ASSESSMENT OF LEPIDOPTERAN-PROTECTED COTTON VARIETIES IN VIRGINIA

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Abstract

Previous research showed that insect-resistant varieties (e.g., Bollgard, Bollgard II, WideStrike) required at least one bollworm insecticide application to achieve yields comparable to that of conventional cotton that received two applications. Current insect-resistant varieties do not protect against plant bug or stink bug injury, so additional applications may be required to protect against these pests. For example, to achieve potential yields, many growers have to apply as many insecticide applications on Bollgard cotton varieties as they used to make on conventional, non-insect-resistant varieties. This project compared lint yields and value of non-insect resistant (RR or RF), single insect resistant gene (BG), and double insect resistance gene (BG2 or WS) cotton varieties, with and without insecticide treatment. Varieties were selected based on local official variety test performances using only the highest yielding varieties from each grouping. Plant bug and stink bug were monitored by assessing square retention and internal bug-induced boll damage. Bollworm was monitored by assessing external worm-induced boll damage. Cotton was harvested from two rows of each plot and the value of each variety was determined by comparing lint value to insecticide treatment cost. Results showed that in both years, even in untreated cotton, square retention was high and internal bug-induced boll damage was low indicating low plant bug and stink bug pressure. In 2006, untreated double-gene varieties had 5-13% bollworm damage, single-gene had 12-30%, and conventional had 49-62%. In 2007, bollworm damage in untreated cotton was 0, 1-2, and 3-21% for these gene categories. Treated cotton in both years had < 3% bollworm damage. In 2006 in untreated cotton, double- and single-gene varieties had significantly higher yields than conventional cotton; and in 2007 in untreated cotton, four of the five single-gene varieties and one conventional variety had numerically higher yields than the double-gene cotton. In 2006, insecticide-treated double-gene, single-gene, and conventional varieties had average yield increases of 18, 176, and 500 lb lint/acre over untreated cotton. Applying insecticide treatment returned 210-282 dollars/acre in conventional varieties, 22-146 dollars/acre in single-gene varieties, but did not offset the cost in double-gene varieties. Bollworm pressure was less in 2007 and insecticide treatment returned less value in all varieties. Insecticide-treated double-gene, single-gene, and conventional varieties had average yield increases of 64, 85, 157 lb lint/acre over untreated cotton. Conventional varieties tended to return more value with insecticide treatment compared with single- or double-gene varieties, but only four varieties returned more than 40 dollars/acre compared with untreated cotton.

Objective

To compare lint yields and value of non-insect resistant (RR or RF), single insect resistant gene (BG), and double insect resistance gene (BG2 or WS) cotton varieties with and without insecticide treatment.

Methods

Research was conducted at the Virginia Tech Tidewater Agricultural Research and Extension Center in Suffolk, Virginia, in 2006 and 2007. Varieties were selected from three groupings based on level of insect resistance: non-insect resistant, or conventional (RR or RF); single insect resistant gene, or single-gene (BG); and double insect resistance gene, or double-gene (BG2 or WS). Varieties were selected based on official variety test performances in Virginia and North Carolina using only the highest yielding varieties from each grouping. Plots were 4 rows (36-inch row center) and 35 feet long. Experimental design was a four-replicate split-plot with insecticide treated vs. untreated as the main plot and variety as the sub-plot. Two insecticide applications were made to treated plots, one in late July and the second in early August: (2006) Baythroid @ 2 oz/acre plus Centric @ 2 oz/acre, and Baythroid @ 4 oz/acre plus Centric @ 2 oz/acre; (2007) Baythroid XL @ 1.6 oz/acre plus Centric @ 2 oz/acre, and Baythroid XL @ 2.56 oz/acre plus Centric @ 2 oz/acre. Plant bug and stink bug were monitored by assessing square retention on five randomly selected plants per plot and percent internal bug-induced boll damage on 10 randomly selected bolls per plot. Bollworm was monitored by assessing external worm-induced boll damage on 25 randomly selected bolls per plot. Cotton was harvested from two rows of each plot using a commercial John Deere cotton picker. A one-pound subsample was ginned from each plot to determine the lint:seed/trash ratio. The value of each variety was determined by comparing lint value ($0.55/lb) to insecticide treatment cost ($28/acre), based on Baythroid XL at $1.68/oz (x 1.6 oz and 2.56 oz), and Centric at $3.98/oz (x 2 oz) plus application cost of $5/acre (x 2 applications).

