CONTROL OF SILVERLEAF NIGHTSHADE IN ROUNDUP READY COTTON WITH ROUNDUP ULTRA

M. Choudhary and D. G. Bordovsky
Texas Agricultural Experiment Station
Munday, TX

Abstract

The second year of this field experiment was conducted to determine the most appropriate cotton growth stage or stages to apply Roundup Ultra® (RU®) herbicide to maximize the control of silverleaf nightshade in Roundup Ready® cotton. Treatments consisted of a control (2 cultivations) and application of RU® on 3 dates in various combinations. Date 1 applications were at the 4 leaf stage, date 2 applications were at 3 weeks past the 4 leaf stage, and date 3 applications were at 20% open bolls. Each treatment was applied to the land areas as in 1999. In 2000, two weeks after the date 3 spray application, approximately 85, 77, 62, 90, and 98% weed control was achieved with spray date 1, date 1 plus 2, date 3, date 1 plus 3, and date 1 plus 2 plus 3, respectively when compared to the control. The percent weed biomass competition was highest with the control. The very hot and dry 2000 growing season severely affected lint yields. Lint yield in 2000 ranged from 38 to 57 lbs/A. Even though yield differences among treatments were significant, they were all too low to be meaningful. Silverleaf nightshade numbers were compared between the spring of 1999 (beginning of study) and the fall of 2000 (end of study). During this time silverleaf nightshade numbers had increased by more than 3 times in the control plots. Application of RU® at the 4-leaf stage and/or 3 weeks past the 4 leaf stage resulted in more than a 65% reduction in stems/A whereas spraying once at 20% open bolls resulted in only an 18% reduction. A combination of RU® applied at an early stage and at 20% open bolls reduced nightshade stems/A by 90%. In 2000, cotton quality was inferior to normal quality due to heavy rainfall 2 weeks prior to cotton harvesting. Regression analysis showed yield losses of 0.12 lbs/A for each increasing silverleaf nightshade stem per acre in 1999.

Introduction

Over 2 million acres of land used for cotton production in west Texas are infested with silverleaf nightshade (Alexander et al., 1990). Smith et al. (1990) reported a negative linear relationship between cotton lint yield and silverleaf nightshade biomass and between cotton lint yield and silverleaf nightshade population. Yield losses approaching 75% due to silverleaf nightshade infestations have also been reported by Abernathy and Keeling (1979). Silverleaf nightshade densities of 10 plants per foot of row (36 inches row spacing) reduced cotton plant height, boll size, harvest efficiency, and lint yield up to 50% in Oklahoma studies (Green et al., 1987). Yield loss in cotton and grain sorghum have been related directly to silverleaf nightshade population density (Smith and Wiese, 1973). Green et al. (1987) reported that silverleaf nightshade was more competitive in dryland cotton than in irrigated cotton. Recently, Everitt et al. (2000) reported 88% control of late season silverleaf nightshade with RU® when applied post-harvest at 1.5 lb ai/A. In 1999 a field experiment was conducted to determine the cotton growth stage or stages at which to apply RU® glyphosate [*N*-(phosphonomethyl) glycine] in order to maximize control of silverleaf nightshade. Treatment effects were tested on changes in silverleaf nightshade stem numbers, lint yield, gin turnout, weed competition, and fiber quality. Our 1999 data indicated that spraying RU® at or before the 6th node growth stage can significantly reduce silverleaf nightshade populations (Choudhary and Bordovsky, 2000). This paper deals with the second year of that experiment.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1226-1228 (2001)
National Cotton Council, Memphis TN

