EVALUATION OF THRYVON COTTON AS A CONTROL METHOD OF COTTON FLEAHOPPERS *PSEUDATOMOCELIS SERIATUS* (REUTER)

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Abstract

In Texas the cotton fleahopper (*Pseudatomocelis seriatus* Reuter) is considered a highly economically damaging pests to cotton (*Gossypium hirsutum* L.). Current control methods rely heavily on the use of foliar applied chemical insecticides during the growing season. Considering the cost of insecticides and the critical timeliness of applications, chemical control methods are often not optimized to reduce the potential yield loss. The Cry51Aa2.834_16 gene in cotton (ThryvOn) has proven effective against thrips and other Miridid insect pests with piercing and sucking feeding behaviors, suggesting the trait may also prove effective at minimizing yield losses due to the cotton fleahopper. To evaluate the traits effectiveness a large plot field trial was conducted to compare a cotton cultivar containing the trait and a non-traited isoline cultivar. The field trial was arranged in a randomized complete block design with the two cultivars either untreated or sprayed with an insecticide when cotton fleahoppers reached the economic threshold. Weekly populations were noted by visually inspecting terminals and fruit retention was calculated weekly by a whole plant examination. While cotton fleahopper population differences were not consistently noted during the growing season the ThryvOn cotton offers boosted square retention in all levels of infestation. All three years of the study showed that the ThryvOn trait alone offers similar protection to fruit as using chemical insecticides to control cotton fleahoppers.

Introduction

In Texas and Oklahoma, the cotton fleahopper is annually a top 5 pest of cotton. It feeds on the developing tissues of cotton and can cause substantial fruit abscission particularly during the early squaring growth stage. The pest itself can be challenging to control due to the wide host range harboring and fast reproductive cycle. Currently in Texas foliar insecticides are the main tool used to control cotton fleahoppers at a threshold of 10-15% infestation. Often control failures are associated with rapid reinfestation, delayed application of an insecticide, or an underestimate of pest populations. However, with new technology from Bayer CropScience, cotton expressing *Bacillus thuringiensis* crystalline protein Cry51Aa2 (ThryvOn) has proven efficacious at controlling Miridid pests of cotton the *Lygus hesperus* and *Lygus lineolaris*. Utilizing ThryvOn technology could aid in the control of the cotton fleahopper minimizing the pest's impact.

Materials and Methods

Plots were arranged in a randomized complete block design with each plot being .2 acres in size to more closely mimic a commercial growing field. To determine the benefit of the ThryvOn trait and compare it to common commercial practices the four selected treatments were: Non-traited Non-sprayed, Non-traited Sprayed, ThryvOn Non-sprayed, and ThryvOn Sprayed. Insecticidal applications were applied at a threshold of 10% infestation and the selected insecticide was determined based on previous years research from Texas A&M University on foliar cotton fleahopper control. The mode of action used was rotated as a commercial operation should to prevent resistance. Commonly used active ingredients were acephate, imicloprid, and lambda-cyhalothrin. Both 2019 and 2020 had 3 replicates of the four treatments while 2021 had 4 replicates in an irrigated setting and 4 replicates in a dryland setting. Due to ample rainfall during the growing season no irrigation was applied to the plots until after the cotton fleahopper counts had concluded therefore the irrigated and dryland replicates were combined into 8 replicates of the four treatments. In-season cotton fleahopper counts started at first square and continued weekly until early bloom. Populations were counted in the terminal portion of the plant (upper 3 nodes) and recorded delineating nymphs by size with 3rd instar and smaller being considered small, 4th and 5th instars considered large nymphs, and adults. Fruit retention was determined by observing the presence or absence of a fruiting structure on each position for all sympodial branches. Fruit retention was taken weekly starting one week post first square until one week post bloom. Differences between treatments were determined utilizing a Tukey-Kramer HSD in JMP Pro15 and differences in population structures were analyzed using a Fishers Exact Test in Prism GraphPad 9.3.

