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Gaucho® Seed Treatment Against Early Season Insects in Cotton Field

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Abstract: Populations of early season insect *Thrips tabaci* Lind. and *Aphis gossypii* Glov., *Tetranychus urticae* Koch. and *Empoasca* spp. was monitored in seedling cotton treated with seed treatment and foliar sprays during the 2001 and 2002 cotton-growing seasons in Aydın province, Turkey. Plant parameters were also monitored. Seed treatment with Imidacloprid (Gaucho®) affected the two populations 30-37 days after planting and did not reduce the population of the two-spotted spider mite. However, there were not significant differences between foliar and seed treatment in the seasonal average of the populations among the treatment. Thrips population in 2002 and aphid in 2001 were rarely found. Seed treatment was not necessary in each year against the two insects due to the variable population. The yields, fiber characteristics including ginning outturn, micronaire, length, uniformity and elongation except for strength and plant height were not affected from the treatments. Thus, seed treatment applications against early season insects were not necessary in recent. However, foliar spray with any insecticide was applicable compared to the seed treatment if the populations of the two pests were over economic threshold or injury level in the following years.

Key words: Seed treatment, early season insects, cotton

INTRODUCTION

Early season insect including *Thrips tabaci* Lind, *Aphis gossypii* Glov., *Empoasca* spp. and *Tetranychus urticae* Koch. frequently infest cotton in the early season. *T. tabaci* and *A. gossypii* are usually major early insects of cotton in Turkey. Thrips is usually the first insect that may cause significant damage to cotton in some years [1-3]. The thrips population varies in severity from year to year. It can feed on young terminal buds of young seedling cotton from the cotyledon stage and throughout 4-5 weeks. This terminal feeding disrupts normal growth of the cotton leaf structure. The result is usually severely deformed leaves, aborted terminals and reduced leaf area. As a result it cause delayed plant growth, maturity[4-6] and branching and sometimes reduce in yields[7,8]. The other potential early season insect of cotton is *A. gossypii*. Aphid feed on young true leaves and terminals resulting in discoloration, disfigurement, abnormal plant development and delayed plant growth and reduced yield[9].

For many years, thrips and aphids control on seedling cotton has been accomplished by the application of foliar sprays in Turkey. However, in recent years seed treatments have become available and provide effective control and yield protection in cotton fields of some countries, mainly in the US[10-12]. One of the seed treatments is the use of imidacloprid registered in the trade name of Gaucho. The active ingredient in Gaucho is imidacloprid, which is a new class of insecticides called as chloronicotinyl. Gaucho is taken up by the roots, translocating throughout the plant to control early season attack. Sucking aphid and thrips attempting to feed on the young terminals ingest the active ingredient, stop feeding and reproducing and slowly die. Some research showed that Gaucho seed treatment reduced the population of aphid and thrips populations[13-16] and increased yield[14,17,18] and encourage two-spotted spider mite[14].

In Turkey the management of *A. gossypii* and *T. tabaci* is mainly with the foliar application of insecticides. No more research is available on the use of seed treatment against early season insects in cotton. A research was conducted against *A. gossypii* in Cukurova region, Turkey by Gülyasar and Bucshbell[19] and they found that Gaucho FS 600 controlled the aphid populations in 35 days and affected the cotton yield, earliness and ginning outturn.

The objective of this study was to evaluate Gaucho seed treatment as a early-season insect control method and compare it to foliar insecticide application on the population of *T. tabaci, A. gossypii, T. urticae, Empoasca* spp. and fiber properties in cotton due to lack of the study on the seed treatment in Turkey.

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MATERIALS AND METHODS

The research was conducted at Adnan Menderes University, Research Farm of Agricultural Faculty in Aydın, Turkey throughout the 2001 and 2002 growing season. Nazilli 87S local cotton variety was used. The soil consisted of 12% clay, 23% silt, 65% sand with a loamy sand structure. The experiment plots consisted of 8 rows wide by 15 m long and 3 m space left to reduce the edge effect. Experimental designs were arranged in a randomized complete block design with three replicates. The treatments evaluated were (1) untreated control (2) foliar application with methamidophos (Tamaron 200 ml/da^{-1}) without paying attention thresholds of aphid and thrips numbers (3) seed treatments with Gaucho FS 600.

