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Variation In Mound Structure Built by The Termite Odontotermes Obesus (Rambur) (Isoptera : Termitidae) In Udaipur (South Rafasthan)

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ABSTRACT
Mound building in termite is a species-specific and innate behavior of worker caste. The mounds built by *Odontotermes obesus* (R.) have variation in structure and dimensions. In the present study the 149 mound built by *Odontotermes obesus* (R.) in five crop fields and one forest nursery, which is hilly area, were observed. There were five different types of mound structure were found. The mound structure are varied large to moderate size, dome shaped to subconial and butteresd ranged from 21-110 cm in height and 25 to 560 cm in basal diameter. Sisarma forest nursery which is hilly area has more II type of mounds which are moderate in size and buttressed. In crop fields maximum no. of mounds were of III type i.e. broad base and irregular in shape.

Keywords : *Odontotermes Obesus, Odontotermes Obesus*

Introduction
Mound and nest building in termite (Insecta: Isoptera) is a largely species-specific architectures and natural behavior (Theraulaz *et al.,* 2003) and termites are sometimes identified in the field with the aid of these structure. Mounds are the result of the mutual effort of a large number of individuals specially worker caste working together to build, organize, and expand the mound structure. Mounds represent an extended phenotype of a super organism (Turner, 2004). Studies of extant termites have shown a correlation between increasing sociality and larger colonies with more complex architectures (Eggleton and Tayasu, 2001).

The nests of termites in particular exhibit a wide variety of structures. This diversity of termite mound is not only related to differences in social complexity, but also to adaptations evolved in response to the needs of the colony, food storage, defense, a homeostatic environment necessary for survival and growth of offspring (Noirot and Darlington, 2000).

Termites clutch two places from the economic point of view. As an ecosystem engineers (Jones *et al.,* 1994), termites play a key ecological role in ecosystems through their nesting and foraging activities. During mound building termites modify the soil properties, increasing soil infiltration capacities (Jouquet *et al.,* 2004). They are beneficial in that they assist in the conversion of dead trees and other plant products to substances that can be utilized by plants.

On the other hand they damage wide range of crops including cash crops such as maize, wheat, groundnuts, rice, sugarcane etc., buildings, and forestry. (Boror *et al*., 1989; Dawes-Gromadzki, 2005).

In the higher termites of the Termitidae, like *Odontotermes obesus,* a true worker caste is present that built the nest (Noirot, 1969). As they have very thin cuticle and prone to desiccation and sensitive to temperature fluctuation, there should be strong selection to built mounds this provides homeostatic condition within the mound. *Odontotermes obesus* (Rambur) (Family:Termitidae; Subfamily:Macrotermitianae) is distributed throughout South Rajasthan including Udaipur and common mound building termite. The mounds in this caste vary considerably in size, shape, as well as methods of construction. The huge variety of mound types differing within species is the outcome of natural selection. The fully grown mounds are high, tower like, get thinner towards the top and some of them have buttresses. It shows most remarkable variations in mature mound structure, from tall, buttressed types to no mound at all (Roonwal, 1977)

Peculiarity of the study area is the large number of termite mound in crop fields of nearby Udaipur whose effects agronomic, economic, social, environmental etc. Explaining variability in mound structure, its functional significance and the degree of construction was still attractive to the researchers as well as laymen. So the mounds built by *Odontotermes obesus* (R.) in different crop fields having different structure are studied and classified them according to their structure in this paper.

Materials and Methods

Study Area

This study was done in the different crop fields near Udaipur (/ 24.58°N and 73.68°E). The area surveyed consisted of cultivable crop field of Sisarma, Lakhawali, Sapetia, Nandvel , Kewara ki Nal and Sisarma forest area nearby Udaipur. Within each area, 1000 m^2 (1 hac.) were delimited to evaluate the different types of mound built by *Odontotermes obesus*(R.) in the crop fields. These sites for survey of *Odontotermes obesus* were favorable habitats in terms of their moisture, soil quality and organic matter content. Soil is in generally medium clayed to loamy, brown, yellowish red to red in color, slightly alkaline pH and calcareous in nature.The major crops grown in fields are wheat, maize, groundnut, vegetables etc.

