

**PERFORMANCE OF TRANSGENIC COTTON
VARIETIES IN ARIZONA**
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Abstract

The purpose of this test was to evaluate the performance of transgenic cotton varieties in Arizona. We conducted four field tests at three Arizona locations in 1999. We included a total of 34 varieties in one or more of these tests. Across locations and varieties, Bollgard (BG) and stacked (BGRR) varieties produced about 7 to 8% greater lint yields than the conventional varieties. Roundup Ready (RR) varieties produced similar lint yields as the conventional varieties. A few transgenic varieties were lower yielding than the conventional parent in these tests. Roundup Ready varieties tended to be taller and more vigorous than the conventional parent. Transgenic varieties were sometimes different from the conventional parent in other traits, such as lint percent, boll weight, or maturity, but the variation was not associated with a particular transgene.

Introduction

Arizona cotton growers have readily adopted transgenic varieties into their production programs. Many new transgenic varieties have been developed and released recently, but data on the performance of many of these varieties in Arizona is scarce. The purpose of this study is to evaluate the performance of transgenic varieties in the state of Arizona relative to each other and relative to the conventional variety from which they were derived.

Materials and Methods

We conducted a total of four field tests at three different locations in Arizona in 1999. Two tests were located at the Maricopa Agricultural Center (MAC and MAC-E), one at the Marana Agricultural Center (MAR) and one at the Safford Agricultural Center (SAC). We used an unbalanced split-split plot design in the MAC, MAR, and SAC tests. Main plots were "conventional families", which consisted of all the Roundup Ready (RR), Bollgard (BG) or stacked (BGRR) transgenic varieties derived from the same genetic or varietal background. The first split plot consisted of the different transgenic versions within a family. For example, the main plot containing the 'DP415' family included split-plots of DP5415, 'NuCOTN 33B', 'NuCOTN 32B', 'DP448B', 'DP5415RR', and 'DP458BR'. Herbicide regime comprised the split-split plot treatments. We planted all the varieties with the Roundup Ready gene in duplicate plots side-by-side

and one plot received two to three applications of Roundup Ultra at maximum label rates, while the other plot was left untreated. For the MAC-E test, we used a split plot design with conventional family as the main plot and variety as the split plot. All varieties with the RR gene in the MAC-E test received three applications of Roundup Ultra at maximum label rates. This experimental design allowed us to obtain side-by-side comparisons of, 1) the treated vs. untreated herbicide regimes to evaluate the response of RR and BGRR varieties to maximum label rates of Roundup Ultra, 2) the performance of the transgenic varieties relative to the recurrent parents from which they were derived, and 3) the performance of transgenic varieties relative to each other.

We planted each variety in two-row plots in the SAC and MAC-E tests and in four-row plots in the MAC and MAR tests. Rows were spaced 36" apart in the SAC test and 40" apart in the other three tests. Plots were 38 to 42' long. We used standard cultural practices, including aggressive measures to control Pink Bollworm, lygus and whitefly, and we kept all plots weed-free.

To keep the experiments to a reasonable size (less than 40 total treatment/entry combinations per test), we did not include all entries in all tests. For example, the MAC-E test included only earlier maturing varieties. We included a total of 34 varieties in one or more of the tests (Table 1).

Results and Discussion

Average lint yields of the tests ranged from 1264lbs/A at Safford to 1940 lbs/A at Marana. Pink bollworm infestations were severe at SAC and MAC, but aggressive control programs were in place that kept losses minimized. Even so, there were probably some yield losses in the conventional and RR varieties to Pink bollworm in these two tests.

Roundup Ultra applications did not reduce lint yield of the RR or BGRR varieties included in these tests. Across all varieties and all tests, average lint yield of the sprayed plots was 1569 lbs/A, while average yield of the unsprayed plots was 1580 lbs/A, a difference of only 11 lbs/A.

Bollgard varieties tended to produce lint yields equal to or significantly greater than their conventional parent. Across locations, six of the nine BG varieties tested were significantly higher yielding than their respective conventional parent (DP448B, NuCOTN33B, NuCOTN32B, NuCOTN35B, DP90B, and STX9901). One BG variety, PM1560BG yielded significantly less than its conventional parent. When averaged across all locations and all families, the BG varieties produced 7% greater lint yield than the conventional variety from which they were derived. The highest yielding BG variety in these tests was STX9901 in the

MAC, MAC-E, and MAR tests, and DP90B in the SAC tests (Tables 2-5).

Roundup Ready varieties produced lint yields that were, in most cases, similar to their conventional parent, although there were two exceptions. DP5690RR produced 118 lbs/A less lint than DP5690 and DP436RR produced 196 lbs/A less lint than DP50. Across varieties and locations, lint yield of RR varieties was similar to the respective conventional parent (averaging about 2% less). The highest yielding RR variety in all four tests was STX9903 (Tables 2-5).

RR varieties tended to be taller than their conventional parent (about 5cm taller on average), yet they produced 1-2 fewer total nodes, resulting in greater height-to-node ratios. These observations indicate that the RR varieties tend to be more vigorous than their conventional parent.

Like the BG varieties, BGRR varieties produced lint yields equal to or greater than their conventional parent. Four of the ten BGRR varieties we tested produced lint yields significantly greater than their conventional parent. Across locations and families the BGRR varieties produced lint yields about 8% greater than their conventional parent. The highest yielding BGRR varieties in these tests were STX9902 in the MAC, MAR, and MAC-E tests and DP655BRR in the SAC test (Tables 2-5).