Materials and Methods

The second year of this dryland field experiment was conducted at the Smith Farm of the Texas Agricultural Experiment Station at Munday ($33^0$19'N, $99^0$34'W). Treatments were maintained in the identical locations occupied in 1999. The soil type was Altus fine sandy loam (fine-loamy, mixed, thermic Pachic Argiustolls). The soil had a slope of 0 to 1 percent, permeability (0-18 inches depth) of 2 to 6 inches per hour, and available water holding capacity (0-18 inches depth) of 0.11 to 0.15 inch per inch (Soil Survey of Knox County, TX, 1979). In 1999, cotton was stripped on November 3, stalks were shredded on December 3, and plots were disked on December 6. On January 10, 2000 the area was subsoiled to a depth of 10 inches. During February and March 2000, plots were field cultivated, disked twice, and rotary hoed. Trifluralin (%,%,%-trifluoro-2,6-dinitro-N, N-dipropyl-*p*-toluidine) was applied at 1.5 pints per acre in 12 gallons of water for control of weedy annuals. The herbicide was double incorporated with a disk and field cultivator. During the second week of April and the first week of May, plots were lightly tilled to control wind erosion. Treatments were as follows: 'TR1' - control treatment using 2 cultivations; 'TR2' (date 1 or 1st spray)- application of Roundup Ultra® (RU ®) over the top at the 4-leaf stage (1qt/A); 'TR3' - date 1 followed by RU® at 1qt/ac post directed, approximately 15-21 days later (date 2 or 2nd spray) (total of 2 qt/a); 'TR4' (date 3 or 3rd spray)- 2 cultivations plus RU® in a semi-directed application at 20% open bolls (total of 2 qt/A); 'TR5' - date 1 plus date 3 (total of 3 qt/A); and 'TR6' - date 1 plus date 2 plus date 3 (total of 4 qt/A). Treatments were arranged in six completely randomized blocks. Experimental plots were 190 feet long by 8 forty-inch rows wide.

The cotton variety 'Paymaster 2326RR' was planted on May 15 using a John Deere "Max Emerge-2" four-row planter set to plant 5 to 6 seeds per linear foot of row. This variety has medium maturity and plant height, indeterminate growth habit, and is semi-smooth (Cotton Farming, 1999). Border rows were planted on both sides of the test area. Plots were rotary hoed on May 22 and 29. On June 10, when cotton was at the 3-4 leaf stage, 1 qt/A RU® was broadcast over the top of 'TR2', 'TR3', 'TR5', and 'TR6'. This treatment was applied using a tractor mounted plot sprayer applying 11 gal/A at 20 psi. Brass flat fan nozzles were 20 inches apart on the boom and approximately 10 inches from a row center. The control and 'TR4' plots were cultivated with a rolling cultivator on June 22 to control weeds. On June 28, RU® was applied post-directed using a hooded sprayer (about 2-3 inches above the ground surface) to 'TR3' and 'TR6' at a rate of 1 qt/A in 11 gallons of water. The hooded sprayer consisted of 5 hoods with centers spaced 40 inches apart. Each hood had 3 nozzles with the center nozzle pointed directly towards the center of the furrow and one pointing horizontally to each side, approximately 12 inches below and 7 inches behind the center nozzle. Sprayer pressure was maintained at 20 psi. On July 12 all plots received 150 lbs/A of 20-10-0 granular fertilizer. Fertilizer was banded about 2 inches deep and 10 inches on each side of a row and incorporated. During the growing season cotton was scouted for insect infestations and damage. Appropriate insecticides were applied when counts reached extension service thresholds. Karate® [%-cyano-3-phenoxybenzyl 3-(2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate] (0.04 lb a.i./A) and Tracer® (Spinosyn A and Spinosyn D) (0.09 lb a.i./A) were applied on July 28 for bollworm and tobacco budworm control. Approximately 20% of bolls were open on August 16. This resulted in the semidirected application of RU® (2 qt/A in 11 gallons of water) to 'TR4', 'TR5', and 'TR6' on that date. The sprayer used drops spaced 40 inches apart, each with two nozzles pointing horizontally opposite to each other and pointing towards the row (approximately at a 60^0 angle from the drop) and third nozzle pointing directly to center of the furrow to deliver the spray material. On October 4, Cyclone® (Paraquat, 1,1'-Dimethyl-4,4'-bipyridinium) was applied at 1 qt/A in 12 gallons of water. The defoliant, DEF-6 was applied at 1 pint/ac on October 18, 2000. Due to heavy rain during the 3rd and 4th week of October, cotton could not be harvested before November 13. Sub-samples

were taken from the harvested cotton to determine gin turnout. Resulting lint samples were sub-sampled to determine fiber quality.

