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Original Article

Seasonal wood degradation activity of *Odontotermes* spp. (Isoptera: Termitidae) in Bangalore urban district, India

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R.R.Shanbhag[1]
R.Sundararaj[1]

1- Institute of Wood Science and Technology, 18th cross, Malleswaram, Bangalore – 560003
rsundararaj@icfre.org

Abstract

Seasonal wood degradation activity of four species of *Odontotermes* viz., *O. horni* (Wasmann), *O. feae* (Wasmann), *O. obeus* (Rambur) and *O. wallonensis* (Wasmann) was studied at Nallal, in Bangalore Rural district of Karnataka, India for two years from November 2007 to October 2009. It revealed that wood degradation was most during April to June, moderate from July to October and least from November to March. The correlation of termite catch with climatic conditions indicated that the activity of *O. obesus* and *O. horni* and *O. feae* was significantly correlated with minimum temperature, maximum soil temperature, minimum relative humidity, total rainfall and number. of rainy days. Maximum soil temperature was negatively correlated with the termite catch. *O. wallonensis* showed non-significant positive correlation with maximum soil temperature and negative correlation with minimum relative humidity, total rainfall and number. of rainy days.

Keywords: *Population dynamics, seasonal trends, Odontotermes spp., wood destroying termite, Hevea brasiliensis*

INTRODUCTION

Termites are the major threats to the service life of wood as they mainly feed on cellulose. Wood being a complex of heterogenous aggregate of cellulose, hemicelluloses and ligninocellulisic matrix fulfills termite's need of cellulose food [Scheffrahn, 1991]. Among the various groups of termites, the subterranean ones are one of the most economically important pests in the world [Su and Scheffrahn, 1998]. They are the most destructive and economically important insect pests of wood and other cellulose products [Beal *et al.*, 1994], and are responsible for 80% of all termite damage [Su and Scheffrahn, 1990] and 95 % total wood damage [Rawat, 2004]. In India, it is estimated that about 33% of timber produced is lost due to biodegradating agents, especially by termites [Sen Sarma *et al*., 1975]. Among the subterranean termite genera, the genus *Odontotermes* Holmgren is a large, most prolific and widespread group of wood destroying termites. Around 200 species of this genus are reported so far of which 107 occur in the Ethiopian region and 88 in the oriental region. Sen Sarma *et al.* [1975] reported 64 species of wood destroying termites in which 15 species belong to the genus *Odontotermes* from India. Chhotani [1997] listed 43 species of *Odontotermes* with 13 as wood destroying termites. A perusal literature revealed that among the 92 species of wood destroying termites reported from India, 18 species belong to the genus *Odontotermes*. Studies on the natural foraging of subterranean termites are complicated due to their small size, cryptic nature and eu-social behavior [Forschler and Townsend, 1996]. Many studies have attempted to describe the population size, caste demographics and foraging behaviour of subterranean termites. Krishnan and Sivaramkrishnan [1993] reported occurrence and seasonal activity of *Odontotermes horni* [Wasmann]. Parihar [1980, 1981] reported foraging and population ecology of subterranean termites in the desert grassland ecosystem. We studied the wood degradation activity of *Odontotermes* species which are found active at Nallal, in Bangalore Rural district of Karnataka and the findings are presented in this paper.

MATERIAL & METHODS

Experiments were conducted for a period of two years from November 2007 to October 2009 to study the seasonal wood degradation activity of *Odontotermes* spp. at Nallal in Bangalore urban district of Karnataka, India. It is located between 13° 4' 0" N / 77° 47' 53" E and is semi arid in nature with an average rainfall of 826 mm and the temperature ranges between 18.8°C - 29.3°C. Rubber wood [*Hevea brasiliensis*] stakes were used as baits for scouting termites due to its high susceptibility to termite attack in order to learn about the degradation activity of termites. Labelled stakes of the size measuring 30.5cm × 3.8 cm× 3.8 cm were weighed and implanted at monthly intervals. Each test stake was half buried, for exposure to termite attack in the ground and they were checked after exposure for a month. The exposed stakes were brought back to the laboratory and termites were removed from wood. Wood stakes were rinsed and scrubbed with a brush to remove all soil and carton material and then air dried in the laboratory. After air drying weight was recorded. Wood degradation in terms of wood consumption was measured by subtracting the remaining weight from the initial weight of the wood stakes. The data thus collected were pooled, mean was computed and analysed and presented in percentage of weight loss. Simultaneously termites, which were active on the stakes, were collected every month, preserved in 70 percent alcohol in vials with scientific labels and their identification was done by using standard keys. The total number of termites in each species was counted and relative abundance of the species and its seasonal variation was assessed. Termite catch was correlated with the weather parameters and regression was worked out.

