EFFECTS OF SAND BURN AND THRIPS INJURY ON COTTON MATURITY AND YIELD

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Abstract

The combined effects of thrips insecticide/nematicide treatments and sand and wind damage (sand burn) on thrips populations, plant stand, maturity and yield were evaluated on D&PL 50 cotton at the Virginia Tech, Tidewater Agricultural Research and Extension Center in Suffolk, VA. Early-planted, sand-burned cotton was compared with late-planted, non-sand-burned cotton. In early-planted cotton, the naturally occurring extreme wind and blowing sand conditions appeared to remove thrips populations from seedlings regardless of insecticide/nematicide treatment. Late-planted cotton appeared to escape most early season thrips damage. Sand burn reduced seedling stand across all treatments from about 2.5 to 1.5 plants per foot of row, with the least loss recorded in Temik 15G treated plots. During the period from July 22 through August 7, flowering was delayed by about 1 week in late-planted, non-sand-burned cotton compared with early-planted, sand-burned cotton. Plant mapping indicated that in general, regardless of treatment, early-planted, sand-burned cotton was taller and had more reproductive structures compared with late-planted, non-sand-burned cotton. Of the treatments mapped, in general, Temik 15G treated plants were tallest and had the most reprductive structures, and Gaucho 480 seed treated and Di-Syston 15G treated plants were taller and had more reproductive structures compared with the untreated control. Yield in sand-burned and late-planted cotton averaged 506 and 466 lb lint/acre, respectively, and was not significantly different (P=0.9505). However, the average yield was almost 1600 lb lint/acre in an adjacent experiment in the same field with early planted D&PL 50, that did not sustain sand damage. Sand burn reduce cotton seedling stand, slowed maturity and caused yield reductions of almost 1000 lb lint/acre. Replanting did not recover those losses.

Introduction

Early season thrips feeding on seedlings is known to reduce cotton yield under certain conditions (Roberts et al. 1990). Field trials in Virginia in 1995 showed that seedling damage by thrips reduced yields by an average of 177-198 lb lint/acre (Herbert 1995). In 1996, a series of field tests was established in southeast Virginia to evaluate the impact of the cotton thrips complex on cotton maturity and yield. Plots were planted and treated with several selected insecticide/nematicides. Twenty days after planting, extreme wind and blowing sand conditions caused severe seedling damage (sand burn). Damage was uniform throughout the tests to the extent that seedling survival was questionable. Many cotton producers across the Virginia cotton growing region also reported extensive sand burn to seedlings. Many were seeking advice concerning the economics of replanting. Cotton specialists and experts in other states were consulted, but little information and virtually no data was available to help guide a recommendation. Although the sand burn to our research plots first appeared disastrous, an opportunity was presented that could never have been planned or artificially created. We decided to take advantage of this opportunity.

Materials and Methods

Delta and Pine Land 50 cotton was planted into a Kenansville soil (well drained, loamy sand) on April 22, 1996, at the Virginia Tech, Tidewater Agricultural Research and Extension Center farm, Suffolk, VA. Ground preparation included moldboard plowing, disking, land conditioning and forming 24-inch wide and 4-inch high seed beds on 36-inch row centers with a peanut row bedder. Insecticide/nematicides were applied at planting time, either as seed treatments (commercially treated or as planter box treatments), or as granules or liquids placed into the seed furrow. All insecticide treated seed, other than planter box treatments, was provided by Gustafson, Inc., Dallas, TX. Gustafson, Inc. also provided insecticide-untreated seed from the same seed lot for use in all remaining test treatments. Planter box seed treatments were prepared by mixing measured amounts of product and seed in the planter boxes just before planting. Granules were applied using tractor-mounted inverted jars calibrated to deliver exact amounts of product through lid holes via gravity. Liquids were applied with a tractor-mounted CO_2 pressurized sprayer calibrated to deliver five gallons total volume per acre at 24 psi through one SS8001E flat fan nozzle mounted just above the planter disks and turned parallel to the row direction to deliver the spray fan into the seed furrow. A randomized complete block experimental design was used with four replicates. Individual plots were four rows by 40 feet long. Only the center two rows of each plot received insecticide/nematicide treatments.

