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Use of Green Lacewing, *Chrysoperla carnea* (Stephens) and Neem Seed Kernel Extract for Management of Insect Pests on Cotton*

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Abstract : Cotton is an important fibre crop that historically has experienced serious insect pest problems. Based on this background the present studies were carried out to manage the insect pests on cotton (cv. DHH-543) involving biocontrol agent, botanicals and intercrop. The results shows that intercrop with lucerne (1:1 row proportion), two sprays of NSKE (5%) on cotton at 38 and 60 DAS and release of *Chrysoperla carnea* (Stephens) grubs @ 0.75 and 1.0 lakhs / ha. starting from 43 DAS redused the sucking pests (leaf hopper, thrips, aphids and white flies) and boll worm, *Helicoverpa armigera* (Hub.) and increased the seed cotton yield from 5.2 q / ha. in untreated check to 8.40 to 9.00 q / ha. in treated plots. These treatments were on par with insecticidal sprays (Recommended package of practice). The mean *H. armigera* eggs and larval population was reduced from 1.14 to 0.39 / plant and 0.79 to 0.23 / plant, respectively by the green lacewing (*C. carnea*) larvae released twice at fortnight intervals @ 0.75 to 1.0 lakh / ha. and yield in the released plot was 8.40 to 9.0 q / ha, respectively.

Key words: *Chrysoperla carnea,* biocontrol agent, *Helicoverpa armigera,* botanicals, intercrop

Introduction

The use of insecticides provided temporary relief from insect pests but disrupted the ecological balance by eliminating natural enemies. In situations, where this ecological balance is disrupted, potential insect pests are relived from the resistance imposed by their natural enemies and therefore, unhindered-population growth resulted in pest outbreak. An attempt of biological control through manipulation of natural enemy density has only limited success due to insufficient knowledge of trophic level interactions between pests and natural enemies in different ecosystems. Apparently, more effective strategies and techniques for the use of entomophages have to be developed for future success in biological control.

Material and Methods

A field experiment was conducted during Kharif 2002 at Main Agricultural Research Station (MARS), Dharwad. Three IPM modules with *Chrysoperla carnea* as a major component in the management of cotton pests along with seed treatment using imidacloprid, intercropping with lucerne, monitoring the bollworm population through sex pheromone trap and application of NSKE (5%) (Table 1) were evaluated in comparison with chemical control and untreated control. The IPM modules consisted different sequences of predator, *C. carnea* and botanicals (NSKE). *H. armigera* sex pheromone traps were installed 45 days after sowing @ 2 traps / ac for monitoring the activity of old world bollworm. Randomized block design was followed with five treatments replicated five times over a plot size of 10 x 11m. DHH-543, an interspecific hybrid was sown on July 12th with a spacing of 90 cms between rows and 60 cms between plants. The crop was raised following normal agronomic practices (Anon., 2002).

IPM treatments were intercropped with lucerne (*Medicago sativa* L.) variety "Sirsa–9". One row of lucerne was grown between cotton rows with 10 cm spacing from plant to plant. Care was taken to maintain uniform plant population in all the plots except for insect management.

The second instar, *C. carnea* grubs were released during cool hours (4-6 pm of a day) with the help of camel hairbrush. Observations on the incidence of pests and *C carnea* was recorded at 15 days interval starting from 30 DAS. Incidence of sucking pests *viz*., leafhopper (*Amrasca bigutulla bigutulla* Ishida); whiteflies (*Bemisia tabaci* Gennadium) thrips (*Thrips tabaci* Lind) and aphid (*Aphis gossypii*) was recorded per three leaves on randomly selected plants from each replication. Eggs and larvae of *H.* armigera and eggs and grubs of *C. carnea* were recorded as from same treatments number per plant. Population of *C. carnea* on intercrop was also recorded as number of eggs and grubs per meter row. Further at each picking, observations were also recorded on good opened bolls and bad opened bolls per plant on five randomly selected and tagged plants in each plot. Later, the yield was recorded and was extrapolated on ha basis. Bollworm damage per plant was recorded and converted to per cent and then subjected to arc sin transformations prior to statistical analysis. Data on good opened bolls, bad opened bolls and yield were analysed with one way ANOVA and then subjected to DMRT as suggested by Gomez and Gomez (1984).