Results

In 2006, square retention in untreated cotton was 91-100% and internal bug-induced boll damage was <5%. In 2007, square retention in untreated cotton was 97-100% and internal boll damage was 0-10%. The high square retention and low internal boll damage in untreated cotton indicates low plant bug and stink bug pressure in both years. In general, bollworm damage to untreated bolls was higher in 2006 than in 2007. In 2006, untreated double-gene varieties (including Widestrike) had 5-13% bollworm damage, single-gene had 12-30%, and conventional had 49-62% and there was a significant difference among varieties ($P < 0.01$) (Fig. 1). In 2007, bollworm damage in cotton was 0, 1-2, and 3-21% for these gene categories and there was a significant difference among varieties ($P < 0.01$) (Fig. 2). Treated cotton in both years had < 3% bollworm damage and there was no significant difference among varieties in either year ($P=0.19$, $P=0.77$) (Figs. 3 and 4) which indicates the effectiveness of insecticide treatments.

In 2006 in untreated cotton, double- and single-gene varieties had significantly higher yields than conventional cotton ($P < 0.01$) (Fig. 5). In 2007 in untreated cotton, four of the five single-gene varieties and one conventional variety had numerically higher yields than the double-gene cotton (Fig. 6). There was no difference in yields of insecticide-treated varieties in 2006 ($P=0.28$) (Fig. 7), but in 2007 there were differences among conventional varieties (1286-1930 lb lint/acre), and between conventional, single-, and double-gene varieties ($P=0.01$) (Fig. 8).

In 2006, insecticide-treated double-gene, single-gene, and conventional varieties had average yield increases of 18, 176, and 500 lb lint/acre over untreated cotton. Figure 9 indicates that in high worm-pressure years, applying an insecticide treatment in conventional cotton returned 210-282 dollars/acre more than untreated cotton. Single-gene varieties would have returned 22-146 dollars/acre from insecticide treatment. However, in double-gene varieties, the value of the lint returned was not enough to offset the cost of insecticide treatment.

In 2007 when bollworm pressure was less compared with 2006, insecticide treatment returned less value in all varieties. Insecticide-treated double-gene, single-gene, and conventional varieties had average yield increases of 64, 85, 157 lb lint/acre over untreated cotton. Figure 10 shows that, as in 2006, conventional varieties tended to return more value with insecticide treatment compared with single- or double-gene varieties, but only four varieties, three of which were conventional, returned more than 40 dollars/acre compared with untreated cotton.

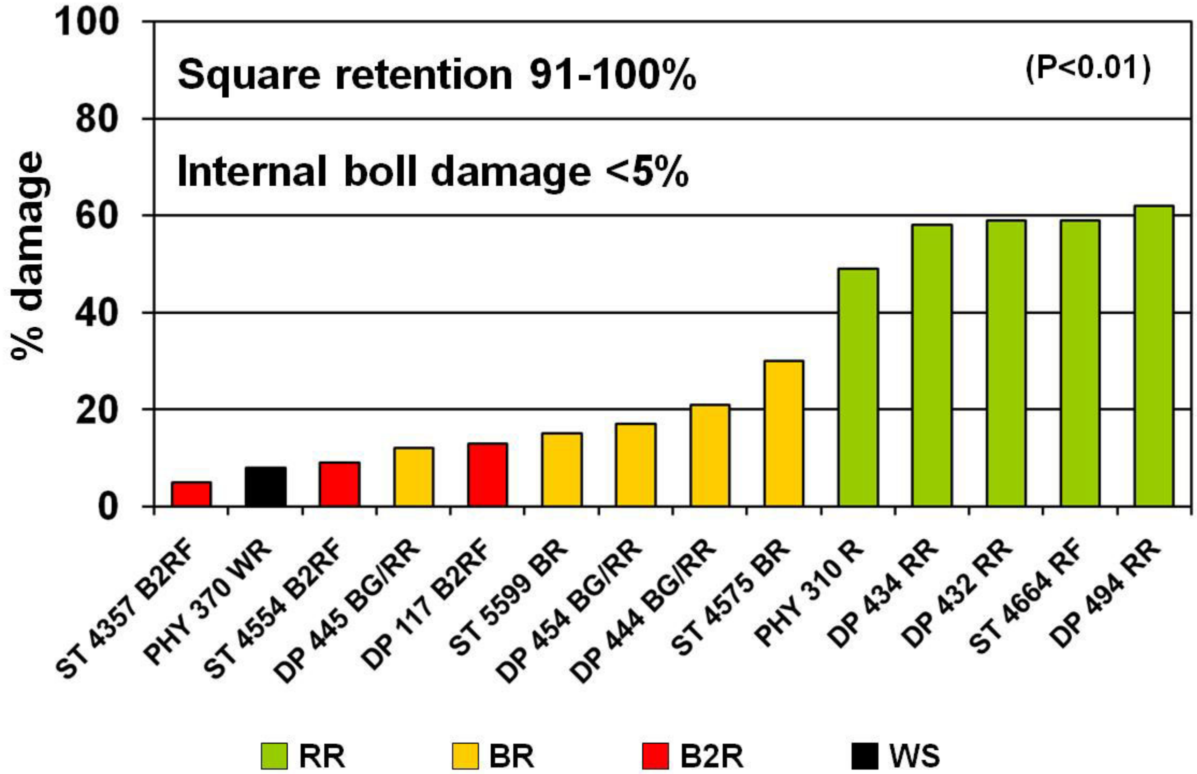

Fig. 1. Percent worm damage to bolls on 14 untreated cotton varieties, 2006.

