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COTTON STALK DESTRUCTION WITH SELECTED HERBICIDES AND EFFECTS OF APPLICATION METHODOLOGY

A.N. Sparks, Jr. and J.W. Norman, Jr.
Texas Cooperative Extension
Weslaco, TX
C. Stichler
Texas Cooperative Extension
Uvalde, TX
J. Bremer
Texas Cooperative Extension
Corpus Christi, TX
S. Greenberg
USDA-ARS
Weslaco, TX

Abstract

One greenhouse and two field tests were conducted to evaluate the efficacy of Harmony Extra and 2,4-D for post-harvest destruction of cotton stalks. The field studies also investigated the influence of application to shredded versus standing cotton, application timing, herbicide rate and spray volume. Rate (within labeled range) and spray volume had minimal impact on efficacy. Both products performance improved when applied to stalks previously shredded. Harmony Extra performed best after regrowth of two weeks compared to applications made 1 day after harvest/shredding and 1 week after. Savage (2,4-D) performed best when applied at 1 day after harvest/shredding as compared to 1 or 2 weeks. Harmony Extra delayed but did not prevent regrowth and squaring in this test. Savage applied to shredded cotton appeared to provide excellent control of regrowth cotton, but will likely require multiple applications to 'clean up' regrowth and control volunteers.

Introduction

The boll weevil remains the major pest of cotton in the Lower Rio Grande Valley of Texas. The cornerstone of area wide management of this pest is establishment and maintenance of a host free period. State law requires that cotton fields contain no live plants from September 1 through February 1 each year. Until recently, this required plowing of all cotton fields during the winter months. While this has always proven challenging, recent increases in minimum tillage or no tillage production systems has added new challenges. While several herbicides have been identified for use to kill cotton stalks after harvest, performance of these products has been erratic.

Two products that have commonly been used to kill cotton stalks in the Lower Rio Grande Valley are 2,4-D (various formulations and trade names) and Harmony Extra (Thifensulfuron-methyl + Tribenuron-methyl; E.I. du Pont de Nemours and Company, Wilmington, DE). While 2,4-D has probably provided more consistent results in commercial use than Harmony Extra, failures have occurred with both herbicides, and 2,4-D has risks associated with its propensity to drift. The purpose of our studies was to evaluate the efficacy of these two herbicides for killing of cotton stalks after harvest and to investigate the effects of application methodology and timing on efficacy.

Materials and Methods

One greenhouse and two field experiments were conducted to evaluate the efficacy of 2,4-D and Harmony Extra for post-harvest destruction of cotton plants. The greenhouse study was conducted at the USDA-ARS SARL laboratory, and the two field studies were conducted at the Texas A&M Research and Extension Center's Hiler farm, Weslaco, Texas. The field studies also investigated the influence of shredding of cotton stalks, timing of herbicide application, herbicide rate and spray volume on efficacy.

Greenhouse Study

The greenhouse study utilized potted cotton plants grown in the greenhouse until they contained opened bolls. Plants were grown in 2.5 gallon pots with 4 to 5 plants per pot. Plants were cut off at 8 to 10 inches from the soil line and allowed to regrow for 5 weeks prior to treatment. Pots were randomly assigned to a treatment with 5 pots per treatment. Treatments included a non-treated check, two rates of Harmony Extra (0.4 and 0.6 oz/ac) and two rates of 2,4-DB (1 and 2 lb AI/ac; Butoxone 200,

dimethylamine salt of 4-(2,4-dichlorophenoxy) butyric acid, Cedar Chemical Corporation, Memphis, TN). Pots assigned to each treatment were aligned and treated as a row of cotton with a CO_2 pressurized (40 PSI) backpack sprayer with three TX10 hollow cone nozzles per row (one over-the-top and one on each side on a drop) in a total volume of 10 gallons per acre. Prior to treatment, all plants were sampled to determine the number of leaves per plant and average plant height. After treatment, plants were held in the greenhouse. At 1 and 2 months after treatment, leaves per plant, average plant height and fruit forms per plant were monitored. Data were analyzed with ANOVA and means separations conducted with Tukey HSD multiple comparisons.

Field Studies

The two experiments were conducted in two irrigated fields planted to SureGrow 125, with a single product tested in each field. Standard production practices were used in both fields. Fields were planted on 20 Feb. and harvested on 23 July, 2001. Yields were not closely monitored, but both fields had higher than average yields for the Lower Rio Grande Valley, with yields estimated at about 2 bales per acre.

