GLANDLESS COTTON IN NEW MEXICO: WEIGHING THE RISK OF INSECT LOSSES

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Abstract

Glandless cotton has been rejected as a viable crop in some areas since the lack of gossypol resulted in a plant that was highly susceptible to losses from insects. New Mexico has lower insect pressure than most other areas of the cotton belt and might be an area where gossypol free cotton is a viable product. Field trials with a gossypol free Acala cotton were initiated in 2010 in New Mexico. In 2011, trials were initiated on a University farm to evaluate insect losses in the field and lab. Laboratory trials were conducted to evaluate preference and survival of cotton bollworm and beet armyworm on the glandless Acala GLS and the local standard Acala 1517-99. Initial results indicate some differences in preference and significantly higher weights for 4th instar larvae fed the glandless Acala. Possible differences in predation were also evaluated by direct sampling of predators in glanded and glandless cotton. Predation levels were also compared by placing sentinel eggs in the field then examining the retrieved eggs under a microscope for signs of predation. Surprisingly, damage to sentinel eggs from chewing predators was significantly higher in glanded cotton early season. This was consistent with sweep net samples of predators which has 5-6 times more adult ladybugs and spiders in glanded compared to glandless plots.

Introduction

Commercially grown Acala cottons have evolved effective chemical resistance that deters many plant feeding animals. Gossypol, in particular, is considered an effective source of plant resistance. Gossypol, however, also makes cottonseed less valuable since about 1% of the seed is gossypol and it cannot be digested by non-ruminant animals.

In 1959, a gossypol-free American upland cotton gossypol was developed. Numerous trials were conducted to determine if it could be grown for commercial use where cottonseed could be used as a source of high protein animal feed or even food products for humans. (Jenkins et al 1966, Bottger et al 1964, Lukefahr et al 1966). However, field trials indicated that damage from a variety of pests to glandless cotton made commercial production unlikely in much of the Cotton Belt. Benedict (1977) concluded that glandless cotton should only be produced in geographic areas that are essentially free of insect pests. New Mexico has less insect pest pressure than many other areas of the cotton belt and might be an area where some production of glandless cotton is feasible. Benedict et al. did indicate that more predators were collected in glandless compared to glanded plots in California (Benedict et al 1977). Biological control levels are also very high in New Mexico and might help compensate for higher susceptibility of glandless cotton.

Materials and Methods

Field plots of the glandless Acala GLS and a local standard Acala 1517-99 were 200 ft. long by 28 rows wide, replicated 4 times. Plots were sampled weekly for insect pests and predators. Early season sampling included sampling for thrips. When squares were available they were sampled and examined for insect damage weekly. Sweep net samples also were collected weekly with the number of pests and predators recorded. Four times over the season sentinel eggs were attached to plants in each plot to determine predation levels.

Field to laboratory bioassays were also conducted using field collected leaves and squares to determine effects on survival, development and feeding preference. First instar bollworm and beet armyworm were fed glandless or susceptible cotton squares or leaves and maintained until pupation.

Results

Figure 1. Beet armyworm damage to glandless cotton in Artesia field trial 2011.

Figure 2. Beet armyworm damage to glanded cotton in Artesia field trial 2011.

Field ratings of beet armyworm damage were significantly higher in glandless compared to glanded cotton (Figure 3). There was no difference in the number of beet armyworm infested plants.

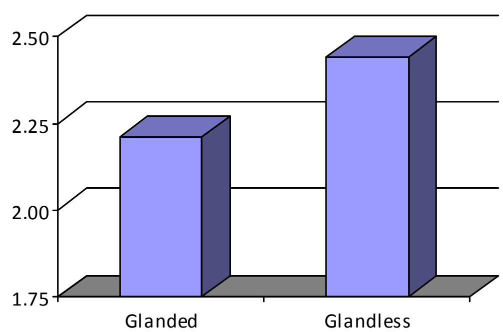


Figure 3. Rating of field damage to glanded and glandless Cotton in Artesia field trial 2011.

Table 1. Percent survival of early instar beet armyworm on glandless cotton for Artesia field trial 2011.

