THRIPS MANAGEMENT WITH GAUCHO® SEED TREATMENT IN NORTH CAROLINA COTTON

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Abstract

Populations of thrips, aphids, and spider mites were monitored in seedling cotton treated with at-planting applications of Gaucho® seed treatment (8 oz/cwt. Seed) or Temik 15 G® (5 lbs/acre). Plant performance parameters were also monitored. In comparison, Gaucho showed short-term thrips control, favorable performance against cotton aphid, and a tendency to promote spider mites. Temik showed a better "earliness profile" (lower fruit set and more early opening bolls). In four tests yields were statistically superior vs the UTC for Gaucho and Temik but were the same for each other. However, Temik was always the highest yielding and averaged 89 pounds/acre more lint over the four studies.

Introduction

Thrips invade North Carolina cotton fields each season and colonize seedlings from the cotyledon stage and ca.6 weeks longer. Several species infest seedling cotton but the tobacco thrips, *Frankliniella fusca* (Hinds), usually predominates in mixed populations. The probability of thrips damage to seedlings is high enough to cause almost all growers to use an at-planting thrips control insecticide on essentially all acreage. Additionally, consultants routinely scout for thrips damage and recommend foliar application of insecticide if new leaves and buds show much necrosis from thrips feeding (usually from larvae). North Carolina State University recommends the use of in-furrow placed at-planting systemic insecticides for control of thrips (Disyston 15 G ®, Orthene 75 S ®, Temik 15 G ®, Thimet 20 G ®, Payload 15 G ® or Phorate 15 G ®) and suggests using foliar treatment as a salvage treatment only (due to concern over stimulating other arthropods, notably aphids, spider mites, and early tobacco budworm) (Bacheler and Van Duyn, 1997). Until recently Temik 15 G was the grower's overwhelming product of choice for thrips protection, however, farmers have been motivated to consider other choices. Primary motivations include the high price of Temik 15 G, reduced activity of Temik 15 G in dry soils, the use of Command herbicide which requires a phosphate in-furrow insecticide as a safener (either Thimet 15 G or Disyston 15 G or 8 EC), and the introduction of Gaucho ® (imidacloprid) seed treatment (Gustafson, Inc. Dallas, TX). Gaucho has been attractive to growers because of its ease of handling, lower cost, and limited worker protection requirements. However, this product was introduced into the market with little public research backing, especially in the Carolinas, and listing in state guides has been withheld until the product's activity is adequately understood.

Studies in Mississippi by Graham et. al. (1995) showed Gaucho (8 oz/cwt. seed) seed treatment to give comparable results as Temik 15 G @ 3.5 lbs/acre. Temik showed significantly fewer adult thrips vs Gaucho but both products suppressed immature thrips equally well. Both products showed similar plant and fruiting profiles, as well as similar yields. Yield increase was approximately 500 lbs of seed cotton/acre more than the untreated check.. Burris et. al. (1995), in Louisiana, showed Gaucho (8 oz/cwt. seed) to give statistically poorer control of immature thrips vs Temik 15 G (3.3 lbs/acre) in one experiment but not in another, the later having low thrips infestation. Where there was a significant difference in immature thrips, there was 355 lbs/acre greater seed cotton yield with Temik 15 G, but this was not significant. Preliminary studies in NC (Bradley and Van Duyn, unpublished) indicated that granular, seed treatment, and liquid in-furrow applications of imidacloprid provided short lived control of immature thrips populations. However, yields were better that expected as predicted from early infestation and damage.

The objective of the current study was to contrast Gaucho seed treatment at the rate sold on commercial seed (8 oz/cwt. seed) with Temik 15 G at the most common use rate in NC, 5 lbs/acre.