Each test included a factorial arrangement of shredded and non-shredded (standing) cotton stalks, three application timings, two volumes of application, and two rates of a single herbicide (total of 24 treatments of one herbicide in each test). Each treatment was replicated four times. These two tests were established the day of harvest and plots designated for shredding were shredded the day of harvest. The herbicide application timings were the morning after harvest (approximately 14 hours after shredding, designated as 0 weeks after harvest), 1 week after harvest and 2 weeks after harvest. On each application date, the designated herbicide was applied at two rates in two volumes of water. Spray volumes were 8.18 or 8.54 GPA (low volume) versus 13.9 or 14.2 GPA (high volume). Herbicides and rates evaluated were 1.0 and 1.5 lb of Savage (dimethylamine salt of 2,4-Dichlorophenoxyacetic acid, United Agri Products, Greeley, CO) per acre and 0.4 and 0.6 ounces of Harmony Extra per acre. In both tests, plots were 4 rows (on 40 inch centers) by 40 feet. Plots were separated down the row by 15 foot allies and across the rows by two rows of standing cotton stalks. The buffer rows were shredded and plowed after the 2 week after harvest application.

All applications were made with a compressed air pressurized sprayer mounted on a Spider Sprayer. The Spider Sprayer is equipped with multiple spray booms, and the four rate/volume combinations were applied with individual booms (thus the low volumes and high volumes varied slightly, but the rates were calculated for actual spray volume). All treatments were applied as broadcast applications with three hollow cone nozzles per row (one over-the-top of the row, one on each side on short drops angled toward the row; low volume used 23 cores with D3 tips, high volume used 25 cores with D5 tips). The 0, 1 and 2 weeks after application treatments were applied on 24 and 31 July and 7 August, respectively. In both tests, a second application was required because of volunteer cotton growth in all plots. This second application was applied at the low tested rate for each herbicide in 8 GPA on 6 Sept.

Plots in both tests were visually rated on a weekly basis until it was necessary to terminate each test. Plots were rated on a 1 to 5 scale as follows (intermediate ratings were used):

1 = No live plants
2 = Some plants alive but appear ‘sick’
3 = Most plants alive, but appear ‘sick’
4 = Some apparently health plants
5 = Most plants appear healthy

In addition to the visual ratings, on selected dates, the number of cotton squares was counted on one meter of row of plants in each plot. In the Savage test, it was necessary to terminate the test before regrowth and squaring occurred (because of volunteer cotton). In this test, a final efficacy rating was conducted by stepping on the cotton stubble and rating the plants on a 1 to 3 scale as follows:

1 = plants break easily, apparently dead
2 = plants show some flexibility
3 = plants show flexibility, high likelihood of survival

Statistical analyses were not performed on the field data. Rather, ratings and square counts are compared simply to the required results of no squares present and preferably no live plants. Any squares present are unacceptable, and an average plot rating above 1.25 would be considered questionable, while a rating at or above 2 would be unacceptable.

Results

Greenhouse Study

While Harmony Extra had obvious adverse effects on plant growth, 2,4-DB had much greater impact on plant growth and only 2,4-DB prevented fruiting at one and two months after treatment (Table 1). Many of the leaves and fruit in the Harmony treatment were deformed, but growth that appeared normal was present by the last sample date. Rates tested did not show a significant effect for either product in this test.

Field Studies

In both tests, herbicide rates and application volume had minimal effect on efficacy, particularly in comparison to the effects of shredding and application timing. Thus, data for individual rates and application volumes are not presented.

Savage (Table 2). Shredding had an obvious effect on performance of Savage, with plots shredded prior to application having better control (lower ratings and fewer squares). Within the shredded cotton, the earliest application timing provided the best results following the first application. After the second application, all of the shredded plots resulted in good control with plots rated very near 1 (no live plants), no squares, and a final rating indicating all plants appeared dead. The standing stalks showed fair results after the second application, with no squares present, but plot ratings indicated live plant tissue present and the final rating gave an indication of high potential for plant recovery. This test had to be terminated because volunteer plants had begun squaring in all plots.

Harmony Extra (Table 3). Harmony Extra delayed or reduced squaring but did not result in plant death in this test. In general, Harmony appeared to work best in cotton shredded prior to treatment, but only after regrowth was allowed. The best results were obtained in plots that had been shredded and allowed to regrow for two weeks prior to application, but even these plots contained numerous squares on the last rating date and had to be destroyed. Standing cotton squared earlier than the shredded cotton and required destruction earlier as well.

Discussion

While Harmony Extra adversely effected regrowth and delayed squaring in post-harvest cotton in these studies, only Savage (2,4-D) provided control. Shredding of plants enhanced the activity of both Harmony Extra and Savage. Savage worked best when applied soon after shredding, whereas, Harmony Extra performed better after regrowth was allowed. It is assumed that Savage worked best after shredding as the damaged plant tissue allowed for uptake of the product. Once this tissue 'heals', uptake and performance is reduced. Potential use of 2,4-D on standing stalks behind stripped cotton, which leaves more scarred tissue than picking, needs to be investigated. Harmony Extra enters the plant through leaf tissue and therefore performed best after plants had been allowed to regrow. The fact that both products failed to perform in standing cotton is likely a result of reduced damaged area for Savage and reduced plant coverage for both products. Coverage problems in the standing cotton were visually apparent in the Savage test, with standing plants generally appearing devoid of leaves in the upper 2/3 of the canopy and older leaves intact in the lower canopy after the first application.

