Indian Journal of Natural Products and Resources
Vol. 6(4), December 2015 pp. 288-292

Field study on repellent efficacy of *Crotalaria burhia* Buch.-Ham. ex Benth. and *Anacardium occidentale* L. against *Odontotermes obesus* (Rambur)

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Received 9 July 2015; Accepted 5 November 2015

Crotolaria burhia Buch.-Ham. ex Benth. and *Anacardium occidentale* L. known for their insecticidal properties were tested for their efficacy against the subterranean termite, *Odontotermes obesus* (Rambur) in wheat and sugarcane fields at Institute of Pesticide Formulation Technology, Gurgaon, Haryana during 2015. Bait mixed with 10 % root extracts of *C. burhia* placed near 6 termitaria along the bunds of wheat field resulted in drastic decline of termite population ranging from 747.22 on 1st day to 289.28 numbers on 12th day after baiting. Total number of termite catch in 6 termitaria along the bunds of wheat fields after baiting period was 6704.61 whereas in untreated check it was 15078.00. Bait mixed with 5 % leaf dust of *A. occidentale* in sugarcane field recorded a minimum termite catch of 261.22 numbers after baiting period of 4 days, while the number was 1095.83 during prebaiting period. A total average termite population of 5655.72 was recorded in *A. occidentale* treated bait against 8657.67 numbers in untreated check. Termite numbers in untreated check ranged from 1277.67 to 2031.67 in wheat field and 530 to 1640 in sugarcane field.

Keywords: *Anacardium occidentale* L., Bait, *Crotalaria burhia* Buch.-Ham. ex Benth., *Odontotermes obesus* (Rambur), Sugarcane, Termitaria, Wheat.

IPC code; Int. cl. (2015.01)– A01N 27/00

Introduction

An impressive increase in the research on development of bait systems for termite management has been observed over years. The rising availability of bait systems for the control of active termite infestations is already significantly assisting termite management practices in many parts of the world. There is even discussion of using such systems as stand-alone measures for the long-term protection of a structure[1,2]. Despite these important and remarkable trends, baiting is a developing technology and many more changes to existing bait technology can be expected[3].

Termites are the most troublesome pest of plants, trees and wooden structures. They severely damage agricultural crops and urban infrastructure. There are about 2,500 species of termites in the world and only 10 % have pest status. Out of 300 species in India, about 35 have been reported as damaging agricultural crops and timber in buildings. In India, 15 to 20 % yield loss is reported in maize accounting for 1,478 million INR. Severe loss by termites has been recorded on highly susceptible crops such as wheat and sugarcane in Northern India. In South India, the crops that suffer maximum damage are maize, groundnuts, sunflower and sugarcane while the victims in North Eastern and Western India are tea and cotton, respectively[4].

In the past, the control of termites has been totally based on chemicals especially synthetic insecticides such as persistent organochlorine and organophosphate insecticides[5]. Replacement of synthetic by bio-rational insecticides is universally acceptable and practical approach worldwide[6]. In this regard, bioactive compounds of plant origin are considered as ecologically safe alternatives. The plant extracts with complex mixtures of such compounds have been investigated for their insecticidal, repellent and antifeedant properties[7,8]. Because of the defense chemicals being present, these plants can be used for the development of effective insecticides against termites and thus these plant chemicals would be able to replace the persistent synthetic insecticides[9].

Crotalaria burhia Buch.- Ham. ex Benth. belonging to family Fabaceae is an undershrub,

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fibrous plant common in the arid regions of West Pakistan, India (Punjab, Rajasthan and Gujarat) and Afghanistan. It is known as *Shinio* in Rajasthan, *Ghugato* in Gujarat, *khip* in Hindi and *Bhata* in Punjabi. The genus *Crotalaria* L. has 300 species worldwide and of these, about 18 species are reported in India. Phytochemical studies have revealed that pyrrolizidine alkaloids are the main compounds in this plant. Anticancer, antimicrobial and antibacterial properties have been reported for these pyrrolizidine alkaloids[10]. The mixture of cow dung, *aak* (*Calotropis* spp.), *kheip* or *khip* (*C. burhia*) and local xerophic plant foliage when allowed to rot in a pit for about two months and then applied in chilli and tomato fields as a manure is very effective for the control of root-knot nematodes, termites and it also aids in good growth of the plants[11].

Anacardium occidentale L. commonly known as cashew belonging to the family Anacardiaceae is a native to Brazil and has great economic and medicinal value. Laboratory studies conducted by Ileke and Olotuah[12] revealed that the powders and oils extracts of *A. occidentale* seeds proved effective against the cowpea bruchid *Callosobruchus maculatus* (Fab.) in cowpea seeds. Research studies revealed that Cashew nut shell liquid and leaf extracts of *A. occidentale* effectively repelled termites in Nigeria[13]. In this regard the present study was undertaken to explore the repellent efficacy of *C. burhia* and *A. occidentale* as baits against *Odontotermes obesus*.

