Conserving through composting- the lifecycle study of pest turned partner

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Abstract : Preserving biodiversity through programmes which will engage public policies and communities along with ecosystems will help in conserving biodiversity. Composting is one such activity which safeguards and conditions diversity of decomposing ecosystem that leads to preservation of certain kind of biodiversity in environment. While conducting this study, the infamously labelled agricultural pest, a scarab beetle lived through compost, not only propagating but helping the composting process in its own way. This pest turned partner accelerated the process as well as increased the nutrient value of compost. Thus the present work aims to educate people about understanding this detritus ecosystem as it leads to conservation of environment and ultimately the biodiversity.

***Key words* :** Composting, pests, detritus ecosystem, biodiversity conservation

Introduction

Biodiversity is the variety of life in the world or in a particular habitat or ecosystem. We visit forests to appreciate splendid greenery and to study the diversity of thousands of beautiful plants and animal species. As a responsible citizen, we never throw trash in forests or even on road. But the trash that is already present in the forest is seldom observed. Since the natural waste found in forest is biodegradable, nature takes care of it by recycling through composting. Composting consists of detritus material thus there exists a detritus ecosystem (Sagade and Pejaver 2009) which helps cleaning up the environment with its team of scavengers along with aerial, terrestrial, wetland and aquatic ecosystem. The micro-organisms like bacteria, fungi and actinomycetes initiate composting, but along with them many silent participants make this process speed up. Among these is soil macrofauna which affect organic matter transformation directly by the incorporation and redistribution of various materials and indirectly by shaping the microbial community with both constructive (e.g., transport of fungal spores) and destructive means (e.g., selective reduction of viability) (Lavelle et al. 1997; Wolters 2000). During present study, many of such compost assistants were found but one of the beetles which was a compost assistant completed its entire life cycle in the compost. Since composting matter can be considered as a micro ecosystem, it was found essential to study it further and educate masses to look at this ecosystem and understand its diversity.

Materials and methods

Site selection: For present study, household biocompost plant in Thane city was selected. The compost feedstock included biodegradable kitchen waste, household and garden waste. **Collection:** The beetles, their larvae and pupae were handpicked from the different levels/depths of the compost.

Identification: The references and keys used to identify beetles included- A general textbook of entomology by A.D. Imms (Ninth edition) and Fauna of British India by G. J Arrow (1910). The beetle was identified as *Protaetia aurichalcea* (Cetoniinae: Scarabaeidae) using the identification keys.

Rearing: A laboratory culture was raised for beetles as well as their larvae and pupae. Optimum air, temperature and moisture conditions were maintained in the units in which these were reared. The food of larvae under study consisted of organic matter, decaying wood or trash and other debris accumulated. Ritcher in 1966 described the similar food habits for all larvae belonging to sub family Cetoniinae.

Life cycle Observation

Protaetia aurichalcea

Taxonomy

Phylum- Arthropoda
Sub-phylum – Hexapoda
Class- Insecta
Order- Coleoptera
Family- Scarabaeidae
Sub-family- Cetoniinae
Tribe - Cetoniini
Genus- Protaetia (Burmeister, 1842)
Species- *aurichalcea* (Fabricius, 1775)

Description of life stages: The beetle showed holometabolic life cycle i.e. Egg-Larva- Pupa – Adult were observed.

The egg- The egg was oval while but as the embryo grew inside, it became spherical (Image 1.1).

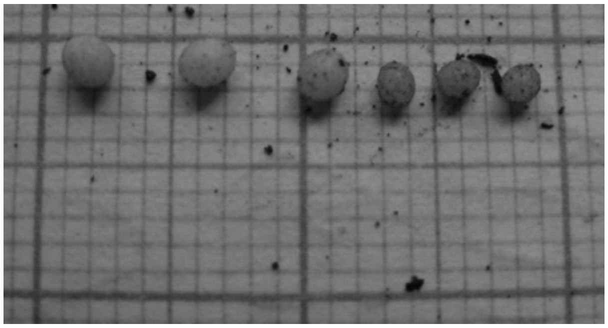

Image 1.1

The colour of egg was milky white to pale white. The incubation period under laboratory conditions varied seasonally. It was minimum 8 days in all seasons while maximum duration varying from 11 to 26 days. Kumbhar *et al* (2012) reported that eggs of Chiloloba orientalis hatched within 11-18 days. Whereas according to Bhattacharjee and Bhatia (1980) incubation period for Melolonthinae grub *Holotrichia serrata,* was 2-3 weeks.

