Attack of Termites in Forest Nurseries and Plantations and Their Management

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Abstract

Termite is one of the major problems of forestry, specially in the tropics. Losses in the forest nurseries and plantations due to termite damage can be substantial. Damage by *Coptotermes, Odontotermes, Microcerotermes, Microtermes* and *Macrotermes* have been found to be serious. This paper describes damages caused by these termites and suggests measures for their management. Various alternative strategies for their management have also been reviewed and discussed.

সারসংক্ষেপ

বনাঞ্চলে, বিশেষতঃ নিরক্ষীয় বনাঞ্চলে, উইপোকার আক্রমণ একটি প্রধান সমস্যা। মানব সৃষ্ট বনে এবং বীজতলায় উইপোকা দ্বারা লক্ষণীয় ক্ষতি সাধিত হয়। *Coptotermes, Odontotermes, Microcerotermes, Microtermes* এবং *Macrotermes* দ্বারা ব্যাপক আক্রমণ দেখা যায়। এ প্রবন্ধটিতে এসব উইপোকা দ্বারা ক্ষতির বিবরণ এবং তাদের দমন পদ্ধতি সম্বন্ধে আলোকপাত করা হয়েছে। এসব সমস্যার প্রতিকার বা প্রতিরোধ বিষয়ে বিকল্প ব্যবস্থাসমূহও পর্যালোচনা করা হয়েছে।

Key words : Control measures, nursery pests, plantation pests, termites, termite management

Introduction

Tree plantation is gaining momentum world-wide specially in the tropics. Various countries have taken up massive afforestation programmes of economically important local as well as fast growing exotics to meet up the ever-increasing demand for fuelwood, fodder, timber and also to stop further ecological degradation. Termite problem is one of the major problems of afforestation specially in the hot and humid countries. A tree can be attacked at any stage of its growth, although young and specially the newly planted fast growing exotics are generally the most susceptible. Termites may cause 50-80% mortality of seedlings and result in complete failure of an afforestation programme (Wardell 1987). Although the critical period is during the first year (4-6 months in the nurseries and 4-5 months after transplanting), losses can also occur three years after planting out. However, losses after first year of planting are negligible (Wardell 1987). This paper describes damages caused by termites and suggests measures for their management in forestry to assist people dealing with this problem in selecting the management techniques best suited to their specific needs.

A. Termites in forest nurseries

Damage

In forest nurseries seedlings and cuttings are maintained generally from six months to one year. In well managed nurseries the problem of termite

attack is negligible. But sometimes it becomes a serious problem, specially in drier areas or sites. Seedlings and cuttings usually become susceptible to termite attack when they are in stressed condition due to physical damage (mechanical, fire), adverse environmental factors (drought, soil) or diseases (microbial infection). Termite attack usually occurs in the upper 20 cm of the soil surface. The bark of the tap root is completely eaten up in a ringed manner. The affected seedlings/cuttings show sign of wilting which results in their death. *Macrotermes* and *Odontotermes* (Termitidae : Isoptera) cut or ring-bark the stem at ground level, and *Microtermes* (Termitidae : Isoptera) damages the root system. These subterranean termites nest either in the soil, or in rotten logs, old tree trunks burried in or in contact with the soil. Some construct epigeal nest (mounds) and others nest in trees but all maintain contact with the soil as a source of moisture and for use as construction of nest galleries.

Management

In nursery beds : For the protection of seedlings/cuttings in the nursery bed, the bed should be drenched with insecticide before seeds are sown. Chlorpyrifos 20 EC @ 30 ml/10 litres of water may be sprayed on to the soil of the nursery bed. Five to ten litres of the mixture is required per square meter of the bed. For quick absorption of the insecticide the bed should be watered at least one day prior to the treatment. Drenching should be carried out in the evening applying the solution uniformly with water can.

In polybags : If the seedlings/cuttings are attacked by termites in polybags, the bags should be treated with insecticide. Each group of 200 bags should be drenched with 10 litres of emulsion using the water can. The emulsion is to be made with 35 ml of chlorpyrifos 20 EC in 10 litres of water stirred with a stick.

