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Evaluation of Chemical, Botanical and Cultural Managements of Termites Control

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Abstract: The study was conducted at Bojdi Dirmaji District, Wollega Zone (Western Ethiopia) using Randomized Complete Block Design with three replications. Eight different treatments of chemical, botanical and cultural control methods independently and in combinations were evaluated to identify the most effective method which is environmentally sustainable and economically feasible in controlling the termite problems. The data were collected over 12 weeks and analysis of variance showed significant difference among the treatments for all parameters. *Maesa lanceolata* 100 g alone showed lower percent damage between 2-8 weeks (33.3%), later on after 9-12 weeks it become non significant and the destructed mound was recovered. Mound treated with Diazinon 60% EC at the rate of 25 and 20 mL alone and Diazinon 60% EC combination with queen removal at rate of 15 and 10 mL showed significant control overall the treatment. From the results of the study the lower rate of Diazinon 60% EC (10 mL per mound) and queen removal could be better option to manage the termite problem and could be more sustainable and integrated manner in the study area.

Key words: Botanical, termites, *Maesa lanceolata,* isopteran, social insects

INTRODUCTION

Termites are social insect comprise the order isopteran. The individuals are differentiated into various morphological forms or castes which exhibit division of labor performing different biological functions and which live in highly organized and integrated units, societies or colonies. They differ from hymenoptera social insects (ants, bees, warps) in that they are hem boles, their castes are usually bisexual and they have no sub social groups (Krishna and Weesner, 1966). Termites are devastating insect pests which lead to sever soil degradation by reducing vegetation and leaving the soil surfaces barren and exposed to the elements of erosion (Abraham, 1990; Abraham, 1990; Kumar and Pardeshi, 2011; Bong *et al*., 2012). The consequence of termites attack reduces farm productivity and increases land degradation (Altieri and Letourneau, 1984). In general agricultural production is very difficult in termite infested areas. The crops are attacked while they are standing in the field and the soil are compacted and difficult to plough, this in turn resulting in lower production, low income and famine in the rural society of the area. As a result farmers are forced to leave their farm lands and exposed to sever poverty (Abraham and Adane, 1995). Degradation of soil and forest resources as a result of termite infestation is one of the main problems treating the livelihood of the population in West Wollega Zone in general and Bodji Dirmaji District in particular. Considerable variation of the percentage of the damages between different plants was reported (Abdurahaman, 1990). Moreover yield loss depends on the extent of stand reduction and the attack at different growth stage of the crops by termites. For instance, 45% crop removal at the six-leaf resulted in only 16.5% yield loss, whereas the same reduction at the teaseling stage caused 39.9% yield loss (Abdurahaman, 1990).

Use of some cultural control methods such as mounds distraction, removal of the queen, flooding water into the mound, use of hot ash and hot pepper independently, are not effective. As a result control methods heavily depend on synthetic chemicals especially organochlorides, which are currently abandoned from the world market due to their persistent toxicity (Abdurahaman, 1990). According to Abraham and Adane (1995), dressing soil application and fertilizer dressing with Aldrin in two weeks before sowing were effective against termite. Even though using chemical insecticide in controlling insects is highly effective, it cannot be environmental sustainable (Kumar *et al*., 2012). Moreover, the organochlorine insecticides are banned due to their environmental side effects (Wardell, 1987; Bigger, 1966). The use of plant extracts to overcome insect pests problems

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can lead to the isolation of new bio-insecticides for the benefit of human health and agriculture production (Derbalah *et al*., 2012). The possibilities of using different control measures such as fungal insecticides, bio-insecticides and botanical method rather than chemical insecticides have been reported (Sahayaraj and Borgio, 2012; Silva *et al*., 2012; Sujatha *et al*., 2012;. Khorram *et al*., 2011; Raghavendra *et al*., 2011; Mirmoayedi and Maniee, 2009; Mirmoayedi *et al*., 2010). The use of indigenous plant extracts as an alternative for insect pest control also has been reported (Sathyaseelan *et al*., 2008; Abdullahi *et al*., 2011). These have created a critical need to find alternative termite control strategies to tackle these problems. Therefore, the objective of this study is to evaluate different termite control options available and to identify the environmental kind and the optimum combinations of the control strategies.

