PREDATION OF SENTINEL BOLLWORM EGGS IN GLANDED AND GLANDLESS COTTON 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 2011-2013 to evaluate potential differences in predation. Insects were also sampled from plots weekly using sweep nets.

Total predation was 56% and 53% in glanded and glandless cotton respectively in 2011, but 71% and 79% in 2012. 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 both years. However, there were significantly more spiders and ladybugs in glanded cotton plots early season in 2011 and significantly more spiders season long in glanded cotton plots in 2012. Predation by predators with chewing mouthparts was also significantly higher in 2012 with an average 78% vs 47% 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, 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 2011-2014 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). This report focuses on potential control of insect pests by predators on glanded and glandless cotton varieties.

Material and Methods

Glandless Acala GLS and a local standard Acala were planted in plots with 32 rows by 100 feet replicated four times. Sweep net samples were collected weekly with the number of pests and predators recorded. Sentinel cotton bollworm eggs, less than 18 hours old, were attached to plants in each plot and examined after 48 hours to determine predation levels. Squares were randomly sampled weekly to evaluate bollworm damage.

Results and Discussion

Predation of Sentinel Eggs

In 2011, overall predation levels between glanded and glandled cotton were not significantly different with an average 56% predation in glanded vs 53% predation in glandless plots. However, sentinel eggs in glanded cotton plots had significantly higher predation from arthropods with chewing mouthparts early season on July13. At the same time there were significantly more ladybugs and spiders in glanded cotton (Pierce et al. 2012).

In 2012, the highest number of predators in 2012 were spiders, followed by damselbugs, then lacewings (Figures 1-3). The most prevalent predators until July 13 were damselbugs with over 7 per 100 feet on each date. After July 13, and for the rest of the season, spiders were the most commonly collected predator with an average 2.9 per 100 feet seasonlong.

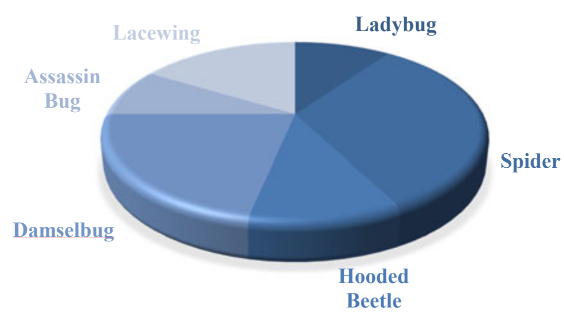

Figure 1. Percent Arthropods Collected in 2012 Sweep Net Samples

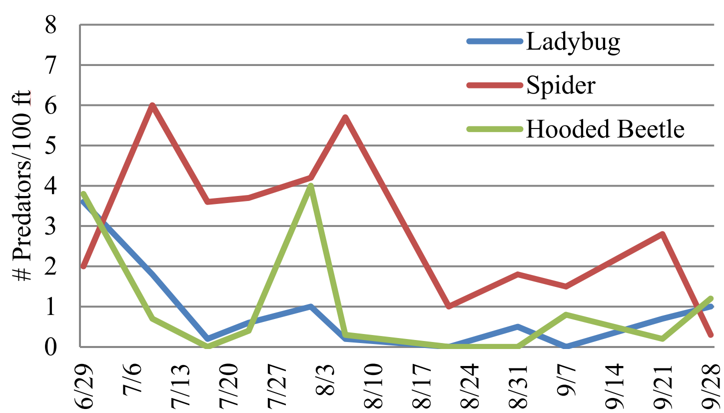

Figure 2. Prevalence of predators in cotton plots in 2012.

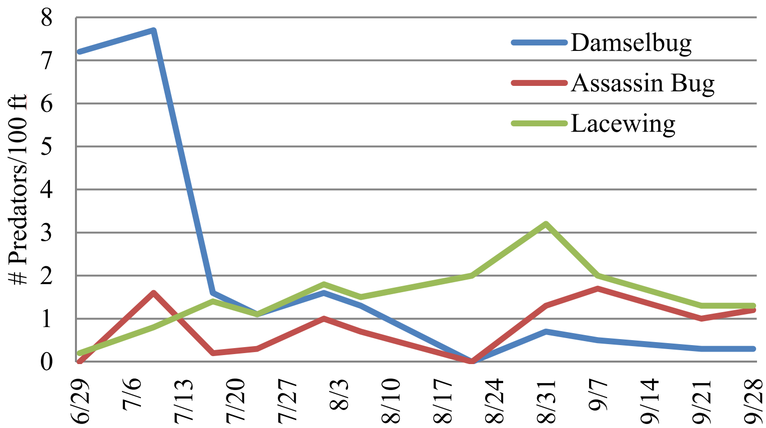

Figure 3. Prevalence of predators in cotton plots in 2012

Predation Levels and Predators in Glanded vs Glandless Cotton

Predators were more prevalent in 2012 compared to 2011, which was mirrored by higher predation of sentinel eggs. Mean predation season long in 2011 was only 49%, but 75% in 2012.

There were significantly more spiders seasonlong in glanded vs glandless plots with 3.6 spiders/100 ft in glanded vs 2.2 in glandless plots in 2012 (Figure 4). Glanded and glandless plots had similar numbers of all other predators.