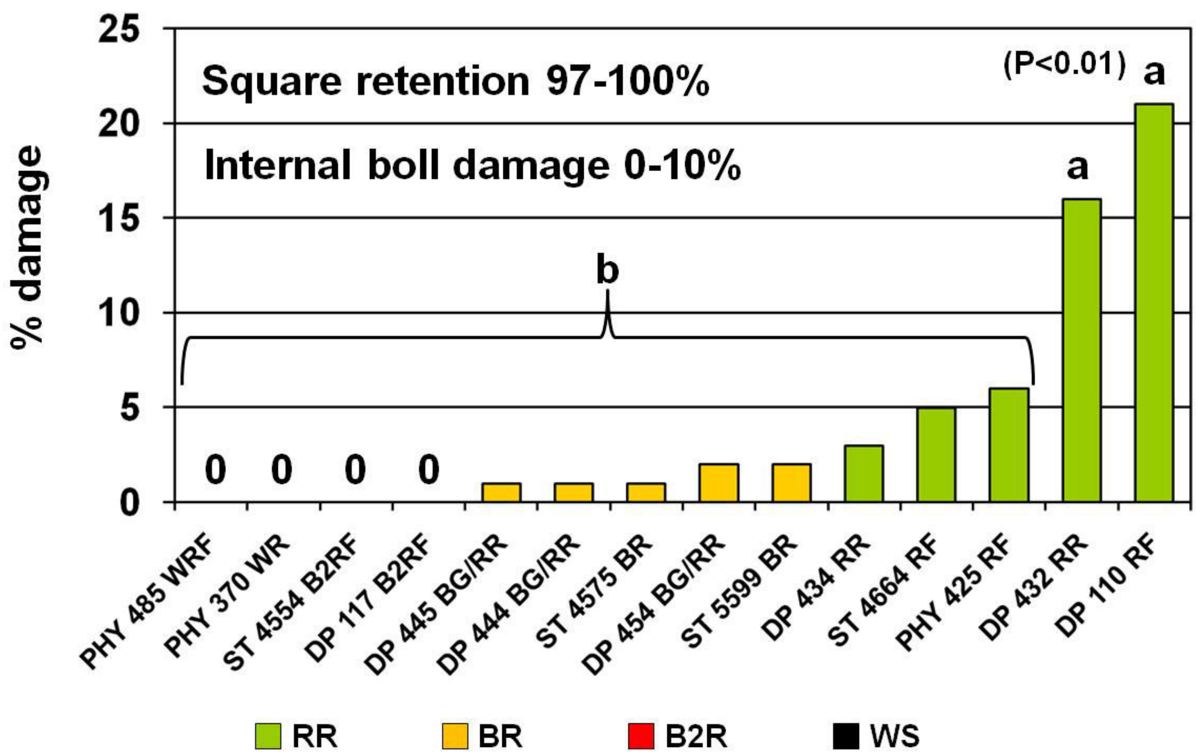

Fig. 2. Percent worm damage to bolls on 14 untreated cotton varieties, 2007.