RESULTS & DISCUSSION

The seasonal wood degradation activity represented in terms of weight loss was presented in Fig –1 [2007-08] and Fig. 2 [2008-09]. They indicate that wood degradation by termites was most during the months of April to June, moderate from July to October and less from November to March. The more degradation from April to June might be attributed due to pre monsoon showers, which provides necessary amount of moisture required for the termite survival [Kumar, 1991]. Degradation was less from November- March which, might be possibly due to higher atmospheric temperature and lower amount of relative humidity both act as a constraint for the foraging behaviour [Krishnan and Sivaramakrishnan, 1993]. Increase in temperature and decrease in atmospheric humidity results in the lower atmospheric moisture because of which soft-bodied insects like termites need to make an expensive trade-off of spending of greater amount of saliva for construction of sheathing under which they forage [Kumar, 1991]. Chatterjee and Sen Sarma [1962] and Krishnan and Sivaramakrishnanan [1993] deny any kind of relationship between the termite incidence and the relative humidity.

Four species of *Odontotermes* viz., *O. horni, O. feae, O. obeus* [Rambur] and *O. wallonensis* were collected from the experimental site. Among them *O. obesus* was dominant followed by *O. feae*, *O. horni* and *O. wallonensis* [Fig. 3]. All the four termite species were active throughout the year. Peak abundance of *O. obesus* was in the month of May, whereas the peak abundance of *O. wallonensis* was between April and May. *O. feae* was active throughout the year without any distinguishable peak. *O. horni* was highly active during June and August and least active during January [Fig. 4].

The correlation and regression analysis of termite catch with climatic condition [Table 1 and 2] indicated that the activity of *O. obesus* and *O. horni* and *O. feae* was significantly correlated with minimum temperature, maximum soil temperature, minimum relative humidity, total rainfall and No. of rainy days. Maximum soil temperature was negatively correlated with the termite catch as high soil temperature results in decrease of soil moisture content. Low temperature preserves moisture content in the soil as well as in the atmosphere which is a positive sign for termite foraging. Studies by Cornelius and Osbrink [2011] also show that there was a significant correlation between wood consumption and air temperature, soil temperature, and soil moisture, but not with precipitation or number of rainy days. Favourable relationship between termites and moisture content was also explained by the positive correlation of termite catch with minimum relative humidity, total rainfall and number of rainy days. Rain softens the dry and hard soil and facilitates quick and active movement of termites. However, *O. wallonensis* showed non-significant positive correlation with maximum soil temperature and negative correlation with minimum relative humidity, total rainfall and No. of rainy days. This feature might be attributed to the mound building pattern of *O. wallonensis* which construct dome shaped structure with open chimney like outgrowth and hence more intensive and frequent rainfall penetrates into inside the mound and can effectively wash off the termitoria [Kumar, 1991].

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Table 1. Correlation matrix for the termite catches with climatic condition

Weather factor	*O. obesus*	*O. horni*	*O. wallonensis*	*O. feae*
Maximum Temperature	-0.13	-0.271	0.30	-0.19
Minimum Temperature	0.729**	0.570**	-0.0242	0.408*
Max Soil Temperature	-0.396*	-0.463*	0.273	-0.395
Min Soil Temperature	0.061	-0.0845	0.25	-0.03
Maximum Relative Humidity	0.382	0.375	-0.278	0.304
Minimum Relative Humidity	0.616**	0.655**	-0.293	0.400*
Total Rain Fall	0.772**	0.667**	-0.382	0.703**
No of rainy days	0.883**	0.806**	-0.298	0.738**

* = Significant at p = 0.05, ** = Significant at p = 0.01, NS= Non significant

Table 2. Regression Equation worked out between number of termites catch and weather parameter

Regression Equation

O. obesus = 9.248 - (0.285 * T_{Max}) + (0.916 * T_{Min}) - (0.111 * ST_{Max}) - (0.0354 * ST_{Min}) - (0.0888 * RH_{Max}) + (0.0430 * RH_{Min}) - (0.00328 * T_{RF}) + (0.252 * No. $_{RD}$)

R = 0.953 Rsqr = 0.909 Adj Rsqr = 0.860

O. horni = 56.682 - (0.893 * T_{Max}) + (0.871 * T_{Min}) - (0.109 * ST_{Max}) - (0.00652 * ST_{Min}) - (0.402 * RH_{Max}) + (0.0191 * RH_{Min}) - (0.00587 * T_{RF}) + (0.231 * No. $_{RD}$)