Assay	Glanded (s.e.)	Glandless (s.e.)	Glanded (s.e.)	Glandless (s.e.)
	24 hours of feeding		48 hours of feeding	
1	67 (4.9)	68 (3.4)	69 (4.3)	67 (2.9)
2	87 (3.1)	88 (1.5)	82 (2.8)	78 (3.6)
3	48 (4.1)	44 (4.8)	56 (4.5)	64 (4.2)
4	88 (2.6)	88 (2.4)	81 (2.5)	88 (2.2)
5	56 (3.9)	60 (4.2)	56 (4.5)	64 (4.2)

Survival of 1-2nd instar beet armyworm was not significantly different with 24 or 48 hours feeding on glanded or glandless cotton. Survival ranged from 53-88% at 24 hours and 56-88% at 48 hours. Survival was 2-3% higher at 24 and 48 hours on glandless cotton, but was not significant (Table1).

Table 2. Percent survival of early instar bollworm on glandless cotton for Artesia field trial 2011.

Assay	Glanded (s.e.)	Glandless (s.e.)	Glanded (s.e.)	Glandless (s.e.)
	24 hours of feeding		48 hours of feeding	
1	39 (1.6)	41 (1.4)	23 (2.1)	29 (2.1)
2	68 (2.7)	81 (2.8)	56 (3.0)	64 (3.3)
3	80 (2.6)	82 (2.7)	71 (3.4)	62 (2.6)
4	66 (3.8)	67 (3.2)	62 (3.9)	60 (2.8)
5	76 (2.1)	80 (2.2)	62 (3.6)	66 (2.9)

There was also no significant difference in survival of bollworm up to 48 hours. Survival ranged from 39-82% at 24 hours and 23-71% at 48 hours. Survival was 2-4% higher on glandless cotton but was not significant (Table 2).

Table 3. Bollworm and beet armyworm development on glandless and glanded cotton for Artesia field trial 2011.

Insect	Host Plant	Larval Wt. (14d)	Pupal Wt	Days to Pupation
		mg (s.e.)	mg (s.e.)	mg (s.e.)
Beet armyworm	glanded	91 (15)	92 (3)	20 (0.9)
	glandless	170 (14)	101 (3)	17 (0.2)
Bollworm	glanded	102 (11)	283 (9)	26 (1.0)
	glandless	158 (16)	28 (14)	25 (0.7)

Beet armyworm larvae were 86% larger when fed glandless cotton, with larval weights 91 vs. 170mg at 14 days. Beet armyworm took 3 days longer to pupate, 20 days vs. 17 days. The 10% difference in pupal weight was not significant. Bollworm larvae were 55% larger but there was no significant difference in pupal weight or time to pupation. (Table 3)

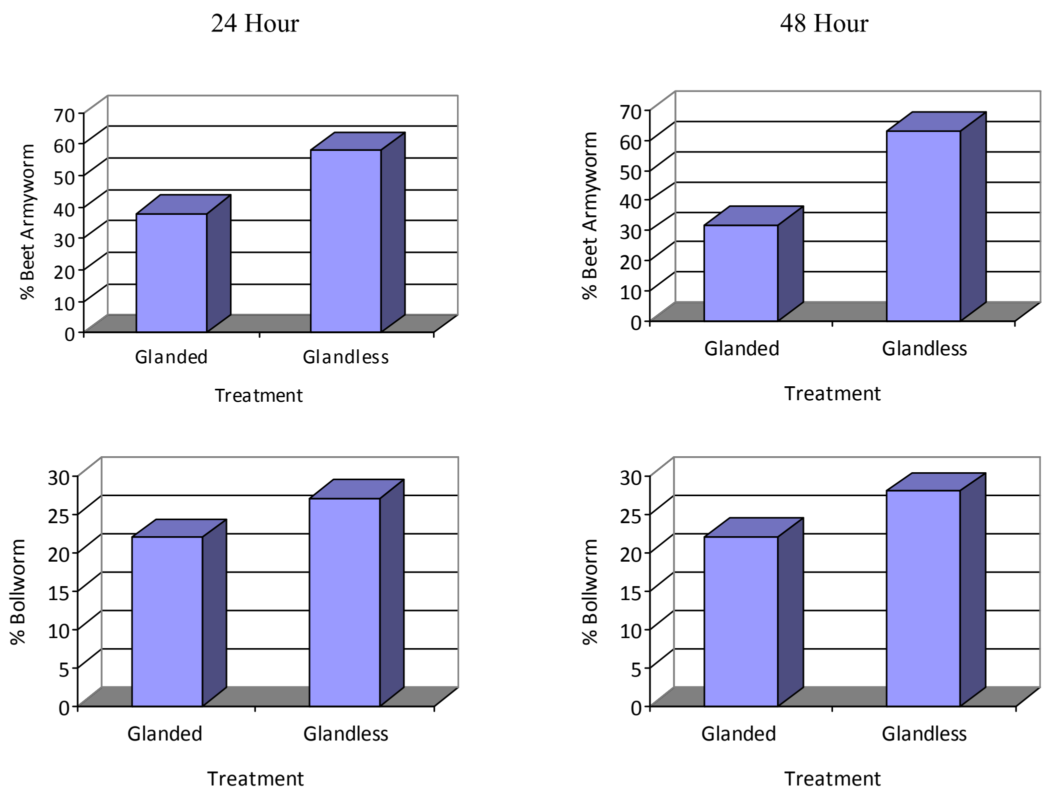


Figure 4. Percent preference for glandless or glanded cotton leaves for Artesia field trial 2011.

