Susceptibility of the Dry-Wood Termite Cryptotermes brevis Walker to the Black Pepper Extracts

Samia I. Moein and Ramadan M. Farrag

Plant Protection Research Institute, Agricultural Research Station, Sabahia, Alexandria.

(Manuscript received 11 May 1999)

Abstract

Effects of hexane, ethanol and petroleum ether extracts of the black pepper fruits, Piper nigrum L., were studied on the dry-wood termite, C. brevis. The results indicated that the hexane extract has excellent efficacy against the insect. Hexane extract at 0.5% concentration induced 50% mortality, which dropped to 47.86 and 14.28% with ethanol and petroleum ether, respectively 2 days post-treatments. Mortalities reached 100, 42.85, and 69.29% at 5% conc. of the above mentioned extracts, respectively.

After 14 days, 0.5% conc. of ethanol and petroleum ether gave 67.77 and 65.56% mortality, respectively and both of them induced 100% mortality at 5% concentration.

Introduction

The dry-wood termite, Cryptotermes brevis Walker, is a destructive pest of paper, wood and wooden products. In the continuing search for new insect control agents to replace the growing number of traditional, potent insecticides that have been banned for use because of adverse environmental impact, much emphasis has been placed on discovery of new compounds, including natural products from plants with various inhibitory effects on insects.

Several studies have indicated the role of natural products for the control of the subterranean termite (Adams et al. 1988; Kawaguchi et al. 1989; Su et al. 1990; McDaniel 1992). A little is published about the dry-wood termite. Among the natural products, black pepper Piper nigrum L., is having insecticidal activities (Lathrop and Kerstein 1946; Su 1977; Scott and Mc Kibbon 1978; Su Horvat 1981).

In this study, we investigated the effect of crude extracts of black pepper on the dry-wood termite, C. brevis, using solvents of hexane, ethanol and petroleum ether.
MATERIALS AND METHODS

Extraction of black pepper: Dry fruits of black pepper were ground in a high-speed micomill into fine powder. Three separate 8-hr extractions with three different solvents; hexane, ethanol and petroleum ether (60-80°C) were performed in a Soxhlet apparatus with 1 litre of solvent for each 100 g of black pepper powder. Finished extracts were filtered through anhydrous sodium sulphate and the solvent removed in vacuo. Each resulting crude extract was measured.

The termite: The dry-wood termite, *C. brevis*, reared in the laboratory of Termite Research Department, at the Agricultural Research Station, Shabnia, Alexandria on wooden chips maintained at 26 ± 2 °C and 70 ± 5% R.H. At least, the 4th nymphal instar was used in the tests.

Bioassay procedure: Stock solution of each extract was obtained by dissolving the yield in acetone and serial concentrations were prepared. Filter paper disks, 6.8 cm diam., were individually treated by dipping in each concentration for 10 sec. Filter papers treated with acetone were used as controls. The treated papers were air-dried to remove solvents and held in 7 cm diam. petri dishes. After that, each paper was exposed to 10 nymphs in closed petri dish with three replicates per concentration. The tests were incubated in a dark cabinet at 26 ± 2 °C and 70 ± 5% R.H. Mortalities were counted at several days after treatment and corrected using Abbott's formula (Abbott, 1925).

Data were subjected to analysis of variance (ANOVA) and means were compared by LSD test at 0.05 level (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The effects of crude extracts of hexane, ethanol and petroleum ether of black pepper fruits on *C. brevis* nymphs are shown in Table 1. The mortality of termites treated with 0.5% concentration of hexane extract was 50% after 2 days of exposure. Percentage mortalities were ranged from 71.43 to 100% at the concentrations of 0.75 to 5% after 2 days. At 0.75% conc., all termites died within 3 days.

At 0.5% conc., the effect of petroleum ether extract was 14.28% mortality after 2 days. Mortality rapidly increased after this period, giving 30.72, 40.36, 50.36 and 65.36% after 3, 5, 7, and 14 days of exposure, respectively. The extract started to show above 50% mortality at 1% conc. after 3 days. A 5% conc. gave 100% mortality.
The third extract (ethanol extract) was somewhat less active and showed 4.76% mortality with 0.5% conc. after 2 days. When a paper was applied with ethanol extract, mortality was significantly increased with the highest concentrations. The conc. 5% induced 53.81% mortality after 3 days and reached to 68.89% after 14 days. The nymphs died within 14 days with the concentration of 2.5%.