Results and Discussion

As depicted in Figure 1 below the cotton fleahopper populations in 2019 were well above threshold in the non-sprayed treatments reaching as high as 237% infestation. Spray treated plots had significantly reduced populations, however there was no noted trait effect influencing populations of cotton fleahoppers. Despite the high levels of festination Figure 2 shows that the square retention of the ThryvOn plots not receiving foliar insecticides showed statistically similar results as that of the non-traited sprayed treatment while the non-traited and non-sprayed plots were significantly lower than the other 3 treatments. In a more moderate infestation shown in Figure 3 the sprayed plots displayed significantly lower levels cotton fleahopper populations similar to 2019 no trait effect was observed in populations. Also, similarly to 2019, as seen in Figure 4 the 2020 fruit retention indicated that the non-sprayed ThryvOn treatments offered similar retention as that of the two sprayed treatments. In 2021 cotton fleahopper population were low (Figure 5) in relation to the previous two years so and in return fruit retention (Figure 6) was also high for all treatments. Although it does show (Figure 5) that both ThryvOn traited treatments had significantly lower populations than that of the non-traited and non-sprayed and the non-sprayed ThryvOn treatment was similar to that of the non-traited sprayed treatment. Square retention showed that the non-sprayed ThryvOn treatment was similar to that of the non-traited and sprayed treatment (Figure 6).

Breaking down the population structure by size of nymphs a combined analysis of all years and spray treatments and analyzed by trait differences. As seen in Figure 7 the ratio of small to large nymphs in the ThryvOn treatments was 2.6:1 meanwhile it was 1.2:1 in non-traited treatments. The difference in these populations structure was highly significant (*P=0.0001)* indicating that the ThryvOn trait is either delaying the development of the cotton fleahopper nymphs or there is higher nymph mortality on ThryvOn cotton.

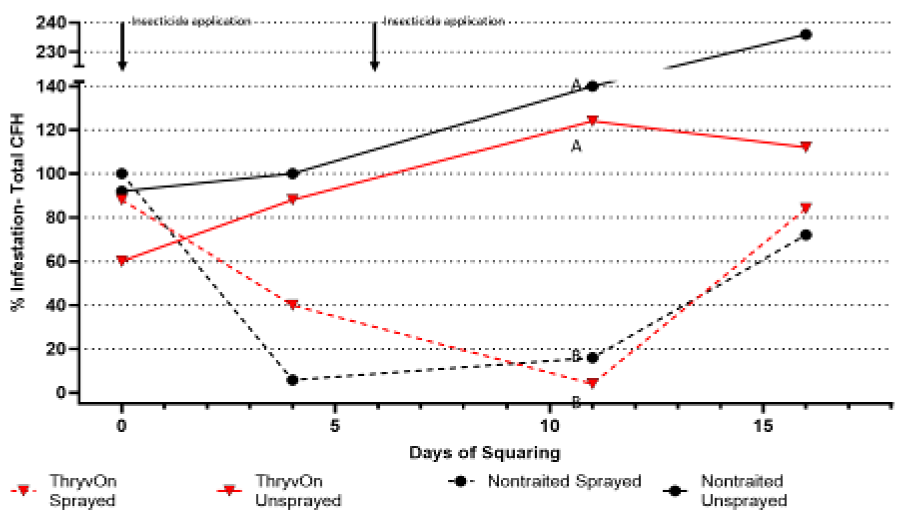

Figure 1: 2019 cotton fleahopper infestations by treatment across the sampling period