On May 12, 20 days after planting, extreme wind and blowing sand conditions caused severe seedling injury (sand burn) almost uniformly across the test area. Seedling stand counts were taken on May 21, after the sand burn phenomenon but before seedlings began to die, and again on May 30, to document stand reduction. Because only the two center rows of each 4-row plot had been treated with insecticide/nematicides, two untreated rows remained between each treated pair. Those untreated pairs of rows were rebedded, which destroyed existing seedlings, and

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replanted on May 20, almost one month after the initial planting. Insecticide/nematicide treatments were applied identically to those in the first planting, each treatment being applied to the two rows just adjacent to the originally planted and treated pair of rows. Thus the tests were essentially doubled to include early-planted, sand-burned versus late-planted, non-sand-burned cotton with each thrips treatment.

Thrips plant injury ratings were taken on June 6, and in addition on June 10 counts of adult and immature thrips were taken on 10 cut and washed seedlings per plot. Flower counts were taken on July 22 (total flowers in both plot rows, 80 row feet per plot), and on July 30 and August 7 (total flowers in 10 row feet from each plot row, 20 row feet per plot). On July 17, 29 and August 14, PMAP procedures (Landivar 1993) were used to document plant height, number of vegetative, reproductive, and total nodes, and number, position and retention rate of squares and green bolls. PMAP data were recorded on six randomly selected plants per plot, a total of 24 plants per treatment. Because of time and labor constraints, only selected treatments were mapped. After defoliation near the end of the season (October 10), number of green open and total bolls was recorded on six plants per plot. Yield was determined by harvesting bolls from 80 row feet per plot using a commercial John Deere 2-row cotton combine. Gross yields were reduced by 63% to account for seed and trash weight.

PMAP data were summarized using programmed procedures that generate averages for all plant responses measured and 'average' stylized plant maps depicting node and fruit set structure for each treatment. Note: the version of PMAP used (5.0) does not include statistical procedures. All other data were subjected to standard ANOVA and mean separation procedures. Factorial analyses were done where appropriate with planting date as the main effect.

Results and Discussion

Plant Stand Loss. Just after the sand burn phenomenon but before seedlings died, the average stand across all treatments was about 2.5 seedlings per foot of row. Within 18 days of sand burn, seedling stand was reduced by 23 to 52%, depending on treatment (Table 1). The least stand loss (23 to 27%) occurred in Temik 15G treated plots. The greatest losses occurred in Thimet 20G (50%) and Di-Syston 8E + Furadan 4F (52%) treated plots. Losses in other plots, including the untreated control, ranged from 30 to 47%. Overall, seedling stand was reduced to an average of about 1.5 seedlings per foot of row.

Thrips Injury. Thrips populations (adults or immatures) and thrips injury to seedlings were almost undetectable in either the early-planted, sand-burned or the late-planted, non-sand-burned cotton and therefore data are not presented. Wind blown sand apparently reduced thrips populations in the early-planted cotton, and late-planted cotton apparently escaped early season thrips populations and injury. However, there were differences in some plant responses due to insecticide/nematicide treatments (see below), which indicates that, however small, some thrips/plant interactions could have occurred. Thrips did cause significant leaf and bud damage in nearby cotton fields where heavier soil and/or cover crop stubble in row middles minimized sand movement and seedlings were not sand damaged.

Flower Number. During the period from July 22 through August 7, flowering appeared to be delayed by about one week in late-planted, non-sand-burned cotton compared with early-planted, sand-burned cotton (Table 2). Cumulative total flowers in early-planted cotton at the end of the sampling period appeared to higher than late-planted cotton, but based on the factorial analysis of the planting date*treatment interaction, the difference was not significant (P=0.6984). There were significant differences within planting dates. Early in the flowering season (July 22), early planted cotton treated with Temik 15G had significantly more flowers than all other treatments (Table 2). Temik treated plots averaged about one flower per foot of row, while other treatments had only about 0.3 per foot of row. These trends continued through August 7. Fore the most part in late-planted cotton, treatment differences were less distinct and not significant. Temik 15G treated cotton did have more flowers than most treatments at the first sample date (July 22), but no other significant differences occurred throughout the remainder of the sampling period.