MATERIALS AND METHODS

Study location: The study was conducted from October, 2007 to February, 2008 at Bojdi Dirmaji District, West Wollega Zone (Western Ethiopia). The study area is located between 08°52' N and 9°07'N latitudes and 35°41'E and 36°10'E longitudes at an altitudes range of 900-1950 m above sea level. The area receives more than 1400 mm annual rain fall. The soil is predominantly nitsol and is characterized by having reddish brown to red color and clay texture. The natural vegetation is predominately woody shrubs, grass land and grass land with river rain forests along the river banks.

Experimental materials and design: The study was conducted by evaluating eight treatments, chemical and botanical pesticides and indigenous knowledge of termite control using Randomized Complete Block Design (RCBD) with three replications. Eight mounds were selected for replications over allocations. A total of 24 mounds including the control were used and mound poisoning was done at the same time over the locations. The treatments used include 25 mL Diazinon 60% EC per mound, 20 mL Diazinon 60% EC per mound, 15 mL Diazinon 60% EC per mound and queen removal, 10 mL Diazinon 60% EC per mound and queen removal, queen removal alone, *Maesa lanceolata* extract 100 g per mound and queen removal, *Maesa lanceolata* extract 100 g per mound alone and untreated check.

Preparation of plant extracts: The fresh leaves of *Maesa lanceolata* were collected from nearby forestland and were chopped and sun dried for three days. The chopped and dried leaves were powdered into fine using blender and 200 g of the leave powder was diluted with one litter tap water and used for application.

Methods of data collection: The treatment was monitored every 14 days for three months and data were collected on the treatment mound with respect to fungal growth i.e. an indication of the destruction of the colony and movement of termite in and around of the mound for three months. Accordingly, 0 = for no movement, 0.5 = for little movement, 1 = for normal movement of the termite was recorded.

Methods of data analysis: The data collected were subjected to analysis of variance for Randomized Complete Block Design as per (Montgomery, 2005). SAS Statistical Software Package (SAS, 2001) was employed for analysis of variance. The statistical significance was determined by using F-test. List Significance Difference (LSD) was used to undertake mean separation in order to identify the most effective treatment.

RESULTS AND DISCUSSION

Analysis of variance showed all the treatments are significantly superior to the untreated (control). But the first four treatments, namely 25, 20 mL Diazinon 60% EC alone and 15 and 10 mL Diazinon 60% EC plus queen removal showed significantly superior result over all the treatments and there was no significant differences between them in controlling the termite (Table 1). The treatment with queen removal alone, extract of *Maesa lanceolata* plus queen removal and *Maesa lanceolata* have showed non significant differences to the control.

Among the control measures used chemical, cultural and botanical control methods were more significant over

Table 1: Mean of termite mound poisoned with eight different treatments of chemical, botanical and cultural control methods over the replications in the three months

Treatments	Mean % age of termite mound destroyed, between (2-12) weeks
25 mL Diazinon 60% EC	100.0^a
20 mL Diazinon 60% EC	100.0^a
15 mL Diazinon 60% EC plus queen removal	100.0^a
10 mL Diazinon 60% EC plus queen removal	97.2^a
Queen removal alone	44.4^b
Maesa lanceolata 100 gm plus queen removal	19.4^b
Maesa lanceolata 100 gm alone	19.4^b
Untreated check	0.0^c
CV% = 12.5	
LSD = 1.83	

Values in the column followed by the same letter are non significant at probability 0.05 level of significance

Table 2: Mean of damage percentage of mound poisoned and destroyed within 2 -12 weeks over the replications