B. Termites in plantations

a. *Termite attack on saplings/transplants*

Damage

The trees after transplanting are at their most susceptible stage. This may be due to moisture stress, transplanting shock, composition of local termite fauna, etc. (Nair and Varma 1981, 1985). Once the trees are well-established after 3-5 years or after canopy closure they seem more able to withstand termite attack. The attack is most serious in dry and semi-arid regions. The young saplings are predominantly attacked by the subterranean termites mostly by species of *Odontotermes*, *Microcerotermes* and *Microtermes* (Termitidae : Isoptera). They either cut the stem near the base, eat the bark of tap root in a ringed manner or cut down the root or the stem and penetrate and excavate galleries within it. The attack was found severe on exotics like *Eucalyptus* spp.

Management

Before planting : Prior to planting the pit soil should be thoroughly mixed with 10 gm of BHC 1% dust for 30 cm^3 and 30 gm for 45 cm^3. It has a residual toxicity of about five years and thus protect the plants at the vulnerable stage (Singh 1977). To avoid adverse environmental impact, instead of BHC, the less persistent chlorpyrifos 5 D may be used.

After planting : 35 ml of chlorpyrifos 20 EC mixed with 10 litres of water should be drenched around the base of the saplings.

b. *Termite attack on mature trees*

Damage

Usually two groups of termites, subterranean and drywood, are responsible for damage in mature trees. The subterranean termites eat away thin layers of dead bark of nearly all the tree species. The attack usually occurs under the cover of earthen galleries through which termites travel to and fro from the ground leading sometimes to tree branches and inside the trunk. However, the

attack is mostly restricted to a localized area. Wounds and broken branches if subject to heavy fungal attack can also be infested by this kind of termites with the possibility of destruction of sapwood and heartwood (Browne 1968, Harris 1971). Sometimes the attack, mainly by the subterranean termite, *Coptotermes curvignathus* (Rhinotermitidae : Isoptera), usually occurs from the soil via the roots into the trunk of the tree. In this case the termites cause extensive damage by hollowing out the trunk. Sometimes the attack is secondary following fire or fungal infection (Cooper and Grace 1987, Harris 1971, Rajagopal 1982). However, the trees under stress are more vulnerable to termite attack (Harris 1971, Perry *et al.* 1985).

The drywood termites such as *Cryptotermes*, *Kalotermes* and *Neotermes* (Kalotermitidae : Isoptera) live and feed inside galleries excavated in dead branches and may sometimes extend their galleries into living parts of the tree but the entire tree is seldom killed. In almost all cases they maintain no contact with the ground as a source of moisture or medium of dispersal.

Many species of the genera *Hypotermes*, *Macrotermes* and *Odontotermes* (Termitidae : Isoptera) make earthen mounds in forest plantations specially in sal forests of Bangladesh. These mounds may become a continuous source of termite attack in the plantations raised in denuded sal forest areas.

Management

For subterranean termites : Chlorpyrifos 20 EC@35 ml / 10 litres of water should be applied on the tree trunk after scrapping off the earthen encrustations and runways made by the termites on the trunk. Then the insecticidal emulsion should be drenched in the pit dug around the base of the tree. The amount of emulsion needed per tree depends on the size of the tree infested. However, this method can be ineffective in which entry of termite is via roots deep in the soil.

For drywood termites : Control techniques for drywood termite are labour-intensive and, therefore, expensive and not appropriate for large-scale use in forestry.

For mound-building termites : Complete destruction of mound-building termites can be achieved by making few holes in the mounds and pouring emulsion of 50 ml of chlorpyrifos 20 EC mixed in 10 litres of water. Two or three holes may be made in the mound, and the emulsion is poured in by means of a bucket and a large mouthed funnel. The quantity required varies with the size of the mound. It takes about a week for complete killing of the entire mound colony. Another most effective method is by poisoning the mounds with aluminum phosphide tablets. Two tablets may be placed inside the mound and closed all the openings with mud. The termite will die due to fumigant action of the insecticide.

