



Impact of Innundative Releases of Bio Agents in the Management of Coconut Black Headed Caterpillar *Opisina arenosella* in Andhra Pradesh under Out Break Conditions

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ABSTRACT

The coconut black headed caterpillar *Opisina arenosella* Walker is a major pest of the coconut and its regular incidence without break under favourable conditions was recorded in coastal Andhra Pradesh from decades and one of the earliest organized attempts for biological control was against this pest in India. Among the important bio agents the most promising bio agents against *O. arenosella* are larval parasitoids *Bracon hebetor*, *Goniozus nephantidis*, pupal parasitoid *Brachymeria nosatoi* and anthocorid predator *Cardiastethus exiguus*. Large scale field demonstration of biological control of coconut black headed caterpillar *O. arenosella* was taken up in the black headed caterpillar affected gardens in eight villages in East Godavari district of Andhra Pradesh during the severe incidence of this pest from October 2011 – June 2013. A total of 22.60 lakh bio agents were mass multiplied in laboratory and systematically supplied to farmers for stage specific release in the infested gardens. The pre release larval population ranging from 71.9 to 168.9 per 10 leaflets in the affected villages completely decreased after innundative bio agents release in three to six months after release.

Key words: Coconut black headed caterpillar, *Opisina arenosella*, Bio agents, innundative releases, Andhra Pradesh

INTRODUCTION

The coconut black headed caterpillar *Opisina arenosella* Walker, the leaf eating caterpillar is a major pest of the coconut palm^{3, 14}. Outbreak of this pest assumes severe proportions on the coastal and backwater tracts. This pest has been observed regularly and is persistent in

Godavari districts of Andhra Pradesh⁶ since 1947. Infestation by this pest in severe cases makes the whole plantation present a burnt appearance due to the drying of leaves/leaflets with only the upper epidermis intact or in cases of old infestation leaves remain with midrib of the leaflet only.

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When palms are severely damaged, the attacked leaves droop, bunches buckle and the immature nuts shed heavily¹⁰. Among the important bio agents the most promising bio agents against *O. arenosella* are larval parasitoids *Bracon hebetor*, *Goniozus nephantidis*, pupal parasitoid *Brachymeria nosatoi* and anthocorid predator *Cardiastethus exiguus*.

A bio-intensive pest management strategy has been developed for the management of this pest when it is in an epidemic form^{11,19}. Pest incidence can be checked by the bio control methods utilizing indigenous parasitoids. Among the parasitoids recorded from India¹⁵, the larval parasitoid *G. nephantidis* Mues. (Bethyridae), the pre-pupal parasitoid *Elasmus nephantidis* Rohw. (Elasmidae) and the pupal parasitoid *B. nosatoi* Habu. (Chalcididae) are the most promising ones. *B. brevicornis* Wesmael (Braconidae) also parasitizes the late larval stage of the pest. Abdurahiman *et al.*¹ in their studies on the biology of *Cardiastethus* sp. reported that both the nymphs and adults fed on egg and early stage larvae of *O. arenosella*. The intrinsic behaviour and life cycle of the anthocorid bug *C. exiguus* on *O. arenosella*¹² and limited scale field efficacy of this predator on coconut leaf eating black headed caterpillar *O. arenosella* has been taken up at Kerala¹³. Kapadia⁷ described the biology of *Cardiastethus* sp. nr. *nazareus* Reuter, predating on the coconut caterpillar in Gujarat.

Though advocated bio control has not made clear inroads as a technology in the farmers fields especially in plantation crops under out break conditions with prime obstacles being large scale, timely availability of the bio agents synchronising with pest cycle. Therefore, to stress on the timely release and importance of biological control in coconut pest management, during black headed caterpillar out break, mass multiplication of major parasitoids, predators was carried out and large scale field demonstration programmes were taken up in the affected gardens of various villages in East Godavari district of Andhra Pradesh

during the out break of this pest from October 2011 to June 2013.

