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Infestation behaviour of termites on *Terminalia arjuna* and their management in the field

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Abstract
The termites are the most destructive pest on *Terminalia arjuna*. Their infestation reduce survivability and vigour of the *T. arjuna*, which in turn, affect the cocoon productivity in tropical tasar silkworm. The present study was intended to quantify level of termite infestation on *T. arjuna* at Kargi Kota and Bilaspur and their management using newer insecticides. Studies revealed that the termite infestation was 4.5% and 6.76% in the respective places, in a negative binomial with a contiguous pattern. Significantly less number of plants was found infested by the termite within 6.0 m periphery from the termite mound. The occurrence of other insect-pests like flat headed borer, bark eating caterpillar and leaf gall on the termite affected plants were also recorded. The insecticide study revealed that imidacloprid 17.8 SL @ 0.6 ml, followed by, imidacloprid 17.8 SL @ 0.4 ml and chlorpyrifos 20 EC @ 2 ml showed highest percent of protection in *T. arjuna* against termite damage.

Keywords: *Antheraea mylitta*, *Terminalia arjuna*, Termite, Insecticide, Flat headed borer, Leaf gall

Introduction
Termites are important soil arthropod which belongs to the order Isoptera. Ecologically, termites act as bio-geo-chemical engineers and regulate various pedogenesis activities. But, they also act as an herbivore in the agriculture, silviculture and urban ecosystem. The most destructive species in termites belong to family Rhinotermitidae, Kalotermitidae, Hodotermitidae and Termitidae and mainly they are either wood dwellers or ground dwellers. The subterranean termites, including mound-building and arboreal species, account for 80% of the economically important species [1, 2]. Many anthropogenic, crop production practices and modification of natural habitats are major predisposing factors which had driven the termites to attain pest status [3]. Termites are principally cellulose feeder and damage symptoms include plants wilt, dry up of the entire plant and which can be easily pulled up during an early stage of the plant. Whereas, termites construct galleries on the stem with a sheet of mud and gnaw away the bark and wood underneath their galleries during a later stage of the plants. By these activities, tree becomes weak and intern seriously affects the plant vigour.

The *Terminalia arjuna*, both in the block and natural plantation, is being maintained as a rainfed crop and utilized for the rearing of tasar silkworm, *Antheraea mylitta* D. Under such conditions, the plants are susceptible to termites attack due to modification of natural habitat. Since termite live in the soil, they feed on root system as well as main stem by constructing earthen runways on the newly transplanted saplings very frequently. So that, entire plant dries up and such saplings are easily pulled out from the soil [4] and the earthen runways visible at collar region of the plant. Initially, leaves become yellow and later on dries up immediately by exhibiting dieback symptom on young plants. Whereas, in the mature plants termites feed without killing the plants. The infestation was recorded from the ground to 4-5 ft above ground level on the *T. arjuna*. Visually, poor & stunted growth, less leaf yield and sickly appearance were the common symptoms on mature plants [4]. The seasonal foraging activity of subterranean termites on forest plants of Mulakalapally region, Khammam (A.P). Two distinct foraging patterns were identified in the species of termites [5]. The *Microtermes* sp. and *Coptotermes* sp. have strong forging activity in the wet season. Whereas, peak foraging activity of *Odontotermes* sp., and *Macrotermes* sp., was recorded during the dry season. Hussain [6] estimated 6-25% yield loss in wheat due to termite attack. Mondal *et al.* [7] reported that the termite damage was on dry wood trees and found 49.03% damage up to bark level and 25.88% up to beneath the bark level. Rathore [8] studied the biodiversity of insect pests of

major forest and Agroforestry trees in Chhattisgarh (Raipur, Durg, Mahasamund, Dhamtari and Bilaspur). Majorly, the *Odontotermes* sp. was the most serious pest reported by the maximum number of respondents (82.56%).

