EVALUATION OF PREPLANT AND PREEMERGENCE HERBICIDES IN ROUNDUP READY® COTTON

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Abstract

Field research was conducted in 1995 and 1996 on the Monsanto Delta Research Farm in Proctor, AR to evaluate the usefulness of preplant incorporated (PPI) and preemergence (PRE) herbicides in weed control systems using Roundup® herbicide (glyphosate) in Roundup Ready® Cotton (*Gossypium hirsutum* L.). In both years, Roundup alone over-the-top (OT) provided excellent control of annual broadleaf and grass weeds, including morningglory (*Ipomoea* spp.), velvetleaf (*Abutilon theophrasti* Medik.), cocklebur (*Xanthium strumarium* L.), prickly sida (*Sida spinosa* L.), and large crabgrass [*Digitaria sanguinalis* (L.) Scop.], 2 to 3 weeks after treatment (WAT). Sequential post-directed (PD) Roundup treatments provided season-long control. Treflan® (trifluralin) and Cotoran® (fluometuron), when used, reduced the weed populations early, but enough weeds still existed to warrant a Roundup OT application. Treflan and Cotoran had little affect on late season weed control. There were no significant differences in yields in 1995. In 1996, however, commercial standard treatments yielded significantly lower than most Roundup treatments.

Introduction

Roundup is a non-selective, systemic herbicide that has primarily been used in cotton for pre-plant burndown applications and through hooded sprayers for in-crop weed control. With the introduction of Roundup Ready Cotton in 1997, Roundup can be used as an early-season, OT herbicide to control annual and perennial weeds up through the 4-leaf stage of cotton. In addition, it can be used PD after the 4-leaf stage to provide control of later emerging weeds. A broad-spectrum herbicide for use OT in cotton could reduce or eliminate the need for PPI and PRE residual herbicides. This study was designed to evaluate the need for residual herbicides in various Roundup Ready Cotton weed control systems, to determine the number of Roundup applications needed for season-long weed control, and to evaluate the effects of Roundup treatment timing on the rates required.

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Materials and Methods

Research was conducted at the Monsanto Delta Research Farm near Proctor, AR on a Commerce silt loam. Test design was a split-plot design with 4 main treatments, 6 sub-treatments, and 4 replications. Plots were 4-rows wide and 30-ft long. Roundup Ready line 1445 in a Coker 312 background was planted on 38-inch rows. Cotton was planted on May 12 in 1995 and May 18 in 1996. Weeds were seeded over the entire test area with a hand seeder prior to planting and were incorporated to a depth of about 0.5 inch. Weeds planted were large crabgrass [*Digitaria sanguinalis* (L.) Scop.], broadleaf signalgrass [*Brachiaria platyphylla* (Griseb.) Nash], Japanese millet [*Echinochloa crus-galli* var. *Frumentacea* (Roxb.) W. F. Wight], prickly sida (*Sida spinosa* L.), mixed pigweed species (*Amaranthus* spp.), mixed morningglory species (*Ipomoea* spp.), cocklebur (*Xanthium strumarium* L.), and velvetleaf (*Abutilon theophrasti* Medik.).

The main plots consisted of:
A) 0.75 lb ai/a Treflan PPI
B) 0.75 lb ai/a Treflan PPI + 1.0 lb ai/a Cotoran PRE
C) 1.0 lb ai/a Cotoran PRE
D) no residuals

The six sub-treatments which were randomized within each main plot were as follows:
1) 0.56 lb ae/acre Roundup at the 1-leaf stage (Early OT) followed by Roundup PD as needed.
2) 0.56 lb ae/acre Roundup at the 4- to 5-leaf stage (Late OT) followed by Roundup PD as needed.
3) 0.75 lb ae/acre Roundup at the 1-leaf stage EOT followed by Roundup PD as needed.
4) 0.75 lb ae/acre Roundup at the 4- to 5-leaf stage LOT followed by Roundup PD as needed.
5) 0.75 lb ae/acre Roundup at the 1-leaf stage EOT followed by Roundup through a hooded sprayer as needed.
6) (1995) 0.5 lb ai/acre Caporal® (prometyn) + 1.5 lb ai/acre MSMA at the 4- to 5-leaf stage PD followed by 1 lb ai/acre Bladex® (cyanazine) + 2 lb ai/acre MSMA PD as needed. (1996) 0.33 lb ai/acre Cotoran + 0.75 lb ai/acre DSMA at the 2-leaf stage OT (salvage treatment) followed by 1 lb ai/acre Bladex + 2 lb ai/acre MSMA PD as needed.

Roundup is labeled for use OT through the 4-leaf stage, after which it must be used PD. Sequential "as needed" applications were made when weed control dropped below 80 %.

Treflan and Cotoran were banded on the row tops. Roundup OT applications were sprayed broadcast on the center two rows of the plots. All PD applications were made using a tractor-mounted cultivator, which banded the herbicide on the row top. Row middles were cultivated at the time of application. The hooded sprayer was run about 2 to 3 inches off the ground to allow the spray to reach onto the row top, as an alternative to PD applications. Surfactant

was added to herbicides when recommended by label directions.