Materials and Methods

The plant samples collected were identified by Dr. M Palanisamy (Scientist D) and Dr. R K Singh (Botanist) at Botanical Survey of India, Southern Regional Centre, Coimbatore.

Preparation of plant extracts

Crotalaria burhia root extract

Roots of *C. burhia* were collected from Udaipur, Rajasthan and then sun dried to remove the moisture content in roots. Roots were hammered well and collected in a tray. Root extract, 10 % concentration was prepared by soaking 100 g of root powder in 1000 mL of distilled water. The supernatant was filtered after 24 h and used for testing its efficacy as bait against *O. obesus*.

Anacardium occidentale leaf dust

Cashew leaves collected from Agricultural College and Research Institute (AC&RI), Killikulam, Tamil Nadu were air dried till the leaves were devoid of moisture. The dried leaves were crushed and then powdered using mixer. One kg of 5 % leaf dust concentration was prepared by mixing 50 g of powdered leaf with 950 g china clay, which acts as a carrier material.

Repellent efficacy of bait

In the field conditions, above prepared root extract of *C. burhia* and leaf dust of *A. occidentale* were used for testing their efficacy for the management of termites through baits. Six numbers of termitaria were selected along the field bunds of wheat and sugarcane fields. Tube pots of 16.5 cm height and 11.5 cm width were taken and filled with old gunny bits, decomposed cow dung, paddy straw and sugarcane baggase (Plate 1). Before filling, all the materials including the pot were made wet by spilling water using hands and 100 g of prepared baits were placed inside the pot. The pots were kept inverted in the soil and their walls were plastered using wet soil to prevent the entry of ants (Plate 1). Seven termitaria near wheat field and seven termitaria near sugarcane field with termite activity were selected at IPFT, Gurgaon, Haryana. Termites of these colonies were collected and identified as *O. obesus* at Department of Agricultural Entomology, AC&RI, Killikulam. Three pots with baits were placed near each termitaria, i. e. 18 pots containing *C. burhia* mixed bait was placed randomly near 6 termitaria in wheat and 18 pots containing *A. occidentale* mixed bait were placed in sugarcane field. Three untreated pots were placed near 7th termitaria in wheat and 3 untreated pots near 7th termitaria in sugarcane field and was maintained as check for both treatments and thus a total of 21 pots were placed in 7 termitaria in each field. The numbers of termites caught were recorded every day by taking out the pots individually and gently tapping the termites adhering to the bait material on to a black muslin cloth placed in a white tray and after counting they were again released into the pots and the pots were kept inverted again. On the 4th day, root extract of *C. burhia* and leaf dust of *A. occidentale* were mixed separately with the bait and the termites were allowed to feed for another 4 days. Baits mixed with 20 mL of 10 % aqueous root extract of *C. burhia* were placed in termitaria along wheat field and 25 g of 5 % powdered leaf dust of *A. occidentale* mixed baits were placed in sugarcane field (Plate 1). On the 8th day, number of termites caught was counted. One bait without *C. burhia* and *A. occidentale* was allowed to be fed by termites for all the 12 days as an untreated check.

Plate 1—Bait stations in wheat and sugarcane field and termite catch in baited pot

Results and Discussion

The efficacy of *C. burhia* root extract administered through bait near the termitaria resulted in an effective control of termite population. Bait stations of untreated check containing 3 pots recorded termite population ranging from 1277.67 to 2031.67 numbers. The total number of termites observed in the untreated check was 15078, which was very high and the colony was strong throughout the study period (Fig. 1).

Termitaria along the bunds of wheat field baited with *C. burhia* root extract recorded the highest mean catch of 1183.33 termites on the 8th day of observation and thereafter the catch declined. The lowest mean catch was recorded on 12th day (289.28 termites). The mean total catch of termites was 6704.61 in bait mixed treatment whereas in the check termitaria the total catch was 15078. The current study falls in line with the findings of Stansly *et al.*[14] who tested insect growth regulator hexaflumuran bait against *Reticulitermes flavipes* (Kollar) in citrus orchard. The results showed that after 2-3 months of baiting period, no new termite activity and subsequent tree injury was detected within the areas of baited colonies.

Bait along with leaf dust of *A. occidentale* recorded a mean number of 1095.83 termites during prebaiting period and the termite population declined to 261.22 after baiting. This trend was observed in all termitaria around sugarcane field baited with *A. occidentale*. On the other hand, a continuous increase of termite population was observed in untreated check which recorded a mean number of 530.00 – 1640.00 termites during the course of experiment (Fig. 2). Similar results were obtained by Singh & Singh[15] who observed 82.15, 64.68 and 50.68 % reduction in termite population by tomatine feeding on 3, 4 and 5 months after application.

The termite population in untreated check of wheat field was found constant after baiting period, where as in untreated check of sugarcane field the termite population had a significant increase after baiting period. The reason behind this is the termite population in wheat ecosystem had attained a steady phase after baiting period which differs from the sugarcane ecosystem.

