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# Sociobiology and Natural Adaptation of Termite and *Termitomyces* in Different Forest Division of Gorakhpur Region

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**ABSTRACT**

*Termites and Termitomyces are symbiotic association of natural forest and adjoining areas. Termitomyces grow in mound of Termite commonly known as termatorium. Different forest ranges of Gorakhpur and Maharajganj district were explored in the rainy season for environmental adaptation of Termite and Termitomyces species and collect data of seasonal variability in relation to temperature, heat, relative humidity, carbon dioxide and oxygen concentration in and around the termatorium. The results indicated that the Termite are most sensitive to their environment especially temperature, heat, humidity and $CO_2$ concentration. Termitomyces is very sensitive fungus growing in rainy season on the brain like comb of Termite insect. When heavy rainfalls occur with thundering in atmosphere, the humidity increase and other environmental factors are favourable for growth, development and differentiation of fungal mycelium within the termatorium and resulted in the production of biofunctional fruiting body of Termitomyces.*

***Key words***:- *Natural adaptation, Sociobiology, Termite, Termitomyces, Forest division.*

## INTRODUCTION

As social insects, termites live in colonies that, at maturity, number from several hundred to several million individuals. Termites are a prime example of decentralised, self-organised systems using swarm intelligence and use this cooperation to exploit food sources and environments that could not be available to any single insect acting alone. A typical colony contains nymphs (semi-mature young), workers, soldiers, and reproductive individuals of both sexes, sometimes containing several egg-laying queens.

Termite mostly feed on dead plant material generally in the form of wood, leaf letter, soil or animal dung and may cause serious structural damage to building, crops and plantation forest. All termites eat cellulose in its various forms as plant fibre. Cellulose is a rich energy source but remains difficult to digest. An edible wild fungus *Termitomyces* may able to free cellulosic material amassed on the comb into substances that are easier for the termite to assimilate. This relation exists between termite and *Termitomyces* develop into a mutual symbiotic association [1].

Some species of Termite practice fungi culture. They maintain a garden of specialized fungi *Termitomyces*, which are nourished by the excrement of the insect. When the fungi are eaten, their spores pass undamaged through the intestine of the termite to complete the cycle by germinating in the fresh faecal pellets.

The termites cultivate the fungus on special structures within the nest called fungus combs. These fungus combs are continuously provided with externally derived plant material (e.g. wood, dry grass, leaf litter), while the older parts, consisting of partially degraded plant material and fungal mycelium and nodules (asexual fruit bodies covered with conidia) are consumed [1, 2, 3].

All species in the genus *Termitomyces* are completely dependent on the termites since they have never been found free-living and they are rapidly overgrown by other fungi, when removed from the termite nest [4]. Mushrooms (basidiomes) of *Termitomyces* species are commonly observed on termite mounds and are collected by humans as food [4].

## METHODOLOGY

Survey of different forest ranges of Gorakhpur forest division viz. Tinkonia range forest, Baanki range forest, Campierganj range forest, Farenda range forest and Chowk range forest for the collection of data regarding various environmental factors/seasonal variability of temperature,

relative humidity, carbon- di- oxide concentration and soil type in and around the termatorium at different study sites with the help of scientifically made instruments, $CO_2$, humidity and temperature analyzer from July, 2010 to September, 2010.

Detail studies about sociobiology, natural adaptation and growth behavior of *Termitomyces* in relation to termite symbiosis have been made in the field as well as in laboratory whenever necessary.

## RESULT AND DISCUSSION

Collection of data from different forest ranges of Gorakhpur forest region viz. Tinkonia range forest, Baanki range forest, Campierganj range forest, Farenda range forest and Chowk range forest during the rainy season of seasonal variability in temperature, relative humidity, carbon di oxide concentration and soil type in and around the termatorium at different study sites from July, 2010 to September, 2010.

