for each location of a State Cultivar Trial, thus enhancing the estimate of cultivar yield stability.

Summary

In summary, Official Cultivar Trial Bulletins remain valuable sources of information growers can exploit in choosing cultivars for their operation. In addition to yield potential, yield stability of cultivars can be estimated from data developed by Official State Trials. Further research is needed to determine if there exists links between environmental stress and crop tolerance to Roundup Ultra of Roundup Ready cultivars. Data from systems trials of Roundup Ready cultivars found no yield reduction in treatments receiving topical or POST applications of Roundup Ultra, suggesting that the gene that softens the plant from the herbicide functions as it was intended. In such instances, the best Roundup Ready cultivars can be chosen on the basis of performance in Official State Trials.

References

May, O.L., E.C. Murdock, and R. Graham. 2000. Herbicide system affects lint yield of Roundup Ready® cotton cultivars. Proc. Beltwide Cotton Conf. 2000. (In press).

USDA-AMS. 1999. Cotton varieties planted – 1999 crop. USDA-AMS, Memphis, TN.

Table 1. Rank for yield of four cultivars (not identified) trialed for four years in the South Carolina Official Cultivar Trials.

CULT.	1998	1997	1996	1995
	Rank Of 23 ¹	Rank of 20	Rank of 16	Rank of 16
A	1	4	*	*
B	2	11	*	*
C	3	1	1	2
D	4	16	8	8

¹Rank of xx indicates number of cultivars in that trial, and along with rank in trial in body of Table 1, indicates whether the cultivar yield was in top, middle, or bottom portion of the trial.

*Cultivar was not trialed in the indicated year.