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Survey of Termite Infested Houses, Indigenous Building Materials and Construction Techniques in Pakistan

Farkhanda Manzoor* and Naeem Mir

Department of Zoology, Lahore College for Women University, Lahore, Pakistan (FM), and Department of Architecture, Engineering University Lahore, Pakistan (NM)

Abstract: Termite cause significant economic damage to wooden structures in Pakistan, thus makes termites of public interest. Eleven out of the 53 termite species described in Pakistan are of significant threat to timber-in-service. Still the fact remains that there is not much public awareness regarding what measures they may take or who to contact in order to safeguard their precious property against the termite attack and damage. Termite control measures are important to take necessary and timely actions to save excessive damage and increase service life of the property. Increased termites problem are also related to construction material and techniques. Before treatment, there is a need to understand building materials and construction well enough. Building fabric once treated must be examined annually to test the efficacy of insecticide and the Inspector must be familiar with the biology of termites and building materials.

Key words: Building material, construction techniques, Life cycle, Termites, termite control measures.

INTRODUCTION

Termites are social insects that live in colonies and have several hundreds to over a million termite individuals. Termite colony is composed of reproductives (queen and king) which are few in number within the termite colony. Termite produce winged reproductives which fly on certain period of the year. There are numerous apterous (without wings) non reproductive soldiers and workers in termite colony. Workers and soldiers are sexually immature and blind. Workers' main task is to feed the colony, construct galleries, hatch eggs etc while soldiers defend the colony from predators. All the colony members share food, water and shelter. All termites live in colonies within the confines of excavations within wood above-ground, or in subterranean and epigeal nest systems. They occur wherever there is timber, decaying wood, plant refuse or soil rich in humus on which they can feed (Harris, 1957; Krishna, 1970).

Majority of insects like termites, ants and Aphids produce winged adults, whose only function is to migrate and propagate the species. In Pakistan, various workers have studied the swarming pattern of termites and have correlated it with rainfall and temperature (Afzal, 1981; Akhtar, 1978; Akhtar and Shahid, 1990). Akhtar and Amanullah (1989) also reported that swarming of *Coptotermes heimi*, *Microtermes obesi*, *Microtermes unicolor* and *Eramotermes paradoxalis* started after second rainfall of the season, which created suitable combination of temperature and relative humidity. Swarming behavior of *Microcerotermes championi* was observed during the swarming season of 1997 and 1998. Swarming took place on 16 nights, out of the 92 nights for which observations were made. Swarming started after second rainfall of the season, which created suitable combination of relative humidity and temperature required for swarming. Peak emergence of alate was observed after heavy rainfall (44.0 mm) of short duration at 22.1±°C to 36.5±°C with 80-84% R.H.. Frequency of swarming was maximum between 8.00 pm to 8.30 pm. Overall sex ratio of *M. championi* indicates that females predominate over males 3:1 (F:M). After swarming male and female fall on ground, show tendon running male closely follows the female, shed off wings and pair. A male (king) and female (queen) pair to establish colony. The pair will move to a moist or damp area to initiate a new colony. The queen's major role is to lay eggs, for that purpose she develops an enlarged abdomen containing ovarioles and associated tissues, a condition known as being physogastric (Collins, 1984). The first batch of eggs is produced by the female within a

* Corresponding author: doc_farkhanda@yahoo.com
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few days. The hatched young are translucent white and feeble at first, but very active from the moment they are hatched (Edwards and Mill, 1986). These larvae are fed from nutrient-rich salivary secretions produced by the parents. They normally undergo a number of moults until they achieve the mature form as sterile workers or soldiers, depending to the need of the colony (Harris, 1957). These developments are determined by extrinsic factors such as pheromones and hormones (Krishna, 1970). Usually, at the beginning of a colony foundation the larva become workers and occasionally the larvae develops large dark brown head with protruded jaws of quite distinct shape, into a soldier (Harris, 1957). The colony grows slowly for many years, accompanied by a continuous increase of termite population, enlargement of the nest and much building activity (Bignell and Eggleton, 1998).