Materials and Methods

Experiments were conducted during the seasons of 1995-1997, however, 1996 data are not presented here due to the detrimental effects of tropical storms; early season 1996 data paralleled those presented herein. Five experiments are reported here, one from 1995 and four from 1997. Tests were planted on the Tidewater Research Station at Plymouth, Washington Co., NC or on private farms in Martin Co. NC. Deltapine 51 cotton seed was used in all cases and planted with commercial planters. Gaucho treated seed was either obtained from Deltapine and Land Co. or untreated seed was treated in small batches using Gaucho 480. To treat seed, five pounds of seed were weighed and placed into a large heavy duty plastic bag with 11.8 ml of Gaucho 480 mixed with water to give 50 ml total volume. Seed were vigorously shaken and rotated for ca. 5 minutes and then placed into a large pan to dry in the laboratory. Treated seed appeared uniformly coated and little liquid remained in the bag. Orthene 80 S (8 oz/cwt. seed) (Valent U.S.A. Corp., Walnut Creek, CA) was used to treat seed in a similar fashion. The granular insecticides Temik 15 G (Rhone Poulenc Ag Co., Research Triangle Park, NC),

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Disyston 15 G (Bayer Corp. Kansas City, MO), and Thimet 20 G (American Cyanamid Co., Wayne, NJ) were applied from the planter with individual calibrated orifice, gravity flow applicators as an in-furrow treatment at the speed of 27 sec./100 ft. The liquid Orthene 90 S in-furrow treatment was applied from a CO^2 pressurized small plot applicator calibrated at 8.3 gallons per acre and 28 psi (27 sec./100 ft); each planter row was fitted with a 8003 flat fan nozzle oriented with the seed furrow. Four tests were planted early in the planting season (late April or early May) whereas one was planted very late (in June) in an attempt to remove the effect of cool temperatures on plant growth from that of thrips damage. All tests utilized the randomized complete block design with four replications. Plot sizes were four rows wide (36" or 38" row spacings) by 45' long.

Scoring included counts for thrips, aphids and spider mites; height and width measurement for a growth index (h x w); first fruiting branch counts; early open/closed boll counts; and yield. Each test did not receive all types of data taking. Sampling for thrips utilized a washing/filtering technique similar to the ALexington Technique@ as described by Irwin and Yeargan (1980). Thrips, aphids, and mites were counted in the laboratory with the aid of a microscope. Yields were determined from picking the two interior rows of each plot with a mechanical cotton picker fitted with a bagging attachment; samples of seed cotton were weighed in the field. Data were subjected to the ANOVA and a LSD based means separations ($p \geq 0.05$) using the Gyllings PRM software, version 4.06. In most instances tests contained more treatments than are presented herein. Data for selected treatments were abstracted from most experiment in order to focus on contrasts relevant to this paper.

Results

Contrasts of Adult and Larval Thrips Populations

Thrips adult numbers in Test 1 were initially depressed by Gaucho at 21 days after planting (DAT) but were significantly higher then either the untreated check (UTC) or Temik at 27 and 34 DAT (Table 1). Greater effect was shown by Gaucho against larval thrips with no differences vs Temik at 21 and 27 DAT, however, at 34 DAT Gaucho was significantly more infested with larvae than the Temik treatment. Gaucho always showed significantly fewer larvae that the UTC. Very high numbers of thrips were encountered at all sites in 1997. In Test 2 (Table 2) Gaucho was never less infested with adult thrips as compared to the UTC and Temik showed significantly fewer thrips than both Gaucho and the UTC. Thrips larvae were equally depressed at 19 DAT in Gaucho and Temik and were statistically separated from the UTC. However, on the 27 and 34 DAT samplings Gaucho was significantly more infested than Temik and significantly less infested than the UTC. Test 3 also included Orthene 80 S treated seed (Table 3). These data parallel that of Test 2 where Gaucho showed adult thrips populations similar to the UTC and significantly fewer larval thrips for the first two samplings (19 and 27 DAT); Gaucho was not separated from the UTC at the 34 DAT sampling. Gaucho showed significantly more thrips larvae at 27 and 35 DAT vs Temik. Orthene seed treatment showed effects intermediate to those of Gaucho and Temik on both adult and larval thrips. In the early planted test in Martin Co. (Test 4) the performance of Gaucho vs the UTC and Temik was very similar to that described above with Gaucho showing suppression of larvae up to 22 DAT but not to 31 DAT (Table 4). The last test, Test 5, was June planted in a moist and warm environment to investigate if the cool conditions interacted with thrips populations to give the observed very poor plant growth. Thrips populations in this test were very high and only Temik showed favorable suppression of thrips larvae (Table 5). Although Gaucho showed significantly fewer larval thrips at 18 and 25 DAT than the UTC, numbers of thrips on Gaucho plants were very high.

