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RESEARCH NOTE

Discrete generation cycles in Coconut black headed caterpillar, *Opisina arenosella* Walker (Lepidoptera: Oecophoridae)

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ABSTRACT: Field study was carried out to determine generation cycles and to comprehend the different developmental stages and their density at a particular time interval to assess the population structure of coconut black headed caterpillar, *Opisina arenosella* Walker (Lepidoptera: Oecophoridae) in Mandya district, Karnataka, India. The sampled population of *O. arenosella* showed discrete generation. The different stages of O. *arenosella* viz., larvae, pupae and adults were not observed on any single sampling date. Therefore, the definite periodicity in the appearance of O. *arenosella* suggested to discreet generation cycles.

Keywords: Coconut palm, discrete generation cycles, *Opisina arenosella*

Insect populations are recognized to discrete generation cycles or non-overlapping generation cycles and continuous generation cycles or overlapping generation cycles. However, DGCs are more common in Temperate environments and characterized by extensive winters where population overwinters through the winter months in a particular developmental stage such as egg, larva, pupa, and adult. Winter conditions select a particular developmental stage which creates uniformity in the surviving population concerning age, causing the subsequent spring populations or summer populations to follow DGCs (Ramkumar *et al.,* 2006). In the Tropics, it is usually believed that lack of such selection could lead to CGCs in insect populations. Fascinatingly, certain multivoltine tropical insect species that are active throughout the year are also known to follow DGCs namely, *Leucoptera caffeina* Washburn, *Levuana iridescens* Bethune-Baker, *Artona catoxantha* Hampson, *Saccharosydne saccharivora* Westwood, *Andraca bipunctata* Walker, *Coelaenomenodera elaeidis* Maulik, *Promecotheca reichei* Baly, *Opisina arenosella* Walker, Limacodidae and Psychidae families (Godfray and Hassell, 1989). Coconut black headed caterpillar, *O. arenosella* is a lepidopteran pest of coconut palm and belong to family Oecophoridae. The populations of *O. arenosella* was shown to follow partial DGCs during outbreaks in Sri Lanka (Perera *et al.,* 1988). *O. arenosella* is having 5 or 6 generations per year (Muralimohan and Sirinivasa, 2008) and breeds all year round on coconut palms without undergoing diapause (Ramkumar *et al.,* 2006). This is one of the major and serious pests of coconut palm and causes considerable economic losses to the coconut growers (Joy and Joseph, 1972). The pest during its larval stage feeds by scarping the lower epidermis of the leaflets resulting a reduction in chlorophyll, affected leaves turn brown and appear scorched (Thippeswamy *et al.,* 2008) and infested areas are always interspersed with un-infested ones, suggest the existence of spatially segregated populations. Considering the importance of *O. arenosella* which cause significant damage to the coconut palm, the study was carried out to determine generation cycles and to comprehend the different developmental stages and their density at a particular time interval to assess the population structure that can aid in management.

The field experiment was conducted at farmer's field at Halebudanuru village in Mandya district in Karnataka, India during 2017-2018. The experiment site consisted of 8-10 years old 100 coconut palms with natural infestation of *O. arenosella.* Twenty coconut palms were marked randomly for the sampling population of *O. arenosella*. Population of *O. arenosella* was observed during September-2017 to February-2018 when the pest was active on coconut palm. The observations on number of larvae and pupae were recorded at different days intervals from randomly selected 15 infested leaflets from each selected coconut palm. Each collected leaflet was labelled and brought to the laboratory and examined under a stereo-binocular microscope for the presence of different stages *viz.,* larvae and pupae. Based on the growth of the larvae (in length) recorded in each observation, they were grouped into four different sizes (in millimetre) namely, small larvae (< 2.5 mm), medium larvae (>2.5-5 mm), big larvae (>5-10 mm) and large larvae (>10 mm). The pupae collected from each sample

Table 1. ***Opisina arenosella*** **populations at different days interval**

Observation	Sampling Date	Sampling days	*Opisina arenosella* counts per leaflet (Mean number ± Standard deviation)						
			Small larvae	Medium larvae	Big larvae	Large larvae	Pupae	Adult emergence	Total population
I	6-IX-2017	1st	1.34 ± 0.28	1.84 ± 0.26	0.22 ± 0.06	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	3.40 ± 0.13
II	9-IX-2017	4th	0.40 ± 0.13	1.38 ± 0.24	1.80 ± 0.23	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	3.58 ± 0.10
III	13-IX-2017	8th	0.16 ± 0.08	0.34 ± 0.10	1.28 ± 0.14	1.48 ± 0.21	0.00 ± 0.00	0.00 ± 0.00	3.26 ± 0.05
IV	22-IX-2017	17th	0.00 ± 0.00	0.14 ± 0.13	0.28 ± 0.10	0.70 ± 0.11	0.00 ± 0.00	0.00 ± 0.00	1.12 ± 0.05
V	25-IX-2017	20th	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.82 ± 0.07	0.00 ± 0.00	0.82 ± 0.05
VI	5-X-2017	30th	0.00 ± 0.00	0.00 ± 0.00	0.00 ±0.00	0.00 ± 0.00	0.00 ± 0.00	0.78 ± 0.08	0.78 ± 0.06
VII	9-X-2017	65th	1.30 ± 0.09	1.93 ± 0.11	0.29 ± 0.03	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	3.53 ± 0.03
VIII	14-XI-2017	70th	0.18 ± 0.03	1.79 ± 0.08	2.32 ± 0.11	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	4.28 ± 0.04
IX	19-XI-2017	75th	0.06 ± 0.02	0.17 ± 0.03	1.57 ± 0.09	2.14 ± 0.10	0.00 ± 0.00	0.00 ± 0.00	3.95 ± 0.03
X	26-XI-2017	82th	0.00 ± 0.00	0.14 ± 0.06	0.44 ± 0.05	1.16 ± 0.07	0.00 ± 0.00	0.00 ± 0.00	1.74 ± 0.03
XI	30-XI-2017	86th	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.62 ± 0.05	0.00 ± 0.00	0.62 ± 0.07
XII	10-XII-2018	96th	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.52 ± 0.04	0.52 ± 0.08
XIII	26-I-2018	143th	1.38 ± 0.07	0.92 ± 0.04	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	2.29 ± 0.02
XIV	10-II-2018	158th	0.61 ± 0.06	1.59 ± 0.09	0.86 ± 0.05	0.42 ± 0.08	0.00 ± 0.00	0.00 ± 0.00	3.47 ± 0.02

