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Assessment of termite infestation in six industrially important bamboo species in semiarid tracts of Karnataka, India

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Abstract: A survey was undertaken to assess the extent of termite damage and to explore the probable reasons for susceptibility to termite attack in young (3 year old) plantations of six industrially important bamboo species in Karnataka *viz*. *Dendrocalamus stocksii, D. strictus, D. asper, Guadua angustifolia, Bambusa bambos* and *B. balcooa.* It was found that the exotic species *Guadua angustifolia* was relatively more susceptible to termite attack in the study location. However, further investigations on the degree of termite infestation on the six species in terms of chemical constituents like cellulose, lignin and total phenolic contents did not reveal any significant correlation in the younger stages of the bamboo plantation.

Keywords: Termite infestation, *Guadua angustifolia*, cellulose, lignin, total phenols.

INTRODUCTION

Bamboo is fast emerging as a potential agroforestry species suited to diverse agro climatic zones of the country. National Mission on Bamboo Application (NMBA), National Bamboo Mission (NBM) and Department of Biotechnology (DBT), Government of India currently promotes cultivation and improvement of around 16 industrially important bamboo species (Swarup and Gambhir, 2008). Apart from various indigenous bamboo species, fast growing exotic species like *Dendrocalamus asper* and *Guadua angustifolia* also have high potential for commercial cultivation in India. In Karnataka, *D. stocksii, D. strictus, D. asper, G. angustifolia, B. bambos* and *B. balcooa* are some of the species being promoted for large scale domestication by Karnataka State Bamboo Mission.

D. stocksii, D. strictus, B. bambos and *B. balcooa* are native to India and have been traditionally grown under different climatic and soil conditions. *G. angustifolia,* native to South America and popular in Columbia and Ecuador is found in well-watered, fertile regions especially in riverine areas at elevations below 1,500 m. asl. The species

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grows best in high rainfall humid tropics and prefers rich loamy soils. This species was introduced to Karnataka a decade back by the Bamboo Society of India and subsequently Institute of Wood Science and Technology, Bangalore has worked on standardizing macro propagation techniques and micropropagation protocols. *D. asper* has its origin in South-East Asia and prefers tropical and subtropical climatic condition and has been sporadically tried out in farmer's fields in Jabalpur, Madhya Pradesh (Berry *et al.*, 2008). However, when these species are taken up for cultivation by stakeholders, assessment of its general adaptability and tolerance to pests and pathogens in different climatic conditions is essential before recommending for large scale plantation programmes.

Termite infestation and resultant damage has been a serious problem in the establishment of most bamboo species. Termites generally infest roots and lower portions of bamboo culms. Termite tolerance of bamboo plants is strongly associated with their age, climatic condition in which they are grown and chemical constitution of bamboo species (Liese, 1980; Dhawan *et al.,* 2007). Cellulose, hemi cellulose and lignin are the main chemical constituents of bamboo which accounts for 90 per cent of the total biomass. Resins, phenolics like tannins, waxes and inorganic salts are minor constituents. Bamboo also contains 2-6 per cent of starch, 2 per cent of deoxidised saccharide, 2-4 per cent of fat and 0.8- 6 per cent of protein. Cellulose provides the principal carbohydrate component in the diet of wood feeding termites and attracts termites towards bamboo (La Fage and Nutting, 1978). Presence of more lignin makes bamboo unpalatable to termites (Walcott, 1946; Abushama and Abdel Nur, 1973). Phenols, the aromatic compounds with hydroxyl groups offer resistance to disease and pests in plants. Since contents of cellulose, lignin and polyphenols largely influence resistance/ susceptibility to termite attack (Scheffrahn, 1991), the current study was undertaken with the objective of assessing termite damage in six industrially important bamboo species in Karnataka in relation to their chemical composition.

MATERIALS AND METHODS

a) Study location: A survey of termite infestation was conducted in 3- year old plantations of six industrially important species *viz. D. stocksii, D. strictus, D. asper, G. angustifolia, B. bambos* and *B. balcooa* in the bamboo location trial of IWST, Bangalore at Nallal experimental station, Bangalore rural district, Karnataka during March 2010. Nallal is located at 77^{0}38′E longitude and 12°58′N latitude and receives a mean annual rain fall of 650-750 mm with four months of distinct dry period from February to May. The soils in the area are red, loamy, with pH 7.0, cation exchange capacity 6-83 mmhos/cm^2 and organic carbon 0. 80%. The soils are considered low in N and P and moderate in K. In the trial location, bamboos were planted in 2007 at a spacing 5 X 5 m in four replications with total of 64 plants of each species.