PMAP Data. Only data from July 17 and August 14 are presented and discussed. On July 17, early-planted, sand-burned plants were taller (14.2 vs. 12.5 inches), and had more reproductive nodes (7.9 vs. 6.2) and squares (15.8 vs. 11.3) compared with late-planted, non-sand-burned plants (Table 3). Square retention rate was high (ca. 97%) and essentially equal across all planting dates and thrips treatments. Plants planted early and treated with Temik 15G were the tallest (17.6 inches), and had the most reproductive nodes (8.3) and squares (17.9). Gaucho 480 and Di-Syston 15G treated pants were taller, and had more reproductive nodes and squares than untreated control plants. Fore the most part, these trends remained in effect through August 14. Early plants were taller (20.7 inches) than late plants (18.1 inches), and had more reproductive nodes (10.3 vs. 8.9) and green bolls (9.6 vs. 5.9) (Table 4). By August 14, square retention rate dropped to about 67% across planting dates and all thrips treatments. The early plants treated with Temik 15G were the tallest (23.8 inches), and had the most reproductive nodes (10.3) and green bolls (12.1). Gaucho 480 and Di-Syston 15G treated pants were taller, and had more reproductive nodes, squares, and green bolls than untreated control plants.

Late Season Boll Number. Within the early-planted, sand burned treatments, about one third of all bolls were green

at the October 10 sampling date, ranging from 13.2% (Temik 15G) to 53.5% (Thimet 20G). Percentage open bolls ranged from 46.5% (Thimet 20G) to 86.8% (Temik 15G). Total bolls ranged from 63.3 to 37.3 per six plants with Orthene 75S + Temik 15G (63.3) having significantly more than Orthene 75S, alone (47.8), Terrachlor Super X with Di-Syston (46.0), Di-Syston 15G (37.3), Gaucho 480 (47.8), or the untreated control (43.3). Compared with early-planted cotton, late-planted, non-sand-burned plants generally had a higher percentage of green bolls and fewer open and total bolls. Percentages of green bolls ranged from 24.5% (Temik 15G) to 71.8% (Thimet 20G), and open bolls ranged from 28.2% (Thimet 20G) to 75.5% (Temik 15G). Total bolls for the six-plant sample ranged from 28.8 (Di-Syston 8E + Furadan 4F) to 49.8 (Temik 15G).

Lint Yield. Factorial analysis showed that planting date (P=0.1634) and the planting date*treatment interaction (P=0.9505) were not significant. Therefore, lint yields (lb/acre) were not significantly different among sand-burned (mean=506, SD=171, range=327 to 743) and late-planted (mean=466, SD=154, range=358 to 626) cotton plants. By way of comparison, the average yield was almost 1600 lb lint/acre in an adjacent experiment in the same field with early planted D&PL 50, that did not sustain sand damage. Treatment (within planting date) was highly significant (P=0.0002) and differences in treatment lint yields were fairly consistent with in-season trends in plant growth and boll formation. Orthene 75S + Temik 15G resulted in the highest yields in both planting dates (Table 5). In early-planted, sand-burned cotton, yield of that treatment was significantly higher than Orthene 75S, alone, Gaucho 480, Di-Syston 15G, Terrachlor Super X with Di-Syston, Di-Syston 15G + Furadan 4F, or the untreated control. In late-planted, non-sand-burned cotton, yield with that treatment was significantly higher than Terrachlor with Di-Syston, Di-Syston 15G + Furadan 4F, or the untreated control.

Conclusions

Sand burn reduced yield by an estimated 1000 lb lint/acre compared with adjacent cotton that did not sustain sand burn. Sand burn reduced stand but surviving plants were larger, matured faster and produced more lint compared with replanted cotton plants. Overall, early-planted, sand-burned cotton and late-planted, non-sand-burned cotton yielded almost the same, an average of about 500 lb lint/acre. Replanting, in this study, did not recover the losses caused by sand burn. Replanting occurred almost one month after the original planting date and cotton planted that late in Virginia appears not to be capable of reaching full yield potential. The decision to replant sand burned cotton will always be difficult, but the time replanting could take place in relation to the growing season should be considered. If replanting would have to take place after optimal planting dates (in Virginia, late April to early May), our study showed that it would not pay. This work also showed that whether early- or late-planted, some insecticides consistently resulted in higher yields than others. Those with highest yields usually had plants that grew faster, were taller, set fruit earlier and set more fruit. There are many existing reports comparing cotton thrips insecticide treatments. In this work, Orthene 75S + Temik 15G resulted in the highest yields, but yields with several other treatments were not significantly lower.

