International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(2): 2713-2718

Received: 13-01-2018
Accepted: 19-02-2018

SS Gurav
Ph. D Student, Department of Entomology, N. M. College of Agriculture, Navsari
Navsari Agricultural University, Navsari, Gujarat, India

GG Radadia
Professor and Head, Dept. of Entomology. Department of Entomology, N. M. College of Agriculture, Navsari
Navsari Agricultural University, Navsari, Gujarat, India

CU Shinde
Assistant Professor. Department of Entomology, N. M. College of Agriculture, Navsari
Navsari Agricultural University, Navsari, Gujarat, India

Correspondence
SS Gurav
Ph. D Student, Department of Entomology, N. M. College of Agriculture, Navsari
Navsari Agricultural University, Navsari, Gujarat, India

Status of coconut black headed caterpillar, *Opisina arenosella* (Walker) and it's associated larval parasitoid, *Goniozus nephantidis* (Muesebeck) under south Gujarat conditions

SS Gurav, GG Radadia, CU Shinde

Abstract
Roving survey has been carried out in major coconut growing talukas of Navsari district viz; Navsari, Jalalpore, Gandevi, Chikhali and Vansda to know the exact status of the pest black headed caterpillar and its associated larval parasitoid, *G. nephantidis* during the year 2015-16 and 2016-17. Pest incidence, Pest intensity and Parasitization percentage has been recorded during survey work. Overall survey results revealed that pest incidence of coconut black headed caterpillar, *O. arenosella* was observed in all talukas throughout the year in the range of 18.79 to 54.92 per cent in Navsari district. Maximum pest incidence was recorded in Vansda taluka (54.92%) and minimum pest incidence was recorded in Navsari taluka (18.79%). Pest intensity was in the range of 8.61 to 52.95 per cent in various talukas of Navsari district. Maximum pest intensity was recorded in Vansda taluka (52.95%) in the month of April while minimum pest intensity was recorded in Navsari taluka (8.61 %) in the month of January. Pest incidence and pest intensity trend showed that peak incidence was recorded during summer months that are from April to May while it decreases from September onwards and reaches to minimum in winter months November and December. In case of percent parasitization, *G. nephantidis* was the dominant parasitoid under Navsari conditions of Gujarat state. Maximum parasitization was observed in Navsari taluka in the month of May (11.76 %) followed by April (10.07 %) while lowest was 2.63 per cent in Chikhali taluka in the month of May.

Keywords: Coconut, opisina arenosella survey, goniozus nephantidis

1. Introduction
The coconut palm, *Cocos nucifera* L. belongs to family Arecaceae is one of the traditional crops known as "Kalpavriksha" as well as "Tree of Life" provides food, shelter, fuel, medicine and employment to billions of people across the world. Coconut is widely cultivated in all the tropical regions of the world. India is third leading country after Philippines, Indonesia in harvested area of coconuts among the Asian countries. In India, coconut is grown in Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Orissa, Maharashtra, West Bengal and Gujarat. (Venkatesan *et al.* 2008) [17]. Now a day, coconut plantation is continuously increasing in Gujarat state especially in south Gujarat and coastal areas of Saurashtra. The coconut palm is infested by a number of insect pests. Among them coconut black headed caterpillar, *O. arenosella* (Lepidoptera: Crytophasidae) stands out as predominant leaf feeder. This is one of the serious and endemic pests of coconut in India (Cock and Perera, 1987 and Rukhsana and Majeed, 2014) [12]. The caterpillar is gregarious in habit and is voracious feeders. It feed on the parenchymatous tissues on the under surface of the leaflets and construct galleries along with silk and excreta. Under favourable conditions, the pest multiplies rapidly and devastates the leaf lamina. This caterpillar attack palms of any age from nursery to grown up plants causing the severe damages to the foliage, depriving the palm of its photosynthetic area and thus, directly affecting the yield reduced to half (Subaharan,2008) [14]. Outbreaks of the pest occur usually under favourable congenial conditions. Moreover, the infestation of pest under south Gujarat conditions reaches serious proportion during the hot months of March to May; thereafter sharp that declines of population the pest due to the onset of monsoon. The abundance of the pest directly correlated with the relative humidity and inversely proportional to the temperature and sunshine hours (Kapadia and Mittal, 1993 and Pushpalatha and Veeresh, 1995) [7, 10].