To study the different types of mound structure built by *Odontotermes obesus* in different crop fields, total of 149 termite mounds (n = 35 Sisarma forest nursery, n = 22 Sisarma crop field, n = 24 Nandvel, n = 28 Lakhawali, n = 18 Sapetia, n= 22 Kewra ki Nal) were sampled. Only active mounds of *Odontotermes obesus* were considered for study of mound structure. Workers and soldiers recovered from samples were gently collected with a paintbrush for the purpose of identification. The specimens were stored in 80% ethanol in labeled vials for identification of termites. The scheme of Roonwal and Chhotani (1989) and Chhotani (1997) was used, which is more acceptable and seems to be more practical and satisfactory in Indian context.

Vernicular names – In Udaipur (Rajasthan), termites are called *udeyi* and mound *vandaka.*

S. No.	Site	Field	Total No. of mound
1	a	Sisarma crop field	22
2	b	Sisarma forest area	35

3	c	Nandvel	24
4	d	Lakhawali	28
5	e	Sapetia	18
6	f	Kewra ki naal	22
		TOTAL	149

Results and Discussion

Structure of epigeal mound built by different species to show the Intraspecific variability

Total of 149 mounds built by *Odontotermes obesus* (Rambur) in different crop fields were studied. The *Odontotermes obesus* (Rambur) which is the common mound building termite of south Asia. Mound structures were quite common in crop fields of Udaipur. The termitarium of *Odontotermes obesus* (Rambur) consist of an earthen mound above the ground level (mound proper), and underground it an earthen part containing royal chamber, fungus gardens, nurseries etc.

The mounds above the ground level were large (older one) to medium size, subconical to dome shaped structure with a broad base, rising to a height of about 21-110 cm. and a basal diameter ranged about 25 to 560 cm. The surface of studied mounds were smooth, granular, irregular in shape, with or without holes, some of mounds have blind papillae like projections and small round openings.

The species shows significant series of variation in mature mound structure from the tall, dome shaped buttressed type etc. Four types of mounds have been found as follows, more than one type occur in same field. (Table 1). Classification of mound structure was done according to Roonwal (1977).

Type *I* : This type of mounds are tall, buttressed (5-12 buttresses), with a rings all around with a single underground burial chamber (hence unilocular) containing fungus-comb, gray and brown in colour, mainly built in Sisarma forest nursery(09no.). When dismantle carefully no fungus combs in the part above ground level was found. Mound walls were pitted on the inside. In total 16 mounds of type I were present in all studied area (Fig 1a,b). The royal chamber is underground.

Type II : This type of mounds (41 in no.) are fairly tall, buttressed, and multilocular type, smaller than type I, with 2-9 buttresses and numerous round underground burial chamber (hence multilocular) found in all studied area Sisarma forest nursery(21), Kewra Ki Nal(06), Sisarma crop fields and Lakhawali (05), and Nandvel and sapetia (02) (Fig 2a,b). In the underground burial chambers fungus combs were well develpoed

Type III: In the crop fields of different area of Udaipur most of the mounds (58 in no.) were of III type. They were broad-based, buttressed, dome shaped, subconical or irregularly-shaped, multilocular type composed of a single unitary structure or of a number of blunt and subconical, hollow projection irregularly scattered. Mound walls not pitted on the inside, numerous burial chambers with fungus combs scattered all over. (Fig 3).

Type IV : Least no. of mound type IV (09)were found in studied area. This type of mounds were low, dome shaped or irregularly-shaped, unilocular type with a large burial chamber carrying a fungus-comb at the level of ground and few smaller chambers having fungus–comb were underground. The royal chamber present above ground level. (Fig 4 a,b).

Type V: This type of mound was mostly associated with different trees like Acacia, Palm, Mango, cactus on fences of crop fields, Eucalyptus etc. The outer layers of the mound were hard and thick but the inside of the mound composed of tunnels. *O.obesus* made the earthen galleries on the tree trunk. (Fig 5). Cactus stem was completely filled with earthen material. The galleries were reaching up to 2.5 meter on few trees.