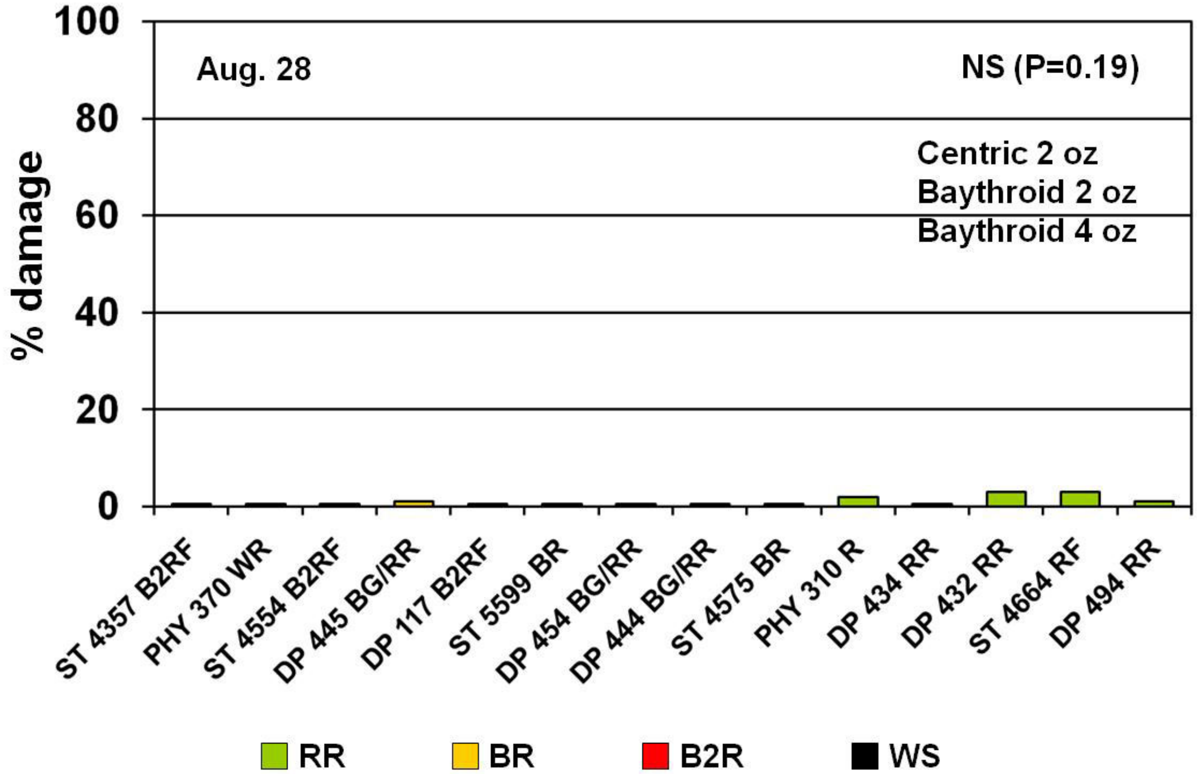

Fig. 3. Percent worm damage to bolls on 14 treated cotton varieties, 2006.

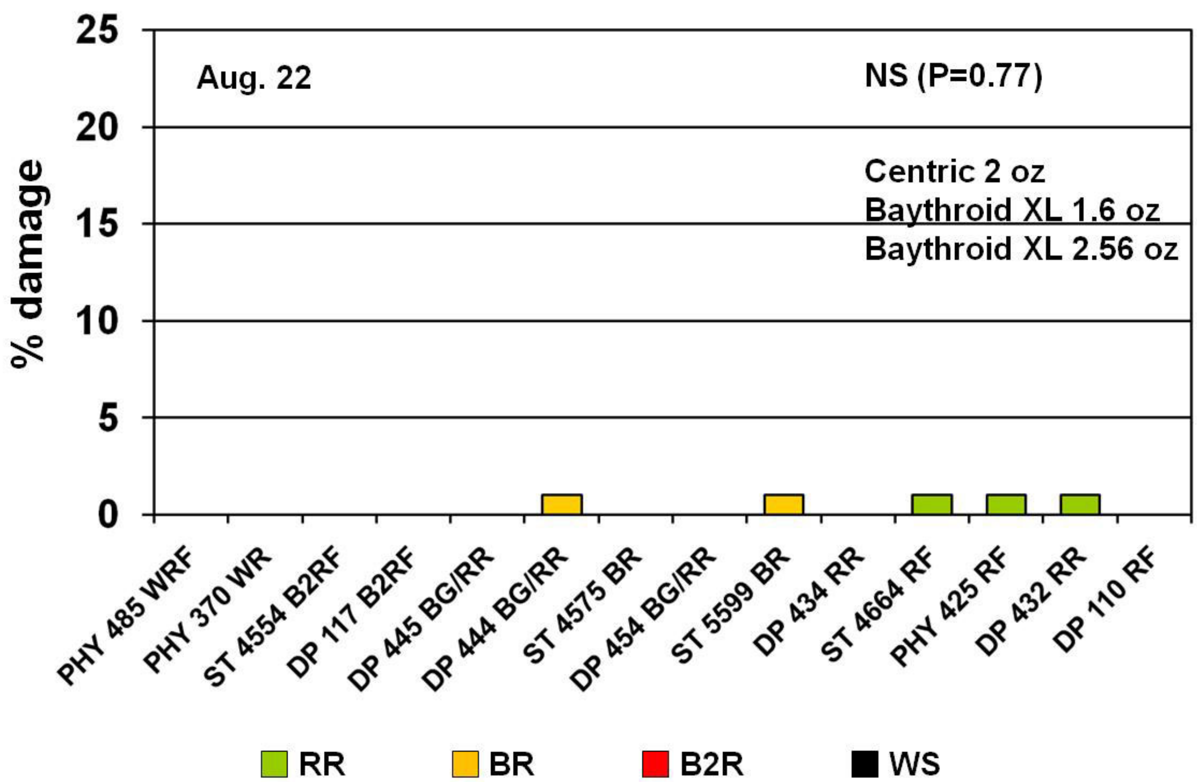

Fig. 4. Percent worm damage to bolls on 14 treated cotton varieties, 2007.