Among various control strategies, biological control is living weapon and excellent strategy over chemical control. Among all parasitoids, *G. nephantidis* is one of the gregarious larval parasitoid responsible for the reduction in pest population under field conditions to the extent of 60 to 70 per cent. Hence, *G. nephantidis* is being widely used in the biological control programme (Venkatesan *et al*., 2007) [16]. In Gujarat, coconut climbing is very expensive due to non availability of expert climbers and the farmers are very reluctant to adopt the pest management practices in the crown area due to this difficulty. The potent bio agent, *G. nephantidis* may be recommended as larval parasitoid for management of black headed caterpillar. Keeping these in view, the present survey work has been undertaken to know the exact status of the pest as well as parasitoids under South Gujarat condition.

2. Materials and Methods

The roving survey of *O. arenosella* and associated larval parasitoids was carried to know the incidence, intensity and natural parasitization of larval parasitoids on coconut plantation at an interval of one month in Navsari, Jalalpur, Gandevi, Chikhali and Vansda talukas of Navsari district during the year 2015-16 and 2016-17. Observations were recorded as per methodology suggested by All India Coordinated Research Project on Palms, Central Plantation Crop Research Institute, Kasargod, Kerala (Anonymous, 2015) [1]

(Fig 1 to 5)

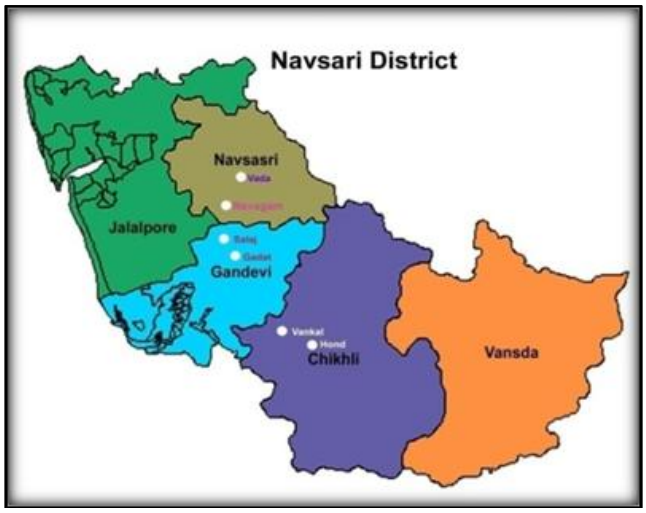

Fig. 1: Survey area in Navsari District

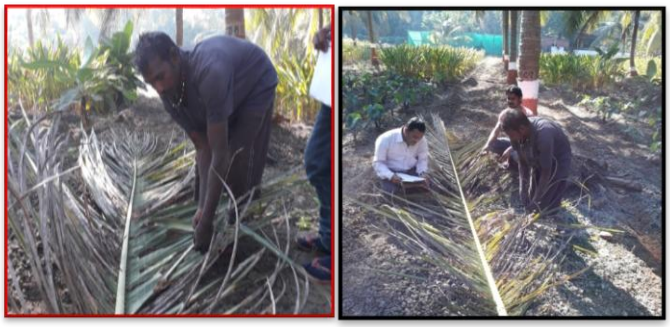

Fig 2: Recording observations during survey work in Navsari District

Fig 3: Heavy infestation of coconut black headed caterpillar

Eggs Larva

Pupa Adult

Fig 4: Life stages of *O. arenosella*

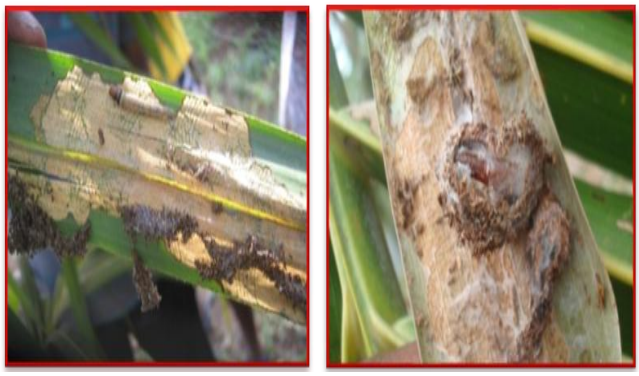

Fig 5: Leaf scrapping by larva

1) Pest Incidence: To know the per cent pest incidence of *O. arenosella*, two coconut fields were selected from each talukas. In each field, number of palms infested with *O. arenosella* will be recorded from total palms. Per cent pest incidence was calculated by using following formula,

