Effect of Some Botanical Pesticides on Feeding Activity of Microtermes najdensis (Isoptera: Termitidae)

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ABSTRACT

Termites are serious insect pests in Yemen. Insecticidal control of termites is largely dependent on chlorinated hydrocarbons that cause residue problems and have harmful serious effects on humans, animals, and the environment. Therefore, there is a need to find alternative treatments against termites. Wood blocks (10x7x2.5 cm), buried in soil, were then treated by botanical materials (10% solution and 24% aldrin) at the rate of 50 ml per block. Mean weight loss of the wood blocks, due to termites feeding, was significantly higher in untreated blocks than all treated blocks. Applying 50 ml/block with a mixture of 1/2 dosage of aldrin and 1/2 dosage of Azadirachta indica A. Juss kernel extract showed the best protection followed by aldrin, A. indica and Melia azedarach (L.).

Key Words: Termite, Neem, Botanical Pesticides

INTRODUCTION

The termite, Microtermes najdensis Harris (Isoptera: Termitidae), is the most destructive and economically important insect pest of crops, various vegetables and fruits as well as other cellulose products in Yemen. This pest is known to be widely distributed throughout Tihama (Wood et al., 1986). At present, insecticidal control of termites in corps, pastures and houses is largely dependent on chlorinated hydrocarbons, such as aldrin, dieldrin, DDT, chlordane, and others (Harris, 1971; Sauds, 1977; Johnson and Wood, 1980; Sen-sarma, 1986). These chemicals give an excellent control, but cause residue problems due to their high persistence and harmful effect on humans, animals, and the environment (Beal and Smith, 1972; Beal, 1980; Ulsperger, 1984; Ashworth, 1985; Badawi and Faragalla, 1986; Wood et al., 1987; Kassem and Ahmed, 1988). Since no enough alternative is available to control termites, farmers still insist on using chlorinated pesticides to protect their crops, in spite of many serious health effects.
that have occurred in several areas (Ulsperger, 1984). Therefore, it is curcial to search for other alternative approaches.

Wide range of plants contain compounds which kill insects or possess antifeedant properties (Harbone, 1968) have been considered for use as insecticides (Stoll, 1986; and Genris and Van Latum, 1988). Among these are Azadirachta indica A. Juss and Melia azedarach (L.) which showed antifeedant effects (Schmuttere, 1985; Chiu, 1993); disrupt insect development (Al-Hemyari, 1993; Grant and Schmuttere, 1987) and sterilants (Schmuttere, 1987). Since little is known about the effect of botanical insecticides on termites, field tests should be carried out to develop safe and economic methods of termite control. The purpose of this study was to evaluate some botanical materials, known to be present in locally, grown trees. The ultimate goal is to find the most appropriate and effective materials that are less persistent than chlorinated pesticides and are safe for humans, animals, and the environment.

MATERIALS AND METHODS

Preparation of extracts: Mature fruits of Melia azedarach and kernels of Azadirachta indica were collected from Tihama, Yemen, air-dried and ground with an electric mill (0.84mm) to obtain a powder. One hundred grams of the powder from each of the two species were added separately to one liter of tap water and thoroughly mixed using electric blender. The solution was filtered twice through muslin cloth and filter paper (p4 medium-fine), then poured into beakers and left for 24 hours. Solutions of 10% concentration of each were prepared and stored in a refrigerator until needed.

Field test: The experiment was conducted in Zabid (Tihama), Yemen, during February, 1992 and 1993. The efficacy of botanical insecticides was determined using a randomized complete block design experiment with five treatments, including an untreated control. Treatments were replicated four times. Soft wood blocks (10 x 7 x 2.5 cm) of Pinus sylvestris were oven dried at 105º C for 24 hrs., weighed, and labeled. A termites infested area (10 x 10 m) was cleaned of shrubs, grasses, and dead wood, and was subsequently divided into 20 continuous study plots (5 m² each).

Four wood blocks were inserted in the soil of each pot to form a square pattern. Treatments consisted of 50ml of 10% M. azedarach extract, 50ml of 10% A. indica extract, 50ml of 24% aldrin (0.05 g a.i./block) were applied separately to each block. In the mixed treatment of 1/2 dosage of aldrin plus 5% of A. indica solution, the mixture was applied at 50ml volume to each block. Ten days later, two blocks of
each treatment in each replication were picked up, cleaned of any debris or soil, oven-dried at 105°C for 24 hrs, and weighed. The same procedure was repeated after 20 days for the remaining blocks.