Effects on Aphids and Spider Mites

Cotton aphid, *Aphis gossyppi* Glover, is frequently encountered in seedling cotton and twospotted spider mite, *Tetranychus urticae* Koch, may become abundant on cotton seedlings in dry weather. Both were encountered in the spring of 1997. Table 6 presents mean aphid numbers for five treatments (some treatments were not included in the thrips presentation for purpose of focus). These data showed that both Temik and Gaucho equally suppressed aphid populations up to 41 DAT (Table 6). However, Disyston 15 G and Orthene 90 SP (in-furrow liquid) became heavily infested with aphids. Test 3 showed a similar effect of Gaucho and Temik, keeping aphid populations low, for up to 34 DAT, but at 42 DAT Temik was significantly less infested than Gaucho (Table 7). Interestingly, Orthene seed treatment stimulated the aphid population and was far more infested than other treatments by 41 DAT. Biocontrol organisms caused aphids in the UTC to show a decline between 34 and 41 DAT but this was not the case with the Orthene seed treatment. Aphid numbers in Test 4 showed treatment seperations at 31 DAT; Gaucho = Temik and both significantly removed from the UTC (Table 8). At 38 DAT all treatments were in a different statistical class and Temik showed the fewest aphids on the seedlings. In the last test, Test 5, aphid numbers at 25 DAT were significantly higher in the Gaucho treatment than either the UTC or Temik treatments (Table 9). Temik showed low numbers of aphids.

Spider mite populations were present in Tests 4 and 5. In Test 4 spider mite numbers were significantly higher in Gaucho plots than either the UTC or Temik, which were equal to each other (Table 8). Mites in Test 5 were significantly higher in Gaucho plots at both 18 and 25 DAT vs both the UTC and Temik (Table 9). Again, Temik showed the fewest mites and was statistically removed from both the UTC and Gaucho.

Plant Growth, Fruiting, and Yield

In 1995 (Test 1) the seedling growth index (height x width = index) showed Gaucho and Temik seedlings to be equally robust and both were significantly larger than the UTC plants (Table 10). Open boll counts in mid September showed Temik to have significantly more open bolls vs the UTC but not more than Gaucho, which occupied an intermediate statistical position between the UTC and Temik. Lint yields for Test 1 were very good but showed no statistical separation among any treatment, but Temik showed the highest poundage. In Test 2, Test 3, and Test 4, early season plant growth data are not presented but seedling growth was severely affected by thrips in all but the most effective treatments. Data from these tests were similar to that shown in Table 9 for Test 5. In this case plant growth differences were not due to cool or dry weather. At 30 DAT plant height data from all three treatments were in different statistical categroies (Temik > Gaucho > UTC) and Temik and Gaucho showed 251% and 144% taller plants vs the UTC. Early fruiting was delayed by thrips in Test 2 (Table 11). In this case average first fruiting position was at node 11.3 for the UTC and 7.48 and 7.25 for the Gaucho and Temik respectively. Gaucho and Temik were statistically the same but removed from the UTC. Lint yield was very high and both Gaucho and Temik showed significantly higher yield vs the UTC but not from each other. Fruiting and yield data from Test 3 are presented in Table 12. Again, no separations were shown between insecticide treatments concerning position of the lowest fruit. Temik showed the earliest fruiting but data were not statistically removed from Gaucho or Orthene; all were statistically different that the UTC. Open bolls counts showed significantly lower numbers of open bolls in the UTC and Orthene vs the Gaucho and Temik. Gaucho and Temik were in the same statistical class. Lint yield for Gaucho, Orthene, and Temik were not statistically different from each other but all were removed from the UTC. Fruiting data from Test 5 (Table 13) show significant differences among all three treatments in percent open bolls on 9/24/97. In this case the UTC and Gaucho had very few open bolls whereas Temik showed 41% of it=s bolls open. Total bolls on Gaucho and Temik were the same as was lint yield, which was harvested on a very late date, 11/21/97, following a fall with favorable weather. Both Gaucho and Temik showed higher yields than the UTC.