Fig 1 : a. Type I Mound Butteresed. Unilocular; height 90 cm., Lakhawali b. Pitted inside wall of mound of type I


Fig 2 : a. Type II: Butteresed, multilocular; heigh 75 cm , Lakhawali;

b. Type II: Butteresed, multilocular; gray colour, height 55 cm , Sesarma forest nursery

Fig 3 Type III: Broad , low, irregular shaped, buttressed; height 60 cm., Nandvel (showing chimneys)

Fig 4 Type IV: a. Broad , conical shape, non-buttressed; height 60 cm., Sisarma Forest Nursery; b. Broad base, conical shaped, non-buttressed, showing swarming tubes (ST); height 110 cm., Kewra ki nal

Table 1: Different types of mounds present in studied area

Type/Area	Sisarma crop Field (a)	Sisarma forest area (b)	Nandvel	Lakhawali	Sapetia	Kewara ki Nal	Total
Type I	-	09	01	-	06	-	**16**
Type II	05	21	02	05	02	06	**41**
Type III	12	-	14	16	05	11	**58**
Type IV	01	02	02	03	01	02	**11**
Type V	04	03	05	04	04	03	**23**
Total	**22**	**35**	**24**	**28**	**18**	**22**	**149**

Thus, in Udaipur a wide range of variations in mound structure of Odontotermes obesus were observed in field. The largest mound (110 cm. high and basal diameter 560cm.) was observed in Kewra ki Nal. The mounds were also highly variable in shape, size, inner construction and abundance. These variations were not geographical since in same area, and field different types of mounds were recorded.

In the area of crop fields where subsoil water is freely available and irrigation was proper, mounds of II type were found. So the broad based, low in height, tower mound (type II) was found in all studied area as there was proper irrigation. The moderately tall, buttressed but multilocular mounds (type IV) appear to be confined to the less wet part area of crop fields. The broad based, non buttressed and conical (III type) found in all crop field in more number as well. On the boundaries of mostly crop fields trees and cactus were infested by termites, the gallaries were found on the tree and mounds were also associated with tree. The internal architecture consisted of ventilation shafts, galleries and a number of fungus-combs located in separate earthen chambers.

Marked difference between the mounds in the two habitats, different crop fields and Sisarma forest nursery area which is hilly and dense, was observed in their architecture. In the Sisarma forest nursery area, mounds of O. obesus had thick walls, about 5 to 10cm with numerous ridges and complex galleries. In the crop fields, mounds had thin walls (about 2 to 6 cm), were dome-shaped with few protruding structures.

The different species of termite built different types of mound. Variations have so far been found largely among the Odontotermes spp. specially among the Odontotermes obesus(Roonwal, 1979). These variations in the structure among the species may due to difference in subsoil moisture and soil type.

When interviewed with the farmer with reference to mound structure responded said that during early growth of mound, mounds increased in size above ground level, both in height and diameter. They said that the mound structure and termites did not derive any benefit and apart from the crop infestation that was prominent with the presence of termite mounds, attack on other aspects of nearby livelihood including house, clothes, books, wood and woody material, furniture etc. was a common occurrence. In the crop fields where no mound was observed, no crop loss was observed from termite. The infestations in crop field increased during the rainy season to the seedlings stage and near ripening stage, before harvesting were more vulnerable. The farmers also reported that incidence of crop loss by termite was highest in maize, groundnut, wheat, sugarcane, vegetables, flowering plants etc.

Termites especially Odontotermes obesus were really harmful during the seedlings but this was avoided by farmers simply by treating the seed with chemicals insecticides. Also, harmful aspect found in related to termites was the attack on field fences like cactus and other trees.

The relationship between mound structure and the nature of the ecological habitat is not so clear. These variations are not geographical since in the same field area different types of construction are encountered. The area of ground covered by termite mound varies with species and locatives and that the space occupied by mounds has significant effect on the landscape, vegetation and local agriculture practice.

Depending on the species of termites and the surrounding environment, the mounds take a variety of shapes and sizes. The shape of a mound depends upon the nature of the subsoil and climate, if the conditions are not suitable for their particular shape of mound, a species will build accordingly (Harris, 1956). These mounds illustrate how termites are well suited for the environment. The termiteria (mound) built by termites are species specific and termites can be identified in the field by these mounds. Collins(1979) was also observed that M. bellicosus builds different types of mounds under different environmental conditions. In the savanna, mounds are highly structured with many ridges and thin walls in contrast, in the forest mounds are more dome-shaped with hardly any protruding structures and have thick walls.

The differences in mounds structure appear to be caused by different environmental temperature in different study area as shown by Korb and Linsenmair, 1998a. According to our data, mound structure is dependent on long-term ambient temperature conditions. Daily ambient temperature cycles and short-term temperature fluctuations were not affecting the mound structure. The mound structure of the M. bellicose was influenced by environmental temperature (Korb and Linsemair, 1998).