The quality cocoon and seed production mainly depend on the high nutritional value of host plants. A negative effect has been noticed on plant vigour and leaf quality of silkworm host due to frequent damage inflicted by the termite. The occurrence and severity of the termite infestation on *T. arjuna* has not been documented systematically in and around Bilaspur region. Therefore, this study is intended to study the details about the occurrence, damage behaviour and their severity as well as an effect of different insecticides on a termite.

Materials and Methods

Studies were conducted at Bilaspur and Kargi Kota, Chhattisgarh state. The Bilaspur is situated in 22.0796° N, 82.1391° E264 m AMSL. The climate is sub-tropical, semi-arid, continental and monsoon type. At Bilaspur, nearly 2.5 ha farm with five years old 7000 *T. arjuna* plants at 4×4 ft spacing was selected in this study. The Kargi Kota is located in 22.1022° N, 82.14685° E 330 m AMSL and the climate is similar to Bilaspur. A total of 17.5 ha areas having more than 15000 *T. arjuna* plant in 4×4 ft spacing was selected at Kargi Kota.

Surveys were conducted during February to August, 2018 for termite infestation in Bilaspur and Kargi Kota farm. For sampling, the entire plot was divided into blocks, and in each block, no. of plants and plants infected by the termites were counted. The information like the status of plant *i.e*. young or old, no. of branches, the height of feeding, feeding area, an infestation of other insects was also assessed during each sampling. The percentage plants infested, pattern of infestation and occurrence of different insect pest in association with the termite were estimated and analysed statistically. To study the effectiveness of insecticides (chlorpyrifos 20 EC @ 0.05%, 0.1% and 0.2%, deltamethrin 2.8 EC @ 0.03%, 0.06% and 0.1%, imidacloprid 17.8 SL @ 0.02%, 0.04% and 0.06%, dichlorvos 76 EC @ 0.075%, 0.15%, and 0.25%, monocrotophos 36 SL @ 0.05%, 0.1% and 0.2% and azadirachtin 10000 PPM (EC) @ 0.0025%, 0.005% and 0.01%), plants infested with termites were selected and market before application of insecticides. Insecticides were treated on the selected 10 plants per treatment. A similar procedure was also followed for all the insecticides and control treatment was maintained without treatment on such selected plants.

The observation was made on 30 days after treatment and per cent reduction in infestation was computed. The percentage data were transformed using ASIN SQRT transformation and analyzed using ANOVA.

Results

The termite infestation was non-significant between the rows (P=0.199) within the block, but, differs significantly between the blocks (P=0.01) at Kargi Kota. The infestation was ranged from 0.8% to 13.6% per block with an average infestation of 4.5%. At Bilaspur, the termite infestation was ranged from 3.75% to 10.86% per block with an average infestation of 6.76% (Fig. 2). The termite infestation differing significantly between the rows within the block (P=0.038) as well as between the blocks (P=0.013). Nearly, 60% and 70% of the infested plants were young at Kota and Pendari, respectively. But, the differences between young and old plants was significant at Kota (P=0.01) and non-significant at Pendari (Fig. 3).

Fig 1: Termite mound and their infested plant in the block plantation of *T. arjuna*.

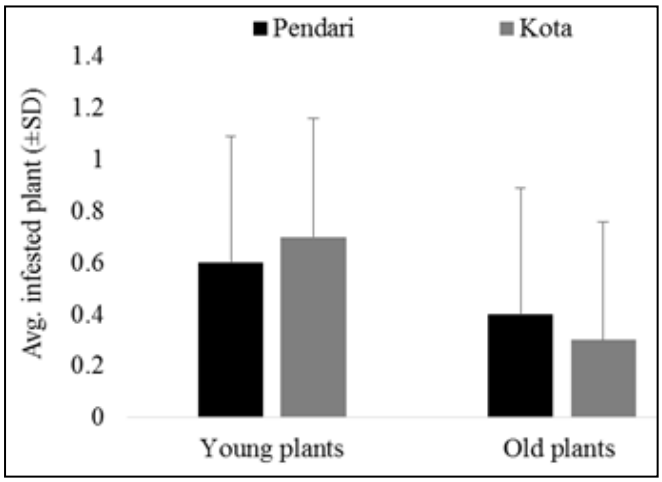

Fig 2: Average infestation of termite in the young and matured plants at Kota and Pendari. The sample size was 30 plants per place.