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Results and Discussion

The results obtained from the studies involving cotton hybrid, DHH-543, with release of *C. carnea* at different doses along with seed treatment with imidacloprid, intercropping with lucerne, application of NSKE (5 %) and monitoring of *H. armigera* using pheromone traps carried out during 2002 *kharif* season are presented in table 2 & 3.

All the sucking pests during the season were below ETL except aphid at 60 DAS. The mean population of leafhopper was significantly less in T3 followed by T2 but next only to RPP (T4). The average aphid population showed the superiority of T2, T3 over T4 followed by T1. Thrips population was noticed throughout the cropping season with a heavy population during early stages of the crop growth. The mean population of thrips indicated significantly lower population in T3, which was superior to other two IPM modules but inferior to T4. Whitefly population was noticed at later stages of the crop growth period. Even at peak incidence, the population of whitefly was below ETL in almost all the treatments and was significantly lowest in T3 followed by T2. The comparative analysis of average population of all the four sucking pests reveal that T3 was as effective as RPP against aphids and whiteflies but inferior to RPP with respect to leafhopper and thrips. Due to initial seed treatment with imidacloprid, the treatments T1, T2, T3 and T4 recorded lower population of sucking pests up to 45 days of sowing. As the days advanced, the sucking pest population in untreated control increased but in T4 (RPP) and other treatments the population decreased gradually due to application of toxic chemicals in RPP and following applications of NSKE (5 %) per cent followed by release of *C. carnea* at different doses *viz.,* 0.50, 0.75 and 1.0 lakh per ha in T1, T2 and T3 treatments, respectively. The population of sucking pests was inversely related to dosage of *C. carnea*

The present findings are in line with Satpute *et al*. (2002) who reported that, seed treatment with imidacloprid or thiamethoxam was not only safe but also attracted the population of coccinellid adults and *C. carnea* for egg laying due to increase in chlorophyll and nitrogen content in the plant. Application of biorational *i.e.* NSKE (5%) and release of *C. carnea* @ 0.50, 0.75 and 1.00 lakh per ha in T1, T2 and T3 treatments, respectively also suppressed the population of aphids, thrips and whiteflies throughout the crop growth.

The average egg load per plant showed the superiority of T3 and T2 compared to other treatments. The release of biocontrol agent (*C. carnea*) in the present study has a significant impact on the population of cotton bollworm. The actual reduction due to release of predator and application of NSKE @ 5 per cent was noticed in T3, T2 and T1 treatments released with 1.0, 0.75 and 0.50 lakhs grubs of *C. carnea* per ha, respectively. The trend of *H. armigera* larval population was similar to that of egg load at different intervals on cotton. Larval population was below ETL up to 60 DAS in all the treatments. Based on the mean larval population of *H. armigera* it is clear

Table 1. Details of treatment imposition in cotton during 2002 kharif season

Date of treatment imposition	T1	T2	T3	T4	T5
At sowing	Seed treatment with imidachloprid 70WS @ 10g /kg of seeds	Seed treatment with imidachloprid 70WS@ 10g/kg of seeds	Seed treatment with imidachloprid 70WS@ 10g/kg of seeds	Seed treatment with imidachloprid 70WS@ 10g/kg of seeds	No seed treatment (control plot)
38 DAS	NSKE 5% spray	NSKE 5% spray	NSKE 5% spray	Acetamaprid 20 SP at 15 g ai/ha	No spray
43 DAS	Release of *C.carnea* @ 50.000/ ha (1/2 dose) + Ha pheromone trap @ 5/ha	Release of *C.carnea* @ 75.000/ ha (1/2 dose) + Ha pheromone trap @ 5/ha	Release of *C.carnea* @ 1,00,000/ ha (1/2 dose) + Ha pheromone trap @ 5/ha	No spray	No spray
60 DAS	NSKE 5%spray	NSKE 5% spray	NSKE 5% spray	Thiodicarb 75 WP at 750 g ai/ha	No spray
70 DAS	*C.carnea* @ 50,000/ha (remaining (1/2 dose)	*C.carnea* @ 75,000/ha (remaining (1/2 dose)	*C.carnea* @ 1,00,000/ha (remaining (1/2 dose)	-	No spray
90 DAS	-	-	-	Cypermethrin 10 EC at 150 g.ai/ ha	No spray
105 DAS	-	-	-	Monocrotophos 36 SL at 900 g ai/ha	

