Comparative Efficacy of Some Insecticidal Plant Materials Against Dry Wood Termite (Cryptotermes cavifrons BANKS (Insecta: Isoptera: Kalotermitidae) Infestation

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ABSTRACT

Laboratory study was conducted to determine the efficacy of six plant extracts Gmelina arborea Roxb (Verbenaceae) leaf, Aframomum melegueta [Roskoe] K. Schum. Zingiber officinalis Rosc., Morinda lucida (L.) (Rubiaceae), Moringa oleifera Lam. (Moringaceae) (seed and leaf) and Garcinia kola Heckel (Guttiferae) on the management of African wood termite under ambient temperature and relative humidity (30°C and 72%). Twenty termites were introduced into a covered container and treated with three levels (0.0 g, 0.5 g, 1.0 g) of the various plant extracts. The experiment was laid out in a completely randomised design (CRD) and replicated four times with factorial arrangement of treatments. Mortality was recorded at 12, 24, 36, 48, 60, 72, 84 and 96 hours exposure periods respectively. A. melegueta and G. kola were effective at 60 hours of exposure for 0.5g rate of application recording 95% mortality while Z. officinale, M. oleifera recorded 100% mortality after 84 hours of exposure. At 1.0 g rate of application, M. oleifera seed and A. melegueta were efficacious after 12 hours, however, M. oleifera recorded 95% mortality after 60 hours and 100 % at 72 hours while A. melegueta and M. lucida recorded 95 and 75 % mortality at 48 hours of exposures respectively. No mortality was recorded untreated experiment. Conclusively, A. melegueta, M. lucida and M. oleifera seed and leaf can be used in the control of wood termite due to higher mortality recorded on application and as a substitute for synthetic insecticides.

Key words: Control, Exposure periods, Insecticidal plants, Mortality, Termite.

INTRODUCTION

Termites (Cryptotermes cavifrons) are often called white ants but are not ants and differ from the latter both in life history and physical features. The most common termites belong to the genus (Cryptotermes) and (Reticulitermes). Termites are highly destructive polyphagous insect pests, which largely damage agricultural and forest crops and products in Nigeria. Biodegradation of wood caused by termites is recognized as one of the most serious problem for wood utilization (Abdullah et al., 2014).

The indiscriminate use of pesticides for the management of termites has generated a number of biological and environmental hazards in air, water, soil and in food chains (Abdullah et al., 2014). Insecticidal plant materials which are very common and are environmentally friendly offer a vast, virtually untapped reservoir of chemical compounds with many potential uses especially in the management of termite. One of these uses is in agriculture to manage pests with less risk than with synthetic compounds that are environmentally undesirable. Various experiments using plant extracts in human and animal health protection, agriculture and household pest management have been particularly promising (Scott et al., 2004). It has been observed that termites conveniently build their nests in fallen logs, stumps of trees, wooden buildings or pieces of wooden debris on the ground, some termites even live on the heart wood of large trees (Rust, 1992). Biospecticides are generally target specific and affect only the target population and closely related organisms. M. oleifera, commonly called “Miracle Plant” belongs to a monogeneric family of shrubs and trees, Moringaceae and is considered to have its origin in North West region of India (Faizi et al., 1994). This plant has many potential uses both in agriculture and industries (Faidi et al., 2001). Moringa benefits are quite plentiful, and these are clearly evident in its exceptional nutritional values and remarkable medicinal properties. This miracle plant is overflowing with vitamins such as vitamins A, B, C, D and E and minerals which include potassium, calcium, iron, selenium and magnesium and is completely safe for consumption (Madukuwe et al., 2012). A. melegueta (Alligator pepper) is another plant popularly used as a food spices and as a traditional medicine for treating various ailments in Nigeria and other parts of the world. There are a lot of scientific work on the activities of A. melegueta such as antinociceptive
Calabar, Nigeria. Calabar lies on latitude 4°56′45″N and longitude 8°20′55″E in the rainforest region of Nigeria with a temperature of 24°C (74°F) to 30°C (86°F) and a relative humidity of 80%.