R = 0.907 Rsqr = 0.822 Adj Rsqr = 0. 727

O. wallonensis = -26.862 + (0.346 * T_{Max}) - (0.110 * T_{Min}) - (0.151 * ST_{Max}) + (0.724 * ST_{Min}) + (0.262 * RH_{Max}) - (0.139 * RH_{Min}) - (0.0373 * T_{RF}) + (0.377 * No. $_{RD}$)

R = 0.538 Rsqr = 0.290 Adj Rsqr = 0.000

O. feae = 43.898 - (0.519 * T_{Max}) + (0.185 * T_{Min}) - (0.183 * ST_{Max}) + (0.390 * ST_{Min}) - (0.251 * RH_{Max}) - (0.114 * RH_{Min}) + (0.00224 * T_{RF}) + (0.204 * No. $_{RD}$)

R = 0.802 Rsqr = 0.643 Adj Rsqr = 0.452

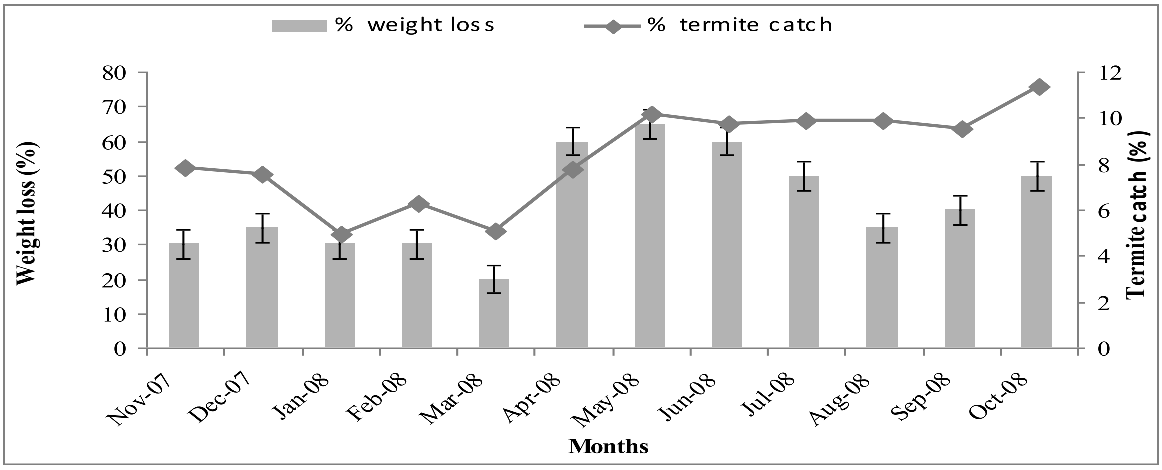

Fig 1. Seasonal wood degradation and total termite catch in different months (2007-08) in Nallal
(Bar indicates standard error of the mean)

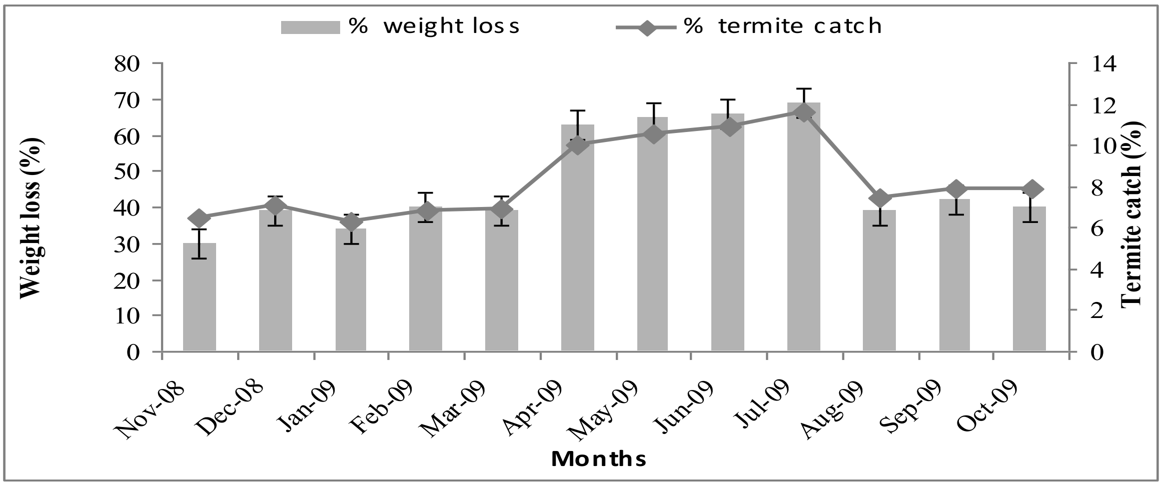

Fig 2. Seasonal wood degradation and total termite catch in different months (2008-09) in Nallal
(Bar indicates standard error of the mean)