Larva-: The C shaped larva showed growth in three instars before undergoing pupation. The body length measured between 3.0 mm to 35.0 $\pm$ 0.2 mm from 1^{st} to 3^{rd} instar and the girth ranged between 0. 1 to 0.8 mm $\pm$ 0. 2 mm in the 3^{rd} instar(Image 1.2, 1.3, 1.4)

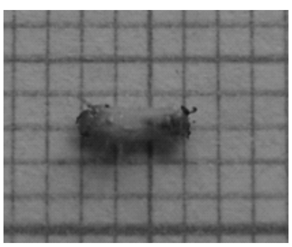

Image 1.2

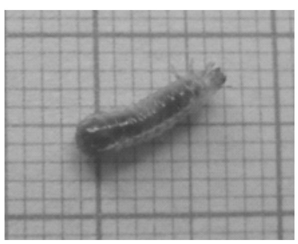

Image 1.3

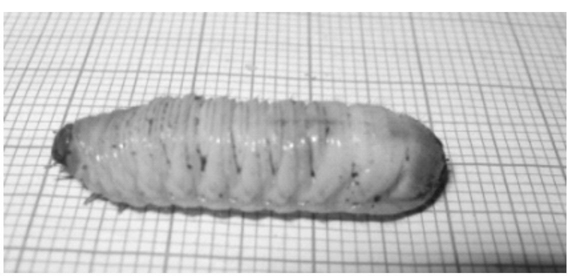

Image 1.4.

The larva in all instars crawled on its back and kept tunneling throughout the compost at various depths, circulating air through it for better action by microbes. The weight of the larva was as less as 0.01 mg in 1^{st} instar while it grew as heavy as 160.0 mg in its 3^{rd} instar. The larva gained this much weight by eating only compost organic matter throughout their span. Similar observations were made by Sipek (2009). Among the three instars, larva of third instar fed voraciously in the first few days and later became less active and sluggish. As there were 3 larval instars, 3 moults were seen (Image 1.5, Image 1.6, Image 1.7)

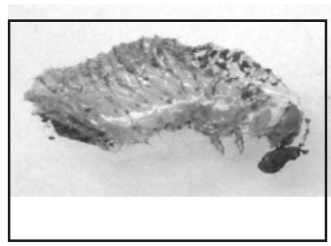

Image 1.5

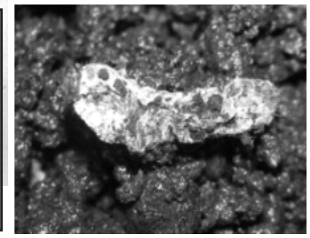

Image 1.6

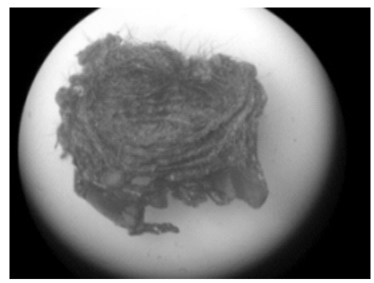

Image 1.7

When matured 3^{rd} instar larva prepared the earthen cocoon for pupation, it moulted inside the cocoon unlike the previous 2 moultings. Hence the 3^{rd} larval moult was found inside the cocoon. As reported by Veenakumari and Veeresh (1996) and Kumbhar *et al* (2012), the larva before attaining the pupal stage does not feed further and considerably shrinks its size and shows very little movement even when disturbed. The larval duration under laboratory conditions ranged between 46-111 days with least (46) in summer and longest (111) in winter. In *Holotrichia serrata*, the average larval duration was 148.7 days as noted by Majumdar and Teotia (1965).