The main purpose of the study was to understand termite distribution, termite attack and public opinion on termite damages and control.

MATERIALS AND METHODS

A survey was conducted during 2008 to 2009 to determine termite activity in infested houses, public perception attitudes towards termite control practices and types of damage and the termite species involved. Different areas of Punjab were included in this survey. A total of 200 questionnaires were distributed in various areas and data was obtained from 185 houses.

Survey was conducted through a specifically designed Questionnaire and Personal survey of infested houses.

Questionnaires were distributed in 200 houses. Each questionnaire was having multiple choice questions. Termite inspection comprised of visual observation of damaged parts of houses including wooden structural parts (furniture and cupboards), door frames, windows and walls etc. Termites were identified to species with the help of taxonomic keys (Akhtar, 1983).

RESULTS AND DISCUSSION

Common termite species in the houses

One hundred and fifty termite samples (soldiers, workers nymphs and alates) were placed in vials containing 90% ethanol were collected during the survey. Thirteen termite species identified. During the survey *viz., Odontotermes obesus, Odontotermes guptai, Odontotermes gurdasurensis, Odontotermes horai, Heterotermes indicola, Microtermes obesi, Microtermes mycophagus, Eremotermes paradoxalis, Coptotermes heimi, Heterotermes indicola, Microtermes obesi* and *Microtermes mycophagus* which were most economic species causing infestation to residential wooden structures. *O. obesus* was abundant in grounds and lawns of the houses and the next important termite species collected from trees and soil was *Coptotermes heimi*. When seasonal variations were studied for different species of termites, it was observed that *H. indicola* and *Microtermes* was more persistent and usually available in every month of the year, while genus *Odontotermes* was more obvious in May, June and July and was more visible in July as compared with January to May.

Wood damage

Regarding the rate of infestation of timber species, the woods used in houses were having following percentage of termite attack: Sagwan, 2.3%; Shisheem, 6.9%; Partal, 12.3%; Diyar, 19.2; Plywood, Chipboard and hardboard (24.6%); and 34.6% of the people did not have knowledge about the kind of wood used in their houses.

Evidence of termite infestation

When a house is inspected for termite infestation, there are several visible signs of termite infestation: remaining of alates Shed wings, dead swarmers of termites, mud or shelter tubes, faecal pellate spots. The presence of mud tubes over the surface of walls in some buildings is the primary sign of a termite infestation. Subterranean termites build earthen, shelter tubes to protect them from dry weather, direct sun light, low humidity and predation. The width of these termite shelter tubes are 6mm (¼ inch) to 12mm (½ inch), and can extend many centimeters in length until wood is discovered. These tubes create special microenvironment for the termites and protect termites form the drying effect of air, and maintain the termites' contact with the soil. The building

Table I.- The indigenous materials used in various regions of Pakistan.

S No	Region	Building components and there materials used					
		Walls	**Floors**	**Roof**	**Cabinets**	**Doors**	**Windows**
1	NWFP (Rural)	Stone	Stone	Timber	Timber	Timber	Timber
	NWFP (Urban)	Stone	Stone	RCC*	Timber	Timber	Steel / Alu
2	Punjab (Rural)	Mud	Mud	Timber	Timber	Timber	Timber
	Punjab (Urban)	Bricks	PCC*	RCC	Timber	Timber	Steel / Alu
3	Sind (Rural)	Sand/Mud	Sand/Mud	Timber	Timber	Timber	Timber
	Sind (Urban)	Cement sand block	Cement sand block	RCC	Timber	Timber	Steel / Alu
4	Baluchistan (Rural)	stone	Stone	Timber	Timber	Timber	Timber
	Baluchistan (Urban)	stone	PCC	RCC	Timber	Timber	Steel / Alu

* RCC Reinforced Cement Concrete is a manufacture of cement sand and crushed stone while using steel as reinforcement.
* PCC Plain Cement Concrete is a manufacture of cement sand and crushed stone without steel reinforcement.

fabric should be inspected at least once a year to safe guard against termite attack.