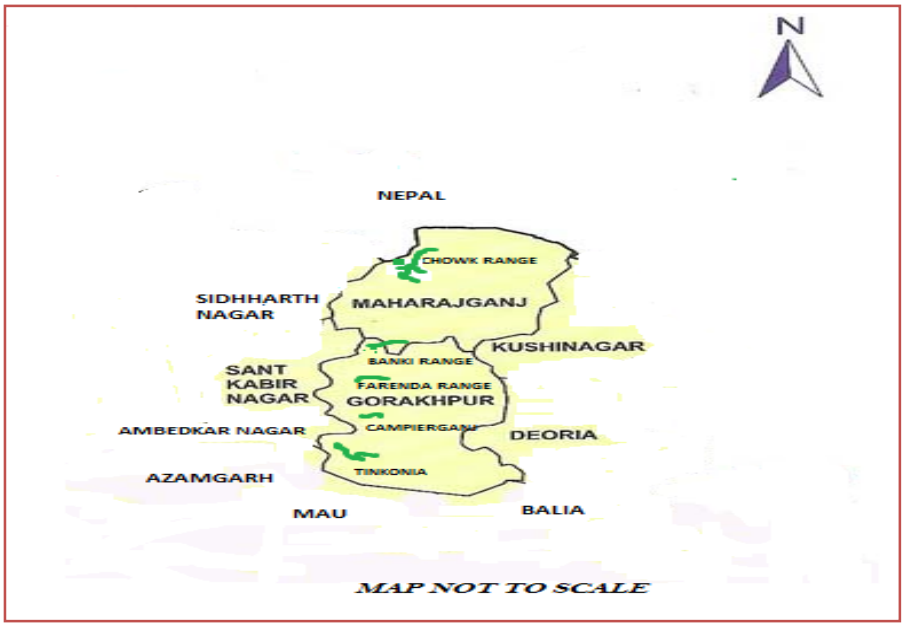


**Fig.1- Map of Gorakhpur Forest Division with District Boundaries**

The data about seasonal variability recorded with the help of carbon dioxide cum temperature analyzer and humidity cum temperature analyzer, data showed in (Table 1). Termite feed on dead plant material in the form of wood, leaf litter, soil or animal dung. The Termites belongs to subfamily Macrotermitinae farm the fungi for food inside their nests on piles of faecal pellets. When the fungi are eaten, their spores pass undamaged through the intestines of the Termites to complete the cycle by germinating in the fresh faecal pellets. The Termites belongs to subfamily Macrotermitinae farm the fungi for food inside their nests on piles of faecal pellets. When the fungi are eaten, their spores pass undamaged through the intestines of the Termites. These undigested asexual fungal spores are inoculated on the fresh material which is continuously added on the top by the Termite. After few days, these fungal spores germinate and covered the whole comb and digest the comb material which is palatable for the Termite. These semi digested materials are eaten by Termites (fig.2).

Termite builds nests to house their colonies. Nests are commonly located in larger timber or in the soil in location such as growing trees, inside fallen trees, underground and in above the ground mounds which they construct commonly called Termatorium / Termite mound /anthills. The termite mound is locally known as Dewkanri / Beemount / Bhita. Termatorium is elaborate structure made up of soil, mud, chewed wood/cellulose, saliva and faeces. The texture of the material is a bit like cork. Nests are built from the dropping of the worker Termites. Worker gathers all the faeces produced by the other castes by eating the faeces. Worker then moves to an area where the colony is building a structure (e.g. nest enlargement, shelter tube, mud tunnel) and

deposits their dropping as the building block of structure. The ability of termites to build highly complex structures is one of the wonders of nature (fig.3).

**Fig. 2- Termite (*Odontotermes obesus*)**

**Fig. 3- An overview of Termatorium**

Termite comb is a structure which is made from macerated wood material gathered by foraging workers that is chewed up and swallowed. When the foragers return to the nest, they evacuate the material very quickly and pseudo feces passing it on the nest workers which take this material and mold into the fungus comb (fig.4). A colony amasses a large number of fungus combs, gathered into a series of galleries atop the nest called a fungus garden. Each fungus comb is placed in a semi-enclosed space called a gallery (fig.5&6).

*Termitomyces* is a fungus growing inside the Termatorium with the association of Termite. *Termitomyces* is the part of an extra corporal digestive system that converts undigested woody material in plants into higher quality oligosaccharide and more easily digestible complex sugars (Termite's actual food). There is some $N_2$ fixation is also takes place.

The result of this study shows that Termite thrive in an atmospheric temperature ranges between 30 to $34^0$C. Air in the fungus chambers is heated by the fermentation process taking place there. The continuous stream of hot air rises within the main tower by pressure and is forced into the ducts system of the ridges. The exterior & interior walls of these ridges are so porous that they enable an exchange of gases to take place. The air is cooled during its passage through the ridges & flow into the air hole by way of lower system of wide duct. From there, it returns to the nest and replaces the rising warm air. House of Termite acts as a natural air conditioner.