It is important to note that sand movement and seedling damage were minimized, even eliminated, in fields with heavier soils (those with a higher percentage of loam or clay) or fields with existing stubble from previous cover crops left between the rows. This advantage was most evident in fields with sandy textured soils where minimum or strip-tillage practices had been applied in a barley or wheat cover.

References

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Table 1. Cotton seedling stand in early-planted, sand-burned cotton. Virginia Tech Tidewater Agricultural Research and Extension Center, Suffolk, VA, 1996.

		Mean # per row ft[1]		
Treatment	Rate/acre	May 21	May 30	% Stand loss
Gaucho 480	8 fl oz/cwt	2.5abc[2]	1.6 bcd	36.5abcde
Orthene 75S	8.53 oz/cwt (PB)[3]	2.2cd	1.5bcd	30.1de
Orthene75S	8.53 oz/cwt (PB)			
+Temik 15G	5 lb (IF)[4]	2.2cd	1.7ab	23.7e
Temik 15G	5 lb (IF)	2.9a	2.1a	27.5e
Di-Syston 15G	7 lb (IF)	2.5abc	1.6bcd	36.8abcde
Di-Syston 8E	1 pt (IF)	2.8ab	1.5bcd	44.9abcd
Terrachlor				
Super X EC				
w/Di-Syston	86 fl oz (IF)	2.5abc	1.3bcd	47.0abc
Di-Syston 8E	12 fl oz			
+ Furadan 4F	1 pt (IF)	2.6abc	1.2d	52.8a
Thimet 20G	5 lb (IF)	2.5abc	1.2cd	50.1ab
Untreated		2.4bc	1.6bcd	33.6bcde
LSD (P=0.05)		0.4	0.4	16.7

1. Cotton was planted on Apr 22 and 1st stand count was recorded on May 21, 29 days after planting and 9 days after the sand-burn phenomenon; 2nd stand count was recorded on May 30, 40 days after planting and 18 days after the sand-burn phenomenon.
2. *Means within a column followed by the same letter(s) are not significantly different (LSD, P=0.05).*
3. *PB = treatment applied to seed in planter box.*
4. *IF = at-planting in-furrow treatment.*

Table 2. Cumulative mean number of flowers in early-planted, sand-burned and late-planted, non-sand-burned cotton. Virginia Tech Tidewater Agricultural Research and Extension Center, Suffolk, VA, 1996.

		Cumulative mean # of flowers per row ft		
Treatment	Rate/acre	Jul 22	Jul 30	Aug 7
Early planted[1]				
Gaucho 480	8 fl oz/cwt	0.2bcd[2]	1.5cd	1.9cd
Orthene 75S	8.53 oz/cwt (PB)[3]	0.4b	2.1abc	2.5abc
Orthene 75S	8.53 oz/cwt (PB)			
+ Temik 15G	5 lb (IF)[4]	0.8a	2.6ab	2.9ab
Temik 15G	5 lb (IF)	0.8a	2.9a	3.2a
Di-Syston 15G	7 lb (IF)	0.2bcd	1.6cd	1.9cd
Di-Syston 8E	1 pt (IF)	0.3bc	1.7bcd	2.2bcd
Terrachlor				
Super X EC				
w/Di-Syston	86 fl oz	0.3bc	1.5cd	1.9cd
Di-Syston 8E	12 fl oz			
+ Furadan 4F	1 pt (IF)	0.2cd	1.1d	1.4d
Thimet 20G	5 lb (IF)	0.2bcd	1.6cd	2.0cd
Untreated		0.2bcd	1.3d	1.6d
LSD (P=0.05)		0.2	0.9	0.9
Late planted[1]				
Gaucho 480	8 fl oz/cwt	0.02abc[2]	1.3a	1.6a
Orthene 75S	8.53 oz/cwt (PB)[3]	0.02abc	0.9a	1.2a
Orthene 75S	8.53 oz/cwt (PB)			
+ Temik 15G	5 lb (IF)[4]	0.04a	1.2a	1.6a
Temik 15G	5 lb (IF)	0.04ab	1.2a	1.4a
Di-Syston 15G	7 lb (IF)	0.00c	1.0a	1.2a
Di-Syston 8E	1 pt (IF)	0.00bc	1.1a	1.5a
Terrachlor				
Super X EC				
w/Di-Syston	86 fl oz	0.00c	0.7a	1.0a
Di-Syston 8E	12 fl oz			
+ Furadan 4F	1 pt (IF)	0.00c	0.8a	1.0a
Thimet 20G	5 lb (IF)	0.00c	0.9a	1.2a
Untreated		0.01bc	0.7a	1.0a
LSD (P=0.05)		0.04	0.7	0.7