To treat the seed, a day before planting 4 kg of seeds were weighed and placed into a large plastic bag with 28 ml of Gaucho FS 600 mixed with 32 ml water. Seeds were vigorously shaken and rotated for 10 minutes and then placed into a large pan to dry for 20 min. in the laboratory. Treated seed appeared uniformly coated and the seed was planted on May 4, 2001 and May 6, 2002 with a stayr 768 brand tractor with a pneumatic spacing drill. The foliar application was done with backpack sprayer at 2 atmosphere pressure.

Efficacy of thrips and aphid was counted weekly by collecting 5 seedlings, which were randomly selected, from each plot. Adults and nymphs for each pest were counted together. The samples were collected 17, 24, 30 and 37 days after planting (DAP). Plant samples were processed by whole plant washing techniques. A plant washing technique was used for thrips and aphids sampling[20]. Five randomly selected seedlings from the centre of each plot were removed from the soil and placed into a cup filled with 70% alcohol. After a few seconds of shaking, the plants were removed from the cup and samples of the pests in the alcohol were taken to the laboratory for examination under a stereo microscope. However, sampling of spider mite was conducted by taking five seedlings from each plot into the laboratory and counted using stereo microscope. Sampling of *Empoasca* spp. was counted visually on the same five seedlings in the field. Five seedlings per plot were weekly measured from the soil to the terminal for plant height throughout the sampling of pest populations.

Two interior rows of each plot by 10 m long in each plot were harvested by the hand picking on September 21, 2001 and October 3, 2002. Samples of seed cotton were weighed in the field and transformed into the ha. Seed cotton sample in Kg was taken from each plot and sent for analyses the lint properties. Fiber analysis was conducted by the SOKTAS Textile Company, Soke, Aydın.

The data were analyzed using ANOVA and Duncan's Multiple Range statistical procedures at the 0.05 level of probability.

RESULTS

On the initial sampling week, 17 DAP thrips levels in 2001 were not observed in Gaucho seed treatment plots, but were significantly higher than either untreated check or foliar application plots ($df=2, 6$; $F=15.25$, $P<0.05$). The population increased at 24 days after planting and significantly differences were observed as well among the treatments ($df=2, 6$; $F=57.57$, $P<0.001$). At 30 DAP the population were higher in untreated check plot than both foliar application and seed treatment and statistically important ($df=2, 6$, $F=149.73$, $P<0.001$). However, there were not significant differences between foliar and seed treatment. The population in foliar application was lower at 37 DAP after application of methamidophos. However, there were not significant differences between untreated check and seed treatment plot (Table 1). In the seasonal mean of thrips population in 2001 significant differences were observed among treatments ($df=2, 35$; $F=10.01$, $P<0.001$). It meant that seed treatment affected the population level 30-37 days after planting and no significant differences were observed between seed treatment and foliar application.

The population was lower in 2002 than that of 2001. There were not significant differences at 17 DAP ($df=2, 6$; $F=2.71$, $P>0.05$) and 24 DAP ($df=2, 6$; $F=2.0$ $P>0.05$). However, the population in seed treatment plot was not found at 30 and 37 DAP (Table 1). In the seasonal means of thrips population in 2002 significant differences were observed between untreated check and seed treatment plot.

The aphid population was not observed at 30 DAP and 37 DAP in 2001. However, the populations were rarely seen at the first two sampling weeks. There were not significant differences at 17 DAP ($df=2, 6$; $F=0.47$, $P>0.05$) and 24 DAP ($df=2, 6$; $F=2.0$, $P>0.05$) (Table 2).