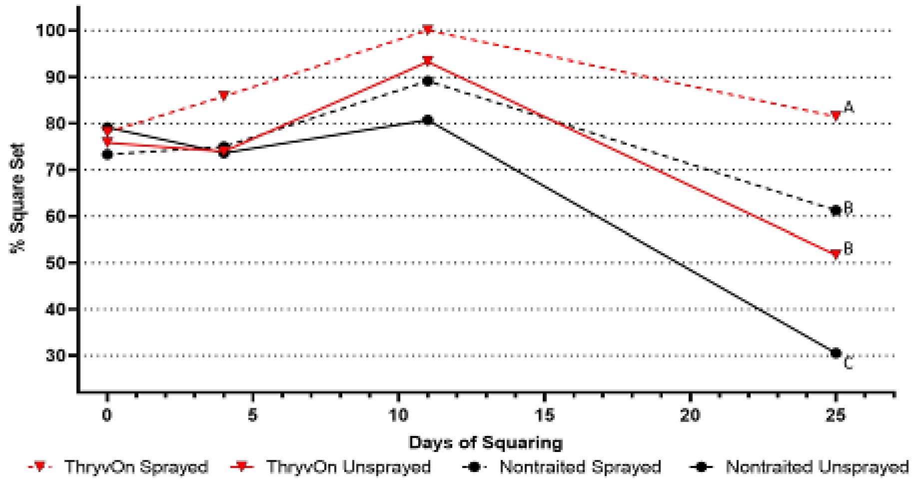

Figure 2: 2019 square retention by treatments across the sampling period

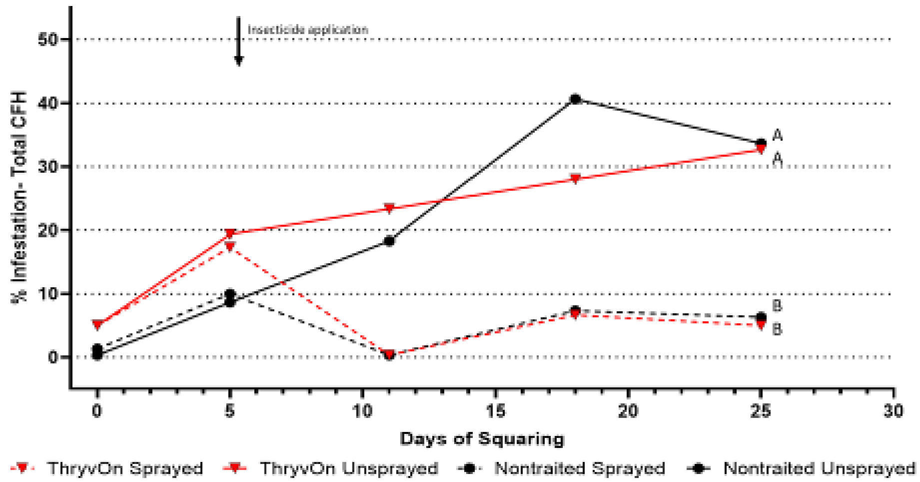

Figure 3: 2020 cotton fleahopper infestations by treatment across the sampling period

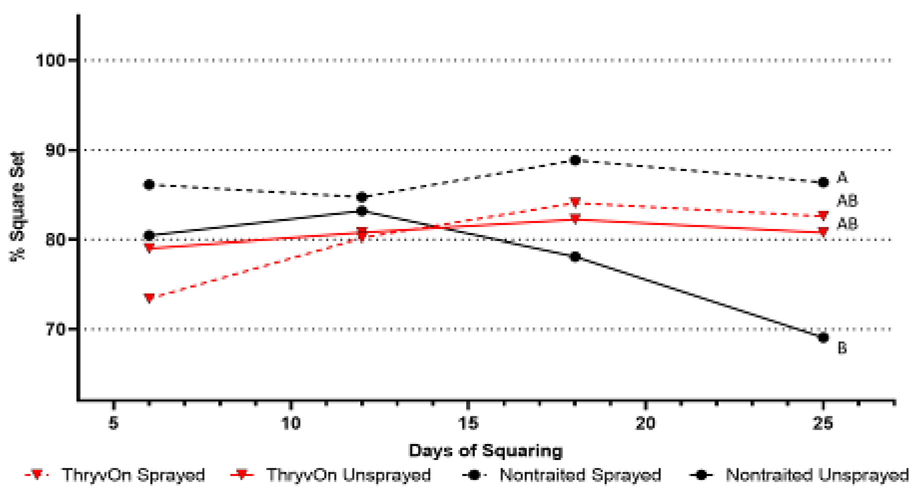

Figure 4: 2020 square retention by treatment across the sampling period

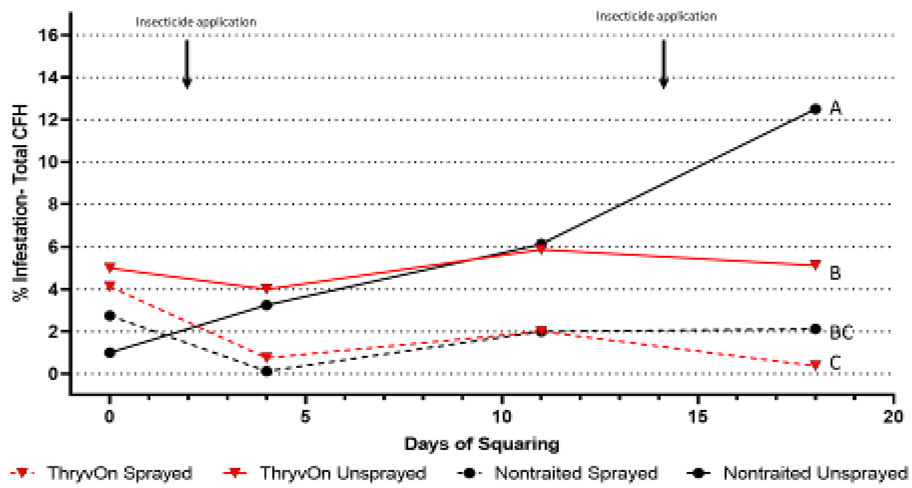

Figure 5: 2021 cotton fleahopper infestations by treatment across the sampling period

