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Impact of Inundative Releases of Parasitoids (*Bracon hebetor* and *Goniozus nephantidis*) against Coconut Black Headed Caterpillar under Severe Infestations

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***Abstract*:** Caterpillar of coconut black headed caterpillar (*Opisina arenosella*) attacks palms of any age from nursery to grown up plants causing severe damage to the foliage and resulting in yield losses up to 50 percent. During 2023-24, a high infestation of black headed caterpillar was observed in the Dr.B.R. Ambedkar Konaseema, West Godavari and Eluru districts of Andhra Pradesh with the incidence ranging from 21.29 to 68.55% from January 2023 to June 2024, A total of 15 lakhs numbers of larval parasitoids *Bracon hebetor* and *Goniozus nephantidis* were released in pest affected coconut plantations. To study the impact of the parasitoid releases, 10 leaflets/ palm were randomly collected from three sample gardens in three villages (Allipalli, Appanacheruvu and Sannavilli) and the pest population recorded., Larval population of *O. arenosella* in the affected gardens decreased by 19.59 -30.64 percent after three months and up to 72.79-85.16 percent after six months of release of parasitoids and no leaf damage and pest population was recorded in the newly emerged leaves. In the random leaflet samples collected the percentage of parasitized larval population recovered was 2.18-3.52 per cent after three months and increased to 12.69-34.59 per cent after six months of release of parasitoids. After six months of release the impact of inundative release of bioagents in the suppression of the pest was visible as pest population could be brought down to very negligible level by the timely release of stage specific parasitoids.

***Keywords*:** Coconut black headed caterpillar, Biological control, Inundative releases, Parasitoids, *Opisina arenosella, Goniozus nephantidis*, *Bracon hebetor*

Coconut (*Cocos nucifera* L.) is the most valuable palm which occupies a unique position among plantation crops worldwide. In India, coconut cultivation is primarily confined to the four southern states, accounting 90% of the area under coconut, among which Andhra Pradesh shares about an area of 1.07 lakh hectares producing 17.07 lakh nuts with a productivity of 15,899 nuts per hectare (CDB, 2023-24). In Andhra Pradesh, Dr. B. R. Ambedkar Konaseema, East Godavari, West Godavari, Eluru, Srikakulam and Visakhapatnam are important coconut growing coastal districts. One of the major factors that contribute to the loss of production and productivity in coconut is the damage due to pests. More than 900 species of vertebrate and invertebrate pests are reported to be associated with cultivated and wild coconut palm (Patel et al., 2023). Of these coconut black headed caterpillar, *Opisina arenosella* Walker is a serious pest of coconut palm causing significant yield loss in all the coconut growing tracts of India (Kumara et al., 2015). The first report of this pest is from Sri Lanka in the year 1900 and the earliest record of the pest on coconut palm in India was in 1909 from Bapatla, Andhra Pradesh (Sathiamma 1993, Subaharan and Ravindran 2009). During severe outbreaks, the pest multiplies rapidly and devastates the leaf lamina and also feeds on the green surfaces of the petioles, spathes and nuts. In case of nurseries or newly planted young palms may lead to the death of seedlings and button drop in the gardens resulting in reduced yields (Muthiah 2007).

The occurrence of periodic out breaks is common in coastal coconut plantations of east coast region. Andhra Pradesh has favorable climatic conditions and ample water resources, besides a long coastline of 974 km for aquaculture. Intensive and successive foliar applications of broad spectrum chemical insecticides for controlling larval stages leads to environmental pollution and disturbance in the natural balance in addition to insecticide resistance development. Pest incidence can be checked by the bio-control methods utilizing indigenous parasitoids. Bio-intensive pest management strategy has been developed for the management of this pest when it is in an epidemic form (Nair et al.,1997).Some indigenous and introduced species of parasites have been quite amenable to laboratory rearing and utilization in the field as biological control agents In the light of these facts, the Horticultural Research Station, Ambajipeta has intensified research and besides identifying the natural bioagents, has standardized methods for mass multiplying them under laboratory conditions and supply to the farmers to release in infested gardens. Present study was carried out in the black headed caterpillar affected gardens in Allipalli, Sannavilli and Appanacheruvu villages of Andhra Pradesh to evaluate the impact of the biocontrol based pest management and contain the spread of pest to neighboring coconut growing mandals.