MATERIAL AND METHODS

Large-scale field validation programme on bio intensive IPM for the management of coconut black headed caterpillar was implemented under the Coconut development board, Kochi, Kerala funded TMOC (Technology mission on coconut) project by HRS., Ambajipeta in a total area of nearly 600 acres in eight villages from October 2011 to December 2012. The incidence was recorded in both fish pond and sole coconut gardens (Table 1). The total operational area of approximately 50 acres in each village was divided into 5 clusters of 10 acres each for assessing incidence of the target pest and inundative bio agents release was made accordingly in the clusters at fortnightly intervals. Egg predator *C. exiguus*, larval parasitoids (*G. nephantidis* and *B. hebetor*) and Pupal parasitoid (*B. nosatoi*) were multiplied in the Entomology laboratory of Horticultural research station Ambajipeta as per the standard multiplication techniques and the details of bio agents released in each village were mentioned in Table 2. Mass culturing procedures of *C. exiguus*², *G. nephantidis*¹⁸ and *B. nosatoi*¹⁶ were utilised for multiplication of these bio agents in lab.

The data on pre and post release population of coconut black headed caterpillar *O. arenosella* was arrived by collecting 10 sample leaflets from lower / middle whorl of leaves through destructive sampling (41-60% leaflets of 20% leaves from the lower or middle whorl) from 40 fixed sample palms from each of the cluster (10 acres each) at monthly interval (totalling to 200 palms for 5 clusters together in the each experimental village) and expressed as average pest population per 10 leaflets and the data obtained was subjected to paired t test. In S. Yanam, Matlapalem, N. Raguvulapeta and Undrajavaram villages the inundative releases were done for three months and data on pest population was recorded at monthly

intervals while in Gogannamatam, Mutyalapalem, Gachhakayala pora and Dwarapudi villages where incidence was observed from December 2012 post Neelam Cyclone occurrence the releases were continued up to six months and the data on pest population was recorded in these villages in one, three and six months after release. The parasitoids were released in the field after assessing the population of the target stage of the pest at fortnightly intervals inundatively as there was a high incidence (all the lower whorls of leaves or entire crown damaged) of the pest. As unconditioned bio agents had only low response to *O. arenosella* as compared to those conditioned to odour of *O. arenosella*^{4,21} therefore, before releasing the parasitoids in field they are fed with honey and are exposed to the host odours for 72 hours for olfactory conditioning (smell of the volatiles of the injured *O. arenosella* larvae and gallery volatiles). The releases in the affected villages were made in accordance to the pest population in the affected gardens and farmer's participation and involvement were ensured during the release programme. The release of parasitoids was continued until a decline in the pest population was observed.

RESULTS AND DISCUSSIONS

The incidence of coconut black headed caterpillar was initially observed on the fish pond bund coconut trees in the Matlapalem village, East Godavari district in December 2011 and an average pre treatment population of 156.9 larvae /10 leaf lets was recorded and a total of 55,000 *B. hebetor*, 8000 numbers *G.nephantidis* and 1600 numbers of *B. nosatoi* parasitoids were released in various months in this village. The release of the parasitoids had resulted in decrease of average larval population to 19.3, 6.8 and nil for 10 leaflets respectively after one, two and three months after release. The incidence of this caterpillar was observed on the fish pond bund coconut trees in the N. Ragavulapeta Village, S. Yanam villages in East Godavari and in Undrajvaram village in West Godavari in first,

second and third quarters of 2012. The average pre treatment larval population observed was found to be high at N. Ragavulapeta Village with 168.9 larvae /10 leaf lets and the inundative release of bio agents has resulted in decrease of average larval population to 47.4 ,23.2 and 5.0 per 10 leaflets respectively after one ,two and three months after parasitoid release. In S.Yanam and in Undrajvaram villages the pre release larval population was found to be 76.8 larvae and 71.90 larvae /10 leaf lets. A total of 1.0 lakhs ,0.63 lakhs of *B. hebetor* parasitoids 0.15 ,0.06 lakhs of *G. nephantidis* parasitoids 800, 600 numbers of *B. nosatoi* parasitoids and 0.75,1.0 lakhs of predator *C. exiguus* respectively were released in the demonstration experimental gardens and a decrease of larval population to 30.5 and 19.3 per 10 leaflets , respectively after one month 7.7 and 9.7 per 10 leaflets respectively, after two months and to 19.3 and nil population respectively, after three months after release of parasitoids was recorded. After three months of release about 97 percent at S. Yanam and N. Ragavulapeta , hundred per cent at Undrajvaram village was recorded .Sujatha and Chalam ²² also recorded a decrease in black headed caterpillar population from 16.73 to 8.73 /palm with 30 % parasitisation that release of larval parasitoid *B. hebetor* , *G. nephantidis* and pupal parasitoid *B. nosatoi* along with *C.exiguus* release which also reduced the pest population from 102.3 to 5.4 /palm. Similar results in the demonstration villages was achieved in present study through inundative releases. However, release of hymenopterous parasitoids viz., *B. hebetor*, *B. brevicornis* and *G. nephantidis* at fortnightly intervals at 15, 20 and 25% of the pest population in four villages in Puri district of Orissa during 1996 and 1997 revealed that effective control was achieved when the parasitoids were released at 20% of the pest population⁹. The efficacy of *C. exiguus* as an efficient egg larval predator of *O. arenosella* was reported by Rajamanickam *et al.*¹⁷ and in present study as stage specific parasitoids were released which were have a

