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CONTROL AND PREVENTION OF BIODETERIORATION CAUSED BY TERMITES (*ISOPTERA*)

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ABSTRACT

The paper reviewed the control measures against damage caused by termites. The objective was achieved using baseline published literature and data. This is particularly important because of the ever present destructive effect and presence of termites in every area of life worldwide. Multiple effective measures, ranging from chemical treatments to independent pest management procedures were identified. The right choice and application of termite preventive and control measures will be a great reprieve to stakeholders all over the world.

Keywords: Damage, Control, Termites.

INTRODUCTION

Termites are social insects belonging to the order *Isoptera*, they are essential in the ecosystem of the soil and are found throughout the world (Abdel and Skai, 2011). Although by their activities they have beneficial values, they also have harmful damaging effects on their targets (Debelo and Degaga, 2014). The undesirable change in the properties of a material caused by the vital activities of living organisms like termites different from physical, chemical and mechanical influences is referred to as biodeterioration. Cellulose containing materials like wood, plants, trees, papers; houses, stones, plastics, leather and almost any other soft material are vulnerable to termite attack (Verkerk, 1990).

Termites or *Isoptera*, commonly called 'white ants' are not true ants. They are considered to be primitive and eusocial creatures (Wilson, 1971). They live in large colonies that have a complex structure of different types of 'castes' which consists of workers, soldiers, kings and queens including developing eggs, larvae and nymphs (Verkerk, 1990; Pinniger and Harmon, 1999; Harmon-Smith *et al.*, 2010). Together with ants, they are about the most common pests in the urban environment (Forschler and Robinson, 2015). They cause serious damage and are increasingly destructive to many objects (Kunika, 2011) especially, wooden houses, wood works, artifacts, buildings, agricultural plantations, trees, structural timber, manufactured wooden goods and papers leading to colossal losses in many parts of the world (Ahmed and Qasim, 2011). In nature, termites function as decomposers that break down dead wood, log or timber which accumulate in and around the soil. The beneficial products of this breakdown are returned to the soil as humus. Tunnels excavated during foraging movements by termites help to aerate the soil. They however,

also attack other useful structures and their presence is seldom noticed until damage is discovered (Kunika, 2011).

Termites are generally divided into three; the drywood eg *Cryptotesines* spp., dampwood eg *Zootermopsis* spp and subterranean termites eg *Retticuliterntes* spp. (Anon., 2015a).
There are over 2,300 termites species in the world, 183 are known to cause damage to buildings, while 83 species cause significant damage. Subterranean termites accounts for 80% of the economically important species (Su and Scheffrahn, 2015).

Some termites develop their colonies and maintain their headquarters in the ground, building their tunnels through the earth and around obstructions to reach food sources. They must have a constant source of moisture either from what they eat or where they nest. They travel underground from the nest to the food source creating mud tunnels across surfaces exposed to air (Kunika, 2011). Oher termites establish colonies in dry, sound wood with low levels of moisture and do not require contact with the soil. They attack wooden items of all kinds, feeding across the grain of the wood, excavating chambers which are connected by small tunnels (Anon., 2015a).

Biodeterrioration by termites

Biodeterrioration is defined as damage to any object caused by living organisms such as termites, fungi etc or the undesirable change in the properties of a material caused by the vital activities of living organisms as distinguished from changes produced by chemical, mechanical and physical influences (Kumar and Pardeshi, 2011). The presence of biodeterriogens like termites endanger objects, structures and properties all over the world causing enormous destruction and economic losses (Khadelwal, 2003).

Materials derived from plants and animals are particularly vulnerable to this biological attack because of the food value of the cellulose or protein embedded in them. Wooden objects and structures, bamboo artifacts, manuscripts, books, textiles, leather, paper, basketry, paintings, stone, masonry are among vulnerable objects (Allsopp *et al.,* 2004).

Most termite species eat anything containing cellulose especially when such materials are wet from rain or dampness or when moisture content is high due to high humidity. The damage done by termites can be extensive when left unchecked. Some other species of termites don't only eat cellulosic materials but also plastic, leather and almost any other soft materials (Kingsolver, 1988; Verkeerk, 1990).
The symbiotic protozoa living in the gut of worker termites enable digestion of cellulose which is typically indigestible, they help the termite to breakdown cellulose to simple sugar which are then used as sustainable nutrients. Termites are not born with these intestinal organisms but they are passed from older termites to nymphs by way of 'trophilaxis' (mouth to mouth transfer) and through other excrements. The protozoa do not survive outside the gut of the termites (Parker, 2002).
The activities of termites can cause agricultural damage due to their verocious appetite for cellulose and other materials (Allsopp *et al.,* 2004).

Crops and ultimately farm yield, timber and timber products, animals and animal products, farm houses, electric poles, installations and fences could be affected (Anon. 2015a). This can lead to agronomic, economic and social challenges (Ruth, 2010).
They are known to cause damage to buildings throughout the tropics, subtropics and temperate regions leading to inestimable negative economic impact worldwide (Abe, *et al.,* 2000).

Termites attack wood and manufactured wooden goods as well as paper (Nkunika, 1994; Grace, 1997). Drywood and subterranean

termites are the most destructive insect pests of wood causing more than $1.7 billion damage each year in the United States (Gouge *et al.,* 2009).
Museums and natural history collections including walls, roofs, windows, doors, artifacts, paintings, potteries, wooden objects, bamboo artifacts, manuscripts, books, papers, leather, basketry, various types of paintings, stones, textiles, monsony, cultural and monumental structures like heritage sites are possible endangered and vulnerable objects to termite attacks (Pinniger and Harmon, 1999; Allsopp *et al.,* 2004).