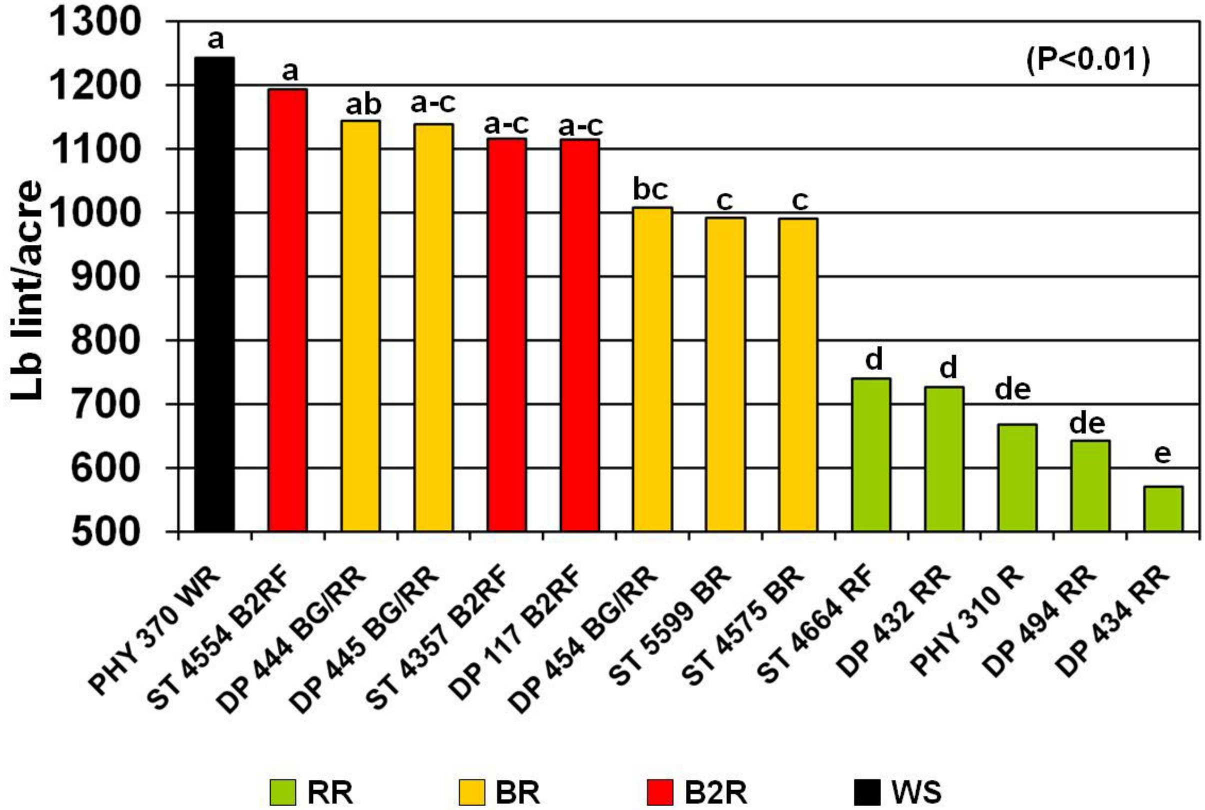

Fig. 5. Yield data, 14 untreated varieties, 2006.