	Mean damage (%)		
	Time interval in the week		
Treatments	2-4 weeks	5-8 weeks	9-12 weeks
25 mL Diazinon 60% EC	100		
20 mL Diazinon 60% EC	100		
15 mL Diazinon 60% EC with queen removal	100		
10 mL Diazinon 60% EC plus Queen removal alone	25	50	50
Maesa lanceolata 100 g plus queen removal	16.7	50	66.7
Maesa lanceolata 100 g alone	25	33.3	0
Untreated check	0	0	0

the control treatment when applied independently i.e., 100, 44.4 and 19.4%, respectively (Table 1). Similar results have been reported result for use of chemical pesticides in controlling pests by Mirmoayedi and Maniee (2009), Mirmoayedi *et al*. (2010). Farmers in the study area also appreciated the use of chemical against termite control without considering the main side effects. Since no one has assessed the deleterious effects of organochlorides on the environment in the zone at all. The combination of 15 mL and 10 mL Diazinon 60% EC with queen removal were as effective as 25 and 20 mL Diazinon 60% EC while *Maesa lanceolata* 100 g with queen removal was less significant as compared to both of them, even though queen removal alone and *Maesa lanceolata* 100 g with queen removal could not completely control the termite from the mound (Table 2). This similar with the reports of (Pearce, 1997), which indicated the queen removal only may not destroy the colony. This experiment also indicated that the using chemical with queen removal was effective. However combination of queen removal with *Maesa lanceolata* minimizes the number of termite per mound for a given period of time (Table 2). This result in agreement with results indicted by Apers *et al*. (2001), Manguro *et al*. (2011), Okemo *et al*. (2003) for antiviral, haemolytic, molluscicidal, bactericidal and fungicidal effects of the chemical found in *Maesa lanceolata* leaf extracts. And it also supports the indication of Gauchan *et al*. (1998), for the use of queen removal to control termites. This result is similar with findings of (Logan *et al*., 1999) which indicated that Neem tree *(Azadirachta indica)* and *Ipomoea fistula* mulches help to reduce termite activities.

The treatments with high dozes 25, 20 mL Diazinon 60% EC and 15 mL Diazinon plus queen removal was resulted in quick destruction of the colony i.e., 100% destroyed the colony and fungal development was observed on each mound immediately within two weeks after the treatment. This result is in agreement with the reports of (Mirmoayedi *et al*., 2010). This indicated the effectiveness of the chemical to control termite problem if it is used without considering their economic and environmental drawbacks. While the lowest chemical doze i.e., 10 mL Diazinon 60% EC plus queen removal produced similar effect with high dozes chemical (Table 2) indicating the possibility to control termite problem by using the combination of lower doses of Diazinon 60% EC and cultural control which may reduce the environmental impact of the chemical pesticides and the expenses to purchase the pesticides. The findings reported by (Mirmoayedi and Maniee, 2009; Su and Scheffrahn, 1998), was similar to the result of above report for utilizing lower dosage of insecticides to control insect pests. The mound treated with *Maesa lanceolata* 100 gm with queen removal and queen removal alone destroyed 66.7% between 9-12 weeks. This result supports the indication of the reports by Scott *et al*. (2003, 2004), Zolotar *et al*. (2002) on the possibility to utilize plant extracts as an alternative method to control pests. According (Sileshi *et al*., 2009), termite managements should be built on farmers' indigenous knowledge and adequate understanding of the ecology of the local termite species. The treatment with *Maesa lanceolata* 100 g alone resulted in the recovery of the mound after 9-12 weeks (Table 2) indicating use of *Maesa lanceolata* 100 g alone to control termite may not be effective. According to (Silva *et al*., 2012), the effectives of utilizing any botanical plants in insect pests protection depends on it toxicity to target pest, its effect on development and reproduction of the target organism or any other factors that leads to the reduction of its population.

CONCLUSION

The aim of this study was to identify termite control method that is environmentally sustainable, integrated and participatory way of managing the pest and the damage caused by it. This was done by conducting an experiment on field with eight different treatments of chemical, botanical and cultural control methods independently and/or in combination. From the eight treatments 25 and 20 mL Diazinon 60% EC were more significant when used independently. The 15 and 10 mL Diazinon with queen removal were also showed equal significance with 25 and 20 mL for it completely destroyed the colony within 2-5 weeks. *Maesa lanceolata* extract 100 g with queen removal and queen removal alone were less significant and only helped to reduce termite number rather than completely eliminating them. While *Maesa lanceolata* extract 100 g alone was found non significant and the destroyed mounds developed to the normal condition between 9-12 weeks. In general, from the result obtained, it could be concluded that the farmers can

use 10 mL Diazinon 60% EC with queen removal in controlling this catastrophic pest since small amount of insecticides are used per nest as it is less likely to pollute the environment. It also could be concluded that using *Maesa lanceolata* extract 100 g plus queen removal could be used for termite control where the intensity of the colony is low and this could be environmentally friendly and economically feasible. Furthermore, further experimentation is needed to determine the most appropriate dosage of *Maesa lanceolata* extract to be used with combination of queen removal to apply it for complete destruction of the colony, as this method is the most environmentally sustainable and economically feasible.