Prevention and control of termite damage

Prevention and control of termite biodeterrioration is complicated because the biodeteriogens require a variety of different treatments which must be rightly chosen so as to be effective and at the same time not posing danger to the direct object involved. It generally involves the use of chemical treatment and integrated pest management (IPM). Chemicals or pesticides are not only expensive and requires skilled labour but also have many harmful effects (Logan*et al.,* 1990). IPM approach includes cultural, physical and biological methods of control (Linnie, 1996). Understanding termite biology, habits, movement patterns and preferred food sources is key to successful prevention and control.

Termite colonies can be detected using wooden bait stakes. This is dependent on the stake being suitable food source and the termite having efficient and timely foraging patterns (Thompson, 1985).
Conduct regular inspection on objects that are vulnerable to termite infestation (Anon. 2015b). Inspection can be carried out monthly using bright flashlight to look for adult, larvae and shed larvae skins or faeces. Trap bait could also be used to detect the presence of termites (Anon., 2015b). Maintain good routine sanitation. Poor sanitation, food debris, grease, loose hairs can attract termites (Ebeling, 1975; Kumar and Pardeshi, 2011; Anon., 2015a).Control exterior lightings because they attract reproductive termites. Minimizing this will reduce the number of flying reproductives that may want to establish colonies in the environment (Mallis, 1990; Penniger and Harmon, 1999).

Lowered humidity and temperature have been reported to reduce the chances of infestation and slow down the growth of existing ones. Temperature as low as 25^0C and relative humidity of 65% is recommended (Story, 1984; TTMPB, 1998; Thompson, 1985; Anon., 2015a). Cold treatments of about 0^0C can be given inside deep freezer for at least 48hours or 4days (Ishizaki, 2003). Heat treatment in an oven at 55^0F for 3 hours have reported to destroy eggs, larvae and adults provided the objects itself will not be adversely affected, metal or wooden heat chambers which utilizes electric heaters, fans and sensors for even heat distribution and monitoring could be used (Zycherman, 1988).

Chemical treatments of objects including fumigation of environment with pesticides could be done. Insecticide dusts could be applied on suitable objects and blown into termite tunnels with the aid of a dust gun. Substances that could be used include paradichlorobenzene, naphthalene, methyl bromide, sulfuryl fluoride, ethylene oxide, carbon dioxide, phosphine gas, vapona, DDVP or dichlorvos, para-dichlorobenzene (PDB), pyrethrine, pyrethroids, alpha cypermethrin, chlorpyrifos, imidacloprid, fipronil, sodium fluosilicate powder, arsenic dust, boric acid and barium metaborate (Malis, 1990; Olkowski *et al.,* 1991; French, 1994; Ahmed and Qasim, 2011).

Chemical treatments may cause damage to certain plastics like Bakelite, soften or shrink resins, adhesives and paints or cause abrasion to some objects therefore should be used with care (Bennett *et al.,* 1988). Soil treatments can be

done using borate or other insecticides to prevent and control termites in the soil. Borate is none repellent and has slow toxic action. (Grace, 1990). There may be need to call a pest management professional to uncover, control and prevent termite infestation (Penniger and Harmon, 1999).

The environment should be made cooler, drier or both since warm moist environment favour the growth of termites especially in confined conditions (Kumar and Pardeshi, 2011).Routine preventive measures that reduce dampness in buildings, structures and environments will help prevent and control the growth of termites. Leaking roof and roof gutters, broken and leaking windows and doors should be repaired (Cor, 2000).Regularly paint timbers, windows and doors to prevent fungal growth which sometimes precedes termite infestation (Cor, 2000).Physical control involves breaking the moulds of the termites and removing the queen and the kings (Akutse *et al.,* 2012). Create physical barriers to termites by sealing gaps at wall joints and around electrical fittings and sewage lines (Grace 1990; Monowar and Noor, 1995).

Low oxygen treatments can be done for objects in which they are placed in a sealed container containing nitrogen or argon and no more than 0.3% oxygen with water vapour added to achieve 55% relative humidity. Objects can also be placed in a sealed bag for 2-4 weeks with ageless oxygen scavenger® which chemically bind with oxygen and removes it from the bag (Rust *et al.,* 1996; Sugiyama *et al.,* 2003). Quarantine new acquisations and returned loans before joining them to the entire collection to prevent introduction of termites from outside especially in museum, natural history settings (Penniger and Harmon, 1999). Gamma radiation will kill termites at high doses and can be used for their control. High safety precausion must however be observed (Penniger and Harmon, 1999).

Entormopathogenic fungi can be used as biological control of termites since termites are highly susceptible to them (Rath, 2000).

Intercropping of some crops have been reported to prevent and control termites in farms. Garlic and sarson intercropping with sugarcane have been reported to yield non significant termite count (Ahmed *et al.,* 2007). Other ethno methods include the planting of elephant grasses, 'banchi/yoobkarugu and wild tobacco, these plants were reported to have antitermitic activities and repellant to termites (Ahmed and Nasir, 2008; Maayiem *et al.,* 2012). Other ethnopreventive and control measures reported include use of wood ash, salt in shea butter residue, human urine stored for 1-2 weeks mixed with carbon used to spray themound directly having both toxic and repellant effects, Fowls introduced to the area infested by termites to pick and feed on then for the purpose of control (Ahmed and Nasir, 2008; Akutse *et al.,* 2012).

CONCLUSION

The problem posed by termites is worldwide and affects most spheres of life. Many objects and material are vulnerable to termites' infestation. These can however, be controlled and prevented using different chemical and non chemical means which have been found to be effective in varying degrees. The choice of control and preventive measures will however depend on a number of factors which include fund, ease of access to control methods, practicability of administration, effect on target objects, man and environment and the level of efficacy achieved.

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