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Integration of Chemical and Biocontrol Approaches for the management of leaffolder, *Cnaphalocrocis medinalis* Guenée and stem borer, *Scirpophaga incertulas* Walker on *Basmati* rice

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ABSTRACT: **Efficacy of various control measures for the management of leaffolder, *Cnaphalocrocis medinalis* Guenée and stem borer, *Scirpophaga incertulas* Walker was evaluated in large scale field trials at farmers' fields in village Karnikhera (Disst. Ferozepur) on Pusa *Basmati* 1121 during *kharif* 2003 and 2004. Integration of one application of cartap hydrochloride 4G@ 1.0 kg a.i/ha 30 days after transplanting with weekly tagging of trichocards (*Trichogramma chilonis* Ishii and *T. japonicum* Ashmead @ 20,000/0.4ha each) during the crop season was the most effective approach in reducing the leaf folder and stem borer incidence. It gave higher grain yield than the untreated control and non-IPM farmers' fields and also showed maximum cost benefit ratio (1:5.08) as against the recommended three applications of cartap hydrochloride 4G (1:1.81).**

KEY WORDS: *Basmati* rice, biological control, chemical control, *Cnaphalocrocis medinalis*, non-IPM farmers *Scirpophaga incertulas*

INTRODUCTION

Insect pests have been recognized as a major biotic stress responsible for significant reduction in yield of rice including *Basmati* in different agro-climatic zones of the country (Chelliah *et al.*, 1989; Dale, 1994). In India, *Basmati* rice cultivation has gained momentum with the introduction of high yielding dwarf varieties (Nayar *et al.*, 1976) and increased export potential of *Basmati* rice. Rice crop covers an area of 43.93 million hectare with production of 91.61 million tons (Anonymous, 2003). This crop is attacked by 385 species of insects, causing 31.5 to 86.0 per cent losses in yield (Gunathiligaraj and Kumar, 1997). Of these, whitebacked planthopper, *Nilaparvata lugens* (Stål.), stem borer, *Scirpophaga incertulas* Walker and leaffolder, *Cnaphalocrocis medinalis* Guenée have assumed major status in the country (Kushwaha, 1988; Dale, 1994). Farmers have been relying mostly on chemical pesticides for the management of these pests. Indiscriminate use of pesticides, however, has led to several problems including destruction of beneficial insects like pollinators, parasitoids and predators (Mathur *et al.*, 1999) and pesticides residue problem in *Basmati*

rice meant for export. Although spraying formulations of various insecticides have been found effective against insect pests of rice, yet it is very difficult to spray the crop uniformly in the standing water. The present study, therefore, was undertaken to evaluate the efficacy of biocontrol agents (*Trichogramma chilonis* Ishii and *T. japonicum* Ashmead) and granules of cartap hydrochloride (Padan 4G) alone or in combination with biocontrol agents in comparison to various practices adopted by the farmers growing *Basmati* rice.

MATERIALS AND METHODS

A demonstration trial on *Basmati* rice was conducted in the farmers' fields at village Karni Khera (Distt. Ferozepur) to evaluate the efficacy of various control measures for the leaffolder and stem borer during *kharif* 2003 and 2004. Variety Pusa *Basmati* 1121 was transplanted in 0.4 ha plots, each plot representing a treatment. These plots were divided into three equal blocks for recording observations. For raising the crop, recommended fertilizer doses and other agronomic practices, except pesticide application, were followed (Anonymous, 2004). In all, there were seven treatments, which consisted of tagging of trichocards (seven weekly releases of *Trichogramma chilonis* and *T. japonicum* @ 20,000/ 0.4 ha each), one application of cartap hydrochloride @ 1.0 kg a.i./ha at 30 days after transplanting (DAT) along with tagging of trichocards as detailed above and application of cartap hydrochloride @ 1.0 kg a.i. /ha (one, two and three applications). An untreated control and non-IPM farmers' practices were also kept for comparison purposes (Table 1).