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REFERENCES

Abdullahi, N., Q. Majeed and T.I. Oyeyi, 2011. Studies on efficacy of *Vitallaria paradoxa* seed oil on the oviposition, hatchability of eggs and emergence of *Callasobruchus maculates* (F.) (Coleoptera: Bruchidae) on treated cowpea seed. J. Entomol., 8: 391-397.

Abdurahaman, A., 1990. Foraging activity and control of termite in Western Ethiopia. Ph.D. Thesis, University of London, Department of pure and Applied Biology, Imperial College of Science, Technology and Medicine. Silwood Park Ascot.

Abraham, T. and K. Adane, 1995. The effect of seed dressing with Aldrin on termite in Maize western Ethiopia. Proceedings of the 2nd Crop Protection Society of Ethiopia, April 26-27, 1995, Addis Ababa, Ethiopia, pp: 23.

Abraham, T., 1990. Termites: Problems and possible methods of their control in agriculture with reference to the Ethiopian condition. Proceeding of the 10th Annual meeting of the Ethiopian Entomologists, February 7-9, 1990, Norway Zurich, Switzerland, pp: 50-74.

Altieri, M.A. and D.K. Letourneau, 1984. Vegetation diversity and insect pest out breaks. Cri. Rev. Plant Sci., 2: 131-169.

Apers, S., S. Baronikova, J.B. Sindambiwe, M. Witvrouw and E. de Clercq *et al*., 2001. Antiviral, haemolytic and molluscicidal activities of triterpenoid saponins from Maesa lanceolata: Establishment of structure-activity relationships. Planta Med., 67: 528-532.

Bigger, M., 1966. The Biology and control of termite damaging field crops in Tanganyika. Bull. Ent. Res., 56: 471-474.

Bong, C.F.J., P.J.H. King, K.H. Ong and N.M. Mahadi, 2012. Termite assemblages in oil palm plantation in Sarawak, Malaysia. J. Entomol., 9: 68-78.

Derbalah, A.S., A.M. Hamza and A.A. Gazzy, 2012. Efficacy and safety of some plant extracts as alternatives for *Sitophilus oryzae* control in rice grains. J. Entomol., 9: 57-67.

Gauchan, D., J. Ayo-Odongo and Vaughan, 1998. A participatory systems analysis of the termite situation in West Wollega, Oromia Regional State. Ethiopia: Working Document Series 68, ICRA, Wageningen, The Netherlands.

Khorram, M.S., N.T. Nasabi, S. Jafarnia and S. Khosroshahi, 2011. The toxicity of selected monoterpene hydrocarbons as single compounds and mixtures against different developmental stages of colorado potato beetle, *Leptinotarsa decemlineata* say (Coleoptera: Chrysomelidae). J. Entomol., 8: 404-416.

Krishna, K. and F.M. Weesner, 1966. Biology of Termite. Academic Press, New York and London.

Kumar, D. and M. Pardeshi, 2011. Biodiversity of termites in agro-ecosystem and relation between their niche breadth and pest status. J. Entomol., 8: 250-258.

Kumar, R., M. Nitharwal, R. Chauhan, V. Pal and K.R. Kranthi, 2012. Evaluation of ecofriendly control methods for management of mealybug, *Phenacoccus solenopsis* Tinsley in cotton. J. Entomol., 9: 32-40.

Logan, J.M.W., R.H. Cowie and T.G. Wood, 1999. Termite control in agriculture and forestry by non chemical methods: A review. Bull. Entomol. Res., 80: 309-330.