Table 2. Influence of different treatments on the insect pests and predator population on cotton at different days

Treatments	Mean population (per three leaves)				Mean population *H. armigera* / plant		*C. carnea* on	
	Leafhopper	Thrips	Aphids	Whitefly	Eggs	Larvae	Cotton (per plant)	Lucern (per m row length)
T1	3.11 (1.76)^{c}	3.11 (1.76)^{d}	3.33 (1.81)^{b}	0.87 (0.93)^{c}	0.59 (0.76)^{c}	0.35 (0.59)^{c}	3.89 (1.97)^{c}	4.70 (2.17)^{c}
T2	2.79 (1.67)^{bc}	2.41 (1.55)^{c}	2.90 (1.70)^{ab}	0.75 (0.86)^{b}	0.41 (0.64)^{b}	0.29 (0.53)^{b}	4.55 (2.13)^{b}	5.06 (2.25)^{b}
T3	2.72 (1.65)^{b}	1.91 (1.38)^{b}	2.63 (1.62)^{a}	0.60 (0.77)^{a}	0.39 (0.62)^{a}	0.23 (0.47)^{a}	5.16 (2.27)^{a}	5.72 (2.39)^{a}
T4	1.64 (1.28)^{a}	1.71 (1.30)^{a}	2.80 (1.67)^{a}	0.58 (0.76)^{a}	0.76 (0.87)^{d}	0.22 (0.46)^{a}	0.46 (0.67)^{e}	-
T5	5.46 (2.33)^{d}	7.60 (2.75)^{e}	15.26 (3.90)^{c}	3.26 (1.80)^{d}	1.14 (1.06)^{e}	0.79 (0.87)^{d}	1.62 (1.27)^{d}	-
S.Em±	0.032	0.005	0.038	0.005	0.005	0.016	0.005	0.012
CD @ 5%	0.097	0.016	0.119	0.015	0.016	0.049	0.015	0.036
CV (%)	8.20	5.77	7.20	5.88	4.60	6.40	4.62	4.90

DAS: Days after sowing

T1: 1. Seed treatment with imidacloprid (70 WS) (10 g / kg), 2. Intercropping of lucern, 3. Application of neem based pesticide (NSKE 5%) 4. Monitoring of *H.armigera* through sex pheromone traps (2 traps /ac), 5. Release of *C.carnea* thrice starting from early reproductive phase at 15 days interval (50,000/ha), T2 = T1 (1-4) + 75,000 *C.carnea*/ha, T3=T1 (1-4) + 1, 00,000 *C. carnea*/ha, T4= RPP, T5= Untreated control

Means followed by similar alphabets in the vertical columns do not differ significantly by DMRT

Figures in the parentheses are square root transformed values.

Table 3. Fruiting bodies damage, yield and yield parameters of cotton as influenced by different treatments

Treatments	Parameters					
	* Mean (%) fruiting bodies damage	GOB / Plant	BOB / Plant	* % locule damage	Yield (Q/ha)	C:B ratio
T1	13.20 (21.18)^{c}	15.36 ^{b}	15.60 ^{b}	23.60 (29.06)^{c}	7.20 ^{b}	1.02
T2	10.25 (18.63)^{b}	21.96 ^{a}	13.94 ^{ab}	19.82 (26.48)^{bc}	8.40 ^{ab}	0.98
T3	8.74 (17.10)^{ab}	22.60 ^{a}	12.86 ^{a}	15.44 (23.11)^{ab}	9.00 ^{a}	0.90
T4	7.09 (15.45)^{a}	23.00 ^{a}	12.80 ^{a}	10.68 (19.2)^{a}	9.10 ^{a}	1.40
T5	18.00 (24.80)^{d}	7.00^{c}	16.20 ^{b}	32.60 (34.82)^{d}	5.20^{c}	–
S.Em±	0.85	1.13	0.87	1.50	0.49	—
CD @ 5%	2.60	3.47	2.60	4.2	1.52	—
CV %	14.30	12.00	14.23	15.80	12.31	—

* Figures in the parentheses are square root transformed values.