Roonwal (1972) also showed that noticeable differences in the mound structure of Odontotermes brunners. Wood & Johnson (1986) also observed that Macrotermitinae and Odontotermes species are known to build huge mounds of selected clay-rich subsoil. Dawes-Gromadzki (2008) also noted that epigeal nesting species were the most abundant species accounting for 88% of the total species in Savanna woodland reserve in Tropical Australia. The epigeal nesters were dominated by Odontotermes species.

Sunitha and Miranda (2011) observed that Odontotermes obesus is a widely distributed mound building termite in Kerala. Mound of O.obesus vary in structure and height from 2-50 cm and 20-116 cm in circumference at the base. These mounds nearly resemble some of the mound observed in crop fields of Udaipur.

CONCLUSIONS

The study of mound structures built by Odontotermes obesus (R.) revealed that five different types of architecture were found in Udaipur area. These variations are not geographical since in the same field area different types of construction are encountered. Further investigation in the intraspecific variation in mound structure of Odontotermes obesus (R.) in different habitat is required. Also the effect of abiotic factor on mound structure will confirm the result.

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REFERENCES

[1] Chhotani, O.B., 1997. Fauna of India-Isoptera (Termites). Vol. 2. Academic Press, Zoological Survey of India, London, New York, pp: 800.

[2] Collins, N.M., 1979. The nests of Macrotermes bellicosus (Smeathman) from Mokwa, Nigeria.Insectes soc. 26:240–246.

[3] Dawes-Gromadzki, T. Z (2008). Abundance and diversity of termites in a savanna woodland reserve in tropical Australia. Australian Journal of Entomology (2008) 47, 307–314.

[4] Eggleton, P. and Tayasu, I. (2001) Feeding groups, lifetypes and the global ecology of termites. Ecological Research 16: 941 – 960.

[5] Haris,W.V.(1956). Termite mound building.Insectes Sociaux 3,261-268.

[6] Korb, J. and Linsenmair, K.E.(1998). The effects of temperature on the architecture and distribution of Macrotermes bellicosus (Isoptera, Macrotermitinae) mounds in different habitats of a West African Guinea savanna. Insectes soc. 45 :51 – 65.

[7] Noirot, C. (1969) Formation of castes in higher termites. In: Krishna, K., Weesner, F.M. (eds) Biology of Termites, Vol. 1. Academic Press, New York: 311-347.

[8] Noirot, C., and Darlington, J. P. E. C. (2000) Termite nests: architecture, regulation and defence. In: Abe, T., Bignell, D.E., Higashi, M. (eds) Termites: Evolution, Sociality, Symbioses, Ecology. Kluwer Academic Publishers, Dordrecht: 121- 139.

[9] Roonwal ML, Chhotani OB 1989. Fauna of India Isoptera (Termites). Kolkata: Zool Surv India Publ.,I: 1-672

[10] Roonwal ,M.L. (1972). Mound structure, Fungus combs and primary reproductives (King and Queen) in the termite Odontotermes brunners (Termitidae) in India. Proc. Indian natn. Sci.Acad.,39(B)1.

[11] Roonwal, M.L.(1977). Field data on intraspecific variability in mound construction and nesting habits in termites and its ecological relationsips. Proc. Indian Natn.Sc. Acad. 43(B)5:159-174.

[12] Sunitha, S. and Miranda, M.T.P. (2011). Population dynamics of termites with special reference to Odontotermes obesus (Desneux) (Isoptera : Termitidae). Asian J. Animal Sci., 6(1): 43-45.

[13] Theraulaz, G. Gautrais, J., Camazine, S. and Deneubourg, J.L. (2003). The formation of spatial patterns in social insects: from simple behaviours to complex structures. Philosophical Transactions of the Royal Society of London A 361(1807): 1263-1282.

[14] Turner, J. S. (2000) Architecture and morphogenesis in the mound of Macrotermes michaelseni (Sjöstedt) (Isoptera: Termitidae, Macrotermitinae) in northern Namibia. Cimbebasia 16: 143-175.

[15] Wood, T.G. and Johnson, R.A. (1986). The biology, physiology and ecology of termites. In: Vinson, S.B. (ed.) The economic impact and control of social insects Praeger publications: 1-68