EVALUATION OF INSECTICIDAL SOAP AS DEER REPELLENT IN S.C. COTTON

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Abstract

An on farm study was conducted across 19 fields and 186 plots to evaluate the use of Des-X insecticidal soap for use as a deer repellant in cotton production. Each plot was assigned one of three treatments: no applications, one application, or two applications. Visual ratings showed significant decrease in deer damage following application of Des-X and suggested effectiveness for about two weeks after each application. Damage to treated plots exceeded damage to untreated plots after expiration of this two week window, presumably because the plants in these plots were growing more vigorously. There were no significant differences in yield as a function of Des-X application, suggesting that yield effect from the later damage to treated plots was as detrimental as the earlier damage to the untreated plots. The study should be repeated to evaluate yield effects of extending treatment further into the growing season, beyond two applications.

Introduction

Though cotton (*Gossypium hirsutum* L.) can aptly adjust to given stress conditions, the plants are only able to overcome damage from whitetail deer to a certain degree. Deer pose a significant threat to young plants, specifically between the 2-5 leaf stage (Collins, 2018). When the cotyledon is eaten from a young plant, it dies, and when eaten later in a subsequent crop stage, it can stunt the plant resulting in yield loss. It is estimated that 58% of the field crop losses are a result of deer damage (Crosby et al.). A Clemson University study (Kirk et al., 2020) showed cotton lint yield losses of 9.3 kg ha^{-1} (8.3 lb ac^{-1}) and 2.6 kg ha^{-1} (2.3 lb ac^{-1}) per percent deer damage at 8-9 WAP.

In recent years, deer repellent methods have varied from pelletized human waste spreads to seed bag scarecrows speckling drivelines around fields. In this study, Des-X, an insecticidal soap labeled for pest control in various crops, was evaluated for efficacy at deterring deer by imparting a repulsive taste. The specific objectives were:

- To determine the performance of an insecticidal soap as deer deterrent by analyzing weekly damage and yield data
- To evaluate the damage caused by deer in cotton

Materials and Methods

This test was conducted across 19 fields in Barnwell County and Aiken County, S.C. Fields were assigned one of three baseline application timings (timing of first application) as: 1 week after emergence (WAE), 2 WAE, or 3 WAE. Within each field, replications were laid out as 91 to 137 m (300 to 450 ft) continuous lengths of endrows or row ends. Each replication was divided into three 30 to 46 m (100 to 150 ft) long plots, with plot widths ranging from 12 to 16 rows, depending on number of endrows present. The three plots in each replication were randomly assigned one of the following treatments: zero, one, and two applications of DES-X. There were 62 replications (186 plots) in total: 40 with a baseline timing of 1 WAE, 4 with a baseline timing of 2 WAE, and 18 with a baseline timing of 3 WAE.

Deer damage ratings and NDVI measurements were conducted along 18 row-m (60 row-ft) positioned along two rows at the center of each plot. Yield monitor data, where available, was extracted from the center two thirds of each plot length. Where yield monitor data was not available, yields were estimated by weighing a minimum of 30 bolls and counting the number of opened bolls per 4.9 row-m (16 row-ft). In treatments with two applications of DES-X, the second application was applied two weeks after the first application. For example, for the baseline timing of 2 WAE, two application treatments were treated at 2 WAE and 4 WAE; for the baseline timing of 3 WAE, two application treatments were treated at 3 WAE and 5 WAE. For all applications, DES-X was applied at a rate of 19.5 mL L^{-1} (2.5 oz gal^{-1}) with a carrier volume of 94 L ha^{-1} (10 gal ac^{-1}), equating to a DES-X rate of 1.8 L ha^{-1} (25 oz ac^{-1}) per

application. At a DES-X cost of \$7.9 L^{-1} (\$30 gal^{-1}), this rate was equal to a cost of \$14.47 ha^{-1} (\$5.86 ac^{-1}) per application. Reports from growers in South Carolina suggest that lower rates are also effective and that the product can be tank mixed with other spray applications.

Results and Discussion

Figure 1 shows weekly deer damage for the on-farm strip trials; treatments are grouped as untreated check (UTC, n=63), One Application (n=63), and Two Applications (n=63). As seen, application of DES-X resulted in a reduction of deer damage of about 50% at 1 week after first application (WAFA) and a reduction of about 25% at 2 WAFA, as compared to the untreated check. At 2 WAFA, the second application of DES-X was applied to all treatments grouped in Figure 1 as Two Applications, the results of which can be observed in the 3 WAFA deer damage data. At 3 WAFA, weekly deer damage for the plots treated with DES-X one time but not again increased to a level approximately twice that of the plots treated again at 2 WAFA. At 3 WAFA, the damage in the untreated plots was similar to that of the plots with two applications. These comparisons suggest that a single application DES-X was effective in reducing deer damage for a period of two weeks, after which a second application should be applied if continued damage mitigation is warranted. Weekly damage for the One Application treatment exceeding that of the untreated check at 3 WAFA and 4 WAFA is thought to be a result of more vigorous growth in the first two weeks after application in the treated plots as compared to the untreated check. This resulted in the plants being able to more rapidly and abundantly produce foliage for the plots treated once than for the untreated plots, which we believe made the plants more desirable for deer grazing. At 5 WAFA, which was also 3 weeks after the last application for the Two Application grouping, there were little to no observable differences between the three groupings. It is worth noting that we observed at one site, a reduction in weekly damage from about 35% to about 5% in the week in which the grower broadcast milorganite; this explains a large part of the reduction in damage observed between 0 WAFA and 1 WAFA in Figure 1.