Means followed by similar alphabets in the vertical columns do not differ significantly by DMRT

Figures in the parentheses are Arc sine transformed values. GOB: Good opened bolls BOB: Bad opened bolls

that T3 was as effective as RPP in reducing the larval load. The potentiality of *C. carnea* to reduce the eggs of *H. armigera* and other lepidopterous pests has been well documented by Longanathan *et al*. (2000). The study made by Praveen and Dhandapani (2001) by the release of predator, *C. carnea* and application of econeem 0.3 per cent for three times at 15 days intervals starting from 45 DAS was found to be effective in reducing sucking pests and fruit borer effectively on bhendi, supports the present findings.

In the present study all the bioagent treatments were moderately effective at the early stage and showed much effectiveness at the later stages which may be due to self perpetuation of *C. carnea* and also non application of insecticides. The preliminary study made by Kulkarni *et al.* (2004) and Panchabhavi *et al*. (2004) with the release of *C. carnea* and other biocontrol agents at different intervals gave significant reduction of *H. armigera* and other sucking pests as good as RPP also supports the present findings. *Chrysoperla carnea* population was significantly higher in T3 followed by T2 and T1 where inoculative release of *C. carnea* (1.0, 0.75 and 0.50 lakhs / ha), was made along with intercropping with lucerne and

application of NSKE 5 per cent which helped in multiplication of *C. carnea* compared to T5 (UTC). Significantly lower *Chrysoperla* population was recorded in T4 (RPP), which may be due to the toxic effect of insecticides used in this treatment. Intercropping with lucerne along with different doses of *C. carnea* release recorded significantly higher population of *C. carnea* in IPM modules which may be due to provision of pollen and nectar for the natural enemy, which enhanced egg laying, and multiplication of *Chrysoperla* and inturn brought down the pest load drastically. Saminathan and Mahadevan (2000) and Saminathan *et al*. (2003a and 2003b) reported that intercrops acted as ecofeast crops and conserved large number of natural enemies by providing pollen and nectar. They also opined that intercropping system increased the diversity in the ecosystem and the population of natural enemies and there by reduced the pest population, which agrees with the present findings. Fruiting bodies damage was recorded as an indication of bollworm incidence. Fruiting bodies damage included flared up squares, damaged green bolls and dropped squares and boll due to damage mainly by *Helicoverpa*, spotted bollworm and pink bollworm. Mean fruiting bodies damage throughout the cropping season was significantly lower in T4, T3 and T2 when compared to T1 and T5 (UTC). T3 was as effective as RPP in reducing the fruiting bodies damage, followed by T2. The present findings are in agreement with Patil *et al*. (2002) who ranked the performance of modules in the order of RPP > biointensive module with respect to bollworm damage. Seed cotton yield followed similar trend as that of good opened bolls, where T3 (9.00 q /ha) and T2 (8.4 q/ha) were at par with each other and recorded higher yield, obviously due to increased predation resulting in lower boll damage and higher yield. The superiority of T4 (recommended package of practices) in registering highest yield was due to effective control of sucking pests and bollworms and recorded more number of good opened bolls and less number of bad opened bolls and finally leading to higher seed cotton yield. These results are in line with the reports of Anon. (1990) and Gill *et al*. (1993). The present findings clearly indicated that, the release of *C. carnea* at 0.75 and 1.0 lakhs per ha along with lucerne as intercrop and application of NSKE @ 5% can effectively manage the insect pests of cotton. However, due to higher cost of *C. carnea* grubs, an analysis of cost effectiveness of release of predator, showed negative net returns under rain fed situation where the trail was undertaken. The highest C:B ratio was recorded in the treatment T1 (which includes release of *C carnea* @) 50,000/ ha. With other IPM components).

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