Two rows in each plot were permanently marked to count surviving silverleaf nightshade stems one day before and two weeks after each spray application. Counting was done in all plots whether sprayed or unsprayed on a given date. To determine weed-cotton competition on a biomass basis, cotton plants were counted and surviving silverleaf nightshade stems were harvested at ground level from 5 linear feet at 9 locations within each pair of permanently marked rows. Fifteen linear feet were skipped between each sampling location. These samples were harvested two weeks after the last spray application. Silverleaf nightshade stems were dried and weighed. Cotton plants were not destructively harvested at this time from these small areas. Cotton plant above ground biomass was estimated by harvesting, drying, and weighing 10 border row plants from each replication. To get total cotton biomass, the average dried cotton plant weight was multiplied by number of cotton plants in each sampling unit. Cotton plant and silverleaf nightshade biomass were totaled for the 9 locations within each plot. Percent weed competition was calculated as: 100 (total weed biomass / total cotton biomass). Data were statistically analyzed using the General Linear Model Procedure of SAS computer program (SAS Institute, 1989). Means were separated using Fisher's Protected LSD Test at a 5% probability level (Steel and Torrie, 1980). Regression analyses were utilized to predict cotton yield. The 1999 lint yield was regressed as a function of silverleaf nightshade number counted two weeks after the date 3 spray.

Results and Discussion

The 1999 and 2000 cotton fiber properties were determined by using HVI (High Volume Instrument System) at the International Textile Center, Lubbock, TX. In 1999, 'TR3' and 'TR6' lint yields were significantly higher than the 'TR4' yield, but not greater than the control yield. Micronaire was found to be in the premium range in 'TR6' and in the base range or non-penalty range with the other treatments. Statistically significant differences were minor. All treatments resulted in 'medium' class fiber length. Fiber uniformity was not affected by treatment and was classified as 'average' for all treatments. Even though fiber strength was higher in 'TR3' than in 'TR4', fiber strength of all treatments is considered 'very high'. Fiber elongation and leaf grade were not affected by treatment application. Degree of reflectance (Rd) was higher in 'TR6' than in 'TR4'. Consequently, yellowness (+b) was lower in 'TR6' when compared to 'TR3' and 'TR4'. Color grade was not affected by treatment application and all treatments had white middling color (31-3/31-4).

Unlike 1999, the 2000 May-September precipitation was about 10 inches less than the 30-yr average. Peak square initiation in cotton normally occurs in July with flowering and boll development in August and September. During this time total rainfall was only 0.28 inch. This severely affected plant growth.