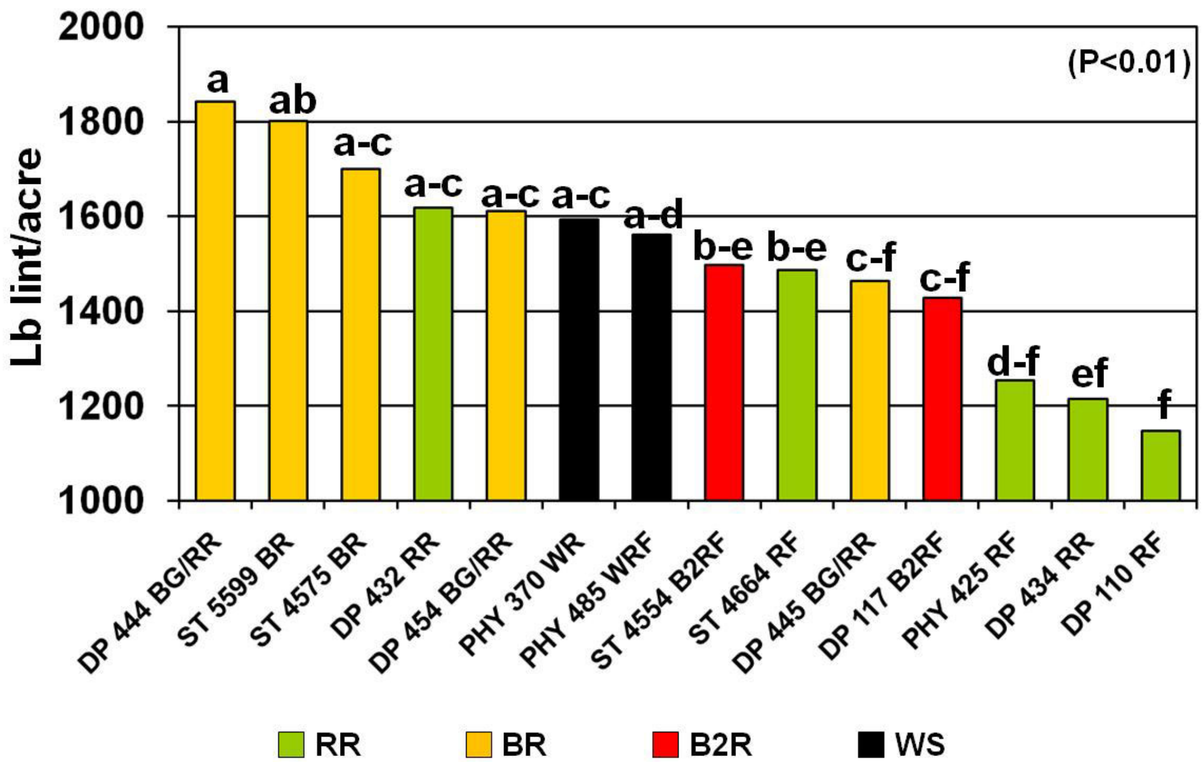

Fig. 6. Yield data, 14 untreated cotton varieties, 2007.

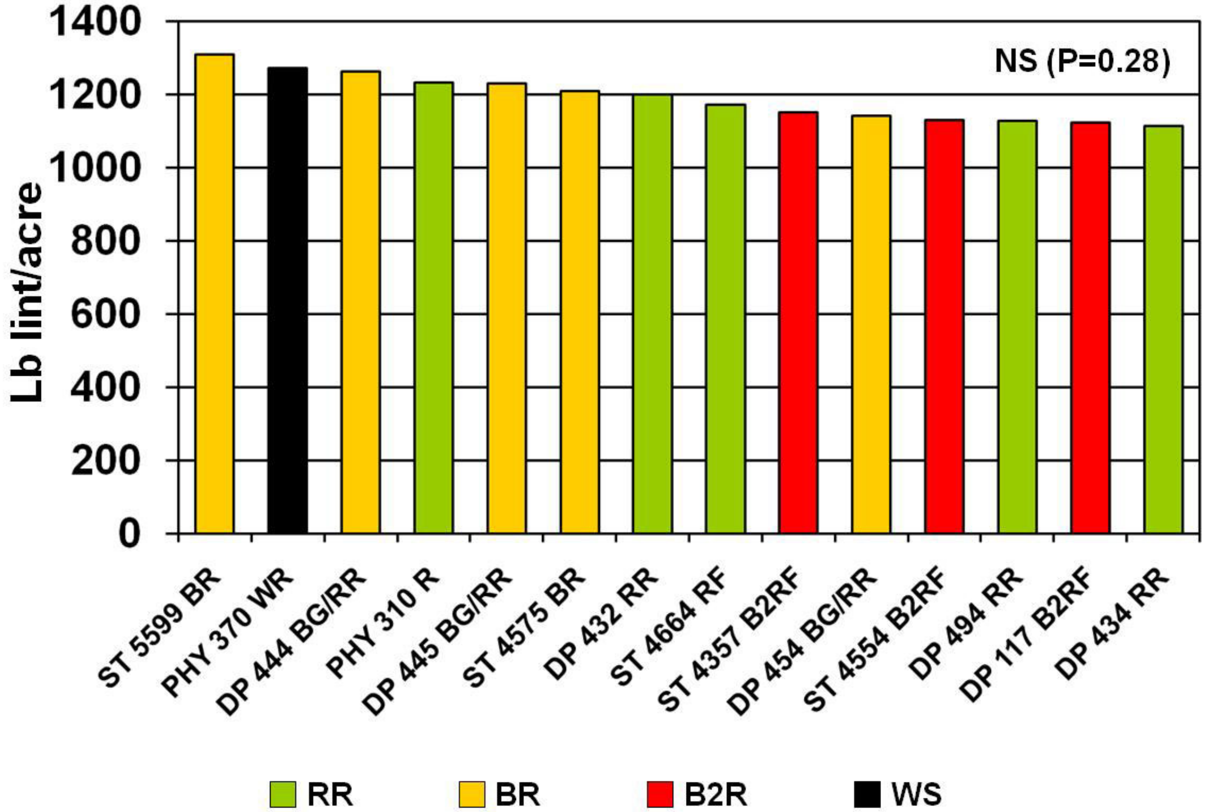

Fig. 7 Yield data, 14 treated varieties, 2006.