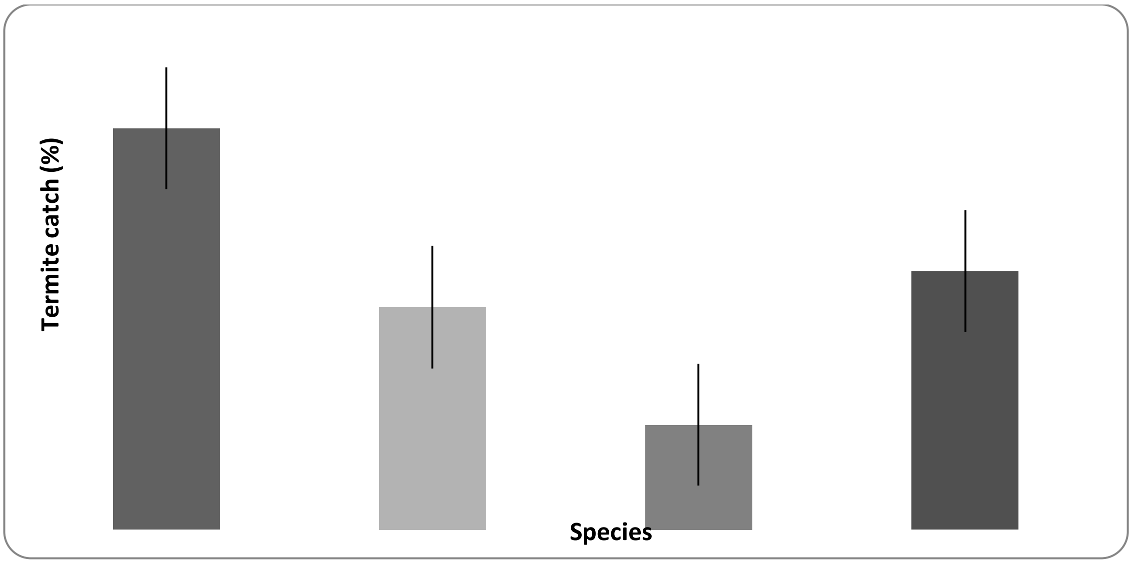

Fig 3. Relative abundance of the termite fauna in Nallal test yard
(Bar indicates standard error of the mean)

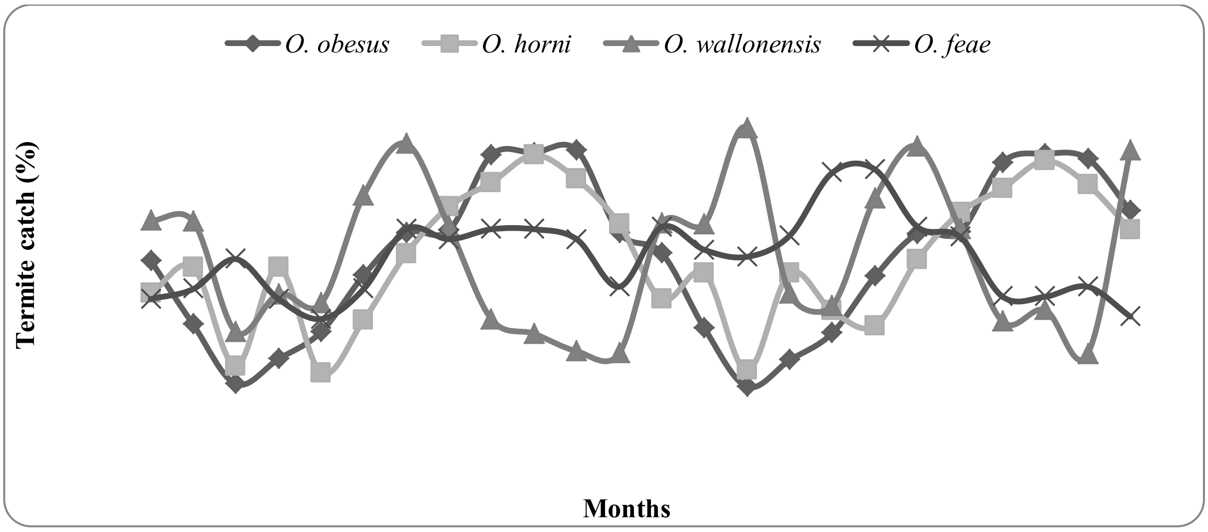

Fig 4. Seasonal abundance of four termite species during the years 2007-2009