$$\text{Pest Incidence (\%)} = \frac{\text{Total number of palms damaged}}{\text{Total number of palms observed}} \text{ X } 100$$

2) Pest Intensity: The pest intensity was calculated by employing methodology suggested by Sathiamma (1993) [13]. To know the pest intensity, two coconut fields were selected from each taluka. In each coconut field, 10 infested palms were selected. From each selected palm, total numbers of healthy and infested leaves were counted. Among total infested leaves, 20 per cent leaves were selected for critical observations. Thereafter, each selected leaf was divided into five parts as per given scale. Out of five parts, middle part of leaf was selected for the presence of egg, larva, pupal cases and adult stage. Numbers of insects were counted. These numbers were used for estimation of the pest intensity (percentage) by using sampling formula regression equations as given below.

Period	Regression Equation
February to March	Y = 22.59 + 5.75 X
April to June	Y = 38.40 + 9.70 X
July to October	Y = 20.57 + 6.20 X
November to January	Y = 6.36 + 8.99 X

Where X = Total no. of observed stages Y = Pest Intensity (Eggs, Larva, Pupa and Adults)

3) Percent Parasitization: In order to know the natural parasitization of *G. nephantidis*; ten randomly infested leaflets were critically examined and larvae of *O. arenosella* were collected and brought to Bio-control Laboratory, N.A.U. Navsari. These collected larvae were kept in plastic jar for the emergence of parasitoid under constant supervision. The count of parasitized larvae was taken out and percent parasitization of *G. nephantidis* was worked out by using following formula,

$$\text{Percent Parasitization} = \frac{\text{Total number larvae parasitized by parasitoids}}{\text{Total number of larvae observed}} \text{ X } 100$$

3. Results and Discussion

The results obtain during the present studies are presented in Table 1 to 3 and discussed hereunder.

Table-1: Pest incidence of black headed caterpillar, *O. arenosella* in different talukas of Navsari district (Year 2016, 2017 and average)

Months	Navsari			Jalalpore			Gandevi			Chikhali			Vansda		
	2016	2017	Average	2016	2017	Average	2016	2017	Average	2016	2017	Average	2016	2017	Average
January	43.86	44.62	44.24	42.59	40.00	41.30	46.30	40.00	43.15	42.00	38.00	40.00	51.52	58.33	54.92
February	45.45	48.89	47.17	44.00	44.68	44.34	50.00	42.55	46.28	44.44	40.74	42.59	45.45	58.18	51.82
March	46.94	51.11	49.02	49.09	45.65	47.37	52.73	45.65	49.19	45.00	41.67	43.33	48.89	58.46	53.68
April	49.25	52.31	50.78	50.00	45.16	47.58	53.23	48.39	50.81	40.68	43.55	42.11	43.64	58.06	50.85
May	52.63	53.97	53.30	51.85	46.67	49.26	48.15	50.00	49.07	40.35	36.92	38.64	41.43	61.11	51.27
June	42.22	39.58	40.90	45.83	43.18	44.51	41.67	47.73	44.70	36.17	34.69	35.43	34.29	42.11	38.20
July	32.76	38.18	35.47	-	-	-	-	-	-	-	-	-	-	-	-
August	32.08	30.91	31.49	-	-	-	-	-	-	-	-	-	-	-	-
September	18.46	19.12	18.79	-	-	-	-	-	-	-	-	-	-	-	-
October	24.53	23.08	23.80	18.37	21.28	19.82	22.45	25.53	23.99	31.91	34.04	32.98	44.62	42.22	43.42
November	26.19	27.78	26.98	24.49	24.44	24.47	24.49	21.74	23.11	32.69	32.00	32.35	49.09	32.50	40.80
December	41.54	25.42	33.48	27.78	23.91	25.85	25.00	23.40	24.20	34.43	31.48	32.95	55.77	29.55	42.66

Note: " - " indicated not surveyed due to unavailability of climber in rainy season.