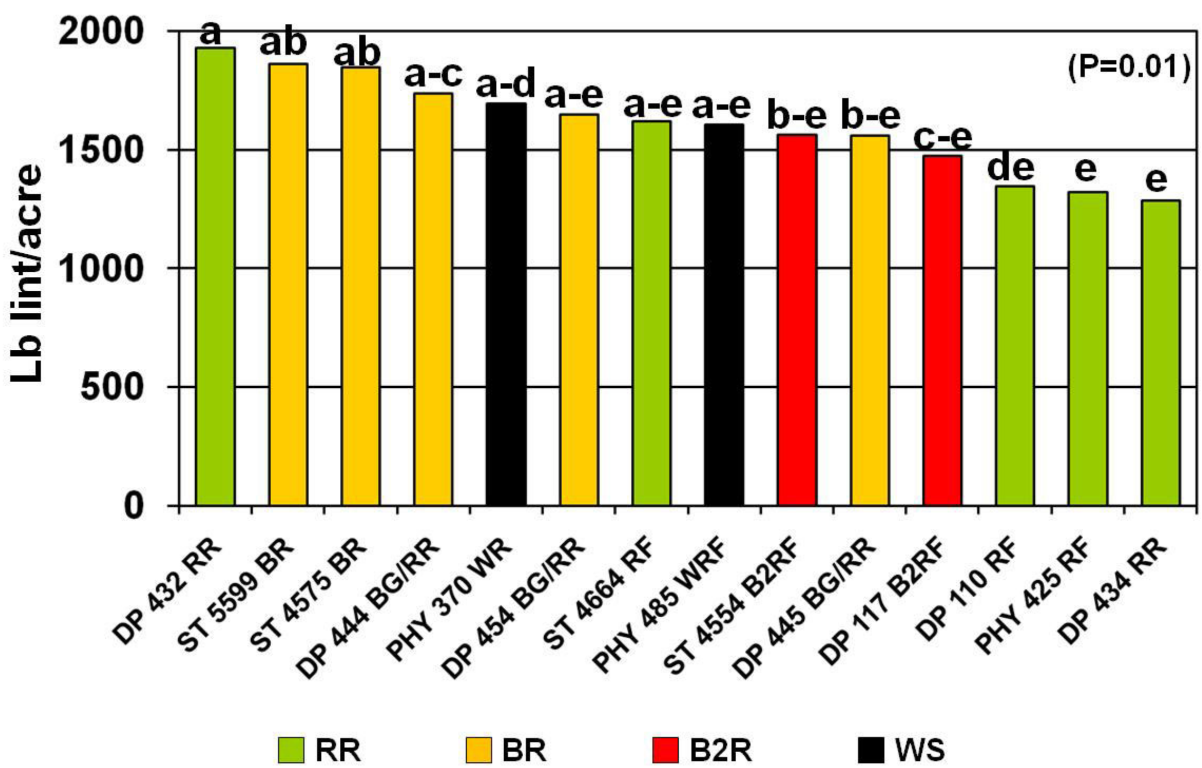

Fig. 8. Yield data, 14 treated varieties, 2007.