The incidence of leaffolder in terms of leaf damage and stem borer in terms of dead hearts was recorded from 15 randomly selected hills from each treatment at weekly intervals. In all, four weekly observations were recorded for both the parameters

Table 1. Details of treatments for the management of insect pests on *Basmati* rice at village Karni Khera during 2003-2004

Treatment/ application	Dosage/conc. (a.i./ha)	Time of application
Tagging of trichocards*	40,000/0.4ha (starting at 30 DAT)	7 releases at weekly interval
Cartap hydrochloride 4G (one application) +Tagging of trichocards	1.0 kg a.i. /ha + 40,000/ 0.4 ha	30 DAT + 6 releases at weekly interval (starting one week after Padan application)
Cartap hydrochloride 4G (one application)	1.0 kg a. i./ ha	30 DAT
Cartap hydrochloride 4G (two applications)	1.0 kg a.i. / ha	30 and 50 DAT
Cartap hydrochloride 4G (three applications)	1.0 kg a. i. / ha	30, 50 and 70 DAT
Untreated control	-	-
Farmers' practices (non-IPM)**	-	-

* *Trichogramma chilonis* + *T. japonicum* (40 trichocards having 500 parasitized eggs of each)

** Chlorpyriphos 20EC twice + Cartap hydrochloride 4G twice + Nuvacron 36SL once + Confidor 200SL once (2003)

Chlorpyriphos 20EC once + Cartap hydrochloride 4G twice + Nuvacron 36SL once + Confidor 200SL once (2004)

during *kharif* 2003. During 2004, however, six and five weekly observations were made for leaffolder and deadheart incidence, respectively. At earhead stage, observations on the incidence of white ears were recorded from 15 randomly selected hills in each treatment. The data on yield were recorded by threshing earheads from three 2 x 2 m randomly selected quadrates in each treatment. The data on per cent infestation were converted to arcsine transformations before subjecting to analysis of variance.

RESULTS AND DISCUSSION

During *kharif* 2003, the differences among various treatments with respect to leaffolder, dead heart and white ear incidence were significant (Table 2). The data indicated that one application of cartap hydrochloride @ 1.0 kg a.i./ha along with tagging of trichocards (*Trichogramma chilonis* and *T. japonicum* @ 20,000/0.4 ha each) showed significantly lower leaffolder incidence (1.99 %) than that in the untreated control and non-IPM farmers'

Table 2. Effect of different control measures on leaffolder and stem borer incidence, and yield of *Basmati* rice

Treatment/application	Per cent damage						Yield (q/ha)	
	Leaffolder		Deadheart		White ear			
	2003	2004	2003	2004	2003	2004	2003	2004
Tagging of trichocards*	3.00 (9.54)	0.17 (2.13)	4.19 (11.56)	1.41 (6.56)	4.30 (11.95)	4.63 (12.25)	52.08	49.75
Cartap hydrochloride 4G (one application) + Tagging of trichocards	1.99 (7.50)	0.20 (2.16)	0.89 (5.34)	0.75 (4.79)	0.95 (5.60)	1.00 (5.71)	57.33	52.58
Cartap hydrochloride 4G (one application)	2.67 (8.68)	1.65 (2.06)	1.70 (7.45)	0.87 (4.93)	3.24 (10.35)	1.25 (6.10)	39.83	50.50
Cartap hydrochloride 4G (two applications)	2.83 (9.33)	0.21 (2.44)	1.52 (7.00)	0.77 (4.40)	4.31 (11.93)	2.75 (9.37)	44.58	50.25
Cartap hydrochloride 4G (three applications)	3.14 (9.57)	0.49 (3.67)	1.75 (7.37)	0.96 (5.31)	4.52 (12.26)	3.12 (10.10)	55.00	47.75
Untreated control	3.93 (11.00)	1.69 (5.93)	3.52 (10.63)	3.02 (9.84)	5.47 (13.48)	8.12 (16.50)	35.00	45.75
Farmers' practices (non-IPM)**	9.70 (18.13)	1.22 (5.24)	7.65 (16.03)	5.00 (10.76)	14.80 (22.60)	4.50 (12.24)	44.00	51.50
CD (p = 0.05)	2.06	NS	1.90	NS	1.76	3.47	5.81	0.78

Figures in parentheses are arcsine-transformed values.