Table-2: Pest intensity of black headed caterpillar, *O. arenosella* in different talukas of Navsari district (Year 2016, 2017 and average)

Months	Navsari			Jalalpore			Gandevi			Chikhali			Vansda		
	2016	2017	Average	2016	2017	Average	2016	2017	Average	2016	2017	Average	2016	2017	Average
January	10.86	10.86	10.86	19.85	10.86	15.35	10.86	10.86	10.86	6.36	10.86	8.61	28.84	33.33	31.08
February	25.47	25.47	25.47	25.47	25.47	25.47	25.47	25.47	25.47	28.34	31.22	29.78	42.72	34.09	38.40
March	28.34	31.22	29.78	25.47	31.22	28.34	31.22	31.22	31.22	31.22	25.47	28.34	39.84	36.97	38.40
April	43.25	43.25	43.25	43.25	43.25	43.25	43.25	52.95	48.10	43.25	43.25	43.25	52.95	52.95	52.95
May	48.10	48.10	48.10	48.10	43.25	45.68	43.25	52.95	48.10	38.40	48.10	43.25	48.10	48.10	48.10
June	43.25	43.25	43.25	43.25	43.25	43.25	38.40	43.25	40.83	43.25	48.10	45.68	52.95	43.25	48.10
July	20.57	23.67	22.12	-	-	-	-	-	-	-	-	-	-	-	-
August	23.67	20.57	22.12	-	-	-	-	-	-	-	-	-	-	-	-
September	29.87	26.77	28.32	-	-	-	-	-	-	-	-	-	-	-	-
October	29.87	26.77	28.32	23.67	29.87	26.77	26.77	32.97	29.87	32.97	26.77	29.87	29.87	39.17	34.52
November	19.85	10.86	15.35	10.86	10.86	10.86	19.85	19.85	19.85	24.34	19.85	22.09	24.34	28.84	26.59
December	19.85	10.86	15.35	6.36	15.35	10.86	10.86	10.86	10.86	28.84	10.86	19.85	28.84	19.85	24.34

Note: " - " indicated not surveyed due to unavailability of climber in rainy season.

Table-3: Percent parasitization of black headed caterpillar, *O. arenosella* in different talukas of Navsari district (Year 2016, 2017 and average)

Months	Navsari			Jalalpore			Gandevi			Chikhali			Vansda		
	2016	2017	Average	2016	2017	Average	2016	2017	Average	2016	2017	Average	2016	2017	Average
January	7.00	8.33	7.67	5.77	7.69	6.73	3.45	3.70	3.58	4.76	7.32	6.04	8.33	5.26	6.80
February	10.22	7.32	8.77	4.76	6.06	5.41	3.28	4.65	3.96	6.35	7.14	6.75	5.13	7.32	6.22
March	15.19	8.33	11.76	2.94	5.56	4.25	4.08	4.44	4.26	3.85	4.17	4.01	6.98	9.68	8.33
April	15.89	4.26	10.07	4.88	7.50	6.19	3.57	4.55	4.06	5.71	8.70	7.20	6.38	9.38	7.88
May	13.86	4.00	8.93	2.78	8.70	5.74	7.14	6.00	6.57	6.00	2.63	4.32	3.13	5.00	4.06
June	7.87	2.56	5.21	2.94	4.88	3.91	4.65	2.44	3.55	8.00	3.23	5.61	7.14	4.88	6.01
July	4.48	5.88	5.18	-	-	-	-	-	-	-	-	-	-	-	-
August	4.00	2.94	3.47	-	-	-	-	-	-	-	-	-	-	-	-
September	3.70	3.33	3.52	-	-	-	-	-	-	-	-	-	-	-	-
October	4.84	8.33	6.59	7.69	8.00	7.85	7.14	2.78	4.96	7.41	7.41	7.41	6.90	8.00	7.45
November	6.67	7.41	7.04	6.06	7.41	6.73	5.26	5.71	5.49	4.55	7.14	5.84	6.98	3.70	5.34
December	8.20	7.69	7.94	3.57	6.90	5.23	5.17	3.23	4.20	4.35	7.41	5.88	9.38	6.90	8.14

Note: " - " indicated not surveyed due to unavailability of climber in rainy season.