MATERIAL AND METHODS

For recording pest and parasitoid population of coconut black headed caterpillar, *O. arenosella* 10 leaflets/ palm were collected from 10 sample palms in the villages Allipalli (17° 11′ 8.86″ N, 80° 59′ 51.07″ E), Appanacheruvu (16° 31' 2.8344" N, 81° 43' 31.2312" E) and Sannavilli (16.5720° N, 82.0993° E) before release at three and six months interval and larval population is expressed as mean larval and pupal population /10 leaflets along with parasitized larval population. Sample leaflets were collected from lower / middle whorl of leaves through destructive sampling (41-60% leaflets of 20% leaves from the lower or middle whorl). In each of the sample palms, population of larvae and pupae of the pest and the associated parasitoids present were recorded from the leaflets. Before releasing the parasitoids in the field were fed with honey and newly emerged parasitoids are released in the field after three days of emergence. The newly emerged parasitoids are exposed to the host odours for 72 hours (smell of the volatiles of the frass from galleries obtained from infested leaflets) as this improves the host searching efficiency of *Goniozus nephantidis* and *Bracon hebetor.* The releases of parasitoids were carried out at fortnightly intervals depending on the stage of the pest population to affect an inundative release in each location

From April 2023 to June 2024, about 16, 69,642 numbers of these parasitoids were produced in bio-control lab at Dr. YSRHU-HRS, Ambajipeta for distribution and released in pest affected gardens in the Allipalli village. Around 115 ha. of Allipalli village was covered and parasitoids were released. In case of Appanachervu village 500 palms and for Sannavilli 500 palms were selected area. Removal and burning of heavily infested 2-3 outer fronds and inundative release of stage specific parasitoids (*G. nephantidis* and *B. hebetor*) were done for the management of black headed caterpillar in three experimental locations.

Usually the parasitoids *G. nephantidis* are to be released at the rate of 20 parasitoid/palm and *B. hebetor* at the rate of 30 parasitoid /palm in at least ten percent of the infested palms in each village at fortnightly intervals in case of low (few damaged leaflets here and there) to medium (2–3 damaged fronds with clear drying) intensity damage. But as there is high intensity (all the lower whorls of leaves or entire crown damaged) inundative release of parasitoids was taken up in the affected gardens of Allipalli, Appanacheruvu and Sannavilli villages.

Statistical analysis: Data was analyzed by using Paired t test in the OPSTAT Software.

RESULTS AND DISCUSSION

The severe incidence of coconut black headed caterpillar was observed in coconut plantations of Alliaplli in area of115 ha. in November 2023 and 500 palms of Appanacheruvu in December 2023 and 1000 palms in Sannavilli in January 2024. The cropping system and date of initiation of release of parasitoid in the infested villages is given in Table 1.

The mean prerelease larval population in the Allipalli, Appanachervu and Sannavilli was 91.38, 79.05 and 76.75 larvae/ 10 leaflets in November 2023, December 2023 and January 2024 respectively. Removal and burning of heavily infested 2-3 outer fronds was done before the inundative release of parasitoids at 15 days intervals. After three months of the inundative release of the parasitoids in the three villages has resulted in the decrease of larval population of black headed caterpillar to 65.64, 63.56 and 53.23 larvae for 10 leaflets at Allipalli, Appanacheruvu and Sannavilli villages respectively. After six months of release, low larval population/ 10 leaflets was further reduced at Allipalli (13.56), Appanacheruvu (19.31) and Sannavilli (20.88) villages (Table 2). The total number of fresh pupae of *O. arenosella* and paralised larvae with cocoons of parasitoids present in the collected samples were also recorded. The number of CBHC pupae present before the release of parasitoids was high in all the experimental villages (21.81,19.76 and 22.52).The decrease in the number of pupae recorded after three months of release of parasitoids differ being lowest in Allipalli (14.79) followed by

Table 1. Number of parasitoids released in the affected villages for the management of coconut black headed caterpillar

Name of the village & District	Date of initiation	Area infested & cropping system	Name of the parasitoid	No. of parasitoids released (lakhs)
Allipalli, Eluru	03.11.2023	115 ha. (Sole coconut gardens and intercropped with cocoa)	*B. hebetor* *G. nephantidis*	8.08 5.41
Appanacheruvu, West Godavari	20.12.2023	500 palms (Fish pond bunds & Sole gardens)	*B. hebetor* *G. nephantidis*	0.6 0.5
Sannavilli, Dr.B.R.Ambedkar Konaseema	08.01.2024	1000 palms (Fish pond bunds & Sole gardens)	*B. hebetor* *G. nephantidis*	0.6 0.5