Discussion

Data presented herein show that Gaucho gives favorable suppression of adult and immature thrips for a relatively short period, for about three weeks after planting. After this, Gaucho plants showed higher adult thrips numbers than UTC cotton and suggested that plants getting early protection, and thereby becoming more healthy, may be favored by colonizing thrips. Graham et. al. (1995) also observed this effect. Soon after observing higher adult thrips, larval thrips populations also rose, suggesting that the titre of imidacloprid dropped coincident with the onset of adult infestation and became insufficient for killing newly hatched thrips larvae. Gaucho showed favorable results in comparison with Temik against cotton aphid. Aphids were controlled by both products in most sites for the duration of sampling, ca. six weeks. However, in Test 5 aphid numbers at 25 DAT in the Gaucho treatment were more numerous than in the UTC or Temik. We suspect that this was due to an artifact of aphid distribution and not a real effect. Two-spotted spider mite populations were stimulated by Gaucho seed treatments in both tests where mites occurred.

Thrips showed a very pronouced effect on plant growth and injured or killed cells from both vegetative and reproductive buds and expanding tissue. Untreated cotton in 1997 was injured to the extent that seedling populations were reduced by 25% to 50% , on surviving plants most fruit below node eleven were killed, and these plants had no vegetative branches below ca. node ten. Fruiting was seriously delayed and yields were significantly reduced. In the present study UTC yield was reduced across all tests by 46% vs Temik and 42% vs Gaucho. These data demonstrate that thrips can be a very serious pest of cotton. Lambert (1985) reported that tests from across the southeast and mid-south showed few instances of yield improvement and suggested that most treatment for thrips were done for cosmetic purposes. Our experience shows that thrips populations dramatically fluctuate with season and location but populations usually affect plants negativley and thrips are frequently a serious threat.

In addition to outright yield decrease, thrips can have other effects on pest management and plant management. If the at-planting insecticide is not adequate for thrips or other seedling pests, seedlings are likely to be sprayed with a foliar treatment (usually a phosphate insecticide) which often causes secondary aphid infestations, sometimes mites infestation, and increases cost. Secondary infestations may also need to be treated. In 1997 many growers in northeastern NC sprayed small cotton up to three times for aphids and mites due to this scenario of cascading pest related events associated with thrips, poor initial efficacy of the at-planting insecticide, and later disruption. Starting thrips control with the most effective and broad spectrum product helps prevent this situation. Products with short residual against thrips, like Gaucho, often show seedling damage and leads consultants and growers to spray cotton, thereby heightening the chances of a pest cascade.

Plant growth and maturity parameters are affected by thrips. Stunted seedlings can be a significant disadvantage to post emergence over-top or directed herbicide use. Maturity delays can also be important. We harvested plots towards the end of the normal harvest period and had very favorable fall weather in 1995 and 1997. Whereas no significant yield decreases were shown for Temik vs Gaucho the data presented on early open bolls suggests that early harvest would have given different results (even so Temik was consistently the highest yielding and averaged 89 lbs/acre more lint across all tests vs Gaucho). Later fruit set may also require more attention to pest management, present more risk to weather, the quality of late maturing fruit is frequently of inferior, and in the northern part of the cotton belt late season DD 60s may not be adequate to mature late bolls. The benefits of earliness are very relative to grower, location, and season. Where and when earliness is a significant advantage, thrips pose a greater risk.

These studies show that the standard practice of using Temik 15 G at 5 lbs/acre is cost effective and helps avoid other problems of cotton production which may be associated with less effective at-planting insecticides.