The bait station kept in wheat field with *C. burhia* recorded only 6704.61 individuals of *O. obesus* whereas in the untreated check the bait catch was 15078 individuals and the bait station at sugarcane field impregnated with leaf dust of *A. occidentale* resulted in 5655.72 individuals which is much lesser when compared to its 8657.67 numbers of termite population in untreated check. This reduction in catch might be due to insecticidal and repellent properties of *C. burhia* and *A. occidentale*. This was in accordance with studies of Nisha[16] which revealed that bait along with tomatine @ 1000 ppm resulted in reduced termite population in all termitaria in coconut field. As per the work done by Nisha[16], the first 3 days, termite catch were recorded by placing baits without botanicals (prebaiting period) in termitaria. Then termites were allowed to feed for 4 to 7 days on bait mixed with tomatine. After feeding, post baiting

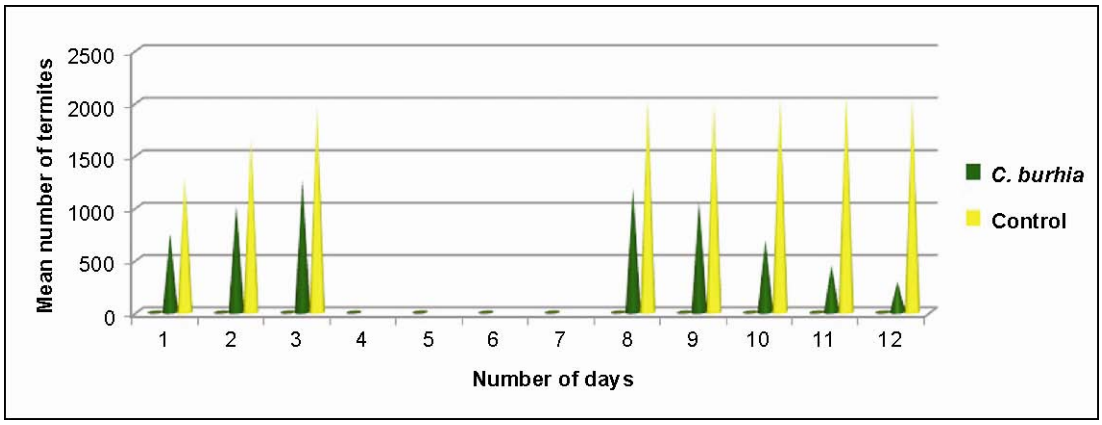

Fig. 1—Repellent effect of *C. burhia* laced bait against *O. obesus*

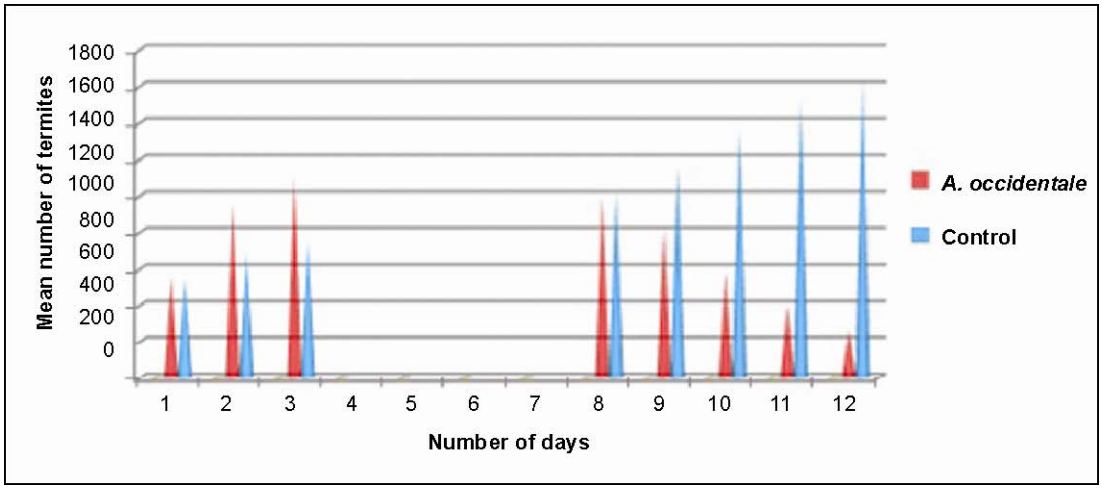

Fig. 2—Repellent effect of *A. occidentale* laced bait against *O. obesus*

count was taken and a sudden decline in termite population was observed and this might be due to the termiticidal property of tomatine. The termite population reduction observed in wheat and sugarcane may be due to the repellent/insecticidal properties of *C. burhia* and *A. occidentale* which was supported by Osiptan & Oseyemi[13] who revealed that extracts of *A. occidentale* gave 60 % repellency against *Macrotermes* spp. Previous study conducted by Ranjith *et al*[17] indicated that aqueous root extracts of *C. burhia* and leaf dust of *A. occidentale* resulted in 66.67 and 56.67 % repellency against *O. obesus* under laboratory conditions.

Conclusion

The population reduction in botanicals treated baits may be due to the repellent and/or insecticidal properties of *C. burhia* and *A. occidentale* and can be effectively used as a repellent in termite attacking crops.

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