b) Survey and identification of termites: Six plots, consisting of 25 plants of each of the six study species were surveyed for collection of termites. Termites (soldier and worker castes) were handpicked from roots of plants by digging pits on soil near the rhizomes, as well as from culms. The collected termites were preserved in 70 per cent ethanol and identified using standard keys. Termite incidence in each species was worked out as the percentage of plants from which any termite was collected in a sample of 25 plants surveyed.

c) Chemical analysis of bamboo: Culms along with rhizomes/offset of each species were uprooted, cleaned, oven dried and powdered for further chemical analysis. Cellulose content was estimated using Anthrone reagent method (Sadasivam and Manickam, 1992), lignin using Klason's lignin method (Rowell *et al*., 2005) and total phenolic content using Folin-Ciocalteau reagent method (Sadasivam and Manickam, 1992). These parameters were further correlated to incidence of termite infestation in each species.

RESULTS AND DISCUSSION

Survey revealed that nearly 32 per cent of *G. angustifolia* and 12 per cent of *D. asper* plants were termite infested where as other species were found to be less affected (Table 1). Termites were found feeding on the underground rhizomes of bamboo species in the study site and severing the culms from the rhizome as infestation progresses up the culms. Both *G. angustifolia* and *D. asper* being non-native species, appear to be particularly vulnerable to termite attack when compared to native species. The growth and survival of the bamboo species in the third year was also found to follow the same pattern with all the four native species recording > 80 per cent survival while non-native species *G. angustifolia* and *D. asper* recorded 40 per cent and 57 per cent survival respectively (Viswanath *et al*., 2008). Studies in other species like *Eucalyptus*

Table 1. Termite incidence in six bamboo species at Hoskote, Bangalore in relation to chemical constitution

Species	Termite incidence (%)	Cellulose (%)	Lignin (%)	Total phenolics (mg/100g)
D. stocksii	4	56.90	18.60	278.27
B. bamboos	4	57.47	19.62	416.87
G. angustifolia	32	52.53	14.62	305.82
B. balcooa	4	49.29	15.30	401.37
D. strictus	4	43.76	16.33	421.00
D. asper	12	49.70	17.10	367.37
Pearson's co-efficient of correlation with termite incidence (p = 0.05)		0.0195 (NS)	-0.581(NS)	-0.494(NS)

NS- Non-significant at p=0.05

also points to the general susceptibility of exotic species to termite attack compared to native ones (Verma and Nair, 1997). Three species of termites *viz. Odontotermes feae* (Wasmann), *O. horni* (Wasmann) and *O. obesus* Rambur of the genus *Odontotermes* Holmgren were found attacking rhizomes and culms of bamboo species. *O. obesus,* well known for its destructive ability was the dominant termite species in the study site.

Chemical analysis of bamboo species revealed cellulose contents ranging from 43.76 per cent in *D. strictus* to 57.47 per cent in *B. bambos*. Lignin content ranged from 19.62 per cent in *B. bambos* to 13.2 per cent in *G. angustifolia.* Total phenolic content was found to be the highest in case *of D. strictus* (421 mg/100g) and the lowest for *D. stocksii* (278.27 mg/100 g). Cellulose content was found to be positively correlated to termite incidence (Pearson's co-efficient of correlation 0.0195 at $p = 0.05$) while negative correlation was found between termite incidence and lignin and total phenolic contents of bamboo (Pearson's co-efficients of correlation -0.581 and -0.494 respectively at $p = 0.05$). However correlations were not found to be statistically significant (Table 1). Studies on chemical composition of the bamboo species *Phyllostachys pubescens* at different ages in China revealed that amount of lignin in the plant increases with age (Li, 2004). Yusoff *et al.* (1992) observed that in the species *Gigantochloa scortechinii* components like lignin, extractives, and silica content increased with increasing age of bamboo. These results indicate that for the species investigated in the present study, chemical constituents can potentially play an important role in the resistance of bamboo to termite attack with further growth as the concentration of these chemicals also tends to increase with age of the clump.

CONCLUSIONS

Native species of bamboo like *B. bambos* and *D. strictus* were found to be more resistant to termite attack than exotic ones in the present study. Relatively higher susceptibility of *G. angustifolia* to termite attack as revealed in the study indicates that being typically riverine, this species is less tolerant of environmental stresses of semi arid areas as seen in the study location. This also emphasizes the need for adopting appropriate pest management strategies while domesticating exotic species in harsh environments. Negative correlation of lignin and total phenolics to termite incidence are indicative that as plants grow, these constituents may well play an increasing role in overall termite resistance. However, further detailed studies are required to examine the role of chemical constituents in conferring resistance against termite attack at further growth stages of the bamboo plantations.

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