Manguro, L.O.A., O.M. Jacob and L.F. Tietze, 2011. Triterpene saponins of *Maesa lanceolata* leaves. ARKIVOC, 3: 172-198.

Mirmoayedi, A. and M. Maniee, 2009. Integrated pest management of cotton's spiny bollworm (*Earias insulana*) with spray of diazinon and relaese of green lacewings. J. Entomol., 6: 56-61.

Mirmoayedi, A., M. Maniee and A. Yaghutipoor, 2010. Control of cotton spiny bollworm, *Earias insulana* boisduval, using three Bio-Insecticides, Bt, Spinosad and Neem-Azal. J. Entomol., 7: 89-94.

Montgomery, D.C., 2005. Design and Analysis of Experimentals. 6th Edn., John Wiley and Sons Inc., USA., Pages: 280.

Okemo, P.O., H.P. Bais and J.M. Vivanco, 2003. *In vitro* activities of *Maesa lanceolata* extracts against fungal plant pathogens. Fitoterapia, 74: 312-316.

Pearce, M.J., 1997. Termites, Biology and Pest Management. CAB International, Willing Ford UK., Pages: 172.

Raghavendra, B.S., K.P. Prathibha and V.A. Vijayan, 2011. Larvicidal efficacy of *Eugenia jambolana* Linn. extracts in three mosquito species at Mysore. J. Entomol., 8: 491-496.

SAS, 2001. Statistical Analysis System Software. Ver. 8.2, SAS Institute Inc., Cary, NC.

Sahayaraj, K. and J.F. Borgio, 2012. Screening of some mycoinsecticides for the managing hairy caterpillar, *Pericallia ricini* fab. (Lepidoptera: Arctiidae) in castor. J. Entomol., 9: 89-97.

Sathyaseelan, V., V. Baskaran and S. Mohan, 2008. Efficacy of some indigenous pesticidal plants against pulse beetle, *Callosobruchus chinensis* (L.) on green gram. J. Entomol., 5: 128-132.

Scott, I.M., H. Jensen, J.G. Scott, M.B. Isman, J.T. Arnason and B.J.R. Philogene, 2003. Botanical insecticides for controlling agricultural pests: Piperamides and the Colorado potato beetle *Leptinotarsa decemlineata* Say (Coleoptera: Chrysomelidae). Arch. Insect Biochem. Physiol., 54: 212-225.

Scott, I.M., H. Jensen, R. Nicol, L. Lesage and R. Bradbury *et al*., 2004. Efficacy of *Piper* (Piperaceae) extracts for control of common home and garden insect pests. J. Econ. Entomol., 97: 1390-1403.

Sileshi, G.W., P. Nyeko, P.O.Y. Nkunika, B.M. Sekematte, F.K. Akinnifesi and O.C. Ajayi, 2009. Integrating ethno-ecological and scientific knowledge of termites for sustainable termite management and human welfare in Africa. Ecol. Soci., 1: 14-48.

Silva, L.B., Z.F. Xavier, C.B. Silva, O. Faccenda, A.C.S. Candido and M.T.L.P. Peres, 2012. Insecticidal effects of *Croton urucurana* extracts and crude resin on *Dysdercus maurus* (Hemiptera: Pyrrocoridae). J. Entomol., 9: 98-106.

Su, N.Y. and R.H. Scheffrahn, 1998. A review of subterranean termite control practices and prospects for integrated pest management programmes. Integr. Pest Manage. Rev., 3: 1-13.

Sujatha, S., L.S. Vidya and G.S. Sumi, 2012. Prey-predator interaction and info-chemical behavior of *Rhynocoris fuscipes* (fab.) on three agricultural pests (Heteroptera: Reduviidae). J. Entomol., 9: 130-136.

Wardell, D.A., 1987. Control of termite in nurseries and young plantation in Africa: Established practices and alternative courses of action common wealth foresty. Review, 66: 77-89.

Zolotar, R.M., A.I. Bykhovets, Z.N. Kashkan, Y.G. Chernov and N.V. Kovganko, 2002. Structure-activity relationship of insecticidal steroids. VII. C-7-oxidized β-sitosterol and stigmasterols. Chem. Nat. Comp., 38: 171-174.