CONTROL OF INSECT PESTS IN GLANDLESS COTTON: THE ROLE OF BIOLOGICAL CONTROL IN NEW MEXICO

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Abstract

Cotton glands produce gossypol, a natural defense against insect pests. Glandless cotton varieties are available, but losses from pests have prevented commercial development. Some areas of New Mexico have lower insect pressure, with high predation and desiccation suppressing pest populations. With appropriate management and monitoring of insect pests, growers could potentially produce glandless varieties as a niche crop with greatly added seed value. Field to lab trials were conducted on New Mexico State University farms to evaluate predation rates in glandless vs. glanded cotton in an effort to develop pest management strategies for glandless cotton protection. Sentinel cotton bollworm eggs were attached to glanded and glandless cotton plants on multiple dates in 2015 to evaluate potential differences in predation. Insects were also sampled from plots before each predation trial using sweep nets.

Total predation was 56% and 57% in glanded and glandless cotton plots respectively in 2015, Damage to eggs was classified as being from predators with chewing or sucking mouthparts. Predators were generally collected in similar numbers in glanded and glandless cotton plots. However, there were significantly more spiders in glanded cotton plots early season in 2015 which was similar to results in previous years. The majority of spiders collected in 2015 were crab spiders *Mecaphesa* spp representing 80% of all spiders collected in glanded cotton. There were three times more *Mecaphesa* spp in glanded vs glandless cotton. Unlike previous years predation by predators with chewing mouthparts was not significantly higher in 2015 with an average 36% vs 37% predation of sentinel eggs in glanded vs glandless plots. Overall similarity in predation rates in glanded and glandless cotton suggests that predation will be an important source of control of insect pests in glandless cotton.

Introduction

Cotton has glands that produce natural toxins, primarily gossypol, that provide resistance to insects. Cottonseed is high in protein, and could be a value added product but it also contains 1% gossypol, and only ruminant animals can digest it well. Glandless, gossypol-free varieties of cotton, show promise in utilizing cotton seed as a protein source in food products increasing seed value for growers. (Jenkins et. al. 1966, Bottger et. al. 1964, Lukefahr et. al. 1966). However, both laboratory and field trials showed greater larval growth of cotton bollworm and tobacco budworm on glandless cotton. (Lukefahr et. al. 1966). Diet containing gossypol fed to beet armyworm and bollworm reduced 10 day larval weights and increased the number of days required for pupation (Bottger, et. al. 1966). Bollworm and beet armyworm survival was 2-6 times higher at pupation when reared on glandless cotton (Pierce et al 2012, 2014)

Glandless cotton was not considered a viable option in much of the cotton belt due to losses from pests. Lower insect pest pressure in New Mexico might allow commercialization of glandless cotton as a niche crop. Beneficial insect populations are also high in New Mexico, particularly in areas that have significant cotton acreage and could help control the higher populations of insect pests. Bt cotton has also reduced the prevalence of once key insect pests such as pink bollworm (Pierce et al. 2013).

Field trials with a glandless Acala cotton, Acala GLS, were conducted from 2011-2015 at a New Mexico State University farm in Artesia, NM to evaluate potential losses from insect pests and compatibility with biological control. Differences in insect growth and development have been reported (Pierce et al. 2012, 2014). Higher rates of predation were noted in glanded cotton in previous years along with higher numbers of spiders early season. (Pierce 2015) This report focuses on potential control of insect pests by predators on glanded and glandless cotton varieties in 2015 only.

Material and Methods

Glandless Acala GLS and a local standard Acala were planted in plots with 32 rows by 100 feet replicated 4 times. Sweep net samples were collected before each egg predation assay with the number of pests and predators recorded. Sentinel bollworm, *Heliocoverpa zea* (Boddie), eggs less than 18 hours old were attached to plants in each plot and examined after 48 hours to determine predation levels. Since there were significantly more spiders in glanded cotton in previous years in 2015 all spiders were identified at least to genus and when possible to species.

Results and Discussion

Predation Levels and Predators in Glanded vs Glandless Cotton

In 2015, total predation was similar in glanded and glandless plots. Season long mean predation levels between glanded and glandless cotton were not significantly different with 57% and 56% predation in glandless and glanded cotton respectively. It was unclear if there was higher eggs mortality by predators with chewing mouthparts. There was significantly higher mortality by chewing predators on August 4 with 34% higher predation in glanded plots but no significant difference on July 20. However, as in previous years, there was significantly more spiders in glanded plots although in 2015 it was only at one point on July 20.

As in previous years there were significantly more spiders in glanded cotton plots early-mid season with more spiders in glanded plots on July 20 and August 4. This response was similar to but more dramatically higher than 70% higher rate in glanded plots in 2012. On August 4, 2015 there was an average of 7.5 spiders/100ft in glanded plots vs only 0.8 in glandless plots, a ninefold difference (Figure 1).