MATERIALS AND METHODS

Study area

The research was conducted in the Department of Forestry and Wildlife Resources Management, University of Calabar, Nigeria. Calabar lies on latitude 4°56′45″N and longitude 8°20′55″E in the rainforest region of Nigeria with a temperature of 24°C (74°F) to 30°C (86°F) and a relative humidity of 80%.

Materials used

Materials used for the study included 32 petri-dishes, 700 Cryptotermes cavifrons (dry wood termites), seven (7) extracts obtained from Gmelina arborea, Afronum melegueta, Zingiber officinale, Moringa oleifera seed and leaf, Morinda lucida, Garcinia kola and Moringa oleifera leaves; note book, pen, cutlass or axe, perforated transparent plastic plates, camel hair brush, woody plant/wastes, muslin cloth, moist cotton buds.

Collection of wood termites

Over 700 population of wood termites (Cryptotermes cavifrons) were obtained from Udeshi village, Basang East in Obanliku Local Government Area in Cross River State. The termites were collected with the help of a cutlass and axe from an infested wood and transferred into a perforated, transparent plastic plate. Woody plants were added to the plastic plates as source of food for the termites.

Treatment and experimental design

The experiment which was made up of three factors, A, B and C laid out in a completely randomized design (CRD) with a factorial arrangement of treatments replicated four (4) times. Factor A constituted the levels of application of the biopesticides (0.0, 0.5 and 1.0 gm respectively), Factor B constituted the time duration (12, 24, 36, 48, 60, 72 and 84 hours) and factor C constituted biopesticides type (GA= Gmelina arborea; AM = Afronum melegueta; ZO = Zingiber officinale; MOS = Moringa oleifera seed; MC=Morinda lucida; GC= Garcinia kola and MOL =Moringa oleifera leaf). Data were collected and subjected to analysis using StartView statistical software and means were separated using Fishers Least Significant Difference (FLSD).

RESULTS

The result of the research showed that biopesticides had significant effects on the mortality of wood termites at various levels and time of application. It was observed that the treatments (biopesticides) used in the experiment had significant effects on the wood termites thereby increasing their mortality. After 12 hours of application of treatments, Moringa oleifera seed had the highest mortality which was not significantly different from A. melegueta and G. kola at 1.0 level of application (Fig.1b). After 24 hours of application, M. oleifera seed still recorded the highest level of mortality and was significantly different from other treatments. There was no significant difference between A. melegueta and M. lucida in terms of potency and were the second most effective treatments (Fig. 2b). Similar trend was observed after 36, 48 and 60 hours of application of M.oleifera seed. A. melegueta and M. lucida were highly efficacious against wood termites and were significantly different from other treatments at both 0.5 and 1.0 g levels of application. Although G. kola was as effective as M. lucida. (Fig. 3-5b)

There was an increase in efficacy of the treatments with an increase in the durations after application. At 72 and 80 hours after application, M. oleifera seed, A. melegueta M. lucida were significantly different from other treatments at all levels of application. There was no significant difference between G. arborea, G. kola and Z. officinale in terms of efficacy while M. oleifera leaf was as effective as Z. officinale and G. kola (Fig 6b & 7b). M. oleifera seed was significantly different from M. oleifera leaf at all levels of application and duration of application.
except at 12 hours after application. Treatments applied at 1.0 g at all levels were significantly different from 0.5 g and 0.0 g (control) with the later being highly effective in the management of wood termite (Fig 1-7a).

