Cooperative Extension

BT Cotton In Arizona: '95 Variety Results

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Nineteen ninety-six will be remembered as the first year of widespread commercial availability of transgenic cotton varieties with built in protection against our major lepidopteran worm pests. Late last year, EPA granted final clearance for NuCOTN® varieties developed by Delta and Pine Land Co. which use Monsanto's Bollgard® gene technology.

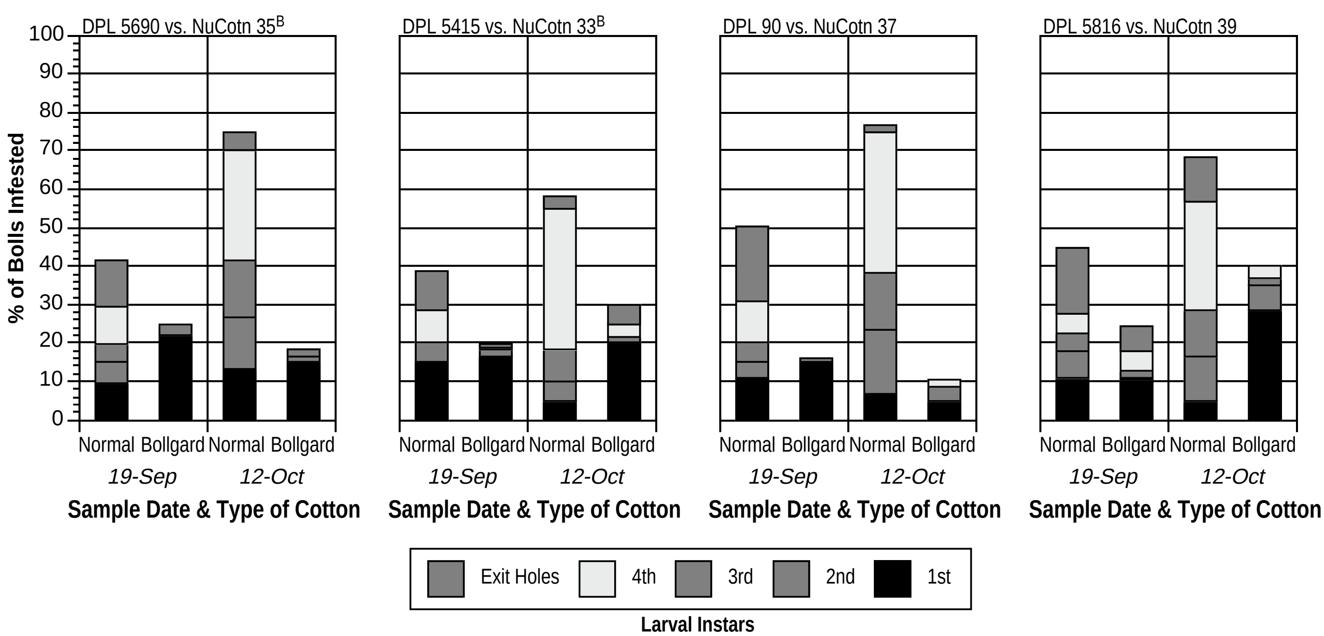
IPM Product Testing

This is a continuation of experiments initiated in 1992 at the University of Arizona, Maricopa Agricultural Center (MAC). The 1995 experiment is second in a series to evaluate entomologic and agronomic performance of 'Bt' varieties in an adapted background (see UA Extension fact sheet, "*BT Cotton in Arizona: 1994 Variety Results*".) Prior to 1994, testing was conducted on non-locally adapted varieties (i.e., Coker 312 background). These earlier studies demonstrated virtually complete suppression of pink bollworm (PBW) populations by the Bollgard gene. Laboratory and other field observations confirmed the efficacy of this gene in controlling cotton leafperforator, salt-marsh caterpillar, cabbage looper, tobacco budworm, and beet armyworm. The 1994 variety test began our evaluations of the 'Bt' gene in commercial varieties. The 1994 agronomic evaluation was hindered by poor stand quality, as a result of "hard" seed produced under atypical production conditions (i.e., winter nurseries). Nonetheless, lepidopteran populations were effectively suppressed by the 'Bt' gene.

The 1995 test at MAC was similar to the 1994 experiment, except that seed from two 'Bt' varieties was available from normal production channels (i.e., previous summer's seed increase; NuCOTN 33^B & 35^B) and two varieties were from winter production sources (NuCOTN 37 & 39). This difference had a significant impact on germination and stand establishment, which was especially noticeable under the poor planting conditions of 1995. The non-'Bt' counterparts (DP 5690, 5415, 90, & 5816) were from normal seed distribution channels.

Four Bollgard, NuCOTN varieties and 4 comparable, non-'Bt', DP varieties were planted in 8 rows by 30 foot plots, replicated 6 times. [Only two of these NuCOTN varieties will be commercially available in 1996 (NuCOTN 33^B & 35^B)]. Seed was wet-planted on 10 Apr and re-watered several times to produce uniform stands. One variety (NuCOTN 39) remained below ground for over 2 weeks and was replanted (75%) by hand on 26 Apr. Stands were hand-thinned to a uniform 27,000 ppa. Irrigation was terminated on 10 Aug. Cotton was inadvertently partially defoliated by drift on 22 Sep, and then sprayed with defoliant on 16 Oct. Cotton was mechanically harvested on 1 Nov. Grab samples from each plot were taken and measured for lint turnouts.