At 24 hours 20% more beet armyworm were feeding on glandless cotton, but 30% more were feeding on glandless cotton at 48 hours. There was significantly more beet armyworm on glandless cotton after 48 hours but not at 24 hours (Figure 4). There was no difference in bollworm numbers at 24 or 48 hours with 4 and 5% more bollworm feeding on glandless cotton.

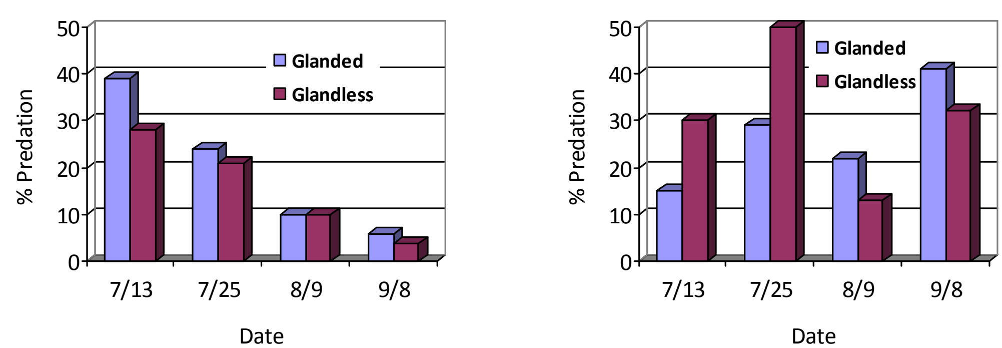
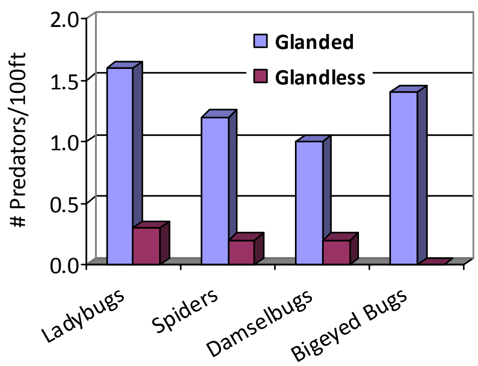


Figure 5. Percent predation of sentinel eggs by chewing and sucking arthropods.



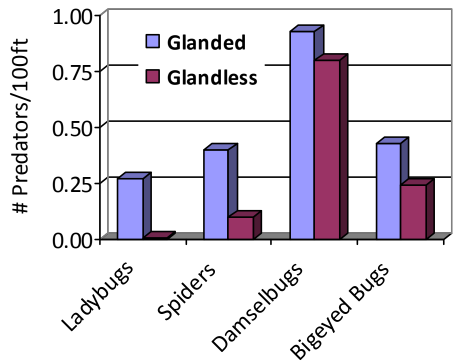


Figure 6. Number of predators collected in glanded and glandless cotton on 7/5/2011 and throughout the 2011 season in Artesia field trials.

There was no difference in total predation of sentinel eggs between glanded and glandless plots. However, there were some differences in predation by specific predators. There was significantly more sucking damage to sentinel eggs in glandless cotton, on July 13 and July 25. Surprisingly, on July 13, there was more chewing damage to sentinel eggs in glanded rather than glandless plots (Figure 5). This was consistent with sweep net samples of insects where there were 5-6 times more ladybugs and spiders in glanded rather than glandless plots on July 5 (Figure 6).

Conclusion

In 2011, glandless cotton was significantly more damaged by beet armyworm compared to glanded cotton. Laboratory trials indicated some differences in preference, development and survival in late instars. Eggs in glandless plots did have higher predation, early to mid-season, by arthropods with sucking mouthparts. Surprisingly, ladybugs and spiders were more prevalent early to mid-season in glanded plots, which also had higher predation by predators with chewing mouthparts. There was no significant difference in damage to field collected squares between glanded and glandless plots.

References

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