RESPONSE OF WHITEFLY POPULATIONS TO IMIDACLOPRID IN STRESSED AND UNSTRESSED IRRIGATED COTTON

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Abstract

Telone II™, 1, 3-dichloropropene, and imidacloprid controlled the reniform nematode, Rotylenchulus reniformis and silverleaf whitefly, Bemisia argentifolia Bellows and Perring, on cotton, respectively. Both pests cause stress of cotton in the Lower Rio Grande Valley of Texas. Interaction of effects by the two stressor pests were evident on the first sample day for silverleaf whitefly but not mean adults (of 8 sample days) or adult populations sampled three and 10 days before first harvest of cotton. Results indicated that both pests reduced yield, especially in the second harvest.

Introduction

The silverleaf whitefly, Bemisia argentifolia Bellows and Perring, is a pest of cotton in the Lower Rio Grande Valley. It has been suggested by researchers in Texas and the arid western states that this insect increases faster on plants which are stressed than plants which are not stressed. The reniform nematode, Rotylenchulus reniformis, is also a pest of cotton in the Lower Rio Grande Valley of Texas and has been shown to reduce yields of cotton in this area (Cook and Namken, 1993).

The objective of this experiment was to compare effects of populations of reniform nematode and silverleaf whitefly alone and their interactions on lint quantity and quality of stressed and nonstressed cotton. Both pest species were the stressors. Telone II™, 1, 3-dichloropropene, and imidacloprid were applied to control the stressors. Imidacloprid is effective against the silverleaf whitefly in the Lower Rio Grande Valley of Texas, (Riley 1994). Results are reported here.

Materials and Methods

Reniform nematode and silverleaf whitefly effects were evaluated in 1995 at USDA North Farm, Weslaco, TX. Plots were located in a field with natural infestation of both pests. Telone II (100%) and Pentadimethalin (Prowl™) 6EC were applied to soil. Dipel™, Bacillus thuringiensis, ES Abbott Laboratory, Libertyville, IL, tebufenazide (Confirm™) 240 g/l Rohm & Haas, Philadelphia, PA., azinphosmethyl 2L (Guthion) imidacloprid (Admire and Provado™) 240 g/l and methysystox-R, 2EC Bayer, Inc., Kansas City, KS, cypermethrin (cymbush) 2EC Zeneca, Richmond, CA, and carbaryl (Seven) 80S, Rhone Poulenc, were applied as foliar sprays at 10 gal/A or 1 gal/A and 140 or 170 kg/cm^2 pressure by ground or airplane, respectively. Sprays were applied during the season as needed for control of weeds or insects. Telone II was chiseled once into soil at 20.5 gallons per acre on day 342 (December 8), 1994, on one-half of the experimental area. Soil type was Hidalgo sandy clay loam (fine-loamy, mixed, hypothermic typic caliustolls). Soil treated with Telone II and soil not treated with Telone II were sampled once (Day 95) for reniform nematode by collecting 3 to 4 lbs of soil from six locations of each main plot. Moist soil at 12 to 20 cm was placed in plastic bags and number nematodes determined as described by Cook and Namken (1993).

Pendimethalin (Prowl™) was incorporated into the soil for preemergence weed control at 1.25 lbs (AI)/A and 60 lbs of nitrogen (21% ammonium sulfate) was applied as a preplant application on day 11 (January 11) 1995, to all experimental plots. Cotton (var DPL 119) was planted on Day 81 (March 22).

A second fertilization of 30 lbs of nitrogen (N-32) per acre was applied as a sidedress application on Day 105, (April 15), 1995.

Experimental design was a split plot with five replicates. Whole plots were the reniform nematode-infested and Telone II treated plots. Subplots were untreated, whitefly-infested and imidacloprid treated plots at 0.25 lb (AI)/acre. They were 4 rows wide (1 m apart) X 17 m long.