The populations in 2002 were higher in untreated check plot than either foliar application or seed treatment at 17 DAP and significant differences were observed ($df=2, 6$; $F=6.14$, $P<0.05$). The population increased in untreated and foliar application at 24 DAP and lowest in the seed treatment plots. The statistical differences were observed among the treatments ($df=2, 6$; $F=6.34$, $P<0.05$). The insecticide metmamidophos (200 cc/da^{-1}) applied into the foliar application plot at 24 DAP and population decreased at 30 DAP and no differences were observed between foliar and seed treatment. At 37 DAP the population were no significantly different among the treatments ($df=2, 6$; $F=1.00$, $P>0.05$) (Table 2). In seasonal

Table 1: Mean number (±SE) of thrips populations per 5 seedlings among the treatments

Treatments	17 DAP	24 DAP	30 DAP	37 DAP	Seasonal Mean
2001					
Untreated check	3.0±0.5a	15.6±1.2a	23.3±1.7a	10.3±0.8a	13.0±2.3a
Foliar application	1.7±0.3b	12.0±1.1b	1.3±0.3b	1.3±0.3b	4.1±1.4b
Gaucho seed treatment	0.0±0.0c	1.3±0.5c	0.6±0.3b	10.6±0.3a	3.2±1.3b
2002					
Untreated check	1.0±0.5a	1.3±0.3a	0.0±0.0	0.0±0.0	0.6±0.2a
Foliar application	2.0±0.5a	2.0±0.5a	0.0±0.0	0.0±0.0	1.0±0.3a
Gaucho seed treatment	0.3±0.3a	0.0±0.0a	0.0±0.0	0.0±0.0	0.1±0.1b

Table 2: Mean number (±SE) of aphid populations per 5 seedlings among the treatments

Treatments	17 DAP	24 DAP	30 DAP	37 DAP	Seasonal Mean
2001					
Untreated check	1.0±0.5a	0.3±0.3a	0.0±0.0	0.0±0.0	0.3±0.2a
Foliar application	2.0±2.0a	1.0±1.0a	0.0±0.0	0.0±0.0	0.8±0.5a
Gaucho seed treatment	0.3±0.3a	0.3±0.3a	0.0±0.0	0.0±0.0	0.1±0.1a
2002					
Untreated check	10.0±6.5a	32.6±9.6a	26.0±2.0a	4.0±0.5a	18.1±4.3a
Foliar application	4.6±2.1b	25.6±2.6a	2.3±0.3b	3.0±0.5a	8.9±3.0b
Gaucho seed treatment	1.3±0.8c	4.6±0.3b	2.3±0.8b	4.0±0.5a	3.1±0.4b

Table 3: Mean number (±SE) of spider mite populations per 5 seedlings among the treatments in 2002

Treatments	17 DAP	24 DAP	30 DAP	37 DAP	Seasonal Mean
Untreated check	22.6±2.7a	116.0±17.6b	2.0±0.5a	0.0±0.0	35.1±14.8a
Foliar application	21.3±3.9a	146.3±14.1a	0.0±0.0	0.0±0.0	41.9±18.6a
Gaucho seed treatment	18.3±4.4a	162.3±31.2a	0.0±0.0	0.0±0.0	45.1±21.5a

Table 4: Mean number (±SE) of *Empoasca* spp. populations per 5 seedlings among the treatments

Treatments	17 DAP	24 DAP	30 DAP	37 DAP	Seasonal Mean
2001					
Untreated check	0.0±0.0a	1.3±0.8a	2.0±0.6a	2.0±0.6a	1.8±0.5a
Foliar application	0.3±0.3a	0.3±0.3a	1.3±0.0a	1.7±0.3a	0.6±0.2b
Gaucho seed treatment	0.3±0.3a	0.6±0.3a	2.0±0.7a	2.0±0.0a	1.3±0.3a
2002					
Untreated check	0.7±0.3a	1.7±0.9a	3.0±0.6a	2.3±0.9a	1.9±0.4a
Foliar application	1.0±0.6a	1.7±0.3a	3.3±0.9a	3.7±0.9a	2.4±0.5a
Gaucho seed treatment	1.0±0.9a	1.0±0.0a	2.6±0.3a	3.0±0.6a	2.0±0.3a

