BIOCOMPOST- A NICHE FOR INSECT DIVERSITY.

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SYNOPSIS

Biocomposting is the purposeful biodegradation of organic matter by micro-organisms with the help of macro- organisms under controlled aerobic conditions. Although microbes as primary consumers initiate the composting, it's the secondary and tertiary consumers including insects, worms, snails and their associates that feed upon this semi converted organic matter, keep the compost pile cleaner, enhance the composting process and convert humus into stable and cured compost. The present work studies diversity and role of insects in household biocompost. The methods included selection of compost samples, Extraction Methods of insect fauna and Preservation and identification techniques. In this study total **12 insects** were found which unfolds the diversity of insects that have created their niche in the compost and their contribution in the making and development of compost. **The present work thus concludes that the household compost contains other invertebrates than earthworms- mainly arthropods- which are equally helpful for the formation of compost. Further study is needed as composting not only supports biological diversity but also mitigates the climate change.**

INTRODUCTION

Composting has been defined scientifically as **"the process of natural degradation of botanical and putrescible waste by the action of bacteria, fungi and other organisms in the presence of an adequate air supply" (Hester and Harrison 2002)** and the product obtained is the bio-compost.

Bio-compost is one of the best natural mulches and soil amendments that can be used as an alternative to commercial chemical fertilizers. It improves soil structure, soil fertility, texture, aeration, water-holding capacity and stimulates healthy root development in plants.

Composting is thus a supporting element to climate changes. The chemical fertilizers give out harmful **nitrous oxide hence** use of compost restricts addition of greenhouse gases in the atmosphere. Similarly when the bio-degradable waste gets composted, it diminishes the emission of hazardous methane given out by huge piles of wastes dumped on the ground.

As decomposition is the crux of the composting process, various organisms play essential role in the making and working of compost heap. Most of them are microscopic, some are large enough to be observed with the naked eye, but all are beneficial, each having a role in breaking down raw organic matter into finished compost.

The microorganisms i.e. bacteria, fungi and actinomycetes do the enzymatic actions while the larger fauna in the heap include nematodes, earthworms, woodlice, beetles, flies, ants, earwigs, springtails, millipedes, centipedes, mites, pseudoscorpions and snails, which suck, chew, bite, tear and grind the materials into smaller pieces, making them more suitable for the chemical work of the microscopic decomposers. Similarly these organisms tunnel in the compost, make the compost heap up and down,

turning it all the while, helping in aeration, needed for the composting process. This is the reason why studying these organisms in the compost is very important. In pilot work it was seen that majority of the macro-fauna is arthropods among which the insects dominate.

To study these macro organisms, one has to extract them from the compost using various physical and dynamic methods and preserve in order to identify them.

As references for extraction of only soil organisms were available and no standard methods were available to extract compost dwelling creatures, methods used by soil ecologists were modified, tested and used for the study. Among these, the insects were further isolated and studied.

The present study thus unfolds the diversity of insects which have created their niche in the compost and their contribution in the making and development of compost.

MATERIALS AND METHODS

A) Sample selection- For the present study, samples of compost from different sites was collected seasonally. The samples contained different types of feedstock (raw materials) and method of preparation for each of them was different.

B) Methods of collection of samples- While collecting, compost was handpicked in random amount from different levels and the process was repeated twice so that organic matter from all the strata was collected. Though samples were collected randomly, defined amount (100 gm) was used every time for study of fauna.

C) Methods for extraction of the fauna- The insect diversity observed among the compost samples were recorded using various extraction methods. For the extraction of the **compost insect,** at present no standard methods are available. Hence the methods used for extraction of soil organisms were modified and used in study. The mechanical methods including hand sorting and flotation methods were used along with direct microscopic observations for separation of insect fauna. Among flotation methods, Ladell's modified method and Salt and Hollick's method were used for the separation of insects.

D) Methods of preservation and identification of insects- The organism were collected using pointed and blunt forceps and were preserved in the commonly used insect preservative, which is a mixture of 70% alcohol and Glycerol [70:30]. The preserved organisms were further identified and classified using identification keys. The references and keys used for the study included- A general textbook of Entomology by A.D. Imms (Ninth edition 1957), Fauna of British India, Ceylon and Burma by Arrow G. (1910) and Guide to invertebrate animals by Webb *et. al.* (1978). Along with these major reference books some Internet references were also used for the identification purpose.

