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TOLERANCE OF COTTON TO FLUMIOXAZIN (VALOR)

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Abstract

Field and laboratory studies were conducted to examine cotton tolerance to flumioxazin application with various adjuvants, nozzle tips, and placement on the cotton plant. There were no differences in the various glyphosate formulations tank-mixed with flumioxazin. None exceeded 5% cotton injury7 or 20 DAT. Weed control was better from the tank-mixes than with flumioxazin applied alone. No differences were observed amongst the various glyphosate formulations tank-mixed with flumioxazin. Seed cotton yields were higher with all combinations than with no treatment. Flood jet nozzles tended to cause more injury early, but by 30 days after treatment no differences in weed control or injury were observed. Differences in weed control and seed cotton yield were not observed. None of the adjuvants applied with flumioxazin caused greater than 10% cotton injury 7 or 14 DAT. Differences in weed control and seed cotton yield were not observed amongst the adjuvants used. The uptake study indicated that flumioxazin penetration through bark tissue was minimal and was significantly lower than flumioxazin penetration through green tissue. Translocation of flumioxazin from application to bark tissue was not observed due to lack of movement across the epidermal layer. Translcoation of flumioxazin was observed from application to green tissue.

Introduction

Flumioxazin has shown great potential as a post-directed herbicide in cotton (Altom et al. 2000). It has been shown to provide rebroad-spectrum control of many important weeds of cotton. However, there have been some concerns about cotton safety with flumioxazin use (Altom et al. 2000; Baker, 1989). The objective of these studies was to examine rates and tank mixes that provide optimum weed control in cotton and to examine if nozzle type affects injury.

Materials and Methods

Field experiments were conducted at the Southwest Georgia Branch Experiment Station near Plains on a Greenville sandy clay loam (Rhodic Paleudult) with a pH of 6.5 and 1.0% organic matter and the Plant Science Farm near Athens on a Cecil sandy loam (clayey, kaolinitic, thermic, Typic Hapludults) with 76% sand, 16% silt, 8% clay, 0.9% organic matter, and pH 5.9 in 2001 and 2002. Glyphosate-resistant cotton ('DP5415BGRR') was planted in Athens and Plains in 2001 while 'Suregrow 501 BRR' was planted in Athens and Plains in 2002. Glyphosate was applied broadcast to the test area at the 2-leaf stage and directed at the 6" stage of cotton.

The experimental design was a randomized complete block with three replications. Individual plots consisted of four rows, spaced 91-cm apart, 6.1 m long. In Plains, sicklepod, Texas panicum, and wild poinsettia were present. In Athens, Palmer amaranth, sicklepod, and tall morningglory were present in the plots.

All herbicide treatments were applied with a tractor-mounted or backpack CO_2-pressurized sprayer, calibrated to deliver 170 L/ha at 220 kPa. Weed control was visually estimated on a 0 to 100% scale where 0 = no control and 100 = complete control. Cotton injury was visually estimated on a 0 to 100% scale where 0 = no injury and 100 = complete kill. Visual estimates of weed control and cotton injury was taken 7, 28 and 45 DAT. All weed control data were subjected to arcsine transformations before analysis. Significance of differences in treatment means for weed control ratings, cotton yield were determined with Fisher's Protected Least Significance Difference Test at the 5% level of probability. Cotton injury and weed control data were combined over locations and years. Seed cotton yield data were analyzed by year and location because of significant interaction. Visual estimates of weed control are expressed as untransformed data for reader clarity.

To better examine cotton tolerance to flumioxazin in the field, three studies were initiated in which flumioxazin was applied with a wide range of nozzle tips, adjuvants, and tank-mixes. For the nozzle tip study, flumioxazin was applied at 70 g ai/ha with 0.5% v/v non-ionic surfactant using a wide range of nozzle tips, a [8003 even flat-fan, 8003UB (under-band) flat fan, 8003 DG (drift-guard), 11003 TT (Turbo TeeJet®), 8003XR (extended range) flat-fan, 8003TJ (TwinJet®), 80015LP (low pressure) flat –fan, floodjet nozzle (TF-VS4), full-cone nozzle (FL-5VS), and AI11003VS (air-induction) nozzle]. For the adjuvant study, flumioxazin was applied at 70 g ai/ha with the following adjuvants: PX331 (liquid ammonium sulfate plus a polymer adjuvant), PX 334 (dry ammonium sulfate plus a polymer adjuvant), PX 338 (dry ammonium sulfate plus a polymer adjuvant), Dyne-A-Pak® (methylated seed oil + 28% UAN), Hook® (non-ionic surfactant), Kinetic® and Silwet L-77® (organosilicone adjuvants), Exchange (60:40 blend of crop oil concentrate), ImpressiveDB (dry ammonium sulfate), Dyne-Amic

(methylated seed oil), Induce® (90% non-ionic surfactant), Ad-Spray 80® (80% active non-ionic surfactant), Roundup UltraMax®, and flumioxazin was applied with a liquid formulation (Chateau 4FL). For the tank-mix study, flumioxazin was applied at 70 g ai/ha in tank-mix with the several glyphosate formulations at 840 g ai/ha: Roundup UltraMax, Roundup UltraMax plus ammonium sulfate, Roundup Ultra, Roundup Original, Touchdown, and Roundup UltraDry.