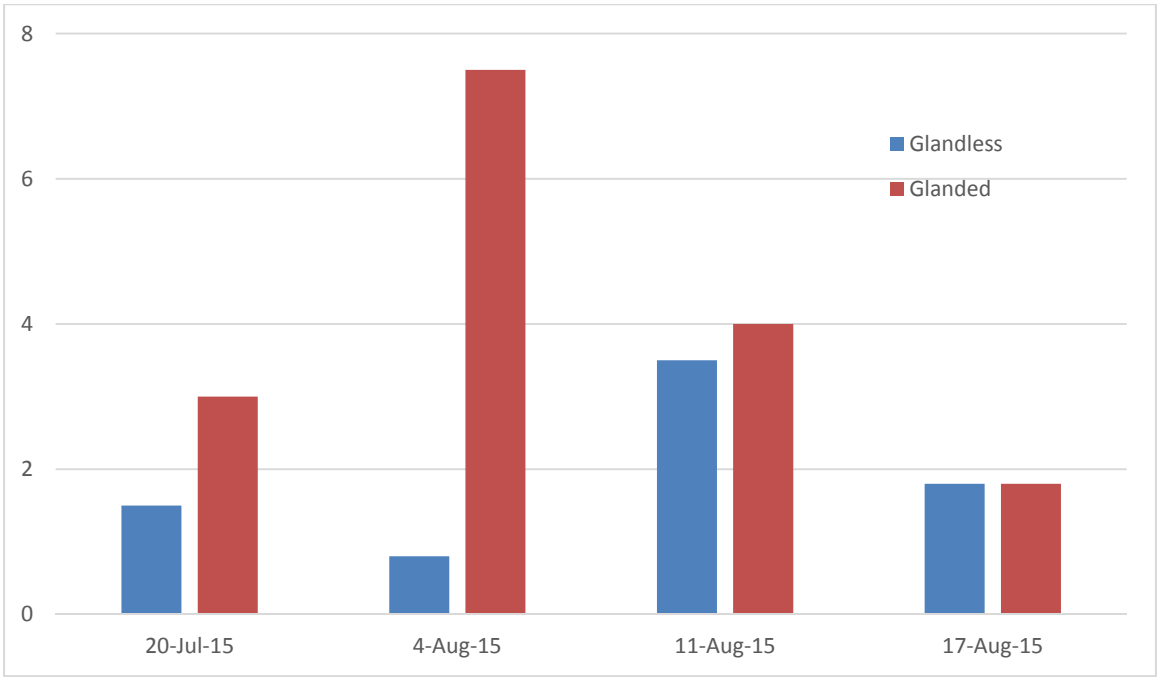

Figure 1. Total Number of Spiders Collected per 100ft in Glanded and Glandless Cotton.

There were twice as many spiders in glanded plots than glandless plots in 2012 with an average of 4.1 in glanded vs 1.9 in glandless plots. Predation differences in 2015 were less clear than in previous field trials. Predation of sentinel eggs from glanded plots by arthropods with chewing mouthparts was higher, for example, on every date in 2012 but only one date in 2015 (Table 1) (Pierce 2015).

Table 1 .2015 Sentinel Egg Predation in Glanded and Glandless Cotton

Date	Total % Predation			% Predation by Chewing Predator			#Spiders/100ft		
	G-	G+		G-	G+		G-	G+	
July 20	72	70	ns	74	54	ns	1.5	3.0	*
August 4	55	58	ns	29	39	*	0.8	7.5	*
August 11	58	51	ns	28	29	ns	3.5	4.0	ns
August 17	43	48	ns	18	23	ns	1.8	1.8	ns

Spiders were significantly more abundant in glanded cotton plots from 7/23-8/7 in 2015 with season long 4 times more spiders in glanded compared to glandless plots (Table 2). However, the majority of spiders collect were crab spiders *Mecaphesa* spp. representing 80% of spiders collected in glanded cotton. There were 3 times more *Mecaphesa* spp in glanded cotton. Since this species prefers floral habitats, and does not have chewing mouthparts, it is likely spiders are not responsible for the difference in chewing damage to eggs.

Table 2. Spiders Collected in Glanded and Glandless Cotton Plots from 7/23/15 - 8/7/15.

Spider Species	Glandless	Glanded
Mecaphesa spp.	2	12
Mecaphesa celer	1	2
Mecaphesa coloradensis	1	0
Tetragnatha laboriosa	0	2
Oxopes salticus	0	1

Spiders have been often significantly more abundant in glanded cotton, particularly early season. Predation of sentinel eggs from glanded plots by arthropods with chewing mouthparts has been often significantly higher also, suggesting that spiders may have been responsible for higher chewing damage to eggs.

Although not all spiders have chewing mouthparts, the higher predation and counts of spiders in trials since 2011 suggested that some species of spider may be more prevalent and producing higher levels of predation in these cultivars of glanded vs glandless cotton. Since the cultivars chosen are not isolines other morphological features specific to those varieties are also a possibility.

In 2015, spiders were identified to help determine if they were likely the source of higher chewing damage to sentinel eggs. Since 80% of early season spiders were crab spiders, *Mecaphesa* spp. which do not have chewing mouthparts spiders are likely not the source of the higher chewing damage in glanded plots. Direct observations will be necessary to determine the source of predation.

Field and lab data suggests that glandless cotton will require close monitoring but that development of insect pest management strategies can make it a viable niche option in areas with lower insect pest pressure. Overall predation levels are not lower in glandless cotton so predation will be a significant source of control of insect pests.

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