were kept for adult emergence. The population data of each sampling of *O. arenosella* recorded at different days interval were analysed by their mean and standard deviation.

The population data of each sampling of *O. arenosella* recorded at different days of the interval are presented in Table 1. The mean larval counts of *O. arenosella* per infested leaflet during the first observation was, small larvae (1.34 larvae/leaflet), medium larvae (1.84 larvae/leaflet), big larvae (0.22 larvae/leaflet), large larvae (0.00 larvae/leaflet), with no pupae and adults and subsequently on the 158th of sampling, small larvae (0.61 larvae/leaflet), medium larvae (1.59 larvae/leaflet), big larvae (0.86 larvae/leaflet), large larvae (0.42 larvae/leaflet) were recorded. The overall results showed that the higher number of small and medium-sized group of larvae were more active at the beginning of the samplings (1st and 4th day of sampling) and a similar observation was recorded on the 65-70 days and 140-150 days after sampling. A similar trend was observed in big and large sized group of larvae and their number was higher on the 8th and 75th days of samplings. The pupae and adults were observed after 20-30 days and on 80-100 days after samplings. The overall sampled population of *O. arenosella* have shown that small and medium sized groups of larvae were active and present in higher numbers per leaflet compared to big and larger sized groups of larvae. The results also showed that initially, small and medium-sized larvae were present in large numbers whereas their number declined when they became big and large-sized.

In the present experiment the sampled population of *O. arenosella* showed discrete generation. The different stages of *O. arenosella viz.,* larvae, pupae and adults were not observed on any single sampling date. Therefore, the definite periodicity in the appearance of *O. arenosella* suggested to DGCs. However, in sampled populations of *O. arenosella,* the larval development period varies according to categorized group namely small, medium, big and large larvae. Similarly, *O. arenosella* larvae were classified based on the growth such as small, medium and large larvae and correlated these larvae to the instars namely small group constituted of larvae in 1st to 3rd instars (<4 mm in length), the medium group larvae in 4th to 6th instars (4-11 mm in length), while large larvae in 7th or 8th instars (>11 mm in length) (Ramkumar *et al.,* 2006). However, in the present study, the larvae were grouped according to the length of the body and not by instars, as they attained at particular growth. Since at a particular growth period of larva it could not be pragmatic that it might attain a certain instar in its developmental period by visual means. Moreover, the biotic and abiotic factors could interact with the development of the larvae and may hamper their successive growth and stages. The present study also observed that initially small and medium-sized larvae were present in large numbers whereas their number declined when they become big and large-sized. It could be hypothesized that in the later growth period (big and large-sized) larvae could migrate from one frond to another frond or one palm to another palm. However, some other factors *viz.,* hot temperature and the onset of rains could play an important role in the generation cycles of insect populations (Wolda, 1988). Whereas in phytophagous and largely monophagous tropical insect populations the DGCs may be regulated by seasons and host-parasitoid dynamics (Ramkumar *et al.,* 2006). Some mathematical models have demonstrated that parasitoids could lead host populations to DGCs under tropical conditions (Godfray and Hassell, 1987; Godfray and Hassell, 1989). Such models have demonstrated in, *Prokelisia marginata* Van Duzee, a species of plant hopper where a common egg parasitoid known as *Anagrus delicatus* Dozier (Hymenoptera: Mymaridae) has shown to regulate the populations of plant hopper and led to DGCs (Reeve *et al.,* 1994).

The present study revealed that *O. arenosella* follows DGCs and there is definite periodicity in the appearance of different stages of the population. Besides, there is a definite time lag in the occurrence of different developmental stages of the *O. arenosella*. The tendency to recur at definite interval of different developmental stages can provide new opportunities in pest management. Hence, it could be an important implication in taking control measure in managing *O. arenosella* population. Moreover, the demonstration of DGCs in *O. arenosella* has momentous insinuations for the management of this pest which causes significant economic losses to the coconut growers. Engrossingly, *O. arenosella* has the hundreds of natural enemies and therefore, spatially distributed populations of *O. arenosella* can aid in an admirable model structure to examine the role of natural enemies in maintaining DGCs of this pest.

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