Discussion

Before any control measure is adopted the level of termite damage should be assessed in order to ascertain whether control is desirable and/or economically feasible. In large scale industrial plantations control measures may be economical but in small scale local forestry the cost of insecticidal control may exceed the benefit it derives. Control in mature tree is rarely economical or practical but control in the nursery providing protection for the first few years after planting is usually effective and worthwhile.

Most termite attack can be prevented by the use of small quantities of cyclodiene insecticides (aldrin, dieldrin, chlordane, heptachlor, etc.) as prophylactic treatment of the potting soil, sometimes supplemented by other techniques. However, the relatively high human toxicity and the unacceptable environmental consequences of cyclodienes, they are increasingly less readily available, and the severe restrictions have been placed on their uses in different countries. As a result the need for alternative strategies is becoming acute.

Alternatives to non-chemical methods of control mainly involve good silvicultural practices, including the use of tree species adaptable to the local climate and environmental conditions, the use of healthy and vigorous planting stock, adequate watering of nursery stock immediately

prior to planting out and timeliness of planting out to avoid subjecting newly transplanted seedlings to draught. But such practice can hardly reduce termite damage to negligible levels (Cowie *et al.* 1989).

Clearing of all woody debris from nursery or planting soil is often recommended but its efficacy remains speculative in the absence of experimental proof.

The efficacy of wood ash, locally available plants, parts of plants or plant extracts as substance toxic or repellent to termites has not been experimentally proved.

A number of other insecticides (eg, chlorpyrifos, isofenphos, permethrin) are marketed for termite control in building (Mampe 1988, Mauldin *et al.* 1987), but these do not have the required persistence (3-5 years) when exposed under agricultural or forestry conditions in the tropics (Wood *et al.* 1987). Controlled release formulations of otherwise nonpersistant insecticides are being developed, but are expensive and not widely available (Cowie *et al.* 1989).

Most damage is caused by subterranean termites. As it is difficult to locate the nest or colony centre housing the royal pair to control them chemically or mechanically, conventional control measures depend on the formation of an insecticidal barrier around the roots. Such a barrier can only be achieved satisfactorily in the nursery or when transplanting, but it must persist until the tree is established (at least 3-4 years) and only the cyclodienes perform adequately (FAO 1985).

Treatment of seedlings in the nursery, either by mixing insecticide with the potting soil prior to filling the plastic seedling bags or by applying a liquid insecticide formulation to the seedling bags in the nursery beds is the most cost-effective and least labour-intensive method (FAO 1985, Nair and Verma 1981, Nair *et al.* 1986, Midgley and Weerawardane 1986, Rajagopal *et al.* 1980, Sen-Sarma 1986, Wardell 1987). The seedlings should be planted in such a way that the treated soil stands 2-3 cm high above the surrounding soil surface (FAO 1985, Rajagopal *et al.* 1980, Midgley and Weerawardane 1986, Rajagopal 1982, Sen-Sarma 1986, Brown 1965). Incomplete removal of the plastic bag, leaving a collar of plastic (approximately 4 cm) around the top to keep treated soil in place has been recommended (FAO 1985, Sands 1962). This reduces the risk of surrounding untreated soil being washed or blown over the treated soil, which would allow access through this untreated soil to termites foraging on or just below the soil surface.

Prophylactic spot treatment of the planting holes and soil in-filling at transplanting is also effective (Nair and Varma 1981, Sands 1962, Sen-Sarma 1986) but uses more insecticide and labour. Prophylactic root-dipping of seedlings in insecticide solution has not been extensively evaluated but is probably not adequately effective (Nair and Varma 1981). Remedial treatment of trees being attacked after transplanting can be effected by applying a solution of one of these compounds (cyclodienes) around the base of the tree (Parihar 1981) but this is costly, labour intensive and only partially effective (FAO 1985, Nair and Varma 1981, Wardell 1987). The efficacy of baits impregnated with insecticides in reducing termite damage is not conclusive (Gao *et al.* 1985).