Means in column followed by the same letter(s) are not significantly different (P<0.05) DAP: Days after planting

Table 5: Mean (±SE) of plant parameters among the treatments

Treatments	Plant height per 5 seedlings (cm)	Seed cotton yields/hectare	
		2001	2002
Untreated check	11.3±1.0a	3137.5±104a	4717.0±222a
Foliar application	12.2±1.1a	3394.7±291a	5171.1±219a
Gaucho seed treatment	12.5±1.1a	3546.6±144a	4782.6±456a

Means in column followed by the same letter(s) are not significantly different

means of aphid population in 2002 there were significant differences among the treatments (df=2, 33; F=6.13, P<0.05). The highest population was observed in untreated check plot compared to foliar and seed treatment. However, there were not significant differences observed between foliar and seed treatment. It meant that seed treatment affected the aphid population 30-37 days after planting in the seed treatment plots.

In addition to aphid and thrips population two-spotted spider mite, *Tetranychus urticae* Koch. was not observed in 2001, but extremely higher in 2002 (Table 3). The Table showed that there were not significant differences among the treatments at 17 DAP (df=2, 6; F=0.349, P>0.05). However, significant differences were observed at 24 DAP (df=2, 6; F=6.214, P<0.05). The population was lowest in untreated check than either foliar or seed treatment. No differences were observed between foliar and seed treatment. After the sampling of the second week the chlofenapyr acaricide was applied into all treatment plots to reduce the effect of the population on yield and other parameters. In the seasonal mean of the two-spotted spider mite there were not significant differences (df=2, 33; F=0.07, P=0.92) and it meant that seed treatment did not reduce the population levels.

Significant differences in the seasonal means of *Empoasca* spp. population were observed among the treatment in 2001 (df=2, 33; F=3.048, P<0.05) (Table 4).

However, no significant differences were observed between untreated check and seed treatment plot. On the other hand, there were not significant differences observed among the treatments at days after planting in 2002 (Table 4). The populations were found in low amount in both years and not economically important.

Plant height (df=2, 6; F=0.33, P>0.05) and seed cotton yield in 2001 (df=2, 6; F=1.10, P>0.05) and 2002 (df=2, 6; F=0.58, P>0.05) were not affected from the treatments (Table 5). Interaction on plant height between

Table 6: Mean number (±SE) of fiber characteristics

Treatments	Ginning outturn (%)	Micronaire (mc/index)	Length (mm)	Uniformity ratio (%)	Strength (g/tex)	Elongation (mm)
Untreated check	44.0±0.8a	4.8±0.1a	29.1±0.6a	83.9±0.3a	29.4±0.6b	11.5±0.1a
Foliar application	43.6±0.9a	4.8±0.1a	28.3±0.2a	84.6±0.4a	31.5±0.5a	12.3±0.3a
Gaucho seed treatment	44.3±0.5a	4.9±0.3a	28.1±0.2a	83.5±0.1a	32.9±0.5a	12.3±0.3a

Means in column followed by the same letter(s) are not significantly different (P<0.05)

2001 and 2002 were not observed where the yield was obtained. The seed cotton yields were higher in both foliar and seed treatment compared to untreated check. There was numerical increase in yield in both seed treatment and foliar application plots but this increase could not be shown statistically important. Differences in ginning outturn (df=2, 6; F=0.17, P>0.05), micronaire (df=2, 6; F=0.07, P>0.05), length (df=2, 6; F=1.56, P>0.05), uniformity ratio (df=2, 6; F=2.47, P>0.05) and elongation (df=2, 6; F=3.14, P>0.05) were not detected. A statistical difference in strength occurred (df=2, 6; F=5.93, P<0.05) (Table 6).