The results indicate significant difference among the solvents, concentration of the extractable material and days of exposure. The bioassay of hexane extract (non polar) showed considerable activity on *C. brevis* followed by petroleum ether extract. Ethanol simply does not completely extract the active components, or it may indicate the presence of additional and more non polar toxic components.

Su and Horvat (1981) mentioned that three amides were isolated from *Piper nigrum* and identified from their spectral characteristics as (E,E)-N-(2-methylpropyl)-2,4-dacadienamide (I), (E,E,E)-13-(1,3-benzodioxol-5-yl)-N-(2-methylpropyl)-2,4,12-tridecatriennamide (II), and (E,E,E)-II-(1,3-benzodioxol-5-yl)-N-(2-methylpropyl)-2, 4,10-undecatrienamide (III). Also, they indicated their contact toxicity on the cowpea weevils. Su (1977) stated that piperine, an alkaloidal amide of oleoresin of pepper, was not the constituent in black pepper than was responsible for contact toxicity to insects.

In conclusion, black pepper fruits contain a component(s) against *C. brevis*. For this reason, extracts of black pepper may be useful for controlling this insect and protecting wood and wooden products.
Table 1: Effects of black pepper extracts on the dry-wood termite, *C. brevis*.

<table>
<thead>
<tr>
<th>Extractive solvent</th>
<th>Conc. (%)</th>
<th>Mortality (%) at indicated days after treatment</th>
<th>Grand Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Ethanol</td>
<td>0.5</td>
<td>4.67 a</td>
<td>10.24 a</td>
</tr>
<tr>
<td></td>
<td>0.75</td>
<td>9.52 ab</td>
<td>46.11 bcd</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>21.42 ab</td>
<td>53.81 bcd</td>
</tr>
<tr>
<td></td>
<td>2.5</td>
<td>28.57 ab</td>
<td>63.81 bcd</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>42.85 bc</td>
<td>76.91 cde</td>
</tr>
<tr>
<td>Hexane</td>
<td>0.5</td>
<td>50 bc</td>
<td>69.21 bcd</td>
</tr>
<tr>
<td></td>
<td>0.75</td>
<td>71.43 cd</td>
<td>100 e</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>85.71 de</td>
<td>100 e</td>
</tr>
<tr>
<td></td>
<td>2.5</td>
<td>92.86 de</td>
<td>100 e</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>100 e</td>
<td>--</td>
</tr>
<tr>
<td>Petroleum Ether</td>
<td>0.5</td>
<td>14.28 ab</td>
<td>30.72 ab</td>
</tr>
<tr>
<td></td>
<td>0.75</td>
<td>25 ab</td>
<td>35.71 ab</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>42.85 bcd</td>
<td>56.03 bcd</td>
</tr>
<tr>
<td></td>
<td>2.5</td>
<td>50 bc</td>
<td>78.57 de</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>89.29 de</td>
<td>100 e</td>
</tr>
</tbody>
</table>

Means followed by the same letter (for each column) are not significantly different at 0.05 level by LSD test.
REFERENCES


حساسية النمل الأبيض Cryptotermes brevis
الأحشاء الحادة لمستخلصات الفلفل الأسود

أماني إبراهيم معين، وحميد فراج

استهدف البحث تطبيق مستخلصات الفلفل الأسود في مكافحة النمل الأبيض التي تسبب
الاحشاح الحادة وبالتالي تقليل النتائج البيئية الناتجة عن الاستخدام المكثف للسيكماوية.
ولذا نُجري دراسة محلية لمستقبلات شوارع النمل الأسود في كل من مدينة الهكسان.

إيثانول، وبنزوريوم إيثيل ضد حوريات النمل الأبيض Cryptotermes brevis

وقد أعطى مستخلصات الهكسان نتائج جيدة مقارنة بمستخلص الإيثانول وبنزوريوم.
إيثانول، حيث أخذت التركيز 5٪ لمستخلص الهكسان موت 100٪ للحوريات بعد يومين من العدالة،
بينما كانت النتائج المقارنة مع مستخلص الإيثانول وبنزوريوم إيثيل على التوالي، كما أخذت التركيز 5٪ للكت المستخلصات الثلاث إلى موت 100٪ و95٪ و80٪ على التوالي.

وبعد 14 يوما من التجربة للفترات 5٪ لمستخلص الإيثانول وبنزوريوم إيثيل كانت النسبة
المئوية للموت 77٪ و71٪ و57٪ على التوالي، بينما ارتفعت إلى 100٪ لكلهما عند التركيز 5٪.