Pupal chamber/Earthen cocoon- : Larva took almost 8-11 days to build the cocoon. The cocoon's rough exterior was of fecal pellets while even walled smooth interior was of fine soil particles adhered with the saliva of the grub (Image 1.8)

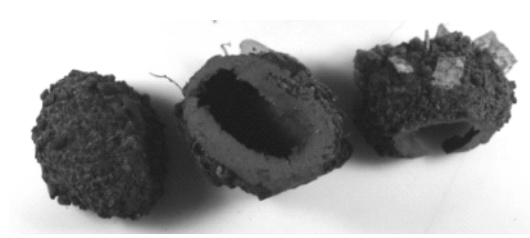

Image 1.8

Last larval moult and pupal moult enclosed was seen inside the empty cocoon after adult broke it and emerged out (Image 1.9).

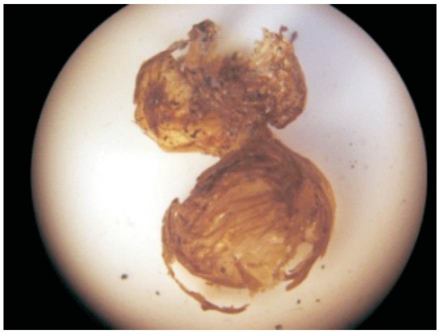

Image 1.9

Similar observations were recorded by Simpson (1990) for the pupal chamber of *Protaetia fusca* and by Veenakumari and Veeresh (1996) in another scarab beetle *Onthophagus gazella*. The larva to pupa duration was varying according to different seasons. The shortest larval period including all the instars and before undergoing pupation was observed to be 46 days in winter and monsoon while the longest was recorded in summer which comprised of 111days.

Pupa-: Pupa was exarate i.e. the wings and legs were free from the body and the abdomen was movable (Image 2.0)

Image 2.0

After complete metamorphosis, adult remained in the cocoon for next 1- 2days and then emerged out by breaking the cocoon. Duration of pupa varied from 20-36 days with minimum 20 days in summer and maximum 36 days in winter. In *Protaetia fusca* this pupal period was recorded up to 4.0 $\pm$ 0.2 weeks by Simpson (1990).

Adult-: Imago was deep bronze in colour and had very shining appearance on the dorsal and ventral surface (Image 2.1).

Image 2.1

The approximate length was 14-20 mm and breadth was 8-10.5 mm. Variation in size of male and female was not prominent (Image 2.2)

Image 2.2

The only conspicuous sexually dimorphic feature was presence of elytral spine/ spinose end of elytra in male. With the help of its strong mandibles, the adult cut vegetable leftover in the feedstock and fed on it.

Results: This beetle was attracted to the compost fauna due to the added feedstock in it. The beetle fed itself and laid eggs as it found the compost favourable for the larvae. This was corroborated with the observations by Dutto (2005, 2007). The larvae consumed the organic matter, pupated and the life cycle continued. Larval excreta were in the form of pellets and he study of its chemical parameters revealed that they are equally nutrient rich in Nitrogen, Phosphorus and Potassium when compared to vermicompost. The shortest lifecycle duration was 78 days in winter while longest was 137 days in summer. Another species of same genus, *Protaetia orientalis* took one year to complete as reported by Lijima and Takeuchi (2007).

Conclusion: Sighting of scarab beetle *Protatetia aurichalcea* during the study led to the study if its lifecycle. In its subject review, it was observed that this beetle was not studied, though the other beetles belonging to family Cetoniinae (Scarabaeidae) were recorded as agricultural pests in India as well as abroad. According to Kühnelt (1976), the larvae of the rose chafer (Cetoniinae) are very active digesters of organic materials in the soil. They mix organic and inorganic materials and redeposit them in the form of cylindrical pieces of excrement Since, it was the first time this beetle was observed in the compost; its study was considered essential. After observing it in all the stages, it was noted that this beetle helped in composting in larval as well as adult stage. The constant tunneling of larva transferred the microbes and air through the compost and its excreta improved the nutrient status. Similarly adult fed on leftover vegetable matter and this cutting of leftover food in small pieces provided more surface area for the microbes to act upon it. Moreover, the beetles never came out of the compost plant and therefore never caused any nuisance. Thus it can be concluded that, along with microbes in compost, the macro organisms should also be studied and rather than labelling all the scarabs as pests and killing them, they should be put to better use by rearing them in compost.

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