Table 2. Larval and pupal population of coconut black headed caterpillar, *O. arenosella* before and after release of parasitoids (Mean ± SE)

Village	Larval population per 10 leaflets			T value	T value	Pupal population per 10 leaflets			T value	T value
	Pre release	Post-release		Pre- 3 months	Pre- 6 months	Pre release	Post- release		Pre- 3 months	Pre- 6 months
		After three months	After six months				After three months	After six months		
Allipalli	91.38 ± 6.19	65.64 ± 3.74	13.56 ± 2.93	3.68 (0.008)	11.12 (<0.05)	21.81± 1.38	14.79 ± 1.77	3.05 ± 0.50	2.47 (0.04)	13.41 (<0.05)
Appanacheruvu	79.05 ± 4.67	63.56 ± 1.86	19.31 ± 3.79	3.46 (0.01)	13.70 (<0.05)	19.76 ± 2.16	14.18 ± 2.41	2.87 ± 0.67	1.82 (NS)	8.08 (<0.05)
Sannavilli	76.75± 6.34	53.23 ± 8.30	20.88 ± 2.53	1.67 (NS)	7.65 (<0.05)	22.52 ± 2.39	15.56 ± 2.25	4.36 ± 0.76	2.10 (NS)	5.95 (<0.05)

Table 3. Parasitized larval population of *O. arenosella* before and after release of parasitoids (Mean ± SE)

Village	Parasitized larval per 10 leaflets			T value	T value
	Pre release	Post release		Pre- 3 months	Pre- 6 months
		After three months	After six months		
Allipalli	0.74±0.28	1.85± 0.38	4.69± 0.53	2.89 (0.02)	7.16 (<0.05)
Appanacheruvu	0.94± 0.22	2.24±0.28	3.13±0.65	3.18 (0.015)	2.88 (0.023)
Sannavilli	0.83 ±0.23	1.69± 0.39	2.65± 0.55	2.00 (NS)	2.97 (0.021)

Appanacheruvu (14.18) and Sannavilli village (15.56). But after six months of release of parasitoids, the decrease in the number of pupae significantly differed in all the experimental gardens being 3.05, 2.87 and 4.36 in Allipalli, Appanacheruvu and Sannavilli. The decrease in the number of pupae represents the reduced pest population of the target pest in the parasitoid released gardens (Table 2).

The naturally parasitized CBHC larvae recorded very low before the release of parasitoids and significantly increased after three months of release of parasitoids except in Sannavilli village. After six months of parasitoids release, there is an increase in the parasitized larval population from 0.74 to 4.69 per 10 leaflets in collected samples of Allipalli which demonstrates the impact of biological control. This indicate that parasitized larval population increased significantly after six months when compared to prerelease showing the impact of inundative release of parasitoids in the CDB-LoDP programme. In case of Appanachervu and Sannavilli parasitized larval population varied 0.94 to 3.13 and 0.83 to 2.65 per 10 leaflets respectively after six months of parasitoids release (Table 3).

In the LODP villages the larval and pupal population of *O.arenosella* in the affected gardens decreased after six months of release of parasitoids and no leaf damage and pest population was recorded in the newly emerged leaves. In the random leaflet samples collected the percentage of parasitized larval population increased after six months of release of parasitoids. The adoption on large area can effectively manage coconut leaf black headed caterpillar and pest population could be brought down to very negligible level by the timely release of stage specific parasitoids. Mohan and Nair (2002) also reported 52.6 and 94.7% reduction in pest population after one and two years, respectively of parasitoid release in heavily infested homestead coconut in Neendakara (Kerala). Chalapathi Rao et al. (2018) also observed similar findings in the area of 675 ha in Allavaram. For large area field management of the coconut black headed caterpillar in an epidemic out-break, inundative releases of parasitoids in the initial periods in coconut plantations of at fortnight intervals and further monitoring and augmentative releases during probable periods of pest build up is required. The self-perpetuating parasitoids prevented the spread of the outbreak to surrounding plantations and regulated

CONCLUSION

The present studies conclude that after six months of inundative releases of parasitoids, *Bracon hebetor* and *Goniozus nephantidis* resulted in the suppression of the coconut black headed caterpillar. The success of biological control programmes needs to be promoted so as to educate the farmers, and replicate them in all the places where it is needed.

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