Differences between the weights of the blocks before and after insertion in the soil were recorded to determine wood consumption. It was assumed that weight lost by the blocks was due entirely to termites feeding. Results were subjected to one way ANOVA, and means were separated at P = 0.05 by the Student Newman-Keuls Test (which computer software or book as reference for this test).

RESULTS AND DISCUSSION

In 1992, the difference in mean weight loss between treated and untreated wood blocks was significant (P = 0.05) (Table 1, 1st inspection after 10 days). The mixture of aldrin and A. indica provided the best wood blocks protection followed by aldrin and A. indica. *M. azedarach* spelling was the least effective protectant treatment. The second inspection (20 days later) revealed more feeding activity (Table 1). However, the trend is approximately similar to the first inspection, except for blocks treated with *M. azedarach* that indicated no significant difference from untreated wood blocks.

**Table 1. Efficacy of botanical and chlorinated pesticides in controlling weight loss of wood blocks of Pinus sylvestris exposed to M. nafdensis attack, Tihama, Yemen, 1992.**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean Weight Loss (%)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>wood pickedup</td>
<td>wood pickedup</td>
<td></td>
</tr>
<tr>
<td></td>
<td>after 10 days</td>
<td>after 20 days</td>
<td></td>
</tr>
<tr>
<td>Aldrin+A. indica</td>
<td>1.74 ± 0.</td>
<td>3.56 ± 2.29*</td>
<td></td>
</tr>
<tr>
<td>Aldrin</td>
<td>3.83 ± 1.71*</td>
<td>3.62 ± 1.05*</td>
<td></td>
</tr>
<tr>
<td>A. indica</td>
<td>9.60 ± 3.17*</td>
<td>13.62 ± 3.55*</td>
<td></td>
</tr>
<tr>
<td>M. azedarach</td>
<td>38.69 ± 13.16b</td>
<td>66.61 ± 21.64b</td>
<td></td>
</tr>
<tr>
<td>Untreated</td>
<td>65.32 ± 17.71c</td>
<td>87.43 ± 11.31b</td>
<td></td>
</tr>
</tbody>
</table>

Means (± Standard Deviation /Error), followed by same letters, are not significantly different at 0.05 level.

In 1993, weight loss of wood blocks in all treatments at first inspection was significantly less than in the untreated except for the blocks treated with *M. azedarach* (Table 2). The percentage of weight loss of blocks was lowest as in Table 2 for the mixture of A. indica and
aldrin (0.82, 2.46%) followed by aldrin (2.29, 3.34%), A. indica (4.64, 10.36%), and M. azedarach (32.47, 54.36%) treatments. The trend of significant differences among treatments, in both inspections, was almost the same, but percentage of consumption was higher in the second inspection than at the first.

In both years, A. indica, aldrin, and their mixture were more effective in controlling termite damage than M. azedarach. The difference in severity of attack becomes apparent between the control and the treated blocks. Although aldrin showed better protection in both inspections, the difference in wood consumption was not statistically significant when compared with that of A. indica.

Table 2. Efficacy of some botanical and chlorinated pesticides in controlling weight loss of wood blocks of *Pinus Sylvestris* exposed to *M. Najdunes* Attack, Tihama, Yemen, 1993.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean Weight Loss (%)</th>
<th>Wood picked up after 10 days</th>
<th>Wood picked up after 20 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aldrin + A. Indica</td>
<td>0.82 + 0.58</td>
<td>2.46 + 1.60</td>
<td></td>
</tr>
<tr>
<td>Aldrin</td>
<td>2.29 + 3.09</td>
<td>3.34 + 1.87</td>
<td></td>
</tr>
<tr>
<td>A. Indica</td>
<td>4.64 + 2.6</td>
<td>10.36 + 3.02</td>
<td></td>
</tr>
<tr>
<td>M. Azedarach</td>
<td>32.47 + 14.39</td>
<td>54.36 + 28.39</td>
<td></td>
</tr>
<tr>
<td>Untreated</td>
<td>58.05 + 28.89</td>
<td>75.30 + 16.41</td>
<td></td>
</tr>
</tbody>
</table>

Means (± Standard Deviation/Error) followed by same letters are not significantly different at 0.05 level.