Within these tests, the herbicide rates and spray volumes tested performed similarly, particularly after the second application in the field tests. Given that a second application will likely be required in a commercial field to eliminate volunteer cotton, the higher rates used in the first application, while potentially providing some initial increased efficacy or 'insurance', would be unnecessary. Furthermore, cost could be reduced in the initial application in shredded cotton by applying the herbicide in a band over the row. The second application would need to be broadcast to cover volunteer cotton and would 'clean up' any regrowth surviving the banded application. The second application could also include additional or alternative herbicides to provide control of weeds and prevent further establishment of volunteer cotton.

Table 1. Plant growth parameters of greenhouse regrowth cotton at one and two months after treatment with Harmony Extra and 2,4-DB, Weslaco, Texas, 2001.

	7/05 - 1 month after treatment			8/01 - 2 months after treatment		
Treatment	No. leaves per plant	Plant height (cm)	Fruit forms per plant	No. leaves per plant	Plant height (cm)	Fruit forms per plant
Check	21.6 a	59.0 a	2.9 a	21.1 a	55.6 a	1.0
Harmony 0.4 oz	17.8 ab	37.0 b	4.2 a	18.7 ab	40.6 b	1.1
Harmony 0.6 oz	14.3 b	37.0 b	3.2 a	16.0 b	37.1 b	0.6
2,4-D 1 lb	2.7 c	29.8 c	0.0 b	0.5 c	29.8 c	0.0
2,4-D 2 lb	3.7 c	28.6 c	0.0 b	1.1 c	28.8 c	0.0

Pretreatment leaves per plant = 17.2.
Pretreatment plant height = 29.2 cm.
Means within columns followed by the same letter are not significantly different (Tukey's, P=0.05).

Table 2. Plot ratings, squares per meter of row and final plot ratings for applications made at 1 day after harvest (Week 0) and 1 and 2 weeks after harvest to standing and shredded plots (averaged across all rates and spray volumes), Savage test, Weslaco, Texas, 2001.

	Standing Cotton			Shredded Cotton		
Variable	Week 0	Week 1	Week 2	Week 0	Week 1	Week 2
Plot ratings (1 - 5 scale)						
8/15	2.31	2.34	2.41	1.40	1.78	2.19
8/21	2.59	2.66	2.38	1.38	1.78	2.09
9/04	2.45	3.03	2.94	1.55	1.81	2.00
9/14	2.19	2.56	2.67	1.27	1.50	1.73
9/20	2.00	2.19	2.17	1.11	1.13	1.25
9/28	1.67	1.67	1.92	1.03	1.03	1.11
10/04	2.08	2.25	2.25	1.05	1.02	1.14
10/12	1.88	2.13	2.13	1.02	1.02	1.06
10/17	1.89	2.06	2.11	1.02	1.00	1.03
Squares per meter of row						
9/04	0.06	0.44	0.31	0.00	0.00	0.25
9/20	0.00	0.00	0.00	0.00	0.00	0.00
10/04	0.00	0.00	0.00	0.00	0.00	0.00
Final plot rating (1 - 3 scale)						
10/17	1.88	2.25	2.31	1.00	1.00	1.00

Table 3. Plot ratings, squares per meter of row and final plot ratings for applications made at 1 day after harvest (Week 0) and 1 and 2 weeks after harvest to standing and shredded plots (averaged across all rates and spray volumes), Harmony Extra test, Weslaco, Texas, 2001.

	Standing Cotton			Shredded Cotton		
Variable	Week 0	Week 1	Week 2	Week 0	Week 1	Week 2
Plot ratings (1 - 5 scale)						
8/15	3.17	3.84	4.25	3.94	2.81	3.47
8/21	3.27	3.31	3.50	3.78	3.03	3.22
9/04	4.13	3.75	3.56	4.66	4.08	3.00
9/14	4.07	4.00	4.09	4.28	4.00	3.13
9/20	3.97	3.97	3.66	3.91	3.59	3.13
9/28	----	----	----	3.94	3.75	3.59
10/04	----	----	----	4.08	3.77	3.75
Squares per meter of row						
9/04	2.27	4.50	0.50	8.44	0.75	0.13
9/20	1.87	1.00	1.63	0.31	0.13	0.00
10/04	----	----	----	5.94	5.13	3.56