FACTORS AFFECTING ROUNDUP READY® COTTON FRUIT RETENTION AND YIELDS

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Introduction

Currently in Roundup Ready cotton (RR), over-the-top applications of Roundup Ultra (RU) should be made prior to the fifth true-leaf stage. All subsequent applications must be post-directed with no herbicide contact to the leaves (Kerby and Voth, 1998; Roundup Ultra label, 1997). This application window limits the grower's ability to make over-the-top applications of RU, which may be necessary to control in-row weeds (Matthews et al., 1998). Applications of RU inconsistent with label directions have led to square and boll abscission resulting in yield loss (Ferreira et al., 1998; Kalaher et al., 1997). Moreover, significant yield reductions have also been observed with the standard RU program (Brown and Bednarz, 1998). Several other experiments have failed to show yield reductions with labeled and non-labeled RU applications (Blackley et al., 1999; Jones and Snipes, 1999; Matthews et al., 1999; Murdock, 1999), and only a small percentage of growers have reported concerns of boll abscission with RR technology (Heering et al., 1998). These contrasting observations warrant a better understanding of the response of RR cotton to RU applications; this may prevent potential yield losses due to possible boll abscission in RR cotton treated with RU.

Objectives

- Determine if there is a critical rate of RU applied over-the-top that influences fruit abscission in a controlled environment.
  (growth chamber experiment).
- Determine if the application method and timing for mid-season RU application affects cotton yield, fiber quality, percent ginout, boll distribution, and abnormality of bolls (field experiment).

Materials and Methods

Growth Chamber Experiment

Cotton, cv. 'DP&L 5690RR'; was grown in a controlled environment and treated with 0, 0.5, 1.0, and 2.0 qt/acre at the 12th-leaf stage. Treatments were applied over-the-top with a CO_2 hand-boom sprayer calibrated to 20 GPA. All treatments were replicated four times. C^{14}-radiolabeled RU was applied with a microsyringe to the three uppermost fully expanded leaves at 0, 1.0, 2.0, and 4.0 microcuries per leaf for the 0, 0.5, 1.0, and 2.0 qt/acre treatments, respectively. Plant mapping was conducted 8 weeks after treatment to determine boll distribution. Individual abscised bolls were collected, dried, and ground. A 0.1-0.2 g sub-sample was oxidized at 900° C for four minutes with a biological material oxidizer. The amount of C^{14}-radiolabeled RU in the boll was quantified with a liquid scintillation counter. Final radiation counts were adjusted for combustion and counter efficiencies, and related back to RU concentration. Data were analyzed using regression and ANOVA; means were separated using LSD at probability levels of 0.05 and 0.10.

Field Experiment

Field experiments were conducted at the Texas Agricultural Experiment Station near College Station, TX using cotton, cv. 'DP&L 5690RR'. Treatments are listed in Table 1. Post-directed applications minimized foliar contact. Experimental design was a randomized complete block with four replications. All plots were maintained weed-free. The center two rows of four row plots were machine harvested to determine lint yield, fiber quality, and percent ginout. Boll distribution patterns, weights, and abnormalities were also determined at harvest. Data was analyzed using ANOVA; means were separated using LSD at probability levels of 0.05 and 0.10.

Results and Discussion

Critical Concentration and Rate

Growth chamber studies indicated that boll abscission was increased with the rate of RU applied. A rate of RU greater than 1.0 qt/A dramatically increased boll abscission (Fig. 1). Further analysis showed that RU concentration in the boll affected the number of bolls abscised; the critical concentration in the boll causing boll abscission was 4 ml/g boll tissue (Fig. 2). Moreover, regression analysis relating RU rate and RU concentration in the boll showed that application of 1 qt/A caused the critical concentration of 4 ml/g boll tissue to accumulate in the boll (Fig. 3). These data suggest that RU translocated to the bolls is the cause of boll abscission. Data also indicated considerable boll abscission at nodes 12-16 (Fig. 4).