RESULTS AND DISCUSSION

For classification, binomial nomenclature method was followed. Class Insecta of Phylum Arthropoda was represented by twelve organisms (table 1.0).

They are identified and described as follows-

1. Earwig

Phylum: Arthropoda
Sub-phylum: Hexapoda
Class: Insecta
Sub-class: Pterygota
Division: Exopterygota
Order: Dermaptera
Sub-order: Forficulina

Eat variety of animal and plant matter. Act as scavengers. Sometimes eat smaller Flies,springtails (Burton and Burton 2002). Majority of the species omnivorous but more species incline to animal food.

(Image 1)

2. Cockroach

Phylum: Arthropoda
Sub-phylum: Hexapoda
Class: Insecta
Sub-class: Pterygota
Division: Exopterygota
Order: Dictyoptera
Sub-Order: Blattaria
Family: Blattidae

Get attracted to damp conditions more often which is why they are found sometimes in moist compost. They are not of great use to compost but sometimes act as scavengers (Copeland 2003).

(Image 2)

Table 1.0

Phylum	Sub phylum	Class	Sub class	Order	Sub order	Family	Organism
Arthropoda	Hexapoda	Insecta	Pterygota	Dermaptera	Forficulina	-	Earwig
				Dictyoptera	Blattaria	Blattidae	Cockroach
				Coleoptera	Polyphaga	Tenebrionidae	Lesser mealworm
							Mealworm sp.
						Nitidulidae	Nitidulid beetle
						Staphylinidae	Rove beetle
				Hymenoptera	Apocrita	Formicidae	Ant
							Honey bee
				Diptera	Brachycera	Stratiomyidae	Soldier fly
					Cyclorrhapha	Drosophilidae	Fruit fly
					Cyclorrhapha	Calliphoridae	Green bottle fly
					Nematocera	Mycetophilidae	Fungus gnat.

3. ***Alphitobius diaperinus.***

Phylum: Arthropoda
Sub-phylum: Hexapoda
Class: Insecta
Sub-class: Pterygota
Division: Endopterygota
Order: Coleoptera
Sub-order: Polyphaga
Super-family Cucujoidea
Family: Tenebrionidae
Sub- family: Tenebrioninae
Tribe: Alphitobiini
Genus: *Alphitobius*
Species: *diaperinus*

4. ***Alphitobius laevigatus***

Phylum: Arthropoda
Sub-phylum: Hexapoda
Class: Insecta
Sub-class: Pterygota
Division: Endopterygota
Order: Coleoptera
Sub-order: Polyphaga
Super-family: Cucujoidea
Family: Tenebrionidae
Sub- family: Tenebrioninae
Tribe: Alphitobiini
Genus: *Alphitobius*
Species: *laevigatus*

Commonly known as 'lesser mealworm' Was the most dominant beetle among all the insects in all samples. Both the larval and adult stages are helpful as cut down the larger plant particles into smaller and provides extra space for microbes.

(Image 3)

The feeding habits and habitat is similar with the sp *diaperinus*. The larvae and beetles feed upon fresh and decaying vegetation. (http://en.wikipedia.org/wiki/Tenebrionid

(Image 4)

5. Nitidulidid beetle

Phylum: Arthropoda
Sub-phylum: Hexapoda
Class: Insecta
Sub-class: Pterygota
Division: Endopterygota
Order: Coleoptera
Sub-order: Polyphaga
Super-family: Cucujoidea
Family: Nitidulidae

Commonly known as sap beetles. Are small (2–6 mm) ovoid. Feed upon plant sap, over-ripe fruits. Help in cleaning compost pile. (http://en.wikipedia.org/wiki/Nitidulidae).

(Image 5)

6 Rove beetle

Phylum: Arthropoda
Sub-phylum: Hexapoda
Class: Insecta
Sub-class: Pterygota
Division: Endopterygota
Order: Coleoptera
Sub-order: Polyphaga
Super-Family: Staphylinoidea
Family: Staphylinidae.

Prey on snails, insects and other small animals. Found in decaying matter including dung and Carcass as are predacious (Imms 1957). Are Swift cusrorials.

