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Field Management of Insect Pests of Cotton Through Augmentation of Parasitoids and Predators

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Abstract: Management of insect pests of cotton depends on the application of chemical insecticides in Pakistan. Use of chemical insecticides induce resistance in insects and destroy the natural pest control agents. Therefore, alternatives to insecticides are receiving much attention. Studies to manage the insect pest through augmentative releases of egg parasitoid, *Trichogramma chilonis* and predator, *Chrysoperla carnea,* indicated that biocontrol technology suppressed the infestation of insect pests of cotton to sub-economic levels. Low establishment of egg parasitoids was recorded in the early crop growing months and gradually increased to peak during the month of October. Whereas, maximum field establishment of *C. carnea* was recorded in the month of August.

Key words: Cotton pests, management, parasitoids and predators

Introduction

Cotton production is adversely affected by the attack of many insect pests, which have traditionally been controlled by large quantities of insecticides. Nevertheless the use of insecticides is unsustainable because of increasing pest resistance, residues and environmental impact (Van Steenwyk *et al.,* 1975; Bariola, 1985). For these reasons, improved methods of pest control are badly needed, with an emphasis on ecologically based pest management strategies. Among them, biological control offers one of the most promising environmentally sound and sustainable approaches to manage the insect pests. Interest has therefore, resurfaced in using the biological control, which has long been recognized as an important pest management component. In many cases biological control alone has managed pests well enough to eliminate the need for further treatment (Ashraf e*t al.,* 1999). The beneficial insects alone or an adjunct to other management tactics has been successfully manipulated with variety of augmentation and conservation strategies (Suh *et al.,* 2000; Orr *et al.,* 2000; Ahmad *et al.,* 2001). The use of *Trichogramma* wasp as a biocontrol agent is a recognized alternative of insecticides and has been applied successfully for the management of cotton bollworms (Ahmad *et al.,* 2001) and other insect pests (Suh *et al.,* 2000). Although, the parasitoids had proved effective against cotton bollworms, but application of insecticides for the management of sucking pests are still needed which negate the advantages of using biocontrol technique in cotton crop. Releases of *Chrysoperla* spp., a predator of jassids, thrips, white flies and also feed on eggs/tiny larvae of bollworms, may be useful for the management of cotton pests. Therefore, studies were conducted to evaluate the efficiency of egg parasitoids, *Trichogramma chilonis* in conjunction with a predator, *Chrysoperla carnea,* to manage the cotton pests.

Materials and Methods

Studies were conducted on 15 acres of cotton. The area was divided in three different blocks of 5 acres each and each block was given a separate treatment. One block was treated with an egg parasitoid, *Trichogramma chilonis* and a predator, *Chrysoperla carnea* (biocontrol technology). The parasitoids and predators were reared on the eggs of Angoumois grain moth in the laboratory maintained at 25 ± 2 °C and 60-70 % relative humidity. For the parasitoids, the eggs of Angoumois grain moth were glued on white paper cards and exposed to parasitoids for 24 hours. The parasitoids prior to adult emergence were released by attaching the cards on the lower side of the cotton leaves at fortnightly intervals at the rate of approximately 8,000 parasites per acre. Two thousand parasitoids were released at four uniformly distributed locations per acre. The eggs of the predators glued on paper cards, were attached to the lower surface of the leaves at fortnightly intervals at the rate of five cards per acre having approximately 100 eggs per card. A second block was treated with conventional insecticides. A total of four sprays (organophosphate and Pyrethroid groups of insecticides two sprays of each group) were applied during the whole cotton season. The third block was kept as control and no treatment was applied for the management of cotton bollworms. The infestation of pink

bollworm and the two *Earias* spp. was recorded at weekly intervals. Ten plants per acre were selected at random and tagged to record the population of sucking pests and the infestation of bollworms. Establishment of the parasitoids was determined by placing fresh eggs of Angoumois grain moth in the field. These cards were brought into the laboratory after 24 hours exposure in the differently treated blocks and parasitoid emergence was recorded.