Pest Incidence

Average data of two years 2015-16 and 2016-17 revealed that pest incidence of coconut black headed caterpillar, *O. arenosella* was observed throughout the year in all places in Navsari District. In Navsari taluka, highest pest incidence 53.30 per cent was recorded in the month of May while lowest 18.79 per cent was recorded in the month of September. In Jalalpore, highest pest incidence was recorded in the month of May (49.26 %) while lowest was recorded in the month of October (19.82 %). At Gandevi location, maximum 50.81 per cent pest incidence was recorded in the month of May while minimum 23.11 per cent was recorded in the month of November. In Chikhali, highest pest incidence was recorded in the month of March (43.33%) while lowest was recorded in the month of November (32.35%). At Vansda, 54.92 per cent pest incidence was observed in the month of January while 38.20 per cent in the month of June.

Overall trend shows that the pest incidence was observed in all talukas throughout the year in the range of 18.79 to 54.92 per cent in Navsari district. Maximum average pest incidence was recorded in Vansda taluka (54.92 %) and average minimum pest incidence was recorded in Navsari taluka (18.79 %). Pest incidence trend showed that peak incidence was recorded during summer months that are from April to May while it decreases from September onwards and reaches to minimum in winter months November and December.

The present findings are more or less similar with various previous studies. Pushpalatha and Veeresh (1995) [10] revealed that the population of *O. arenosella* was present throughout the year, reaching peak during March to May and lower during September to December at Bangalore, Karnataka. In another study at Kerala by Lyla and Beevis (2003) reported the occurrence of the coconut black-headed caterpillar, *O. arenosella* during the dry months (January - May). They reported the peak incidence of *O. arenosella* was 51.34 and 42.94 per cent at two different locations in the month of March. The leaf infestation level decreased in May to 34.06 and 38.73 per cent at respective locations.

Pest Intensity

Average data of two years 2015-16 and 2016-17 revealed that pest intensity of coconut black headed caterpillar, *O. arenosella* was more or less in all places in Navsari District. In Navsari taluka, maximum pest intensity was recorded in the month of May (48.10 %) while minimum was recorded in the month of January (10.86 %) followed by 15.35 per cent in the month of November and December. In Jalalpore taluka, maximum pest intensity was recorded in the month of May (45.68 %) and minimum was recorded in the month of November and December (10.86 %). At Gandevi taluka, April and May months recorded more i.e. 48.10 per cent pest intensity followed by 40.83 per cent in the month of June whereas January and December months showed less 10.86 per cent pest intensity. In Chikhali taluka, average 45.68 per cent pest intensity was recorded in the month of June followed by 43.25 per cent in the month of April and May whereas minimum pest intensity was recorded 8.61 per cent in the month of January. In Vansda taluka, 52.95 per cent pest intensity was recorded in the month of April followed by 48.10 per cent in the month of May and June whereas minimum pest intensity was 24.34 per cent in the month of December.

Overall average data showed that the pest intensity was in the range of 8.61 to 52.95 per cent in various talukas of Navsari district. Maximum average pest intensity was recorded in Vansda taluka (52.95 %) in the month of April and average minimum pest intensity was recorded in Navsari taluka (8.61 %) in the month of January. Pest intensity was more in summer while less in winter months.

With regard to pest intensity, in previous study, Subaharan and Ravindran (2009) [15] reported that the pest occurs around the year with a peak in population during summer i.e. March to May and under favorable conditions the sporadic outbreaks lead to severe damage in coconut plantations in Tamil Nadu, Kerala, Karnataka, Andhra Pradesh, Orissa, West Bengal and Gujarat. Gurav *et al.* (2014) [4] reported 39.90 per cent pest incidence from Thane district and 54.16 per cent pest incidence was reported from Kolhapur district in Maharashtra. Jnanadevan (2015) [5] reported that the pest occurs round the year with a rise in population during summer i.e. March to May in certain pockets of Palakkad and Polachi areas of Tamilnadu in the year 2015. The results of present investigation were more or less similar to results of earlier investigation.