Telone II was applied in one-half of the plots. In plots treated with and without Telone II, imidacloprid was applied nine times for control of the silverleaf whitefly on days 155, 159, 163, 166, 170, 173, 180, 187 and 191 (June 5, 9, 12, 16, 19, 22, 29 and July 6 and 10). The other insecticides were applied throughout the test for control of boll weevil Anthonomus grandis (Boh.), beet armyworm, Spodoptera exigua (Hibn.), bollworm, Helicoverpa zea (Boddie)/tobacco budworm, Heliothis virescens (Hubn.). These eight applications were made on days 116, 128, 159, 166, 178, 182, 188 and 194 (April 26, May 8, June 2, 9, 16, 28, July 1, 7 and 13) at 0.125 lbs (AI)/A metasystox-R + 0.125 lbs/A azinphosmethyl, same, 0.125 lbs (AI)/A, tebufenazide, 0.125 lbs (AI)/A tebufenazide + 0.25 lbs (AI)/A azinphosmethyl, 1.25 qts Dipel + 0.3 (4.3 oz), cypermethrin, 0.125 lbs (AI)/A tebufenazide + 0.25 lbs (AI)/A azinphosmethyl, azinphosmethyl (0.25 lbs (AI)/A, and azinphosmethyl (0.25 lbs(AI)/A) to all plots, respectively.

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Seed cotton was harvested on days 201 (July 20) and 214 (August 3) from one 13.1 row. Cotton from each harvest sample were saw-ginned and lint weight determined.

Also, 200 g of lint from both harvests were sent to USDA, Textile Quality Laboratory, Clemson, SC for "sticky" cotton by counting "sticky" spots with themodetector and percentage of total sugar (Perkins and Brushwood, 1993). When themodetector analysis indicate < 5 spots the lint was considered to be nonsticky, 5 to 14 spots on lint indicate light stickiness, 15 to 24 spots on lint indicate moderate stickiness and > 25 spots on lint indicate heavy stickiness.

Whitefly counts, on third leaf from top leaf of plant, of adults by leaf turn method and egg, first, second and third instar larvae on underside of same leaf were determined. Three leaves were randomly selected in each plot on 172, 176, 184, 191, 202, 204 and 206 (June 22, 26, July 3, 11, 18, 21, 24 and 26) days.

Analysis of variance were determined on each day and total whitefly counts "sticky" cotton and sugar by spit-plot of SAS (1985). Means for treated vs. untreated plots were separated by least significant differences (LSD). Interaction of the two treatments on days of sampling were indicated by F. of treatment x replicate interaction.

Results and Discussion

Samples of fumigated and nonfumigated soil taken 14 days after planting and 109 days after fumigation showed 5 and 218 nematodes per pound of soil, respectively. Telone II reduced nematode populations 95%.

Imidacloprid controlled each of the stages silverleaf whitefly (Table 1). The two imidacloprid treatments had significantly lower populations, total populations of adults, eggs and first, second and third instar larval stages from eight sample dates. Mean populations of adults, eggs, first second and third instar larvae were significantly greater in stressed and nonstressed (Telone II treated) cotton. A ratio of eggs per adult were determined for each treatment. Ratio for check, imidacloprid, Telone II, and Telone II + imidacloprid were 13, 13.8, 14.8 and 17.4, respectively (Data not shown in table). Both the number of adults and eggs were greatest where there was no whitefly control and these results suggest that there was a stimulation in oviposition where an ineffective treatment was used. When total whitefly populations of adults, eggs, first, second and third instar larvae were compared between the two Telone II and reniform nematode infested treatments they were similar (812.7 (Telone II + imidacloprid) vs. 797.4 (Telone II alone) and 275.4), indicating that mean populations across nematode treatments were not different.

Averaged across the whitefly treatments, the Telone II treated plots produced significantly higher yields than the reniform nematode-infested plots (Table 2). In reniform nematode infested plots lint yields (Cook et al. 1996) were reduced 42% in the first harvest and 49% in the second harvest. Total yields were reduced 42% by the silverleaf whitefly (386.2 vs. 233.9). Averaged across the reniform nematodes treatments, significant yield differences were observed between the imidacloprid-treated and untreated plots for the second harvest and total yield only. The second harvest of imidacloprid plots was 150 pounds per acre versus 56 pounds per acre in the untreated, whitefly infested plots. Results indicated the total harvest was reduced from 310 to 188 pounds per acre or 39%. The greatest effect on yield was in the second harvest, indicating that the stress of these two pests may reduce the plant's ability to continue to the physiological functions necessary to continue flowering and fruit set. When the reniform nematode and silverleaf whitefly were both controlled, yields were 386 pounds per acre versus 118 pounds per acre where no reniform nematode or silverleaf whitefly control was obtained.
Lint in all plots indicated moderate stickiness (15 through 24 spots) and there was no significant difference in any of the treatments (Table 2). There was no significant difference in percentage sugar in the first harvest. However; there was a significant difference between imidacloprid and the check and Telone II and the check and percentage sugar of the second harvest.