Application Timing and Method

The field study indicated that following an early-season, labeled application of RU, both over-the-top and post-directed applications of RU caused yield loss (Fig. 5). This data agrees with previous research that showed significant RU absorption through cotton stems (File et al., 1999). Post-directed applications at the 8th- or 18th-leaf stage reduced lint production on the lower part of the cotton plant (nodes 5-10), while over-the-top application at the 8th-leaf stage reduced lint production at nodes 13-15 (Fig. 6-7). RU application did

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not significantly affect fiber quality, percent ginout, or the occurrence of boll abnormalities (data not shown).

In both experimental studies, RU appeared to affect the cotton plant above the application zone suggesting acropetal translocation.

Conclusions

- The 4 ml/ g boll tissue was the critical concentration causing boll abscission.
- Producers may need to prevent RU contact with both cotton stems and leaves when applying RU after the 4^{th}-leaf stage to prevent possible yield losses.

Future Research

- Investigate RU application effects on other RR varieties.
- Investigate RU absorption through cotton stems and translocation patterns of RU throughout the entire plant.
- Examine the effects of RU applications on RR cotton on seed number and viability.

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Table 1. Roundup Ultra treatments**.**

Trt	**4 leaf**	**8 leaf**	**8 leaf**	**18 leaf**	**18 leaf**
	top	***post-direct***	***top***	*post-direct*	*top*
utc	1 qt/A				
8pd	1 qt/A	1 qt/A			
8top	1 qt/A		1 qt/A		
18pd	1 qt/A			1 qt/A	
18top	1 qt/A				1 qt/A

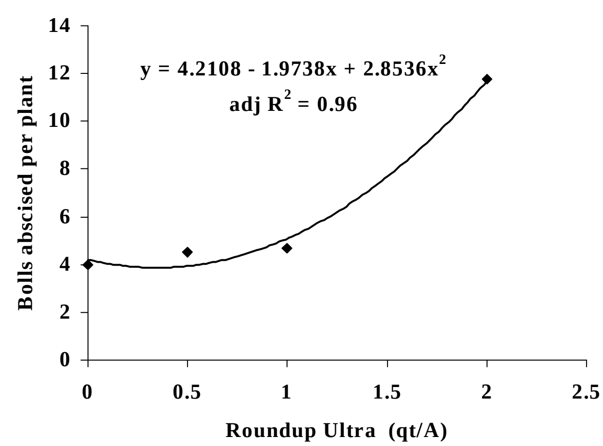

Figure 1. Relationship between abscised bolls and Roundup Ultra applied.

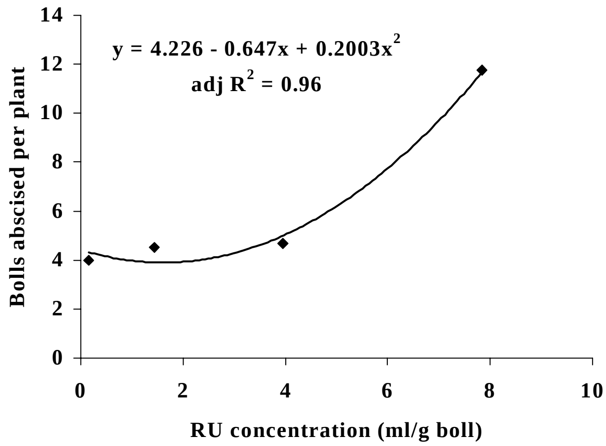

Figure 2. Relationship between abscised bolls and Roundup Ultra concentration within those bolls.

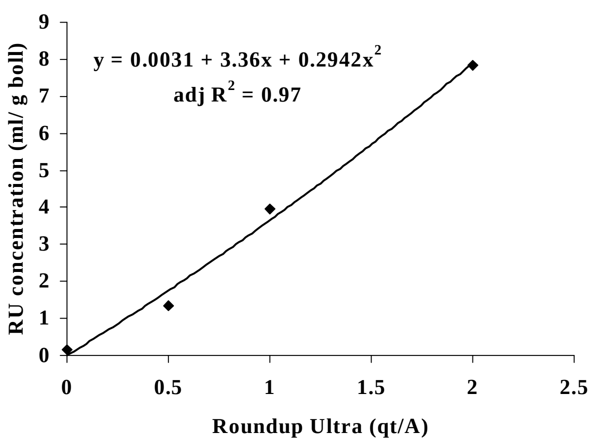

Figure 3. Relationship between Roundup Ultra concetration in abscised bolls and Roundup Ultra applied.