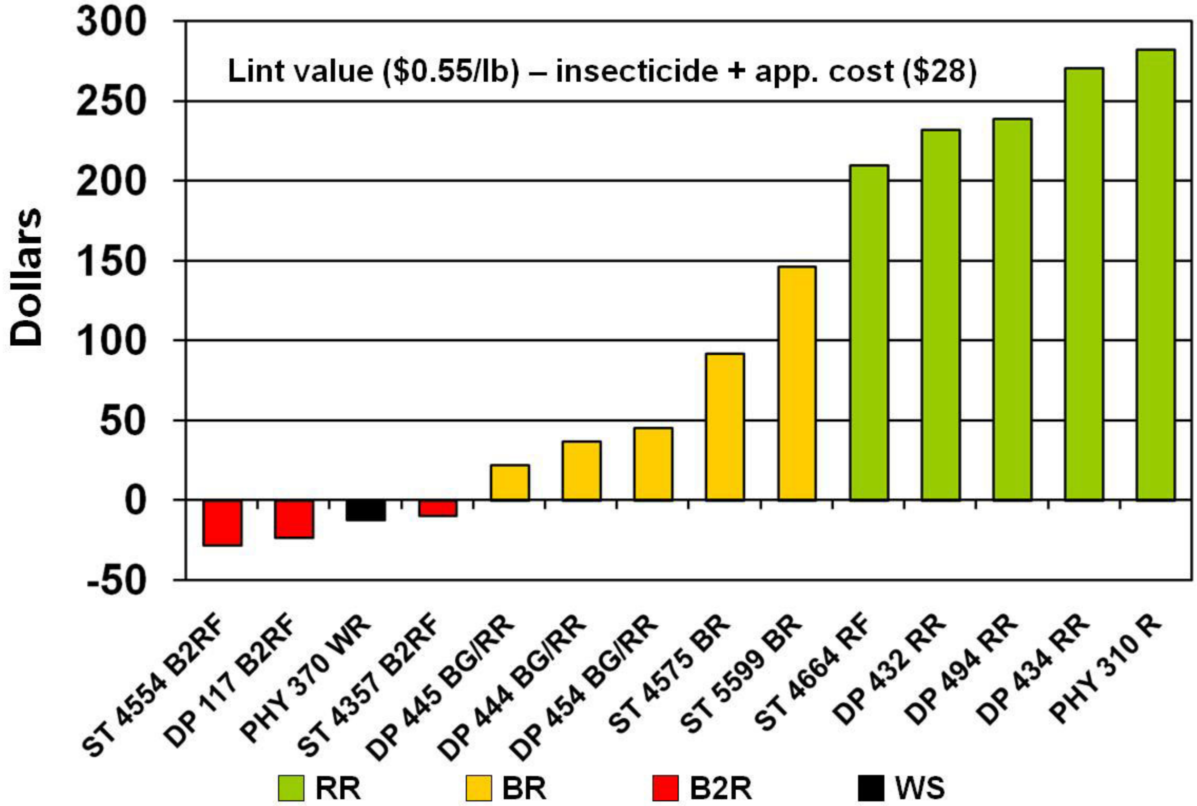

Fig. 9. Value of lint gain due to insecticide sprays, 2006.

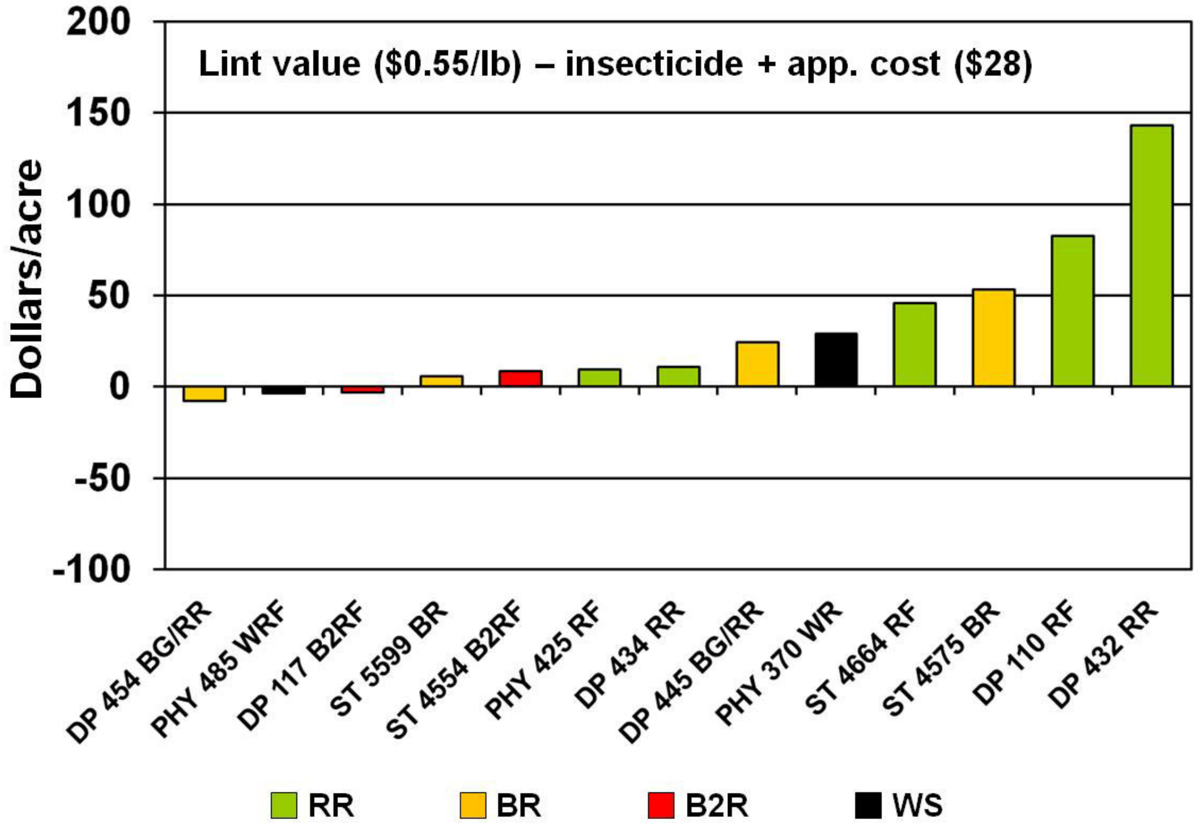

Fig. 10. Value of lint gain due to insecticide sprays, 2007.