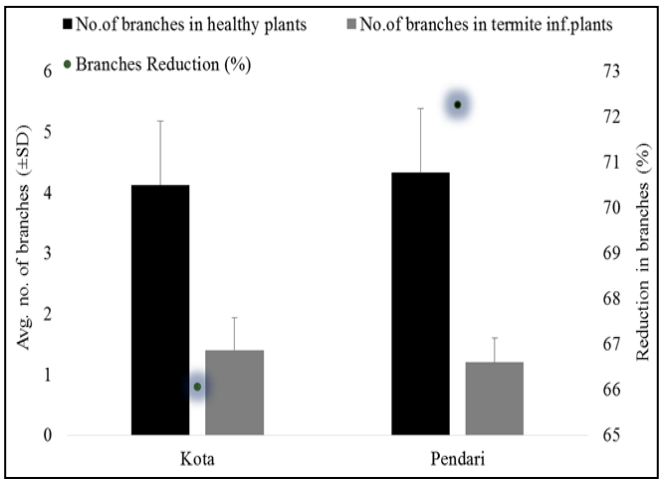

Fig 3: Average number of (±SD) plants in the termite infested and healthy plants at Kota and Pendari fields. The sample size was 40 plants per place.

Table 1: Efficacy of different insecticides with different concentration on termite infestation on *T. arjuna*.

Treatments	Qt. applied (ml/l)	Reduction in termite damage (%)
Chloropyrifos 20% EC	0.5	86.67
	1	90.00
	2	96.67
Deltamethrin 2.8% EC	0.3	43.33
	0.6	63.33
	1	70.00
Imidacloprid 17.8% SL	0.2	90.00
	0.4	96.67
	0.6	100.00
Dichlorvas 76% EC	0.75	60.00
	1.5	56.67
	2.5	66.67
Monocrotophos 36% SL	0.5	56.67
	1	63.33
	2	76.67
Azadirachtin 10000 PPM (EC)	0.5	40.00
	1	43.33
	1.5	53.33
Control (Without spray)		16.67

The termite infestation (Fig. 1) was distributed in negative binomial with the contiguous pattern at Kargi Kota (7.59±35.01) (Mean± Variance) and Bilaspur (36.8±98.2). A total of 8 and 24 termite mounds were found randomly distributed in Pendari and Kota farm, respectively (Fig. 1). Significantly, less number of plants were found infested by the termite within 6.0 m peripheries from the termite mound comparing to outside of the periphery ($t=6.33$; $df=23$; $p=0.01$). The termites were found feeding on approximately 616.06 cm^2 area in a mature plant with an average daily feeding area of 1.43 cm^2. The depth of infestation was 2.5 cm in mature plants. The occurrence of other insect-pests like flat-headed borer, bark eating caterpillar and leaf gall on the termite affected plants also varied significantly at Bilaspur ($p<0.01$) and non-significant at Kota ($p=0.807$). The flat headed borer infestation was more at Bilaspur field compared to Kargi Kota. But, bark eating and leaf gall infestation were more in Kota field compared to Bilaspur. The termite infestation reduces the vigour of the plant in terms of number branches. The reduction in branches was significantly more in both Kota and Pendari fields ($p<0.01$). The decline in branches was 66.06% and 72.25% in the respective places.

The feeding inhibition of termite due to insecticide treatment on *T. arjuna* varied significantly between the treatments ($F=9.15$; $df=18, 56$; $p<0.01$). The results indicated that imidacloprid 17.8 SL @ 0.6 ml, imidacloprid 17.8 SL @ 0.4 ml and chlorpyrifos 20 EC @ 2 ml were found 100.00%, 96.67% and 96.67% effective for protection plants from termite attack, respectively. The next was imidacloprid 17.8 SL @ 0.2 ml (90.00%) and chlorpyrifos 20 EC @ 1 ml (90.00%) followed by chlorpyrifos 20 EC @ 0.5 ml (86.66%), monocrotophos 36 SL (76.67%) and deltamethrin 2.8 EC @ 1 ml (70.00%).

