Disruption of sexual communication in the pink-spotted bollworm, Pectinophora scutigera (Holdaway), with synthetic pheromone

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Introduction

During the 1988/89 cotton season trials were conducted to evaluate the potential of synthetic pheromones to control the pink-spotted bollworm, Pectinophora scutigera, by mating disruption (Walker et al. 1990). Polyethylene tube dispensers, specially formulated with P. scutigera synthetic pheromone, were obtained from commercial suppliers (Shin Etsu Chemical Company Ltd., Japan) and applied to four cotton fields near Biloela, Central Queensland. A single application of 1,000 dispensers/ha, during early squaring of cotton, was successful in disrupting sexual communication of P. scutigera over the entire season, as indicated by a 97-100% reduction in pheromone trap catch when compared to pheromone untreated fields. However, despite good disruption in pheromone trap catch, larval infestations of P. scutigera developed in all four pheromone treated fields. While rates of

infestation were lower in three of the pheromone treated fields than in near-by untreated fields, very high numbers of larvae were found in the smallest treated field (2.4 ha).

The development larval infestations in pheromone treated fields was probably due to the immigration of mated females from other untreated cotton crops. Consequently, the success of the pheromone treatment would depend on the area of cotton treated and the degree of isolation from untreated areas which may act as a source of mated females.

Further mating disruption trials were conducted in the 1989/90 season by treating all cotton grown on D.P.I. Research Station, Biloela, with pheromone. The reliability of pheromone traps as an indicator of mating disruption was investigated.

Also, polyethylene tube dispensers formulated with P. gossypiella synthetic pheromone were applied to determine whether they can be used to disrupt mating in P. scutigera. The use of P. gossypiella formulated dispensers would make the purchase of pheromone products easier and cheaper for the limited Australian market.

Methods

All cotton grown on the D.P.I. Research Station, Biloela, was treated with P. scutigera formulated pheromone dispensers at a rate of 1,000

dispensers/ha. The area of cotton treated totaled 15.9 ha and comprised of six small fields surrounded by other summer crops and pasture land. The nearest untreated cotton field was situated approximately 2 km away. One of the pheromone treated fields (2.7 ha in area) was not sprayed with insecticides throughout the season, while all other fields were sprayed according to the recommendations of local cotton scouts. Dispensers were applied during the early squaring stage of growth on 13 December 1989, or 10 January 1990, depending on the planting date of the cotton. Bolls (N = 100) were sampled from the unsprayed field and one sprayed field at approximately weekly intervals and inspected for P. scutigera larvae. Pheromone traps were placed in each field before the application of dispensers. The mated status of all P. scutigera females caught in an ultraviolet light trap placed in the unsprayed field, over 12 nights during January, February and March, was determined by dissection. These females were compared with the mated status of those caught in a light trap placed in a commercial cotton field that was not treated with pheromone.

Unmated P. scutigera females, originating from laboratory cultures, were placed within pheromone treated cotton and in adjacent non-cotton crops. Three to five clipped-winged females were placed in

containers, with a leaf of the respective crop they were placed in, and tied onto plant stems at sunset. Females were observed during the period of sexual activity, between midnight and dawn. Unmated male and female moths were also placed together inside small containers in pheromone treated and untreated areas. Sweep net samples were taken at approximately half-hour intervals throughout the period of observation to assess the number of P. scutigera within each area.

A commercial cotton field (ca 8 ha) was treated with P. gossypiella pheromone dispensers, at rate of 1,000/ha, during early squaring on 16 December 1989. The number of moths caught in pheromone traps and rates of larval infestation in bolls was compared with a near-by untreated field.

Results and Discussion

As in the 1988/89 season, disruption of pheromone trap catch within the pheromone treated cotton fields was spectacular. Only two P. scutigera males were caught in pheromone traps over the entire cotton season, after pheromone dispensers were applied. In comparison, more than 5535 males were caught in one 3.9 ha pheromone untreated field cotton field on the D.P.I. Research Station during the 1988/89 season. However, when pheromone traps were placed immediately outside the treated cotton,

in non-cotton crops, during late February, large numbers of male P. scutigera were caught. These traps were placed in a bean and sorghum crop less than 3 m from treated cotton fields.

Again, as seen in previous trails, despite good disruption of pheromone trap catch, P. scutigera larval infestations still developed in three of the treated fields sampled. In the unsprayed field, levels of boll infestation were low when compared to previous data collected from unsprayed cotton over three seasons (Walker, unpublished data). However, this may have been partly related to the effects of the very hot and dry weather experienced in Central Queensland which considerably advanced the growth of the cotton plants. Boll infestation in one of the sprayed fields reached 20% and it was necessary to apply an insecticide spray to control P. scutigera larvae.