At the end of the 1999 season 2300 to 2500 nightshade stems were present in 'TR1' and 'TR4', 1600 in 'TR2', about 1000 in 'TR3' and 'TR5' and about 250 with 'TR6'. At this time silverleaf nightshade populations were higher in 'TR1' than in 'TR6' and higher in 'TR4' than in 'TR5'. During the fall and winter of 1999-2000 plots were tilled and beds were formed. Silverleaf nightshade counts were made twice during the spring of 2000 prior to planting. On April 24, 2000, silverleaf nightshade numbers ranged from 50 to 1800 stems/ac and were higher in 'TR1' compared to all other treatments; higher in 'TR2' compared to 'TR4', 'TR5', and 'TR6'; and higher in 'TR3' compared with 'TR5'. However, within two weeks stem counts increased more than 2 fold. On May 5, 2000, nightshade counts were higher in 'TR1' compared to all other treatments, while 'TR2' and 'TR3' stem counts were higher compared to 'TR5' and 'TR6'. When counts were made one day before the 1st spray application (at 4 leaf stage), silverleaf nightshade numbers were higher in both 'TR1' and 'TR2' than those in 'TR5' and 'TR6' and in 'TR4' stem numbers were higher than in 'TR6'. However, two weeks after the 1st spray application, silverleaf nightshade populations were lower with all sprayed treatments when compared to the non-sprayed treatments, 'TR1' and 'TR4'. Between two weeks after the 1st spray application and one day before the 2nd spray application (2-3weeks after 1st spray) silverleaf nightshade numbers with 'TR1' and 'TR4' had decreased. Two weeks after the 2nd spray application nightshade stem count was lower in all treatments compared to 'TR1'. Between two weeks after the 2nd spray and one day before the 3rd spray (20% open boll) silverleaf nightshade numbers were higher in 'TR1' and 'TR4' compared to all other treatments except 'TR3'. When counts were made two weeks after the 3rd spray application, silverleaf nightshade numbers were similar to 1 day before the 3rd spray application. To determine weed competition (on the basis of number of surviving silverleaf nightshade stems counted 2 weeks after the 3rd application) percent weed control was calculated as: 100 [1-(number of stems per acre in treatment plots / number of stems per acre in control)]. About 85% weed control was achieved with 'TR2' (sprayed on date 1), 77 % with 'TR3' (sprayed on date 1 and 2) and 90% with 'TR5' (sprayed on date 1 and 3), about 100% with 'TR6' (sprayed on date 1, 2, and 3), and only 62% with 'TR4'. Percent weed biomass competition (on a dry weight basis) was higher with 'TR1' compared to all other treatments. Total boll count ranged from 73,000 to 81,000/A, but there were no significant differences among treatments. Gin turnout was higher in 'TR4' compared to 'TR2', 'TR3', and 'TR6'. The heat and drought of 2000 severely affected lint yields. Lint yields ranged from 38 to 57 lbs/ac. Hot weather during growing season and heavy rain prior to harvest resulted in low lint wt per boll in 2000. It was about 25% of that in 1999.

Silverleaf nightshade stems were counted 1 day before the first Roundup Ultra® herbicide application in 1999 and two weeks after last Roundup Ultra® herbicide application in 2000. The percent reduction was calculated as: [(no. of nightshade in spring of 1999-no. of nightshade in fall of 2000) x 100 / no. of nightshade in spring of 1999]. In the control plots silverleaf nightshade numbers have gone up by more than 3 times. Spray application of Roundup Ultra herbicide at the 4-leaf stage and/or 3 weeks past the 4 leaf stage resulted in more than 65% reduction in nightshade stems whereas spraying once at 20% open boll resulted in only a 18% reduction during the 2 years of study. A combination of Roundup Ultra applied at early stages and at 20% open bolls reduced silverleaf nightshade stems by 90%.

In 2000, compared with 'TR2' micronaire was higher in all treatments except 'TR5'. However, micronaire was in the "discount" range with all treatments. Fiber length ranged from 0.97 to 0.98 inch (medium) and was not affected by spray treatments. Within "medium" fiber length, fiber strength ranged from 26 to 27 and was designated as "high". Uniformity ratio ranged from 78 to 79 and was classified as "low". It was not affected by spray treatments. Although fiber elongation was higher with 'TR4' than all other treatments, it was classified as "very low". Leaf content ranged from 2.0 to 2.8 and was not affected by spray treatments. The Rd value ranged from 61 to 62 and was higher in 'TR2' as compared to 'TR3'. The Hunter +b ranged from 10.3 to 10.8 and was higher in 'TR1' and 'TR4' compared to either 'TR5' or 'TR6'. In 2000 cotton was classified was as spotted low middling. Compared with 1999, year 2000 cotton was of lower grade due to high rainfall prior to cotton harvesting.

Regression analysis showed yield losses of 0.12 lb/A for each increasing silverleaf nightshade stem per acre in 1999. From data presented by Smith et al. (1990) it was extrapolated that there was a lint yield loss of 0.0068 and 0.0066 lb for each increase in stem number per acre for 1- vs. 2-yr-old established nightshade stands. Our data showed that yield losses were twice as much as shown by Smith et al. (1990).