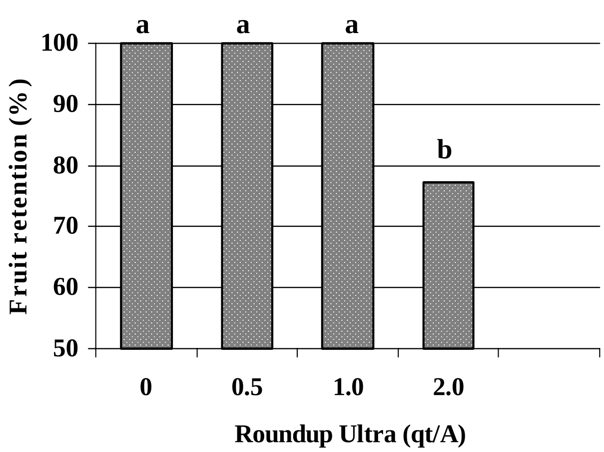

Figure 4. Percent fruit retention from nodes 12 through 16. (P < .0076).

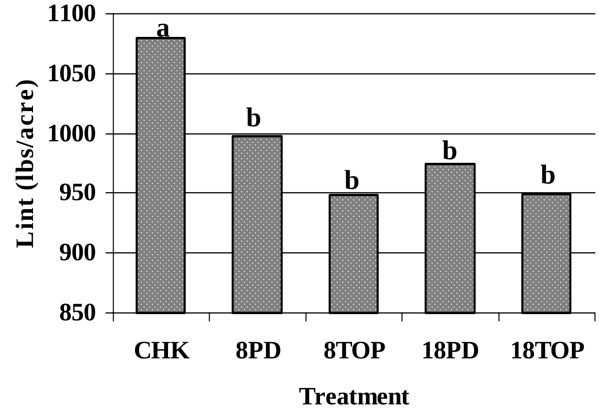

Figure 5. Lint yield of RU-treated cotton. (P < .10).

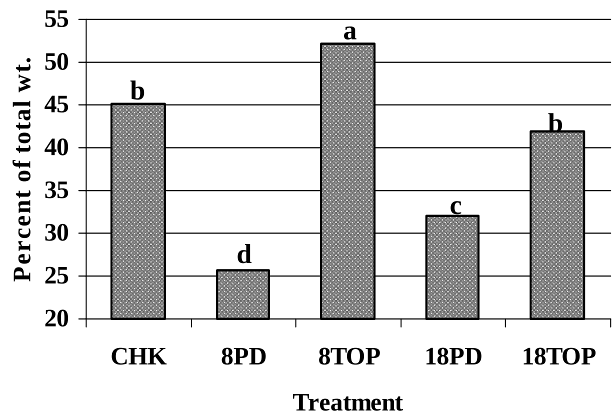

Figure 6. Percent of total cotton weight from nodes 5 through 10. (P < .0029).

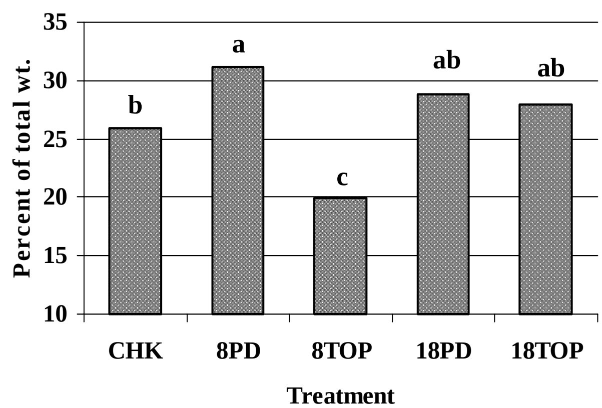

Figure 7. Percent of total cotton weight from nodes 13 through 15. (P < .10).