Weed control ratings were taken only on the row top. Preemergence weed control was evaluated approximately 3 weeks after planting. Later evaluations were timed to the applications, usually about 2 weeks after application. A final weed control rating was taken after harvest in 1996. The center two rows of each plot were harvested with a spindle picker and weighed. Seed cotton weight was calculated from this data. In both years, cotton was irrigated whenever needed to activate herbicides and avoid drought stress. The test was aggressively scouted and managed for insect control. Mepiquat chloride was applied as needed to moderate vegetative growth. Weed control, injury, and yield data were analyzed using Duncan's Multiple Range Test and the Least Significant Difference test at the 5 % level of probability.

Results and Discussion

Early weed control ratings indicate that Treflan and Cotoran both reduced weed pressure. Despite the weed population reduction, enough weeds survived to necessitate an application of a postemergence herbicide for control. PPI and PRE herbicides did not affect the number of Roundup applications required to provide season-long weed control.

EOT (1-leaf cotton) Roundup applications controlled weeds and grasses present at both the higher and lower rates, regardless of whether PPI and PRE herbicides had been used. Weed sizes at the time of application were in the 2- to 4-inch range. Control ratings in 1995 were in the 90 to 100 % range when evaluated 2 (WAT), while in 1996 they were in the 70 to 90 % range. In 1996, 2 sequential PD applications of Roundup were required after the initial EOT application to maintain weed control later in the season, regardless of the residual program. The first sequential was applied about 3 WAT, with the layby sequential applied about 3 weeks later. In 1995, only one sequential PD treatment was required approximately 5 WAT. This was due to the fact that much higher weed pressure was encountered in 1996 than in 1995.

The LOT (5-leaf cotton) application of Roundup was made to larger weeds. Weed pressure was heavy, especially in the treatments that did not include PPI or PRE herbicides. Most weeds were in the 3 to 6-inch range. Roundup still provided good to excellent control. The control ratings in 1995 and 1996 ranged from 85 to 100 % 2 WAT. Only one sequential PD treatment was needed after the LOT to maintain late season weed control, as opposed to the 2 sequential treatments required at the EOT timing in 1996. This sequential was applied about 5 WAT in both years, and provided excellent weed control. The 0.56 lb ae/acre rate of Roundup was sufficient for weeds encountered in this test, especially when sequential applications were used.

In 1995, the initial commercial standard PD treatment was applied at the 5-leaf stage, and provided good to excellent weed control, except where no PPI or PRE herbicides were used. The initial treatment was followed by a sequential PD about 5 weeks later, except for the treatment where no PPI or PRE herbicides were used. This required 2 sequential applications, 3 and 5 weeks after the initial. Good to excellent late season weed control was obtained with the commercial standards in 1995. Due to heavy weed pressure in 1996, the initial commercial standard treatment was changed to a salvage treatment of 0.33 lb ai/a Cotoran + 0.75 lb ai/a DSMA EOT, which caused cotton injury and reduced yields. This treatment controlled most of the broadleaves present but was weak on grasses when Treflan was not used. The initial treatment was followed by 2 PD treatments, the first 10 days after treatment (DAT), and the second 4 WAT. In general, sequential applications resulted in good control of all weeds 2 WAT, except for some grasses when Treflan was not included. Weed control was still good to excellent in the commercial standards at harvest except for velvetleaf control, which was in the 70 to 80% range.

No differences in early season stand density or seedling vigor were observed between various herbicide programs. Roundup did not injure the cotton in any of the treatments. In 1995, there was no injury in any treatment and no significant differences in yield between the commercial standards and Roundup treatments. Treatment mean yields ranged from 3144 to 3645 lb seed cotton per acre. In 1996, the commercial standards did cause injury with chlorosis ratings ranging from 20 to 28 % and significant yield reductions when compared to most of the Roundup treatments. Mean yields of commercial standards ranged from 1748 to 2246 lb seed cotton per acre, compared to Roundup treatment yields of 2292 to 2969 lb seed cotton per acre.

Conclusions

According to the results obtained in this study, Roundup used in a weed management program with Roundup Ready Cotton offers potential for outstanding weed control with more flexibility than current herbicides allow. Its broad spectrum of weed control and early OT application capability can allow reduction or elimination of PPI and PRE herbicides. Roundup used OT to control the initial flush of weeds can be applied earlier than standard postemergence herbicides. Roundup can replace the early PD treatments of standard herbicides, which can often cause injury to the crop, allowing for better early season growth and greater yield potential. Sequential PD or hooded sprayer Roundup applications, after the 4-leaf stage, are effective against later emerging weeds as well as weeds that escaped the initial treatment. Sequential treatments are also instrumental in control of perennial weeds. Due to its flexibility, the Roundup Ready Cotton technology should be easily adaptable to most cropping systems.

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