Water is needed for the nest because termite bodies have thin membranous skin that needs a constantly humid atmosphere. Besides water for the consumption of the termites, water is also needed for making mortar for the construction of the nest. Humidity level must be 89-99%, High much concentration of carbon dioxide in the because of metabolic activity of Termite and fermentation process. The carbon dioxide content in the Termatorium is usually very high; in which human cannot survive but Termite survive easily. The exchange of gases takes place through the pores and ridges of the Termatorium.

The Termites are most sensitive to their environment especially temperature, heat, humidity and $CO_2$ concentration. When heavy rainfalls occur, the humidity increase up to 99% and other environmental factors are favourable, the growth, development and differentiation of fungal mycelium occur within the Termatorium and resulted in the production of *Termitomyces* takes place. The results indicates that the Termite are most sensitive to their environment especially temperature, heat, humidity and $CO_2$ concentration (Table-1).

*Termitomyces* is very sensitive fungus growing in rainy season on the hexagonal comb of insect. When heavy rainfalls occur, the humidity increase and other environmental factors are favourable the growth, development and differentiation of fungal mycelium occur within the termatorium and resulted in the production of *Termitomyces* takes place (fig.7).

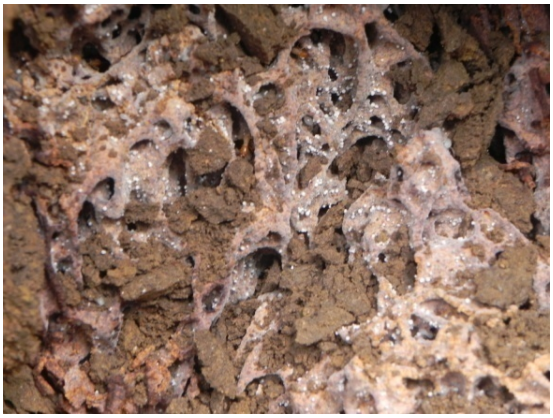

**Fig.4-Comb showing Fungal Sporodochia**

**Fig.5- A fungus comb, showing incipient pin heads**

**Fig.6- Dynamics of Termite in Termite comb**

**Fig.7- An overview of *Termitomyces* fungus**

According to indigenous people of this region *Termitomyces* produced in large amount when heavy rainfall and thunder lightening occur. This fungus were collected and consumed by local people as a pride of delicious food item produced in natural forest. It is locally known as Bhuiphor, Garjua, jungal wala and sold by harvester in the local market for getting income. They consumed directly as fresh or in dried form latter on.

**Table-1:** Seasonal variability in temperature, humidity and $CO_2$ concentration (mean) in and around the Termatorium during survey in different forest ranges

| S.No. | Forest ranges | Inside Termatorium | | | Outside and around the Termatorium | | |
|---|---|---|---|---|---|---|---|
| | | Temperature ($^0$C) | Relative humidity (%) | $CO_2$ concentration (ppm) | Temperature ($^0$C) | Relative humidity (%) | $CO_2$ concentration (ppm) |
| 1. | Tinkonia | 33.8 | 78.0 | 6299 | 33.1 | 65.7 | 387 |
| 2. | Campierganj | 33.6 | 84.5 | 6177 | 33.7 | 76.0 | 480 |
| 3. | Farenda | 33.3 | 88.0 | 6321 | 32.2 | 80.8 | 395 |
| 4. | Baanki | 33.6 | 85.9 | 6386 | 33.2 | 70.9 | 455 |
| 5. | Chowk | 33.9 | 82.0 | 6180 | 33.6 | 64.0 | 390 |

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## REFERENCES

1. Aanen, D. K., Eggleton, P., Rouland-Lefe`vre, C., Frøslev, T. G., Rosendahl, S. &Boomsma, J.J.(2002). The evolution of fungus-growing termites and their mutualistic fungal symbionts. Proceedings of the National Academy of Sciences, USA 99: 14887–14892.
2. Batra, L. R. & Batra, S. W. T. (1979) Termite-Fungus Mutualism. In Insect–FungusSymbiosis:mutualism and commensalism (L. R. Batra, ed.): 117–163. Allanheld & Osmun, Montclair, NJ.
3. Rouland-Lefe`vre, C. (2000). Symbiosis with fungi. In Termites: evolution, sociality,symbioses, ecology (T. Abe, D. E. Bignell & M. Higashi, eds): 289–306. Kluwer Academic Publishers, Dordrecht.
4. Darlington, J. E. C. P. (1994). Nutrition and evolution in fungus-growing termites. InNourishment and Evolution in Insect Societies (J. H. Hunt & C. A. Nalepa, eds): 105–130. Westview Press, Boulder, CO.