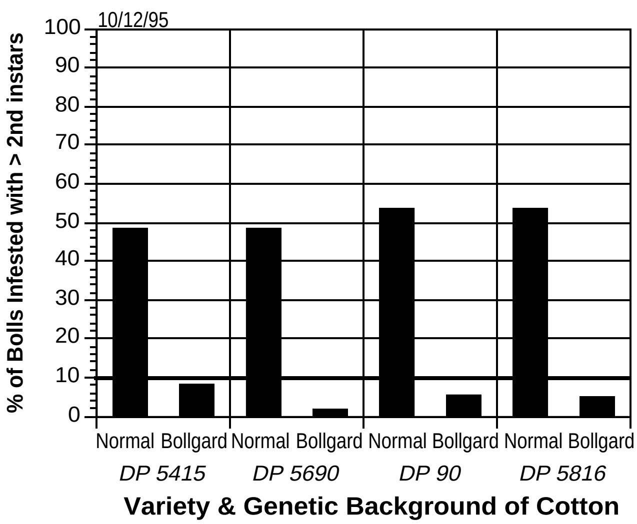
We sprayed the test once with Knack® for whitefly control (8/10) and once with Vydate C-LV® (7/27) for *Lygus* control. Half of each plot was to be treated for PBW (& other worms) on an as needed basis; however, threshold levels of PBW were not reached until late in the fruiting cycle. There-



fore, we never sprayed for lepidopteran pests. Bolls were sampled biweekly from the "susceptible" varieties until PBW levels increased, and then all varieties were regularly sampled. All bolls were examined for live larvae, noting PBW size and extent of damage.

Entomological Performance

Previous measures of the Bollgard gene (Ellsworth *et al*. 1995a) and NuCOTN varieties (Ellsworth *et al*. 1995b) in controlling PBWs have indicated nearly complete suppression of larval development. This study confirms the high level of PBW control that can be expected in these 'Bt' varieties. Boll infestations (with live larvae) of the "normal" varieties reached up to 40% in September and 75% in October (see graphs pg. 1), whereas the comparable NuCOTN varieties had about half as many live larvae in the bolls. Because PBW larvae need to ingest boll tissue before dying, direct counts of live larvae need to consider the size or instar of the larva. We proposed an operational treatment threshold of 10% bolls infested with "pink" larvae (3rd & 4th instars, & exit holes). Based on this criterion, the normal varieties exceeded threshold with over 50% bolls infested, while the NuCOTN varieties stayed below threshold (ave.=6% on 10/12; see graph above). Note that the normal varieties were never treated for worm pests (which triggered on 8/24), and on 19 Sep NuCOTN 39 did exceed the provisional threshold briefly with about 11% infested bolls.



Agronomic Performance

The two sets of commercial varieties established equivalent stands. In the remaining two sets of varieties, the NuCOTN versions lagged behind their non-'Bt' counterparts in seedling germination, emergence and stand establishment. The effects of poor stand establishment can be long-lasting and depress final yields. The table below shows the seedcotton, turnouts, and lint yields from the 1995 variety test. Only NuCOTN 37 had a significantly lower yield compared to its non-'Bt' counterpart or to the rest of the varieties. Yields were fair overall. They were relatively unaffected by PBW pressure, because PBWs came too late in the fruiting cycle to negatively impact yield. Turnouts were significantly different between each of the NuCOTN varieties and their DP counterparts. NuCOTN varieties have

Variety	Seedcotton (lbs/A)	Turnout (%)	Lint (bales/A)
DP 5415	3256 ± 209 a	39.4 ± .20 a	2.57 ± .16 a
NuCOTN 33^{B}	3169 ± 171 a	38.5 ± .28 b	2.44 ± .14 a
DP 5690	3254 ± 189 a	39.7 ± .17 a	2.59 ± .16 a
NuCOTN 35^{B}	3488 ± 122 a	38.8 ± .29 b	2.70 ± .09 a
DP 90	3381 ± 75 a	39.6 ± .25 a	2.68 ± .06 a
NuCOTN 37	2840 ± 76 b	38.2 ± .19 b	2.17 ± .07 b
DP 5816	2888 ± 235 a	40.2 ± .22 a	2.33 ± .19 a
NuCOTN 39	2971 ± 206 a	38.7 ± .71 b	2.31 ± .18 a

Values for each variety pair followed by different letters are significantly different by orthogonal contrast ($P < 0.05$).

been reported to be larger seeded, and this was reflected in our test by lower turnouts (about 1.2% less). No other agronomic measurements were taken in this experiment.

Summary

Two of the commercially-ready 'Bt' varieties (NuCOTN 33^{B} & 35^{B}) performed extremely well in controlling PBW populations, and yielded similarly to their "normal" counterparts (DP 5415 & 5690). Two soon to be released 'Bt' varieties also controlled PBWs; however, one variety (NuCOTN 37) did not yield as well as its non-'Bt' version (DP 90). This discrepancy was likely due to the late establishment caused by "hard" seed.

Should you plant 'Bt' cotton? This depends heavily on whether your fields are at risk of sustained PBW pressure. As an IPM tool, 'Bt' cotton is unsurpassed in PBW management; however, **caution should be exercised in making full use of this new technology, in part because further work is needed in Arizona to properly assess the agronomic potential of these new transgenic varieties.**

References

1. Ellsworth, P.C., J.W. Diehl & T.F. Watson. 1995a. BT Cotton in Arizona: What Will Change?. Univ. of Arizona Cooperative Extension.
2. Ellsworth, P.C., J. Silvertooth & J.W. Diehl. 1995b. BT Cotton in Arizona: 1994 Variety Results. Univ. of Arizona Cooperative Extension.

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