A laboratory study was initiated to compare ^{14}C-flumioxazin uptake in green and bark tissue of cotton stems similar to what would happen in a pos-directed application. Cotton ('Suregrow 501BRR') was grown in 500-ml cups in a controlled environment chamber to an approximate height of 30-cm (12") when bark tissue was present on the lower stem. ^{14}C-flumioxazin (SA 12.9 MBq/mg) was mixed with formulated flumioxazin (Valor 51WP) and 18 Bq of flumioxazin was spotted on either green stem or bark tissue. After 4 h, stems were washed with water; split into 1-cm segments which were the epidermal tissue was separated from the vascular tissue. All plant material was oxidized using a Harvey OX-500 biological oxidizer. Samples were counted using liquid scintillation counting (Beckman LS-500). All treatments were replicated three times.

Tank-Mix Study

There were no differences in the various glyphosate formulations tank-mixed with flumioxazin. None exceeded 5% cotton injury7 or 20 DAT. Weed control was better from the tank-mixes than with flumioxazin applied alone. No differences were observed amongst the various glyphosate formulations tank-mixed with flumioxazin. Seed cotton yields were higher with all combinations than with no treatment.

Nozzle-Tip Study

Flood jet nozzles tended to cause more injury early, but by 30 days after treatment no differences in weed control or injury were observed (Figure 1). Differences in weed control and seed cotton yield were not observed.

Adjuvant Study

None of the adjuvants applied with flumioxazin caused greater than 10% cotton injury 7 or 14 DAT. Differences in weed control and seed cotton yield were not observed amongst the adjuvants used (Figure 2).

Uptake Study

The uptake study indicated that flumioxazin penetration through bark tissue was minimal and was significantly lower than flumioxazin penetration through green tissue. Translocation of flumioxazin from application to bark tissue was not observed due to lack of movement across the epidermal layer. Translcoation of flumioxazin was observed from application to green tissue. Additional research is being conducted to examine the effects of adjuvants on uptake and movement of flumioxazin across green and bark tissue of cotton.

References

Altom, J. V., J. R. Cramer, and J. A. Pawlak. 2000. Valor (flumioxazin) herbicide – The new standard for layby applications in cotton. Proc. Beltwide Cotton Conf. Vol. 2:1462-1463.

Baker, R. S. 1989. Experimental herbicides for broadleaf weed control in cotton. Proc. Beltwide Cotton Conf. Pp. 383-385.

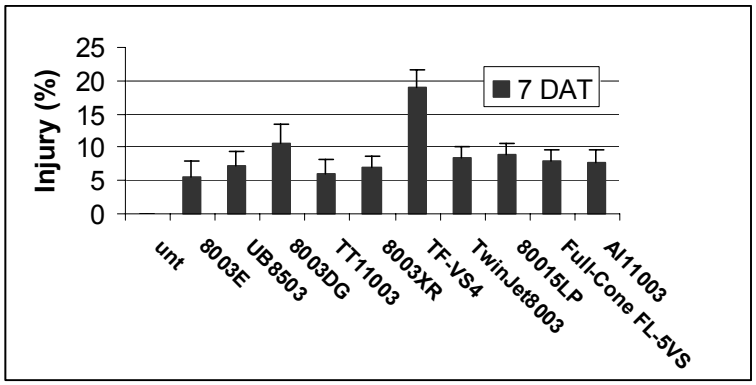

Figure 1. Cotton injury from flumioxazin applied through several nozzle tips.

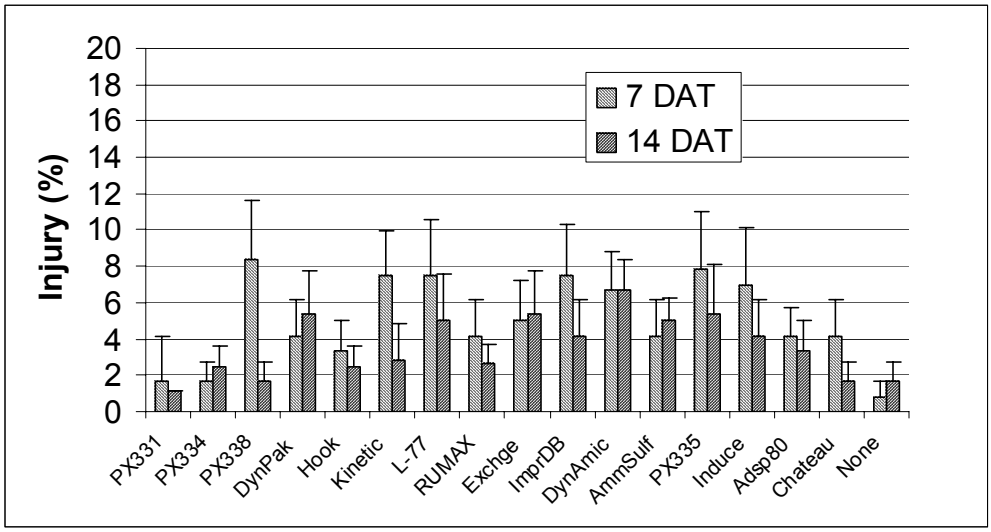

Figure 2. Cotton injury from flumioxazin applied with several adjuvants. Error bars indicate standard error of the mean