oviposition preferences for the larvae the efficacy of *C. exiguus* was not affected as it mainly feeds on eggs. After the receipt of high rainfall due to Neelam cyclone in November 2012 in coastal Andhra Pradesh a high incidence of black headed caterpillar was observed in new villages viz., Gogannamatham, Mutyalapalem, Gachakayalapora and Dwarapudi where again inundative releases were taken up for a period of six months. The pre release larval population in these villages was found to be ranging from 84.1 to 124.1 larvae /10 leaflets and after inundative release a decrease in larval population ranging from 33.84 to 53.15 per cent (ranging from 39.4 to 82.10 larvae per 10 leaflets) after one month and over 75 per cent in three months (ranging from 21.0 to 32.40 larvae per 10 leaflets) was observed. The pest population had decreased to nil in all the villages after six months (June 2013). A significant decrease in larval population was observed between the months in all the villages during the entire study period. Similar results of success of biological control in coconut was earlier reported by Sathiamma *et al.*²⁰ who had observed 94 % reduction in pest population in a heavily infested coconut garden of 2.8 ha (Thodiyoor, Kerala) for a period of four years. Chandrika Mohan and Nair⁵ reported 52.6 and 94.7% reduction in black headed caterpillar pest population after

one and two years, respectively of parasitoid release in heavily infested homestead coconut gardens in an area of 3 ha in Neendakara (Kerala). Further, the survival of *G. nephantidis* and *B. brevicornis* from eggs to adult eclosion was 89.6 and 81.8%, respectively, when larvae of *O. arenosella* were exposed to these parasitoids individually and both these parasitoids tend not to oviposit on parasitised hosts bearing larvae of either parasitoid, and the parasitoids did not kill the larvae of the other species²³. The effectiveness of *C. exiguus* as a predator of *O. arenosella* under field conditions was reported by Kumar *et al*⁸.

Therefore, systematic, inundative and timely release of stage specific bio agents even under outbreak conditions will successfully manage coconut black headed caterpillar in larger areas and the self perpetuating parasitoids prevents the spread of the outbreak to other mandals. The farmers can be educated from resorting to the use of hazardous insecticides monocrotophos and dichlorovos in the coconut ecosystem if a successful bio control programme is in operation. In the days where hazardous pesticides usage is becoming a matter of concern, this success of biological control as an alternate system of pest control, gives impetus to sustainable agriculture and can strengthen the concept of pesticide free produce in this important plantation crop.

Table 1: Details of experimental villages affected by coconut black headed caterpillar and dates of initiation of bio agents release

S. No	Name of the village	Mandal and district	Date of initiation of bio agents release	Area in acres in each village selected	Coconut cropping system
1	S Yanam	Uppalaguptham, East Godavari	15.10.11	50	Fish pond bund trees
2	Matlapalem	Tallarevu, East Godavari	13.12.11		Fish pond bund trees
3	N.Raguvulapeta	Uppalaguptham, East Godavari	22.01.12		Fish pond bund trees
4	Undrajavaram	Undrajavaram, West Godavari	13.04.12		Sole gardens
5	Gogannamatam	Razole, East Godavari	20.12.12		Sole gardens
6	Mutyalapalem	Razole, East Godavari	21.12.12		Sole garden
7	Gachhakayala pora	Uppalaguptham, East Godavari	22.12.12		Fish pond bund trees
8	Dwarapudi	Mandapeta, East Godavari	31.12.12		Sole garden

Table 2: Total number of different bio agents supplied to the farmers for release in coconut black headed caterpillar affected villages (In thousands)