Summary

This was the second year of a study to determine the appropriate cotton growth stage or stages at which to apply Roundup Ultra® to get maximum control of silverleaf nightshade in Roundup Ready cotton. Treatments were applied to the same plots both years and consisted of a control (2 cultivations) and application of Roundup Ultra® on 3 dates in various combinations. Date 1 applications were done at the 4 leaf stage, date 2 applications at 3 weeks past the 4 leaf stage, and date 3 applications at 20% open bolls. In 2000, two weeks after the date 3 application about 85, 77, 62, 90, and 98% weed control was achieved with date 1, date 1 plus 2, date 3, date 1 plus 3, and date 1 plus 2 plus 3 applications, respectively when compared to the control. Percent weed biomass competition was higher in the control compared to all other treatments. Year 2000 was very hot and dry, severely affecting lint yields. Lint yield ranged from 38 to 57 lbs/A. Silverleaf nightshade counts in the spring of 1999 (beginning of study) and the fall of 2000 (end of study) were compared. Silverleaf nightshade numbers in the control plots increased by more than 3 times during that period. Application of Roundup Ultra® herbicide at the 4-leaf stage and/or 3 weeks past the 4 leaf stage resulted in more than a 65% reduction in silverleaf nightshade stems while spraying once at 20% open bolls resulted in only an 18% reduction. A combination of Roundup Ultra applied at the early growth stages and at 20% open bolls reduced silverleaf nightshade stems by 90%. In 2000, cotton quality was inferior to normal quality. This was due to heavy rainfall 2 weeks prior to cotton harvesting. Regression analysis showed yield losses of 0.12 lb/A for each increasing silverleaf nightshade stem per acre in 1999.

Acknowledgment

This study was supported by Cotton Incorporated.

References

Abernathy, J.R. and J. W. Keeling. 1979. Silverleaf nightshade control in cotton with glyphosate. Proc. South. Weed Sci. Soc. 32:380.

Alexander, U. U., B. E. Warrick, and D. N. Weaver. 1990. Silverleaf nightshade control in West Texas Cotton. Bull. L-2436. Texas Agric. Extn. Service, College Station.

Choudhary, M. and D. G. Bordovsky. 2000. Control of Silverleaf Nightshade in Roundup Ready (Glyphosate-tolerant) Cotton. Proc. 2000 Beltwide Cotton Conferences. P. 1467-1469.

Cotton Farming. 1999. Cotton Farming's 2000 Guide to Seed Varieties. Vance Publishing Corporation. Memphis, TN. P. 18-20.

Everitt, J. D., J. W. Keeling, P. A. Dotray, and T. S. Osborne. 2000. Perennial Weed Management in Roundup Ready (Glyphosate-tolerant) and BXN (Bromoxynil-tolerant) cotton on the Texas Southern High Plains. Proc. 2000 Beltwide Cotton Conferences. P. 1487.

Gannaway, J. R., T. A. Wheeler, R. K. Boman, M. Murphy, L. Schoenhals, and V. Morgan. 2000. Cotton Performance Tests in the Texas High Plains and Trans-Pecos Areas of Texas 1999. Texas A&M Univ. Agricultural Research and Extension Center, Lubbock-Halfway.

Green, J.D., D.S. Murray, and L. M . Verhalen. 1987. Full-season weed interference of silverleaf nightshade (*Solanum elaeagnifolium* Cav.) with cotton (*Gossypium hirsutum*). Weed Sci. 35:813-818.

SAS Institute. 1989. The SAS System for Windows. Version 4.0.1111. SAS Institute Inc., Cary, NC.

Smith, B. S., J. A. Pawlak, D. S. Murray, L. M. Verhalen,, and J. D. Green. 1990. Interference from Established Stands of Silverleaf Nightshade (*Solanum elaeagnifolium*) on Cotton (*Gossypium hirsutum*) Lint Yield. Weed Sci. 38:129-133.

Smith, D. T. and A. F. Wiese. 1973. Crop losses from several annual and perennial weeds. Abstr. Weed Sci. Soc. Am. 3: 53-55.

Soil Survey of Knox County, TX. 1979. USDA Soil Conservation Service, Washington, DC in cooperation with Texas Agricultural Experiment Station, College Station.

Steel, R. G. D. and J. H. Torrie. 1980. Principles and procedures of statistics. McGraw-Hill, New York.