* *Trichogramma chilonis* + *T. japonicum* (40 trichocards having 500 parasitized eggs of each)

** Chlorpyriphos 20EC twice + Cartap hydrochloride 4G twice + Nuvacron 36SL once + Confidor 200SL once (2003)

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fields. Though, a large number of insecticidal applications were made at the farmers' level, but the leaffolder incidence was very high (9.70%). This could be because the farmers might not have properly timed the insecticidal applications, either being too early or too late, with respect to appearance of the leaffolder infestation. The other treatments showed intermediate incidence. Treatment 'one application of cartap hydrochloride along with tagging of trichocards' also faired better than the treatment where 'tagging of trichocards' alone was used. All the three treatments of cartap hydrochloride, i.e. one, two and three applications also proved better than the untreated control and non-IPM farmers' fields. Similarly, treatment of 'one application of cartap hydrochloride @ 1.0 kg a. i. / ha along with tagging of trichocards' showed significantly lower dead heart (0.89 %) and white ear (0.95 %) incidence than that in the untreated control and non-IPM farmers' fields.

The grain yield in treatment 'cartap hydrochloride 4G + trichocards' was significantly higher (57.33 q/ha) than that in the untreated control and treatment of one application of cartap hydrochloride 4G alone. The former treatment (cartap hydrochloride 4G + trichocards) also showed higher grain yield than the non-IPM farmers' fields while it was on a par with the treatment where three applications of cartap hydrochloride 4G were made.

During *kharif* 2004, the differences among various treatments with respect to leaffolder and deadheart incidence were non-significant (Table 2). However, treatment 'cartap hydrochloride 4G + trichocards' showed relatively low incidence than the untreated control and non-IPM farmers' fields. The white ear incidence differed significantly among various treatments. Its incidence was significantly low (1.00 %) in the treatment 'cartap hydrochloride 4G + trichocards' than that in the untreated control, followed by tagging of trichocards alone and non-IPM farmers' fields. High incidence of white ears (8.12%) in the untreated control may be attributed to the high incidence of stem borer during 2004 than in 2003.

The grain yield also showed significant differences among different treatments. Treatment 'cartap hydrochloride 4G + trichocards' gave significantly higher yield than the untreated control. The non-IPM farmers' fields showed higher yield than the plots where varying applications of cartap hydrochloride 4G were made, which could be due to larger numbers (five) of insecticidal applications made by the farmers' for the control of attack of various insect pests.

On the basis of two years' data, it may be concluded that combination of first dose of cartap hydrochloride at 30 DAT along with weekly tagging of trichocards (*T. chilonis* and *T. japonicum* @ 20,000/0.4 ha each) starting one week after chemical application during the crop season effectively reduced the leaf folder infestation and dead heart and white ear incidence due to stem borer and also gave higher grain yield as compared to the untreated control and other insecticidal and biocontrol treatments.

When economics of this integrated approach for the management of pests of *Basmati* rice was compared with standard application of three doses of cartap hydrochloride and farmer's practices, it was observed that the cost to benefit ratio was maximum (1: 5.08) in the former treatment as against 1:1.81 for cartap hydrochloride application alone (Table 3). The control practices adopted by the farmers, however, did not even meet the expenses incurred on various insecticidal applications made for the control of insect pests of *Basmati* rice crop. These results corroborate earlier findings of Balasubramanian *et al.* (1994), who suggested that integration of biocontrol agents with insecticides was effective for the management of leaf folder and stem borer. These results also are in conformity with Arasumallah *et al.* (1984), who reported that the release of *T. japonicum* gave higher yield of rice as parasitization of eggs of *C. medinalis* by this parasitoid effectively reduced the leaf damage.

Table 3. Economics of integration of chemical and biocontrol approaches against leaf folder and stem borer on *Basmati* rice

Treatment	Yield* (q\ha)	Increase in yield over control	Gross** income (Rs.)	Cost*** of application (Rs.)	Net gain (Rs.)	Cost: Benefit ratio
Cartap hydrochloride 4G (One application) + Tagging of trichocards	54.95	14.58	17,496.00	2,877.00	14,619.00	1:5.08
Cartap hydrochloride 4G (three applications)	51.37	11.00	13,200.00	4,695.00	8,505.00	1:1.81
Farmers' practices**** (non-IPM)	47.75	7.38	8,856.00	4,779.00	4,107.00	1:0.85
Untreated control	40.37	-	-	-	-	-

* Mean of two years data

** Price of produce = Rs 1200.00/q

*** Padan 4G - @ Rs 59.00 per kg, Cost of labour @ Rs 90.00/day/ application, Trichocards @ Rs 35.00/ card (6.25 cards/ ha), cost of tagging = Rs 90.00 per 6 taggings

**** Based on 5.5 insecticidal applications (6 & 5 applications during 2003 and 2004, respectively).

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