S. No	Name of the villages	Duration of release	<i>C.exiguus</i>	<i>B. hebetor</i>	<i>G. nepantidis</i>	<i>B.nosatoi</i>
1	S. Yanam	1 st month	5000	20000	3000	100
		2 nd month	10000	25000	5000	140
		3 rd month	3000	15000	1800	0
		Total	18000	60000	9800	240
2	Matlapalem	1 st month	0	20000	2000	500
		2 nd month	0	25000	5000	800
		3 rd month	0	10000	1000	200
		Total	0	55000	8000	1600
3	N.Raguvulapeta	1 st month	15000	20000	1500	200
		2 nd month	25000	35000	2000	300
		3 rd month	10000	10000	1000	100
		Total	50000	65000	4500	600
4	Undrajavaram	1 st month	0	20000	2000	200
		2 nd month	10000	25000	3000	300
		3 rd month	0	18000	1000	100
		Total	10000	63000	6000	600
5	Gogannamatam	1 st month	15000	20000	300	0
		2 nd month	15000	30000	1500	800
		3 rd month	18000	50000	2500	1200
		4 th month	10000	50000	1500	0
		5 th month	5000	50000	500	0
		6 th month	5000	4500	200	0
		Total	68000	204500	6500	2000
6	Mutyalapalem	1 st month	12000	30000	200	0
		2 nd month	15000	75000	2000	100
		3 rd month	15000	70000	2000	800
		4 th month	15000	50000	3000	500
		5 th month	15000	30000	500	0
		6 th month	5000	3250	200	0
		Total	77000	258250	7900	1400
7	Gachhakayala pora	1 st month	10000	20000	0	100
		2 nd month	10000	30000	1000	100
		3 rd month	22000	70000	1500	300
		4 th month	15000	80000	500	600
		5 th month	10000	20000	300	200
		6 th month	8000	3380	0	0
		Total	75000	223380	3300	1300
8	Dwarapudi	1 st month	10000	20000	500	200
		2 nd month	20000	50000	1000	200
		3 rd month	30000	60000	1500	400
		4 th month	50000	60000	2000	400
		5 th month	50000	60000	1000	300
		6 th month	23000	38000	500	100
		Total	183000	288000	6500	1600

Table 3: Impact of inundative release of bio agents in suppression of coconut black headed caterpillar *O.arenosella* in the affected villages

S. No	Village and date of initiation of bio agents release	Total number of bio agents released (in thousands)	Mean $\pm$ SE (per 10 leaflets)				T value		
			Pre release	Post release			Pre-1month	Pre-2 months	Pre-3months
				After 1 month	After 2 months	After 3months			
1	S Yanam 15.10.11	88040	76.80 $\pm$ 6.28	30.50 $\pm$ 1.25	7.70 $\pm$ 1.02	2.00 $\pm$ 0.42	7.18**	10.41**	12.16**
2	Matlapalem 13.12.11	64600	156.90 $\pm$ 9.87	19.30 $\pm$ 1.87	6.80 $\pm$ 1.64	0.0 $\pm$ 0.0	12.32**	14.92**	15.88**
3	N.Raguvulapeta 22-01-12	120100	168.9 $\pm$ 12.13	47.40 $\pm$ 5.77	23.20 $\pm$ 2.57	5.00 $\pm$ 0.788	11.39**	12.99**	13.47**
4	Undrajavaram 13-04-12	79600	71.90 $\pm$ 3.55	19.30 $\pm$ 1.32	9.70 $\pm$ 1.52	0.0 $\pm$ 0.0	14.43**	15.55**	20.23**
			Pre release	After 1 month	After 3 months	After 6months	Pre-1month	Pre-3 months	Pre-6 months
5	Gogannamatam 20.12.12	281000	119.20 $\pm$ 5.29	65.20 $\pm$ 3.22	32.40 $\pm$ 2.46	0.0 $\pm$ 0.0	11.06**	16.51**	22.51**
6	Mutyalapalem 21.12.12	344550	124.10 $\pm$ 5.57	82.10 $\pm$ 2.63	25.00 $\pm$ 1.70	0.0 $\pm$ 0.0	6.84**	19.62**	22.27**
7	Gachhakayala pora 22.12.12	302980	123.80 $\pm$ 4.00	76.30 $\pm$ 3.34	26.00 $\pm$ 1.57	0.0 $\pm$ 0.0	13.83**	23.65**	30.87**
8	Dwarapudi 31.12.12	479100	84.10 $\pm$ 2.36	39.40 $\pm$ 1.89	21.00 $\pm$ 1.20	0.0 $\pm$ 0.0	18.23**	22.83**	35.48**
	Total	2259970							

The values with ** are significantly differ with each other at 1% LOS

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