Adult whitefly populations (Table 3) are shown on Days 198, 202 and 204. Peak populations occurred on day 202 and showed much greater populations than on the first day of sampling.

Probability values of effects by Telone II versus no nematode treatment (main plot effects), imidacloprid versus no imidacloprid (subplot effects) treated plots for mean adults (all sample days) and interaction of treatments for pests show significant difference on all sample dates (Table 4). Interaction of mean of all dates and those taken on days 17 (Day 184), 10 (Day 191) and 3 (Day 198) days before first harvest were not significant. However, there was a significant interaction of adult whitefly populations on day 176 the first sampling day. This indicates that there were more than additive effects by the two treatments at the beginning of the season than just before (10 and 3 days) first harvest.

Conclusion

The results of this study indicate the potential yield losses that reniform nematode and silverleaf whitefly can cause. The greatest yield reductions were realized in the second harvest, indicating that these pests may severely reduce the yield potential of the plant as the season progresses, especially if these two pests attack the plant simultaneously. This could be particularly important in making decisions to plant late cotton and/or in making decisions to continue late-season inputs in cotton attacked by these pests. The deleterious late season effects that the reniform nematode and silverleaf whitefly appear to cause demonstrate the importance of managing for an early crop, as well as the need to use cultural practices that reduce or avoid these pests.

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Table 1. Mean whitefly populations of stages from 8 sample days and total populations of all stages. Weslaco, TX. 1995.

		Mean Insects/Leaf				
			Larvae			Tot Whitefly
Treatments	Adult	Egg	1st	2nd	3rd	(Adults+ Eggs+Larvae)
Check	45.3	589.2	3.8	122.4	36.8	797.4
Imidacloprid	14.9	205.9	1.9	48.8	4.4	275.44
LSD (0.05)	8.7	157.8	n.s	24.5	25.5	158.0
Telone II	36.4	537.4	22.5	184.9	31.5	812.7
Telone II + Imidacloprid	12.9	223.9	9.7	69.2	5.7	321.4
LSD (0.05)	7.7 2	37.1	n.s	87.3	13.68	358.9

Table 2. Stickiness (based on themodetector reading) and sugar from silverleaf whitefly populations in two pickings of cotton lint. Weslaco, TX 1995.

	Stickiness		Sugar (%)		Tot Yld
	1st	2nd	1st	2nd	Lbs/A)
Trtmts	Hvst	Hvst	Hvst	Hvst	(Both Hvsts)
Check	19.8	21.4	0.47	0.48	118.2
Imidacloprid	17.2	23.8	0.55	0.97	233.9
LSD (0.05)	n.s	n.s	0.038	0.22	44.1
Telone II	15.0	19.6	0.45	0.47	258.5
Telone II + Imidacloprid	16.8	17.4	0.49	1.12	386.2
LSD (0.05)	n.s	n.s	n.s	0.06	62.1

Table 3. Populations of adult silverleaf whitefly on three sample days. Weslaco, TX. 1995.

	Adults/Leaf on Days		
Treatments	198	202	204
Check	43.6	61.5	61.6
Imidacloprid	12.7	31.27	12.2
LSD (0.05)	17.2	27.3	19.0
Telone II	20.0	46.5	49.6
Telone II + Imidacloprid	7.5	20.3	10.4
LSD (0.05)	13.1	17.5	6.6

Table 4. Probability of F ratio of silverleaf whitefly adults/leaf for treated and not treated plots with nematocide and imidacloprid and interaction. Weslaco, TX. 1995.

	F Ratio				
Treatments	176	184	191	198	Mean of 176 to 198
Telone II vs no Telone II	0.0025 0.0584	0.054	0.14		0.037
Whitefly vs no Whitefly	0.0001	0.0006	0.0001	0.0001	0.0002
Interaction	0.032	0.74	0.26	0.16	0.2980