Discussion

The *T. Arjuna* plantations are being raised as a rainfed crop for the rearing of tasar silkworm. Monoculture nature, intermittent dry spell, stressed plants, crop residues, improper transplanting technique and faulty cultural practices were the main factors enhance the termite attack [9] both in block and natural plantation. Since, tasar silkworm is being reared on host plants which are raised under in-situ conditions, the growth, development and reproduction of silkworm and cocoon production are highly influenced by the quality of host plant. Further, rearing of the silkworms are being practised regularly once in year and such utilized host plants have to produce new flushes immediately after rearing. This process creates stressed conditions for host plants and lead to susceptible for a variety of the insect pests. In addition to the termites, the flat-headed borer, bark eating caterpillar and leaf gall were also reported on the systematic plantation at Bilaspur and Kargi Kota regions. Nearly 4.5% and 6.75% of the plants were affected by termites at Kargi Kota and Bilaspur, respectively. Manzoor *et al.* [10] studied on feeding preference of *Heterotermes indicola* and *Coptotermes heimi* on different hosts revealed that *H. indicola* and *C. heimi* found the moderate attack on *T. arjuna*. Nageswara Rao and Sammaiah [5] reported *Odontotermes brunneus* and *Odontotermes gupti* on *T. arjuna* damage up to 35% to 80% in Khammam, Andhra Pradesh. Termite damage to living trees falls under two categories, mainly, monophagous colonies with restricted distribution and host plants, whereas the damage by polyphagous termite which forage over a wide range of distance in search of food. Since, *Odontotermes* sp. attacking *T. arjuna* have wide range of host plants and distribution, so that, they cause huge loss in tasar sericulture sector in India.

The distribution of insect-pests depends on biotic and abiotic factors, which often contributes occurrence and distribution. The occurrence and species composition of termites mainly depends on altitude, drainage conditions and intensity of tillage. The Termite infestation was distributed in a contiguous pattern at Kargi Kota and Bilaspur farm. Aggregation benefits easy finding mates, food, shelter, breeding sites and protection against natural enemies, which ultimately led to the success of an organism. But, termite mounds were randomly distributed in the study area indicating an equal chance for the new colony without competition in a habitat. A total of 8 and 24 termite mounds were found distributed in Bilaspur and Kargi Kota farm, respectively. A study by Jean-Pierre *et al.* [11] found that the density of the 3 different types of termite mounds and found that very high scattered mounds with an average of 8.99 per ha. Bandiya *et al.* [12] recorded a density of 10.08 mounds/ha in a Semi-arid Zone of Nigeria. The randomized distribution could be explained mainly by the stability of the habitat. The

termite infestation reduces the vigour of the plant in terms of number branches due to continuous attack. Termite infestation was recorded throughout the year on *T. arjuna*. Major factors like stress, crop residues, poor intercultural operations, root damage of plants due to improper planting techniques, etc., escalated the termite problems.

Termites are managed indigenously by physically destroying the termite mound and its queen, application of ash or crushed fruits [13], clean cultivation, regular agronomic practices, crop rotation and intercropping of non-host plants. The spraying of chemicals in the off-season protects the infestation of termites. Application of 0.5% aldrin emulsion to the pits before planting of the plants, stems protected by spraying with 5% aldrin in the root zone for protection of *T. arjuna* plants from termite attack during the 1900s [14]. The present study on feeding inhibition of termite on *T. arjuna* found that the imidacloprid 17.8 SL @ 0.6 ml, imidacloprid 17.8 SL @ 0.4 ml and chlorpyrifos 20 EC @ 2 ml were highly effective and prevented host plants from termite attack. Other studies have reported that imidacloprid, carbofuran, chlorpyrifos, phorate, quinalphos and methyl parathion were found effective against termites in different crop [15, 16, 17, 18].