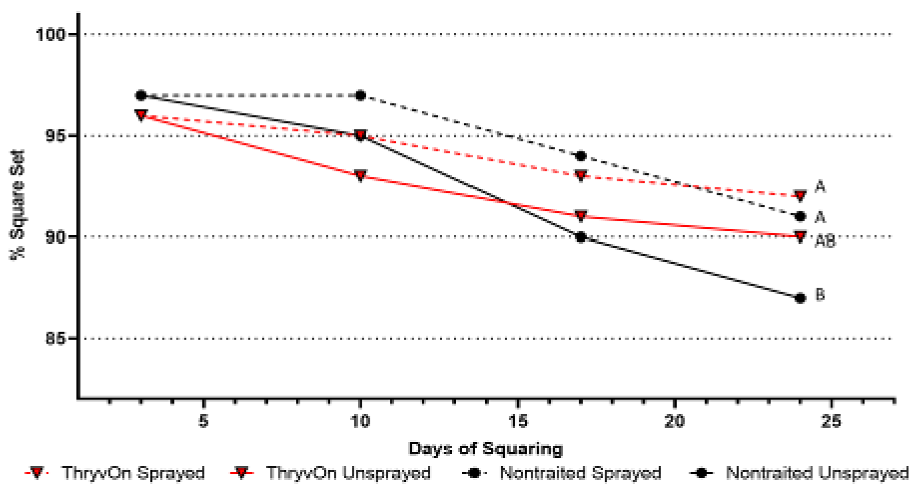

Figure 6: 2021 square retention by treatment across the sampling period

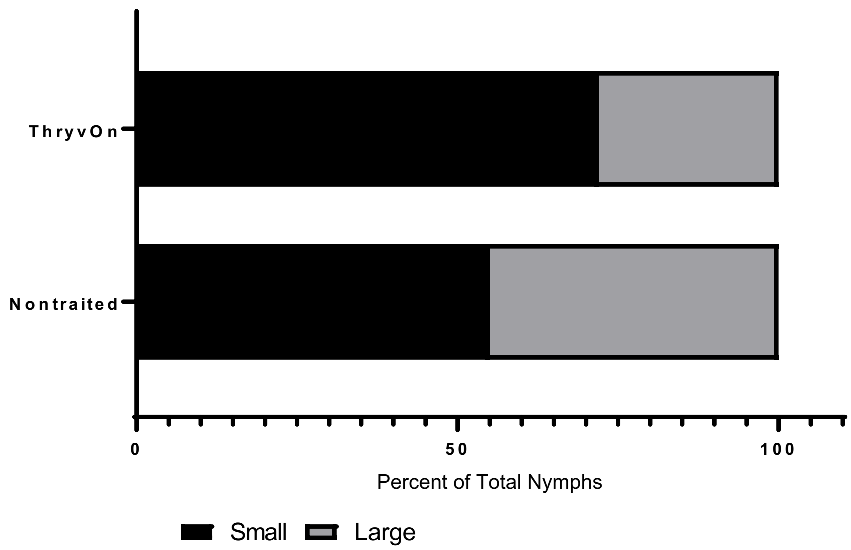

Figure 7: Combined analysis of nymphs by size across years and treatments

Conclusions

In moderate and high infestations of cotton fleahoppers not apparent trait effect on populations was present while at low levels the ThryvOn trait reduced populations without the need for chemical insecticides. Populations could still reach the recommended threshold, but when combined with insecticides the plots also containing the ThryvOn trait delayed reinfestation as compared to the non-traited isoline. This could mean that less applications will be necessary to control cotton fleahoppers during the growing season. Nymph development also appears to be delayed on ThryvOn cotton as less were able to molt into later instar nymphs. In terms of square retention, the ThryvOn trait offers similar protection to fruit as that of using chemical insecticides suggesting that even with higher populations the severity of cotton fleahopper feeding may not be as drastic.

Acknowledgements

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