DISCUSSION

Data presented here in showed that seed treatment with Gaucho® reduced the population of thrips and aphids 30-37 days after planting. However, population of the two pests is variable year to year. Thrips population in 2002 and aphid in 2001 was rarely found. However, in other years the populations were higher and reduced by seed treatment with Gaucho. Duyn *et al.*[14], Graham [8,13], Smith *et al.*[15] and Wells *et al.*[16] reported that seed treatment reduced the thrips and aphid populations. Even it was highly effective against thrips and aphid populations in the US, applications against early season insects were recently not necessary in Turkey. Since populations were not seen in each year. Foliar application with any insecticide was applicable compared to the seed treatment if the populations of the two pests were over economic threshold or injury level in the following years.

Data obtained from the study showed that seed treatment did not affect the two-spotted spider mite. Duyn *et al.*[14] reported that mite numbers were significantly higher in seed treatment with Gaucho than untreated plot at 18 and 25 DAP. He also mentioned that two-spotted spider mite populations were stimulated by Gaucho seed treatment where mites occurred. In the study it was thought that seed treatment did not encourage the populations since the population was not observed in 2001. The amount of population in 2002 was not related to seed treatment and may be affected by the environmental factors. It was concluded that the seed treatment did not reduce the two-spotted spider mite populations.

Plant growth was not affected by the treatments. It was thought that the populations were under economic threshold level. However, Almand[17], Smith *et al.*[15], Tol and Lentz[18] reported that plant height was significantly affected by the seed treatment compared to untreated plots due to high population densities of the insect populations in untreated plots.

There was numerical increase in yield in both seed treatment and foliar application plots but this increase could not be shown statistically important. Cook *et al.* [21], Bacheler and Mott[22], Parker and Montemayor[29], Parker and Alaniz[23], Parker and Stapper[24], Reed *et al.*[25] reported that the seed treatment with Gaucho and other seed treatment insecticides did not significantly improve lint yield compared to the untreated control. It was thought that the amount of the population did not affect yield. Consequently, Graham[13], Duyn *et al.*[14], Tol and Lentz [18], Reed *et al.*[25] mentioned that seed treatment with Gaucho and increased the yields. Seed cotton yields in this study were higher in 2002 than in 2001 and interaction was found between years. It can conclude that the differences between years and seed cotton yields were due to high temperature in 2001. Higher temperature and period episodes of heat stress, however, could exacerbate the effect on many aspects of crop growth and development and reduce yields. The temperature and heat period above 32°C which is the optimum temperature for photosynthesis have higher in 2001 and was 312 h which is 30.5% more in July and 236 h which is 12.6% more in August of 2001. Perry and Krieg[26] reported that temperature above 32°C decrease gross photosynthesis and bolls seize[27] and they decrease boll-fill period [28]. In other study conducted by the cotton research centre in the region emphasized that Both boll numbers and yields were less in 2001 in Aydın province and other cotton growing regions (Personal communications) in the country. Such high temperatures would be expected to hasten boll growth, reduce boll size and yield.

Fiber characteristics including ginning outturn, micronaire, length, uniformity ratio and elongation were not affected by the treatments. However, a statistical difference in strength was observed. Parker and Stapper[24] and Parker and Montemayor[29] reported that no differences were observed in cotton fiber characteristics. Consequently, some researchers found various result that the seed treatment with Gaucho affected the fiber characteristics. Parker and Alaniz[23] mentioned that statistical differences were observed in strength and elongation and the same workers in the other study[30] reported that differences were observed in microanire. It

can be concluded that the fibre characteristics mainly did not affected. Consequently, differences on the fiber characteristics were variable depending on the treatments.

As a result, seed treatment applications against early season insects were not necessary in recent due to different amounts of pest level in each year and foliar spray with any insecticide was more applicable compared to the seed treatment if the populations of the two pests were over economic threshold or injury level in the following years.

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