In biological control, the introduction or encouragement of predatory ant has been suggested (Beeson 1941). The entomogenous fungi-*Beauveria bassiana* and *Metarhizium anisopliae* caused mycoses to *Coptotermes curvignathus*, the latter being the more pathogenic (Sujap and Jan 1990). Some fungal and bacterial pathogens, including some strains of *Bacillus thuringiensis* are toxic to various termite species in the laboratory but have not been successful in the field, even when applied directly to the nest (Hanel and Watson 1983, Khan *et al.* 1985, Smythe and Coppel 1966). Nematode (*Heterorhabditis* sp.) can successfully control drywood termites in tea (Danthanarayan and Vitarama 1987) but are unlikely to be successful in the control of subterranean termites (Mix 1985). Part of the reason for this lack of success with pathogens may be that many termite species isolate dead or infected individuals in the nest (Pearce 1987, Su *et al.* 1982), thus restricting the spread of the pathogen.

The use of resistant tree species is probably

the only satisfactory means of prevention. Differences in susceptibilities to termite damage in species/strains of forest trees are well known (Brown 1965, FAO 1985). However, their relative susceptibilities depend on locality and termite species available. However, due to the availability of cheap, effective insecticides to protect trees from termites, it still remains the popular termite control strategy. Until adequate knowledge is generated for termite resistant species and its silviculture, there will be a need to continue to use insecticides or to develop alternative methods of termite control in forestry.

Conclusions

The termite problem is really a serious threat to the afforestation programmes specially with increasing acreage of the exotics. It is, therefore, very important to realize the significance of the problem and ensure that appropriate preventive and remedial measures are incorporated in the working plans of a plantation programme.

References

Beeson, C. F. C. 1941. A guide to the control of termites for the forest officers. *Indian Forest Records* 4 : 47-87.

Brown, K. W. 1965. Termite control research in Uganda (with special reference to the control of attacks in *Eucalyptus* plantations. *East African Agricultural and Forestry Journal* 31 : 218-223.

Browne, F. G. 1968. *Pests and Diseases of Forest Plantation Trees.* Clarendon Press, Oxford. 1330 pp.

Cooper, P. A and Grace, J. M. 1987. Association of the eastern subterranean termite, *Reticulitermes flavipes* (Kollar) (Isoptera : Rhinotermitidae), with living trees in Canada. *Journal of Entomological Science* 22 : 353-354.

Cowie, R. H. ; Logan, J. W. M. and Wood, T. G. 1989. Termite (Isoptera) damage and control in tropical forestry with special reference to Africa and Indo-Malayasia : a review. *Bulletin of Entomological Research* 79: 173-184.

Danthanarayan, W. and Vitarama, S. I. 1987. Control of the live-wood tea termite *Glyptotermes dilatus* using *Heterorhabditis* sp. (Nemat.). *Agriculture Ecosystems and Environment* 19 : 333-342.

FAO 1985. Methods of termite control in exotic forestry plantations on the Fauta Djallon, Guinea Republic. FAO Tech. Rep. FO : DP/GUI/82/003, Rome. 15 pp.

Gao, D.; Zhu, B. ; He, S. and Yuan, S. 1985. A new toxic bait for the control of forest-infested termites (In Chinese). *J. Nanjing Inst. For.* 1985, 128-131.

Hanel, H. and Watson, J. A. L. 1983. Preliminary field tests on the use of *Metarhizium anisopliae* for the control of *Nasutitermes exitiosus* (Hill) (Isoptera : Termitidae). *Bulletin of Entomological Research* 73 : 305-313.

Harris, W. V. 1971. *Termites, Their Recognition and Control* (2nd edition). Longman, London. 186 pp.

Khan, K. I. ; Jafri, R. H. and Ahmed, M. 1985. The pathogenicity and development of *Bacillus thuringiensis* in termites. *Pakistan Journal of Zoology* 17 : 201-209.

Mampe, C.D. 1988. Making the right choice. *Pest Control* 56 (3) : 34-36.

Mauldin, J. ; Jones, S. and Beal, R. 1987. Viewing termiticides. *Pest Control* 55 (10) : 46-49.

Midgley, S. J. and Weerawardane, N. D. R. 1986. Termite control in Sri Lanka. *ACIAR Forestry Newsletter* 2: 3-4.