Like the RR varieties, BGRR varieties tended to be taller and more vigorous (greater height to node ratios) than the conventional parent.

We also observed variation between the transgenic varieties and their conventional parents for lint percent, boll weight, fruit retention and nodes above white bloom. The trends in these traits, however, were not associated exclusively with the transgenic trait – some of the transgenic varieties were greater than the conventional parents and some were less than the conventional parents.

Table 1. List of varieties entered in one or more University of Arizona Transgenic Variety Tests in Arizona in 1999.

Variety	Number of tests in 1999	Variety	Number of tests in 1999
DP5415	3	DP20	2
DP5415RR	2	DP422BRR	2
DP458BRR	3	DP20B	2
NuCOTN33B	3		
NuCOTN32B	3	SG125	4
DP448B	3	SG125BRR	4
DP5409	2	SG501	2
DP429RR	2	SG501BRR	2
DP409BRR	2		
		PM1560	2
Deltapine 90	3	PM1560BG/RR	2
DP90B	3	PM1560BG	2
DP5690	3	STV474	4
DP5690RR	3	STX9903	4
DP655BRR	3	STX9902	4
NuCOTN35B	3	STX9901	4
Deltapine 50	1	STV239RR	1
DP436RR	1		
DP450BRR	1		
DP50B	1		

Table 2. Lint yield of conventional and transgenic varieties at the Maricopa Ag Center (MAC) in 1999.

Conventional Variety	Lint yield	Transgenic version	Lint yield
<i>Bollgard varieties</i>			
DP5415	1276	NuCOTN33B	1503
		NuCOTN32B	1526
		DP448B	1691
Deltapine20	1450	DP20B	1524
DP5690	1223	NuCOTN35B	1354
Deltapine90	1245	DP90B	1407
STV474	1606	STX9901	1839
<i>Roundup Ready varieties</i>			
DP5415	1276	DP5415RR	1280
DP5409	1354	DP429RR	1344
DP5690	1223	DP5690RR	1166
STV474	1606	STX9903	1695
<i>Stacked (BGRR) varieties</i>			
DP5415	1276	DP458BRR	1353
Deltapine20	1450	DP422BRR	1499
DP5409	1354	DP409BRR	1548
DP5690	1223	DP655BRR	1368
SG125	1568	SG125BRR	1618
STV474	1606	STX9902	1784

LSD to compare means within a family=116. LSD to compare any two means=135.

Table 3. Lint yield of early maturing conventional and transgenic varieties at the Maricopa Ag Center (MAC-E) in 1999.

Conventional Variety	Lint yield	Transgenic version	Lint yield
<i>Bollgard varieties</i>			
Deltapine20	1228	DP20B	1253
Deltapine50	1259	DP50B	1291
Deltapine51	1026	DP428B	1053
STV474	1720	STX9901	1896
<i>Roundup Ready varieties</i>			
Deltapine50	1259	DP436RR	1063
Deltapine51	1026	DP425RR	1086
STV474	1720	STX9903	1734
<i>Stacked (BGRR) varieties</i>			
Deltapine20	1228	DP422BRR	1346
Deltapine50	1259	DP450BRR	1164
Deltapine51	1026	DP451BRR	1132
SG125	1253	SG125BRR	1197
STV474	1720	STX9902	1746

LSD to compare means within a family=116. LSD to compare any two means=143.

Table 4. Lint yield of conventional and transgenic varieties at the Marana Ag Center (MAR) in 1999.

Conventional Variety	Lint yield	Transgenic version	Lint yield
<i>Bollgard varieties</i>			
DP5415	1906	NuCOTN33B	2065
		NuCOTN32B	2049
		DP448B	2116
DP5690	1783	NuCOTN35B	1907
DP90	1605	DP90B	1936
PM1560	1872	PM1560BG	1741
STV474	2136	STX9901	2147
<i>Roundup Ready Varieties</i>			
DP5409	1907	DP429RR	1868
DP5690	1783	DP5690RR	1576
STV474	2136	STX9903	2208
<i>Stacked varieties</i>			
DP5415	1906	DP458BRR	1976
DP5409	1907	DP409BRR	1955
DP5690	1783	DP655BRR	1870
PM1560	1872	PM1560BG/RR	1959
SG125	1815	SG125BRR	1963
SG501	1937	SG501BRR	1930
STV474	2136	STX9902	2177

LSD to compare means within a family=134. LSD to compare any two means=166.

Table 5. Lint yield of conventional and transgenic varieties at the Safford Ag Center (SAC) in 1999.

Conventional Variety	Lint yield	Transgenic version	Lint yield
<i>Bollgard varieties</i>			
DP5415	1234	NuCOTN33B	1385
		NuCOTN32B	1280
		DP448B	1427
DP5690	1280	NuCOTN35B	1366
DP90	1306	DP90B	1397
PM1560	1126	PM1560BG	973
STV474	1177	STX9901	1257
<i>Roundup Ready varieties</i>			
DP5415	1234	DP5415RR	1244
DP5690	1280	DP5690RR	1219
STV474	1177	STX9903	1375
		STV239RR	1057
<i>Stacked (BGRR) varieties</i>			
DP5415	1234	DP458BRR	1401
DP5690	1280	DP655BRR	1425
PM1560	1126	PM1560BG/RR	1334
SG125	1049	SG125BRR	1193
SG501	1111	SG501BRR	1191
STV474	1177	STX9902	1330

LSD to compare means within a family=173. LSD to compare any two means=218.