Survey showed that that 47.34% of termite evidence was in the form of damaged wood, 45.56% damage was in the form of mud tubes, only 1.78% evidence was revealed by wings. It was also observed that the rate of infestation of termite attack increases with the age of house. In present study, the age of surveyed houses was between 10-30 years and no drainage was observed around the houses.

Preferred sites of termite attack in the house

Termites were found to be present in different parts of the house including wall, door frames, house stump, timber frame and window frame etc. Around 34.32% damage was detected on door frames, 15.97% to timber frame, 4.73% to walls, 33.13% to window frames, 10.05% to wall stud and 20.71% damage was detected outside houses by tree stumps etc.

Public perception of termite treatment

When house owners were enquired about the perception of termite treatment methods, it was observed that 42% were of the opinion that termites can be controlled by chemicals, 11% opted for traditional methods for termite control whereas 47% did not want to involve insecticide company for termite control.

Construction material and construction techniques

Table I shows the indigenous material used for construction of house in different geographical region of Pakistan.

Timber solid sections are mainly used in structural elements where strength is primary requirement *e.g.* in the frames of roof / floor, door, window, wardrobe staircase etc. The variety of timber used is deodar, *partal* and *kail*. These are expensive therefore, various timber product have been developed to economize on cost of non-structural elements where strength is secondary requirement.

Timber products such as Plywood sheets, Chip Boards, Soft Boards and Hard boards are manufactured from low strength inferior type of timbers such as eucalyptus, popular, bamboo, mulberry, mango and sugar cane skin. Being manufacture of inferior type of timber that is raw and non-seasoned with higher content of sap wood and cellulose these product are 'Schiff special' for termite and are eaten in the first course.

Generally speaking use of timber in residential architecture of Pakistan is about 15% of that used in Europe, UK and USA. The vulnerability of the buildings to termite attack in Pakistan is lesser than those in Europe, UK and USA. but the gravity of problem can not be denied and needs to be addressed.

The termite treatment is usually done by digging foundation trenches and termiticide treatment on side walls and beds of these trenches with pressure as per instruction of the manufacturer that specifies the concentration and penetration of the termicide into the soil. Typical concentration is 1:40 and it should penetrate min. 2" or 5 cm. That makes the liquid barrier around the foundation

structure acting as first defense line against termite attack.

Floors should be filled up with granular material like sand for leveling purpose instead of each filling and termicide be sprayed on the total filling surface before placing floor finishes with the same concentration and penetration.

The open space around the buildings up to 5' 12.5 cm width is also treated by creating liquid barrier of termicide.

Termite proofing

These techniques currently in practice were not developed by research into the local condition *i.e*. information on local species of termite their growth pattern and interaction with the indigenous construction materials but on the recommendations of sales representatives of the foreign manufacturers of termiticides on a hit and trial basis. High rate of termite destruction in our buildings is the obvious results of this practice. We need to look into the issue in a comprehensive way and design our solutions following the classic wisdom 'precaution is better than cure' and pre-construction anti-termite treatment should be considered mandatory for new construction regardless of presence or absence of termite on the site. Application of termiticide alone is just one part of the whole anti-termite proofing process. For better practice we may adopt the following line of action (i) Nest destruction before construction work starts (ii) Building up defense lines within and around the building with the help of appropriate termicide liquid barrier or physical barrier considering the species of termite and type of construction materials used for construction; (iii) controlling quantum of timber/timber products, paper cloth and any other materials having larger contents of cellulose being used in the construction through the use of alternative modern synthetic materials *e.g.* UPVC (un-plasticized poly vinyl chloride) and (iv) using treated timber to avoid termite attack and damage.

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