**Fig 1**: Effects of concentration (a) and levels (b) on mortality of termites at 12 hours after application. (GA = *Gmelina arborea*; AM = *Afromomum melegueta*; ZO = *Zingiber officinale*; MOS = *Moringa olifera* seed; MC = *Morinda lucida*; GC = *Garcinia kolae* and MOL = *Moringa olifera* leaf)

**Fig 2**: Effects of concentration (a) and levels (b) on mortality of termites at 24 hours after application. (GA = *Gmelina arborea*; AM = *Afromomum melegueta*; ZO = *Zingiber officinale*; MOS = *Moringa olifera* seed; MC = *Morinda lucida*; GC = *Garcinia kolae* and MOL = *Moringa olifera* leaf)
Fig 3: Effects of concentration (a) and levels (b) on mortality of termites at 36 hours after application. GA = Gmelina arborea; AM = Afromomum melegueta; ZO = Zingiber officinale; MOS = Moringa olifera seed; MC = Morinda lucida; GC = Garcinia kolae and MOL = Moringa olifera leaf.

Fig 4: Effects of concentration (a) and levels (b) on mortality of termites at 48 hours after application. GA = Gmelina arborea; AM = Afromomum melegueta; ZO = Zingiber officinale; MOS = Moringa olifera seed; MC = Morinda lucida; GC = Garcinia kolae and MOL = Moringa olifera leaf.
Fig 5: Effects of concentration (a) and levels (b) on mortality of termites at 60 hours after application. GA = Gmelina arborea; AM = Afrormomum melegueta; ZO = Zingiber officinale; MOS = Moringa olifera seed; MC = Morinda lucida; GC = Garcinia kola and MOL = Moringa olifera leaf.

Fig 6: Effects of concentration (a) and levels (b) on mortality of termites at 72 hours after application. GA = Gmelina arborea; AM = Afrormomum melegueta; ZO = Zingiber officinale; MOS = Moringa olifera seed; MC = Morinda lucida; GC = Garcinia kola and MOL = Moringa olifera leaf.

Fig 7: Effects of concentration (a) and levels (b) on mortality of termites at 84 hours after application. GA = Gmelina arborea; AM = Afrormomum melegueta; ZO = Zingiber officinale; MOS = Moringa olifera seed; MC = Morinda lucida; GC = Garcinia kola and MOL = Moringa olifera leaf.
DISCUSSION

The mortality of wood termites arising from the different concentration of biopesticides and duration of application after five days are presented in showed mortality of wood termites under different concentration of biopesticides. It was observed that the performance of different biopesticides varied under different concentrations and durations. The study showed that mortality of wood termites was generally higher where biopesticides were applied than in the control treatment where no biopesticide was applied. Each of the treatment used had significant effects on wood termite at various levels of application and time duration. Extracts of M. oleifera seed, A. melegueta and M. lucida were the most efficacious biopesticides in the management of wood termite. This is similar to the mortality rate reported by Adenekan, et al. (2013) that extract M. oleifera showed potentials in the control of bruchid beetles on cowpea seeds as bio-insecticide. Etusim, et al. (2013) also reported 100% mortality on Simulium larvae which is in conformity with this research work. Similar report was given by Ojo et al. (2013) on the efficacy of Moringa leaf powder as protectant against Callosobruchus maculatus on stored cowpea. The toxicity and repellence property of Z. officinale, D. trepitala ethanol extracts against insect pests such as brucid on grains and adult Dermetes maculatus on cat fish has been reported by many authors including Ukeh, (2011), Umoetok, et al. (2013) also reported that efficacy of biopesticides was also shown to increase with increased rate of application and time of exposure to the target pests. These results are confirmation of earlier reports by (Sanaa, et al., 2008; Abdullah, et al., 2014 on the use of biopesticides in the management of wood termites. It is evident from these results that extracts did pose a hindrance to activities of the termite (Peterson & Ems-Wilson, 2003; Mao & Henderson, 2007), but the termite, however, may become insensitive towards the extracts upon longer period of exposure and this period depends upon termites species. In order to find out alternative to synthetic insecticides, anti termite properties from plants will continue to expand base of the effective molecules to be developed to go well with the ecology of termites.

CONCLUSION

Based on the results obtained from the study, it may be concluded that A. melegueta, M. lucida and M. oleifera seed and leaf extracts have insecticidal effects on dry wood termite and the extracts could have potentials as bio-insecticides on stored wood products The above can be recommended since they are very common and are environmentally friendly compared with synthetic pesticides.

REFERENCES