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Table 1. Adult and larval thrips mean numbers at 21, 27, and 34 days following at-planting treatments. Early (April) planted cotton. Washington Co., NC. 1995 (Test 1).*

Treatment	Adult / larval thrips 21 DAT	Adult / larval thrips 27 DAT	Adult / larval thrips 34 DAT
Untreated	3 ab / 17 a	15 b / 73 a	21 b /69 a
Gaucho 480 @ 8 oz/cwt.	6 a / 2 b	39 a / 13 b	35 a / 46 b
Temik 15 G @ 5 lbs/acre	1 b / .3 b	6 c / 1 b	17 b / 5 c

* per five plant sample

Table. 2 . Adult and larval thrips mean numbers at 19, 27, and 34 days following at-planting treatments. Early (May) planted cotton. Washington Co., NC. 1997 (Test 2).*

Treatment	Adult / larval thrips 19 DAT	Adult / larval thrips 27 DAT	Adult / larval thrips 34 DAT
Untreated	7 a / 35 a	19 a / 71 a	11 a / 88 a
Gaucho 480 @ 8 oz/cwt.	7 a / 2 b	15 a / 39 b	10 a / 52 b
Temik 15 G @ 5 lb/acre	1 b / 2 b	4 c / 3 c	4 b / 4 c

* per six plant sample

Table 3. Adult and larval thrips mean numbers at 19, 27, and 34 days following at-planting treatments. Early (May) planted cotton. Washington Co., NC. 1997 (Test 3).*

Treatment	Adult / larval thrips 19 DAT	Adult / larval thrips 27 DAT	Adult / larval thrips 34 DAT
Untreated	11 a / 37 a	17 a / 103 a	61 a/ 105 a
Gaucho 480 @ 8 oz/cwt.	8 b / 3 b	12 ab / 41 b	38 ab / 55 ab
Orthene 80 S @ 8 oz/cwt.	5 bc / 2 b	9 b / 13 bc	21 b/ 27 b
Temik 15 G @ 5 lb/acre	2 c / 1 b	6 b / 5 c	4 c/ 4 c

* per six plant sample

Table 4. Adult and larval thrips mean numbers at 22, 31, and 38 days following at-planting treatments. Early (May) planted cotton. Martin Co., NC. 1997 (Test 4).*

Treatment	Adult/larval thrips 22 DAT	Adult/larval thrips 31 DAT	Adult/larval thrips 38 DAT
Untreated	11 a / 18 ab	6 ab / 83 a	3 b / 138 a
Gaucho 480 @ 8 oz/cwt.	12 a / 3 b	8 a / 32 ab	12 a / 123 b
Temik 15 G @ 5 lb/acre	0 b / 0 b	2 b / 5 b	3 b / 9 c

* per five plant sample

Table 5. Adult and larval thrips mean numbers at 18 and 25 days following at-planting treatments. Late (June) planted cotton. Martin Co., NC. 1997 (Test 5).*

Treatment	Adult thrips 18 DAT	Larval thrips 18 DAT	Adult thrips 25 DAT	Larval thrips 25 DAT
Untreated	12 b	474 a	17 a	107 a
Gaucho 480 @ 8 oz/cwt.	32 a	267 b	14 a	76 b
Temik 15 G @ 5 lb/acre	4 c	1.5 c	6 b	15 c

* five plant sample

Table 6. Mean numbers of aphids at 27, 34, and 41 days following at-planting treatments. Early (May) planted cotton. Washington Co., NC. 1997 (Test 2).*

Treatment	Aphids 27 DAT	Aphids 34 DAT	Aphids 41 DAT
Untreated	121 a	127 a	1013 a
Gaucho 480@ 8 oz/cwt.	2 c	2 b	18 d
Temik 15 G @ 5 lb/ac	1 c	2 b	10 d
Disyston 15 G @ 6.5 lb/ac	16 bc	121 a	584 bc
Orthene 90 SP @ 1.1 lb/ac	20 bc	5 b	166 cd