(Image 6)

7. Ants

Phylum: Arthropoda
Sub-phylum: Hexapoda
Class: Insecta
Sub-class: Pterygota
Division: Exopterygota
Order: Hymenoptera
Sub-order: Apocrita
Super-family: Vespoidea
Family: Formicidae

Feed upon varied materials like fungi, seeds

8. Honey bee

Phylum: Arthropoda
Sub-phylum: Hexapoda
Class: Insecta
Sub-class: Pterygota
Division: Exopterygota
Order: Hymenoptera
Sub-order: Apocrita
Infra-order: Aculeata

Was a surprise visitor to the compost.

sweets, scraps, other insects and sometimes other ants (Martin *et.al.* 1992). Usually seen when the pile is cooler and drier. During study large ants, about 6-7mm in length were found.

(Image 7)

probably was feeding on the juices of the decaying fruits and vegetables. Did not appear accidentally but was hovering and settling on compost heap.

(Image 8)

9. Soldier fly

Phylum: Arthropoda
Sub-phylum: Hexapoda
Class: Insecta
Sub-class: Pterygota
Division: Endopterygota
Order: Diptera
Sub-order: Brachycera
Family: Stratiomyidae

These are rather large, more flattened and with white, yellow or green markings. Mostly occur in umbelliferrous and damp situations. The larvae are saprophagous scavengers. The larvae were voraciously eating the debris, while the adult fly was feeding upon vegetable trash.

(Image 9)

10. Fruit fly

Phylum: Arthropoda
Sub-phylum: Hexapoda
Class: Insecta
Sub-class: Pterygota
Division: Endopterygota
Order: Diptera
Sub-order: Cyclorrhapha
Family: Drosophilidae

Flies are identified with prominent red eyes. Found on flowing sap, decaying fruit or fleshy parts of vegetables. Get attracted to fermenting decomposing matter. Were observed feeding on herbage and wandering among freshly added feedstock.

(Image 10)

11.Green bottle fly.

Phylum: Arthropoda
Sub-phylum: Hexapoda
Class: Insec ta
Sub-class: Pterygota
Division: Endopterygota
Order: Diptera
Sub-order: Cyclorrhapha
Family: Calliphoridae

Very often, metallic green coloured adult flies. Larvae saprophagous or flesh feeders hence occur in carrion. Fly lay eggs in trash containing remnants of flesh and larvae grown

12. Fungus gnat

Phylum: Arthropoda
Sub-phylum: Hexapoda
Class: Insecta
Sub-class: Pterygota
Division: Endopterygota
Order: Diptera
Sub-order: Nematocera
Family: Mycetophilidae

Very tiny fly. Smaller in size than fruit fly. Feeds mainly on fungal pores in compost and decomposing fruits and vegetables. Larvae sometimes parasitic if fly lays eggs inside

in it. During study the green bottle fly was confined to the compost containing non vegetable matter in feedstock.

(Image 11)

the body of insects. Keeps hovering in compost hence microbes attached to its body get transferred in compost.

(Image 12)

CONCLUSION

In the urbanization era, household garbage disposal is becoming a great problem due to unavailability of space, transportation and many other factors. Composting of this household garbage is essential at the level of housing societies as this will reduce the dumping problem, lessen health hazards and curb methane emission, which in turn supports the environment and fights the climate change.

The insects found in compost should be used for the composting process which will also save biodiversity. But further study related to them need to be done. The present study thus leads to the following conclusions-

- The compost formation initiates with the microorganisms but gets completed with the help of macro-organisms.
- The household compost contains other invertebrates than earthworms- majorly arthropods- which are equally helpful for the formation of compost.
- The study of diversity of arthropods revealed presence of 12 insects in the compost which help in formation and curing of the compost.
- Some insects complete their entire life cycle in compost and thus help composting in their larval as well as adult stage.
- Thus it can be suggested that, household biocompost is a niche for insect diversity and it can be maintained without use of earthworms in the compost

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PHOTOPLATE

Image 1
Earwig

Image 2
Cockroach

Image 3
Alphitobius diaperinus

Image 4
Alphitobius laevigatus

Image 5
Nitidulidid beetle

Image 6
Rove beetle

Image 7
Ant

Image 8
Honeybee

Image 9
Soldier fly

Image 10
Fruit fly

Image 11
Green bottle fly.

Image 12
Fungus gnat