Per cent parasitization

During survey work, observations on parasitization of *G. nephantidis* on *O. arenosella* were also recorded. Parasitization with *G. nephantidis* was observed more or less in all talukas in Navsari district. In Navsari taluka, overall average of both the years revealed that maximum parasitization was observed in the month of March (11.76 %) followed by April (10.07 %) while minimum parasitization was observed in the month of August (3.47 %) and September (3.52 %). In Jalalpore taluka, maximum parasitization was observed in the month of January and November (6.73 %) followed by 6.19 per cent in the month of April while minimum percent parasitization was observed in the month of

March (4.25 %). At Gandevi taluka, maximum 6.57 per cent parasitization was recorded in the month of May while minimum 3.58 per cent parasitization was recorded in the month of January. In Chikhali taluka maximum 7.41 per cent parasitization was observed in the month of October and December while minimum 2.63 per cent parasitization was observed in the month of May. At Vansda taluka maximum parasitization was observed in the month of March (8.33 %) while minimum parasitization was observed in the month of May (4.06 %).

Overall data showed that *G. nephantidis* was the dominant parasitoid under Navsari conditions of Gujarat state. Maximum parasitization was observed in Navsari taluka in the month of May (11.76 %) followed by April (10.07 %) while lowest was 2.63 per cent in Chikhali taluka in the month of May.

Observations on percent parasitization are more or less similar with earlier survey reports. In past, Manjunath (1985) [9] reported that the larval parasitoids, *G. nephantidis* recorded 28 per cent parasitism on *O. arenosella* in Guntur district of Andhra Pradesh. In Gujarat, Vyas and Butani (1986) [18] recorded 12.2 per cent *G. nephantidis* parasitization in the month of June and 7.9 per cent in the month of May, respectively. Kapadia (1987) [6] reported 5.98 per cent parasitization by the larval parasitoids *G. nephantidis* in the month of November 1981 under Gujarat condition. Kapadia and Mittal (1993) [7] also reported that the maximum parasitization by *G. nephantidis* was 5.98 per cent in November (1980-81) followed by 5.75 per cent in February (1981-82). The average parasitization of *G. nephantidis* throughout four years was maximum in February (3.66 %) followed by November (3.20 %) and the activity of the parasitoid was low in May (1.04 per cent). Chalapathi Rao *et al*. (2013) [2] reported natural parasitization of *G. nephantidis* on *O. arenosella* was 37.3 and 43.1 per cent in 2011 and 2012, respectively at Ambajipetha, Andhra Pradesh. Recently Repalle and Shinde (2017) [11] reported *G. nephantidis* was the dominant species under Navsari condition of Gujarat state and maximum parasitization of *O. arenosella* by *G. nephantidis* was observed during 2nd fortnight of May (17.69 %) and lowest parasitization was found during 1st fortnight of October (2.23 %).

4. Conclusion

Roving survey data revealed that coconut black headed caterpillar, *O. arenosella* is major pest on coconut in Navsari district and larval parasitoid *G. nephantidis* observed in all coconut growing talukas. This survey data will helpful to know the exact status of the pest, *O. arenosella* and natural parasitization by larval parasitoid, *G. nephantidis*. Also this data will be helpful as a pathway to plan efficient bio control strategy against this pest of this region.

5. Acknowledgement

Authors are sincerely thankful to the Director of Research and Dean PG studies, Principal and Dean, N.M. College of Agriculture and Professor and Head, Dept. of Entomology, NAU, Navsari for providing the necessary facilities to execute the research work. We are sincerely thankful to various coconut farmers in south Gujarat area and coconut climber for their help.