* per six plant sample

Table 7. Mean numbers of aphids at 27, 34, and 41 days following at-planting treatments. Early (May) planted cotton. Washington Co., NC. 1997 (Test 3).*

Treatment	Aphids 27 DAT	Aphids 34 DAT	Aphids 41 DAT
Untreated	7 a	177 a	91 bc
Gaucho 480@ 8 oz/cwt.	7 a	49 b	144 b
Orthene 80 S@ 8 oz/cwt.	31 a	240 a	888 a
Temik 15 G @ 5 lb/ac	3 a	4 c	25 c

* per six plant sample

Table 8. Aphids and spider mite mean numbers at 31 and 38 days following at-planting treatments. Early (May) planted cotton. Martin Co., NC. 1997 (Test 4).*

Treatment	Aphids 31 DAT	Aphids 38 DAT	Mites 38 DAT
Untreated	23 a	60 a	2 b
Gaucho 480 @ 8 oz/cwt.	0 b	13 b	22 a
Temik 15 G @ 5 lb/acre	0 b	3 b	1 c

* per five plant sample

Table 9. Aphids and spider mite mean numbers at 18 and 25 days and average plant height following at-planting treatments. Late (June) planted cotton. Martin Co., NC. 1997 (Test 5).

Treatment	Aphids* 25 DAT	Mites* 18 DAT	Mites* 25 DAT	Height** 30 DAT
Untreated	34 b	22 b	32 b	5.45" a
Gaucho 480 @ 8 oz/cwt.	75 a	162 a	114 a	7.85" b
Temik 15 G @ 5 lb/acre	29 c	1 c	11 c	13.68" c

* per five plant sample ** per 10 plant sample

Table 10. Mean plant growth index (height X width in inches), early open bolls, and lint yield following at-planting treatments. Early (April) planted cotton. Washington Co., NC. 1995 (Test 1).

Treatment	Seeding growth index 6-15-95*	Open bolls per 10 rf 9-21-95	Lint yield lbs/acre 10-26-95
Untreated	429 a	86 b	1145 a
Gaucho 480 @ 8 oz/cwt.	712 b	101 ab	1276 a
Temik 15 G @ 5 lb/acre	851 b	111 a	1337 a

* height X width (") per 10 plants

Table 11 . Mean first fruiting branch and open bolls at late season and lint yield at late harvest. Early (May) planted cotton. Washington Co., NC. 1997 (Test 2).

Treatment	First fruiting branch* 9-26-97	Open bolls per 10 rf 9-26-97	Lint yield lbs/acre 11-22-97
Untreated	11.30 a	4.3 a	848 a
Gaucho 480 @ 8 oz/cwt	7.48 b	13.3 b	1605 b
Temik 15 G @ 5 lb/acre	7.25 b	22.3 c	1731 b

* per 10 plant sample

Table 12. Mean first fruiting branch and open bolls at late season and lint yield at late harvest. Early (May) planted cotton. Washington Co. NC. 1997 (Test 3).

Treatment	First fruiting branch* 9-26-97	Open bolls per 10 rf 9-26-97	Lint yield lbs/acre 11-22-97
Untreated	12.92 a	1.8 a	669 a
Gaucho 480 @ 8 oz/cwt.	6.45 bc	74 bc	1525 b
Orthene 80 S @ 8 oz/cwt.	6.63 b	53 b	1522 b
Temik 15 G @ 5 lb/acre	6.10 c	81 c	1647 b

* per 10 plant sample

Table 13. Mean percent green vs open bolls, total bolls at early boll opening, and lint yield resulting from at-planting treatments. Early (May) planted cotton. Martin Co., NC. 1997 (Test 3).*

Treatment	Percent open / green bolls* 9-24-97	Total Bolls* 9-24-97	Lint yield (lb/acre) 11-21-97
Untreated	3 / 97 a	100 a	455 a
Gaucho 480 @ 8 oz/cwt.	13 / 87 b	132 b	943 b
Temik 15 G @ 5 lb/acre	41 / 59 c	131 b	990 c