1. *Cotton was planted on Apr 22, and then again on May 20 due to sandburn conditions of test.*
2. *Means within a column followed by the same letter(s) are not significantly different (LSD, P=0.05).*
3. *PB = treatment applied to seed in planter box.*
4. *IF = at-planting in-furrow treatment.*

Table 3. PMAP[1] data for early-planted, sand-burned (SB) and late-planted, non-sand-burned (LP) cotton. Virginia Tech Tidewater Agricultural Research and Extension Center, Suffolk, VA, July 17, 1996.

	Plant ht. (in)		# Repro. nodes		# Squares		% Fruit retention	
Treatment	SB	LP	SB	LP	SB	LP	SB	LP
Gaucho 480								
8 oz/cwt seed	12.9	12.5	8.1	6.3	15.8	10.9	97.4	94.9
Di-Syston 15G								
7 lb (IF)[2]	13.9	13.0	8.0	6.0	15.7	11.5	97.7	99.0
Temik 15G 5 lb (IF)	17.6	13.2	8.3	6.5	17.9	12.6	95.4	98.9
Untreated	12.5	11.5	7.3	6.0	13.8	10.3	96.5	98.8

1. *PMAP (Landivar, 1993), values represent the average for 24 plants per treatment (6 per replicate, 4 replicates). This PMAP version does not contain statistical procedures.*
2. *IF = at-planting in-furrow treatment.*

Table 4. PMAP[1] data for early-planted, sand-burned (SB) and late-planted, non-sand-burned (LP) cotton. Virginia Tech Tidewater Agricultural Research and Extension Center, Suffolk, VA, August 14, 1996.

	Plant ht. (in)		# Repro. nodes		# Squares		# Green bolls		% Fruit retention	
Treatment	SB	LP	SB	LP	SB	LP	SB	LP	SB	LP
Gaucho 480 8 oz/cwt seed	20.8	18.4	11.1	9.1	10.0	6.5	10.4	6.0	74.4	62.4
Di-Syston 15G 7 lb (IF)[2]	20.0	18.5	10.2	8.8	5.8	5.9	8.8	5.5	64.1	64.5
Temik 15G 5 lb (IF)	23.8	19.8	10.3	9.5	4.7	8.6	12.1	7.3	63.2	72.7
Untreated	18.1	15.8	9.7	8.5	5.2	5.8	7.2	5.0	63.9	65.1

[1] *PMAP (Landivar, 1993), values represent the average for 24 plants per treatment (6 per replicate, 4 replicates). This PMAP version does not contain statistical procedures.*

[2] *IF = at-planting in-furrow treatment.*

Table 5. Lint yields for early-planted, sand-burned and late-planted, non-sand-burned cotton. Virginia Tech Tidewater Agricultural Research and Extension Center, Suffolk, VA , 1996.

		Lint lb/acre [1]	
Treatment	Rate/acre	Early-planted[2]	Late-planted
Gaucho 480	8 fl oz/cwt	486bc[3]	528ab
Orthene 75S	8.53 oz/cwt (PB)[4]	563ab	478ab
Orthene 75S + Temik 15G	8.53 oz/cwt (PB) 5 lb (IF)[5]	743a	626a
Temik 15G	5 lb (IF)	644ab	582ab
Di-Syston 15G	7 lb (IF)	464bc	429ab
Di-Syston 8E	1 pt (IF)	613ab	519ab
Terrachlor Super X EC	w/Di-Syston 86 fl oz	435bc	391b
Di-Syston 8E + Furadan 4F	12 fl oz 1 pt (IF)	327c	358b
Thimet 20G	5 lb (IF)	510abc	411ab
Untreated		404bc	381b

[1] *Cotton was harvested on Oct 17. Gross yields were reduced by 63% to account for seed and trash weight.*

[2] *Cotton was planted on Apr 22, and then again on May 20 due to wind burn conditions of test.*

[3] *Means within a column followed by the same letter(s) are not significantly different (LSD, P=0.05).*

[4] *PB = treatment was applied to seed in planter box.*

[5] *IF = at-planting in-furrow treatment.*