Results and Discussion

Results indicated that the infestation of pink bollworm (Table 1) and the two *Earias* spp. (Table 2) was least in blocks treated with biocontrol technique followed by insecticide treatment. Infestation of the two *Earias* spp. was higher in buds as compared to the pink bollworm. However, the infestation of the three cotton bollworms was identical in flowers and green bolls. The infestation of cotton bollworms was maximum in the block received no treatment.

Table 1: Effect of biocontrol technology to control the pink bollworm of cotton

	Infestation (%) of pink bollworm in		
Treatments	Buds	Flowers	Green bolls
Biocontrol technique	0.00a	4.40a	2.90a
Insecticides	0.00a	8.20b	10.01b
Control	7.77b	32.69c	29.64c

Means sharing similar letters are non-significant (P≤0.05).

Table 2: Effect of biocontrol technology to control the two *Earias* spp. of cotton bollworms

Treatments	Infestation (%) of the two *Earias* spp. In		
	Buds	Flowers	Green bolls
Biocontrol	3.08a	3.65a	7.31a
Insecticides	7.87b	6.88a	11.45b
Control	39.03c	26.04b	27.42b

Means sharing similar letters are non-significant (P≤0.05).

The establishment of parasitoids was low during the hot cotton growing months. The parasitoid population started increasing in the cotton field as the environmental conditions became favourable (Table 3). The population of the parasitoids gradually started increasing in the month of August and peak parasitization in the field was recorded in the month of October, the harvesting time of the crop. The maximum parasitization recorded in the month of October may be attributed to the successive generations produced by the parasitoids, favourable environmental conditions and presence of higher number of the host eggs in the field.

Establishment of parasites and predators in the field may be influenced by crop microclimate particularly in the crop grown in rows. Jones (1992) reported that crop microclimate is influenced by plant size, density, and architecture, and has been shown to have a substantial effect on *Trichogramma* augmentation (Kot 1979; Orr *et al.*, 1997). In the present studies, increased population of parasitoids during later part of the crop season may also be due to the crop microclimate, which has stimulated the range of conditions that helped the establishment of *T. chilonis* in the field. Studies revealed that temperature affected the released parasitoids in the field which may also be a factors limiting establishment of parasitoids in the cotton as King *et al.* (1985), reported that high frequency of parasitoid releases were required to maintain significant levels of parasitism. One way to reduce the frequency of *T. chilonis* releases, and ultimately costs, is to apply multiple cohorts of *Trichogramma* during a release so that emergence occurs over an extended period of time. Orr *et al.* (1997) found little difference in the emergence between cohorts of *brassicae* timed to emergence 1 and 4 days after field release when the capsules were placed on the bare soil surface in seed cornfield. Predators may also reduce the efficiency of the released parasitoids as Orr *et al.* (1997 and 2000) reported the similar events in other crop. Based on the predation reported by Orr *et al.* (2000) in pine plantations, we suspect that cotton fields infested with predacious ants may substantially reduce the number of *Trichogramma chilonis* available for emergence.

Table 3: Establishment of egg parasitoids, *T. chilonis* in the field during different months.

Months	Mean parasitism percentage*	Mean no. Of *C. carnea***	Mean Temperature	Mean R.H. (%)
May	0.0	0.0	34.20	58
June	0.0	0.0	33.75	66
July	2.5	9.0	32.00	70
August	11.0	230.0	30.60	71
September	49.3	92.0	30.25	68
October	70.0	36.0	29.00	66

* Parasitization percentage on the cards having Angoumois grain moth eggs.
** Number of C. *carnea* observed per ten meters row length.

Our studies demonstrated that biocontrol technology has a potential to control the cotton pests. Further studies need to be conducted to evaluate the role of the predators for reducing the emergence of released parasitoids in the field with the provision of supplemental hosts for initial survival and establishment.

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