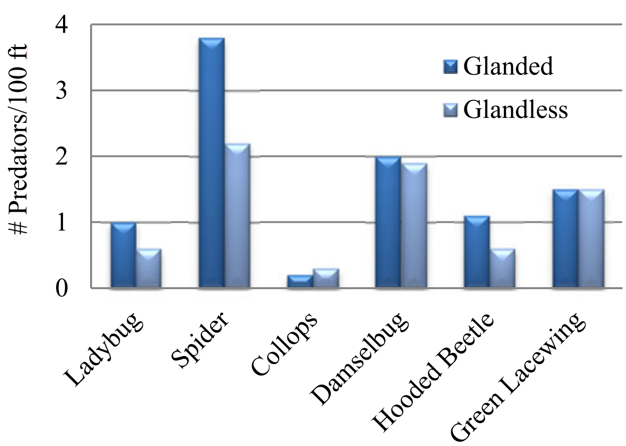

Figure 4. Season long means of sweep net samples of predators in glanded vs glanded plots in 2012

Total predation in 2012 was not significantly different in glanded vs glandless plots with 61-81% predation in glandless plots and 72-86% predation in glanded plots (Figure 5).

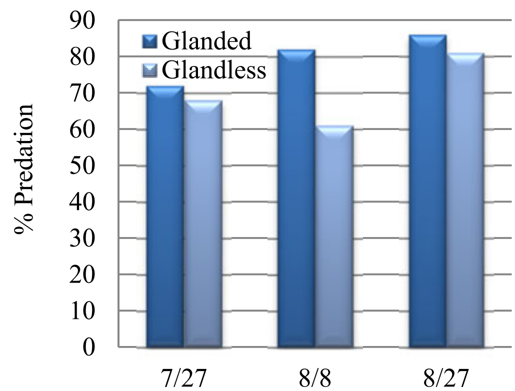

Figure 5. Percent predation of sentinel eggs in glanded and glandless cotton plots in 2012

However, predation of sentinel eggs by arthropods with chewing mouthparts was significantly higher in glanded plots on 8/8/12 when there was almost twice as much predation 78% in glanded vs 47% in glandless plots (Figure 6). Predation by arthropods with sucking mouthparts was relatively low and was not significantly different in glanded and glandless plots (Figure 7).

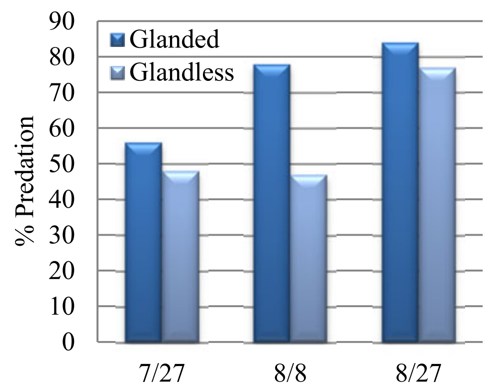

Figure 6. Pred g mouthparts

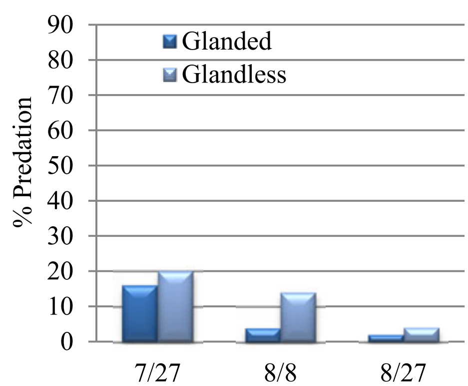

Figure 7. Predation of sentinel eggs by arthropods with sucking mouthparts.

This higher predation, by predators with chewing mouthparts, in glanded plots was two days after sweep net samples from August 6 collected almost twice as many spiders in glanded cotton plots. Glandless plots had 4 vs 7.3 spiders per 100 feet in glanded plots (Figure 8).

Although not all spiders have chewing mouthparts, the higher predation and counts of spiders in both 2011 and 2012 suggests 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.

Field and lab data suggest 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.

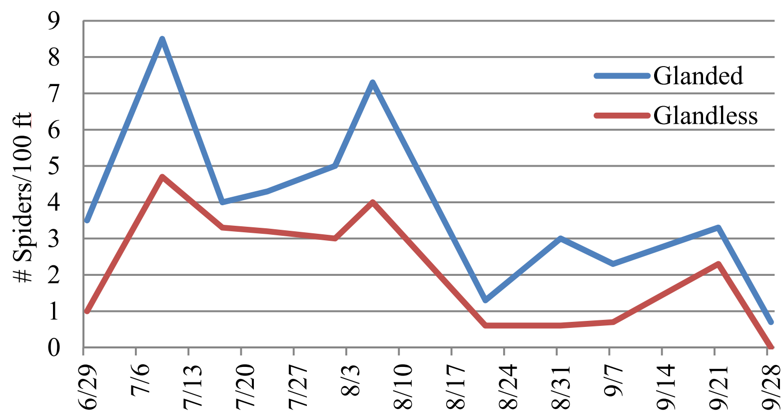

Figure 8. Spiders in Glanded vs Glandless Cotton

Acknowledgement

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