Mix, J., 1985. Beal's research shows nematodes don't control subterranean termites. *Pest Control* 53: 22-23.

Nair, K. S. S. and Varma, R. V. 1981. *Termite Control in Eucalypt Plantations.* Research Report No. 6, Kerala Forest Research Institute, Kerala. 48 pp.

Nair, K. S. S. and Varma, R. V. 1985. Some ecological aspects of the termite problem in young eucalypt plantations in Kerala, India. *Forest Ecology and Management* 12 : 287-303.

Nair, K. S. S. ; Varma, R. V. ; Karunakaran, C. K. ; Muhammad, E. and Chand Basa, S. 1986. Field trials for controlling termites in eucalypt plantations. *In :* Sharma, J. K. ; Nair, C. T. S.; Kedharnath, S. and Kondas, S. (eds.) *Eucalypts in India : Past, Present and Future.* Kerala Forest Ressearch Institute Peechi, India. pp. 356-363.

Parihar, D. R. 1981. Termites affecting *Eucalyptus* plantations and their control in the arid region of India. *Z. angew Ent.* 92 : 106-111.

Pearce, M. J. 1987. Seals, tombs, mummies, and tunnelling in the drywood termite *Cryptotermes* (Isoptera : Kalotermitidae). *Sociobiology* 13 : 217-226.

Perry, D. H. ; Lenz, M. and Watson, J. A. L. 1985. Relationship between fire, fungal rots and termite damage in Australian forest trees. *Australian Forestry* 48 : 46-53.

Rajagopal, D. 1982. Relative incidence of termites on exotic species of *Eucalyptus* in Karnataka. *Myforest* 18 : 9-13.

Rajagopal, D. ; Veeresh, G. K. and Kaushalappa, K. A. 1980. Antitermite treatment in the establishment of *Eucalyptus* seedlings. *Myforest* 16 : 127-130.

Sands, W. A. 1962. The evaluation of insecticides as soil and mound poison against termites in agriculture and forestry in West Africa. *Bulletin of Entomological Research* 53 : 179-192.

Sen-Sarma, P. K. 1986. Economically important termites and their management in the Oriental region. *In* : Venson, S. B. (ed.). *Economic Impact and Control of Social Insects.* Praeger, New York. pp. 422.

Singh, P. 1977. Insect problems (in *Eucalyptus). In :* Bakshi, B. K. (ed.). *Disease-Insect Survey Report.* Forest Research Institute, Dehra Dun, India. pp. 12-13.

Smythe, R. V. and Coppel. H. C. 1966. Pathogenicity of externally occurring fungi to *Reticulitermes flavipes Journal of Invertebrate Pathology* 8 : 266-267.

Su, N. Y. ; Tamashiro, M. ; Yates, J. R. and Haverty, M. I. 1982. Effect of behaviour on the evaluation of insecticides for prevention of or remedial control of the Formosan subterranean termite. *Journal of Economic Entomology* 75 : 188-193.

Sujap, A. S. and Jan, P. T. 1990. Pathogenicity of two entomogenous fungi, *Beauveria bassiana* and *Metarhizium anisopliae* on the termite *Coptotermes curvignathus. In :* Hutacharern, C. ; McDickens, K. G. ; Nair, K. S. S. and Ivory, M. H. (eds.). *Pest and Diseases of Forest Plantation in Asia-Pacific Region.* Proc. IUFRO Workshop held in Bangkok, Thailand, RAPA Pub. 1990/9, Bangkok. pp. 266-270.

Wardell, D. A. 1987. Control of termites in nurseries and young plantations in Africa : established practices and alternative courses of action. *Commonwealth Forestry Review* 66 : 77-89.

Wood, T. G. ; Bednarzikes, M. and Aden, H. 1987. Damage to crops by *Microtermes najdensis* (Isoptera, Macrotermitinae) in the irrigated semi-desert areas of the Red Sea Coast. 1. The Tihama region of the Yemen Arab Republic. *Tropical Pest Management* 33 : 142-150.