The results of this study inferred that the application of imidacloprid 17.8 SL @ 0.6 ml was protected the tasar silkworm host plants from the termite attack effectively. In additions to insecticides, structural alteration of the host plant canopy by pruning & pollarding, modification of microclimate by erecting bunds and circular basins around the plants to conserve the soil nutrients and application of fertilizes, FYM, vermicompost, *etc*. are being followed to maintain the host plant vigour and enhance resistance/tolerance to different pests.

References

1. Rajagopal D. Economically important termite species in India. Sociobiology. 2002; 41:33-46.
2. Pearce MJ. Termites: Biology and pest management (1st ed.p. 192). Chatham: CABI, 1997.
3. Wood TG. The agricultural importance of termites in the tropics. Agricultural Zoology Reviews. 1996; 7:117-155.
4. Rathore MS, Chandrashekharaiah M, Sinha RB, Sahay A. Studies on termite infestation on *Terminalia arjunaa* and possible management practices. EPRA International Journal of Multidisciplinary Research. 2018; 4(10):107-111.
5. Nageswara Rao A, Sammaiah. Intensity of foraging activity in subterranean termites at Mulakalapally forest region, Khammam district, Andhra Pradesh India. International Journal of Pharmaceutical Research and Biomedical Analysis. 2012; 1(3):1-9.
6. Hussain MA. Pest of wheat crop in India. Proceedings of 2nd World Grain Exhibition and Conference, 1935, 562-564.
7. Mandal BK, Bashar K, Howlader AJ, Rahman KMZ. Incidence of termite infestation to tree species in Jahangirnagar University Campus, Bangladesh. Bangladesh Journal of Life Sciences. 2010; 22(2):7-15.
8. Rathore PS. Biodiversity of insect pests of forest and agroforestry trees in Chhattisgarh plains. M.Sc. (Agri.) Thesis, Indira Gandhi Krishi Vishwavidyalaya, Raipur, 2004.
9. Schneider MF. Factors encouraging termite attac8k and control of termites, 1999. http://www.fzi.uni-freiburg.de/InsectPestKey-long%20version/termite5.htm.
10. Manzoor F, Abbas M, Latif MU. Comparative Study of Resistance and Feeding Preference of 24 Wood Species to Attack by *Heterotermes indicola* (Wasmann) and *Coptotermes heimi* (Isoptera: Rhinotermitidae) in Pakistan. Sociobiology. 2015; 62(3):417-425.
11. Jean-Pierre *et al*. Spatial distribution and density of termite mounds in a protected habitat in the south of Cote D'ivoire: case of National Floristic Center (CNF) of Ufhb of Abidjan. European Scientific Journal. 2015; 11(3):242-259.
12. Bandiya HM, Majeed Q, Ibrahim ND, Shindi HA. Density and Dispersion Pattern of Mounds of *Macrotermes bellicosus* (Isoptera: Termitidae) in Some Local Government Areas of Sokoto, Semi-arid Zone of Nigeria. Research in Zoology. 2012; 2(1):1-4.
13. Sileshi GW, Kuntashula K, Matakala P, Nkunika PO. Farmer's perceptions of tree mortality, pests and pest management practices in agroforestry in Malawi, Mozambique and Zambia. Agroforestry Systems. 2008; 72:87-101.
14. Singh RN, Goel AK, Thangavelu K. Succession of insect pests in tasar ecosystem in Bihar. Indian Journal of Ecology. 1992; 19:177-182.
15. Santharam G, Kumar K, Kuttalam S, Chandrasekaran S. Bioefficacy of imidacloprid against termites in sugarcane. Sugar Tech. 2002; 4:161-163.
16. Singh M, Singh D, Madan YP. Evaluation of different soil insecticides for the control of termites in sugarcane. Indian Sugar. 2001; 51:365-368.
17. Singh SK, Singh G. Comparative evaluation of chemical and botanical insecticides against termites. ENTOMON. 2002; 27:153-160.
18. Kumawat KC. Evaluation of some insecticides against field termites, *Odontotermes obesus* and *Microtermes obesi* in wheat, *Triticum aestivum*. Annals of Plant Protection Sciences. 2001; 9:51-53.