Capture of males in pheromone traps placed in non-cotton crops suggested that mating can take place in these areas immediately outside the treated cotton. This was verified when clipped-winged virgin female P. scutigera were placed in the field. While all virgin females placed within treated cotton remained unmated, a high proportion of females placed in the adjacent sorghum and bean crops were successfully mated by feral P. scutigera males.

Furthermore, sweep net samples taken inside the sorghum and bean crops revealed the presence of large numbers of feral male and female P. scutigera, including mating pairs.

When unmated male and female P. scutigera were placed inside small containers within pheromone treated cotton, they were able to mate successfully. This suggests that the pheromone treatment is only effective at disrupting long distance sexual communication.

The proportion of unmated females caught in a light trap placed in the unsprayed, pheromone treated cotton was initially high in late January but decreased as the season progressed (Table 1). The number of spermatophores in a female indicates the number of times that female has mated, as males can only pass one spermatophore within 24 hours (Vickers 1982). At the end of January, between 65 and 86% of all females caught in the pheromone treated field were unmated, while nearly all other moths caught had mated only once (Table 1). In the first half of February, the percentage of unmated females caught decreased to between 42 and 62%, and the percentage of females that had mated more than once increased. Compared to the mated status of females caught in a pheromone untreated field during the same period, the incidence of multiple mating in

the pheromone treated field was low (Table 1). In the pheromone untreated field, unmated females were very rare. Most females had mated one to three times although up to six spermatophores were found in some individuals. By the end of March very few unmated females were caught in the pheromone treated field and the incidence of multiple mating increased to levels similar in pheromone untreated cotton.

The P. gossypiella pheromone dispensers gave very good disruption of P. scutigera pheromone trap catch until early March. During January and February only 1 male was caught in the pheromone treated field compared to over 2602 in the untreated field. However, in March trap catch in the pheromone treated field increased sharply. A total of 625 moths were caught in five pheromone traps and during this period boll infestation in both fields increased to very high levels.

Conclusion

A single application of synthetic pheromone, formulated in polyethylene tube dispensers, at a rate of 1,000 dispensers/ha was successful in disrupting long distance sexual communication in P. scutigera over the entire cotton season. However, control was confounded by the ability of P. scutigera to successfully mate in adjacent non-cotton crops. This led to mated P. scutigera females

laying fertile eggs in the pheromone treated cotton thus reducing the treatment effect.

Adequate control of P. scutigera by mating disruption with synthetic pheromone would only occur when all possible sources of adult moths are eliminated by either treating very large areas of cotton or areas that are isolated from other cotton crops. P. gossypiella formulated dispensers are not suitable for P. scutigera control unless they are applied more than once over the cotton season.

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References

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Table 1. The mated status of P. scutigera females caught in an ultraviolet light trap placed in cotton treated or untreated with synthetic pheromone. The number of spermatophores/female indicates the number of times mating has occurred.

Date caught	No. caught	Percentage of females containing spermatophores 0	1	2	3	4	5	6
		Pheromone treated cotton						
29/1/90	40	65.0	35.0					
30/1 "	38	76.3	18.4	5.3				
31/1 "	28	85.7	14.3					
6/2 "	44	61.4	36.4	2.3				
7/2 "	19	42.1	47.4	10.5				
14/2 "	38	55.3	34.2	10.5				
15/2 "	32	62.5	28.1	6.3	3.1			
20/2 "	76	36.8	53.9	6.6	1.3	1.3		
21/2 "	83	34.9	56.6	7.2	1.2			
2/3 "	180	16.1	55.5	22.2	4.4	1.7		
12/3 "	144	31.9	45.1	10.4	9.7	2.8		
13/3 "	109	8.3	55.1	22.9	10.1	2.7	0.9	
		Pheromone untreated cotton						
8/2/90	11	0	27.3	27.3	18.2	9.1	9.1	9.1
14/2 "	19	5.3	52.6	21.0	5.3	15.8		
15/2 "	15	0	86.7	6.7	0	6.7		
16/2 "	31	12.9	38.7	32.3	6.4	3.2	3.2	3.2
20/2 "	8	12.5	50.0	25.0	12.5			
21/2 "	12	0	33.3	41.7	0	25.0		
1/3 "	51	9.8	68.6	13.7	5.9	0	2.0	