*M. Azedarach*, in both years, was significantly less effective than all other treatments. Similar findings were reported by Hanif-Gul et al., (1980) who tested stakes of 13 tree species exposed to termites and found that the only treated stakes consumed by termites were those treated with *M. Azedarach*. Termites fed for 7 days with seed powder of *M. Azedarach* had 65% mortality (Lin and Wang, 1988).

The results of this study indicated that *M. Najdensis* generally did not avoid foraging on wood blocks treated with *A. indica*. However, the damage for all inspected blocks was less than 13.62%. This suggests that termite workers had been virtually eliminated by either the toxicity of the *A. indica* or by its deterrent effect. This is in agreement with studies by Alder and Vebel (1984) who stated that Margarine (commercial name for *A. indica* extract) showed antifeedant activity.
against Dissoleira carolina, Diapheromera femorala and Gryllus pennylanricus. Vankateswarla et al., (1988) stated that neem oil at 8-16% exhibited complete repellency and antifeedent activity against Spodoptera litura.

Schumuttere (1988) stated that Schistocerca gregoria preferred to die from starvation than to feed on treated food plants. Japanese beetle, Popillia japonica, was deterred from feeding on soybean leaves treated by a 1% aqueous emulsion of neem seed kernel extracts (Schumuttere, 1987). This study extends their observation to the termite, M. nadjensis

Comparison of first and second inspection for both years, showed that mean wood consumption was higher after 20 days than after ten days. This is true with most plants-based insecticides which break down rapidly in soil due to many physical and biological factors. For the same reasons, they do not give the prologoed protection to crops and trees required to control termite (Logan et al, 1990).

In conclusion, this study demonstrated that A. indica kernel extract effectively suppressed M. nadjensis activity in a region where this termite is a major economic pest. However, the extract showed limited persistence under field conditions. This means that the residue effect losts for short period and thus does not present long term environmental problem. Using A. indica kernel extract as a pesticide against termites would required several applications to protect the wood.

Azadirachta indica is locally available and can by crushed and used without complicated extraction procedures. In addition, it has low toxicity to environment and non-target organisms, especially humans and beneficial insects. Therefore, A. indica could be suitable for integrated pest management. Further research is needed on the active compounds which may lead to the development of nontoxic repellent or feeding deterrent. More research in mixing A. indica with synergists or low toxicity pesticides is also necessary to develop inexpensive, effective, and environmentally sound pesticides.

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تأثير بعض المبيدات النباتية على النشاط الغذائي للنمل البيضاء

Effect of some botanical pesticides on feeding activity of Microtermes najdensis (Isoptera Termitidae)

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ملخص:
يعتبر النمل الأبيض من الآفات الخطرة في اليمن، ويعتمد في مكانة هذه الحشرة بضرورة أساسية على المبيدات الكيميائية، وهذه المبيدات تسبب كثير من المشاكل الخطرة للإنسان والحيوان والبضائع، وهكذا دعت الحاجة إلى البحث عن طرق أخرى لمكافحة النمل الأبيض.

أجريت التجربة في منطقة تهامة اليمن وفي قطعة أرض تم تنظيفها من المخلفات النباتية، تم غرس قطع خشبية (107×10 سم) في النسيج وعولمت كل قطعة منفردة بـ24 حشرة (1 حشرة لكل قطعة)، وجرد أن متوسط القشر من وزن القشر والنتائج عن تذيب النمل الأبيض عليها كان دقيق معنوي عال مقارنة بالعنصر في القشر الذي لم يتمال. وفي القطاع الخضبي التي عولمت نصف التهريب من الدرن مخلوطاً Azadirachta indica ونصف التهريب من الدرن تلمelta A. indica ونسبة 100 مل/ لكل قطعة أعت حماية عالية يليه اللدرين ثم أخيراً Melia azedarach

كلمات مفتاحية: النمل الأبيض، النسيج، المبيدات النباتية.