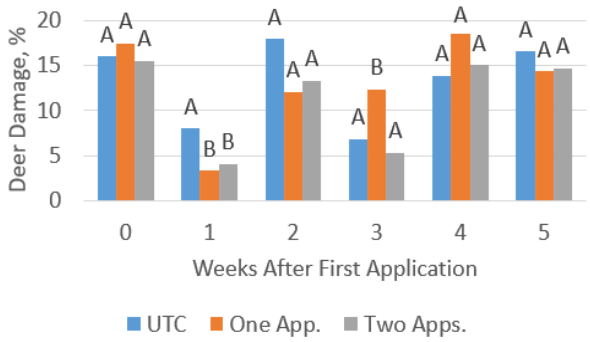
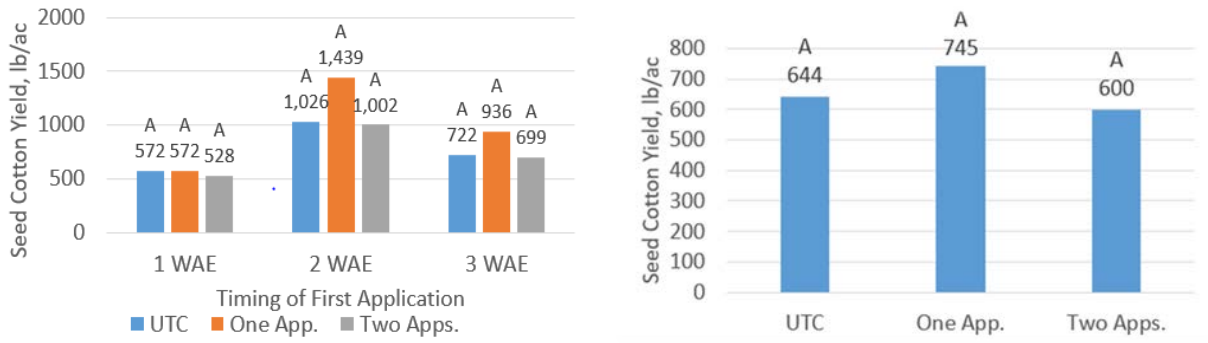


Figure 1. Weekly deer damage as a function of weeks after first application (WAFA) for no DES-X applications, one application of DES-X, and two applications. For the two application treatment, the second application was applied at 2 WAFA.

Figure 2 shows yield effect from the DES-X treatments; in Figure 2a results are broken out by baseline timing and number of applications and in Figure 2b results are expressed solely as a function of number of applications. There were no significant differences in yield across any of the comparisons shown in Figure 2. At 2 WAE and 3 WAE baseline timings (Figure 2a), one application of DES-X was numerically higher yielding (by 42% as compared to 2 WAE baseline timing and 32% as compared to 3 WAE baseline timing) than two applications or no applications, which were similar in yields. Independent of baseline timing, one application was also numerically higher yielding than no applications and two applications, with a 20% yield increase, although not statistically significant. Inherently, deer damage is highly variable and it is therefore challenging to account for this variability in a replicated trial, hence the reason for the large number of replications used in this study. Gin turnout showed no significant differences between the treatments (number of applications), although there was a slight numeric increase in turnout for the strips where DES-X was applied. Average gin turnouts were 43.0% for the UTC, 43.7% for one application of DES-X, and 43.7% for two applications of DES-X.



(a) (b)

Figure 10. Seed cotton yield as a function of baseline timing for the three treatments in the on-farm strip trials (a) and seed cotton yield as a function of number of applications for the on-farm strip trials (b).

Conclusion

Significant damage reduction following application of Des-X suggests that it can be an effective product for prevention of deer damage in South Carolina cotton. Generally, Des-X was most effective through two weeks after any given application. The shift in damage from the untreated check plots to the treated plots, three weeks after application suggests that deer preferentially fed on the tender growth of the most vigorous plants. Though not significant, yields were consistently highest with only a single application, suggesting that the later damage in Two Application treatments was as damaging to yield as the early damage that occurred in the untreated check plots.

This test compared number of applications at fixed application rates and fixed timings of first application within each replication. Future work should include experimental design to facilitate assessment of Des-X application rates and timing of first application. In this study there were no significant differences in yield associated with Des-X application, presumably because damage ensued after the last application; additional work should investigate additional numbers of applications, extending further into the growing season to seek to determine most profitable repellant termination timing. For any spray-applied repellent to be most cost effective, it should be tank-mixed with other products whenever possible. Tank mix compatibility studies should be conducted with Des-X and commonly employed cotton pesticides.

Acknowledgments

Thank you to the South Carolina Cotton Board for providing the funding to support this project. Thank you also to the individuals who assisted in data collection: Kayla Carroll, Ben Fogle, Perry Loftis, Brennan Teddy, and Alex Samenko.

References

Collins, Guy (2018). Evaluating and Managing Deer-Damaged Cotton. NC State Extension. https://cotton.ces.ncsu.edu/2018/04/evaluating-and-managing-deer-damaged-cotton-collins-edmisten/ (Accessed 11-6-2019)

Crosby, Mark, and Mengak, Michael. Farmers' perceptions of white-tailed deer damage to row crops in 20 Georgia counties during 2017. Georgia Extension. https://www.warnell.uga.edu/sites/default/files/publications/WSFNR-17-38%20Mengak_0.pdf (Accessed 11-6-2019)

Kirk, K. R., B. E. Teddy, M. T. Plumblee, J. D. Mueller, J. K. Greene, and B. B. Fogle. 2020. Intensive spatial data characterization: Spatial data relationships in cotton production. Paper presented at the 2020 Beltwide Cotton Conferences. January 8-10, 2020. Austin, Texas.