6. References

1. Anonymous. All India Coordinated Research Project on Palms, 2015. Annual Report, 2014- 15, pp. 56-60.
2. Chalapathi Rao, NBV, Emmanuel N, Subaharan K. Impact of olfactory conditioned parasitoid *Goniozus nephantidis* (Muesebeck) in suppression of *Opisina arenosella* (Walker) under field conditions in east coast of Andhra Pradesh. Journal of Plantation Crops, 2013; 41(3):460-462.
3. Cock MJW, Perera PACR. Biological control of *Opisina arenosella* Walker (Lepidoptera: Oecophoridae). Coconut Research Institute of Sri Lanka. B.N.I, 1987; 8:283-309.
4. Gurav SS, Khandekar RG, Sawant VS, Narangalkar AL. Impact of olfactory conditioned parasitoid *Goniozus nephantidis* in suppression of *Opisina arenosella* Walker under field conditions in konkan region of Maharashtra. Book of abstract of Placrosym XXI organized at Kozhikode, Kerala, 2014; pp :133-134.
5. Jnanadevan R. Summer arrived; leaf eating caterpillar is active in coconut gardens. Indian Coconut Journal, 2015; 57(10):37-38.
6. Kapadia MN. Occurrence and distribution of different parasites of *Opisina arenosella* Walker under Mahuva conditions of Gujarat. Gujarat Agricultural University Research Journal, 1987; 12 (2):17-21.
7. Kapadia MN, Mittal VP. Seasonal development of *Goniozus nephantidis* Muesebeck and its effectiveness against Opisina arenosella. Gujarat Agricultural University Research Journal. 1993; 19(1):47-51.
8. Lyla KR, Beevi SP. Occurrence of coconut black headed caterpillar, *Opisina arenosella* Walker and its parasitoid, *Brachymeria nosatoi* Habu in Thrissur, Kerala. Proceedings of the Symposium of Biological Control of Lepidopteran Pests, 2003, Pp. 87-89.
9. Manjunath TM. India – Coconut black headed caterpillar on banana and coconut. FAO Plant Protection Bulletin. 1985; 33(2):71-72. [Fide: www.cabdirect.org]
10. Pushpalatha NA, Veeresh GK. Population fluctuation of coconut black headed caterpillar *Opisina arenosella* Walker (Lepidoptera: Xylorictidae). Journal of Plantation Crops. 1995; 23(1):44-47. [Fide: www.cabdirect.org].
11. Repalle Naganna, Shinde CU. Seasonal abundance of ecto-larval parasitoids of coconut black headed caterpillar, *Opisina arenosella* Walker under south Gujarat conditions. Pest Management in Horticultural Ecosystems. 2017; 23(1):50-54.
12. Rukhsana K, Majeed PP. The effectiveness of biocontrol of *Opisina arenosella* (Lepidoptera: Oecophoridae) using *Bracon brevicornis* (Hymenoptera: Braconidae). The Journal of Zoology Studies. 2014; 1(2):1-3.
13. Sathiamma B. *Opisina arenosella* Walker, the leaf eating caterpillar of coconut palm. *Technical Bulletin 27* Published by Central Plantation Crops Research Institute, Kasargod, Kerala, 1993, pp. 1-12.
14. Subaharan K. Educating the parasitoids: Olfactory learning in *Goniozus nephantidis* Muesbeck, the parasitoid of coconut black headed caterpillar, *Opisina arenosella* Walker. ICAR-AP Cess Fund Scheme – Final Report, 2005-08, pp. 4.
15. Subaharan K, Ravindran P. Leaf eating caterpillar –a menace to coconut cultivation. Indian Coconut Journal. 2009; 51(11):2-3.
16. Venkatesan T, Jalali SK, Srinivasamurthy K, Rabindra, RJ, Dasan CB. Economics of production of *Goniozus nephantidis* Muesebeck, an important parasitoid of coconut black headed caterpillar, *Opisina arenosella* Walker for bio-factories. Journal of Biological Control. 2007; 21(1):53-58.

17. Venkatesan T, Ballal CR, Rabindra RJ. Biological control of coconut black headed caterpillar *Opisina arenosella* using *Goniozus nephantidis* and *Cardiastethus exiguous*. *Technical Bulletin 39* Published by Project Directorate of Biological Control, Bangalore, 2008, pp. 1-14.
18. Vyas HN, Butani BG. Some studies on indigenous parasites of black heads caterpillar (*Nephantis serinopa* Meyrick) under Junagadh (Gujarat State) conditions. *Pesticides*. 1986; 20(1):21-22. [Fide: www.cabdirect.org]