J. Univ. Kuwait (Sci.) **19**, 1992

Durability of imported wood to desert subterranean termites in Kuwait and their control by chlordane and dursban

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ABSTRACT

Imported white soft wood (*Pinus* sp.) proved highly susceptible to attack by the termite *Psammotermes hybostoma* Desneux. Reconstituted blockboard wood was moderately susceptible, while film-faced shuttering plywood was reasonably resistant. Red hard wood (Singaporan Red Marenti) was highly resistant. Compared with *Anacanthotermes vagans* (Hagen), *P. hybostoma* was less susceptible to chlordane at low concentrations; but the two species were equally susceptible to dursban even at a concentration as low as 0·01%. Spraying the soil with 1% chlordane or 0·05% dursban prevented infestation by subterranean termites in the Kuwait desert for a complete year. The same effect was obtained when wood was soaked in insecticide before being exposed. Trenching at a depth of 12–15 cm did not prevent termite attack.

INTRODUCTION

All wood used in building and furniture in Kuwait is imported. The commonest imported types are white soft wood (*Pinus* sp.), red hard wood (Red Marenti) and reconstituted wood (blockboard and film-faced shuttering plywood). Public complaints of termite attack on wooden structures, furniture and other cellulose materials have frequently been voiced. However, no official control policy has yet been endorsed, although advertisements for termite control by the private sector have begun to appear in the local Kuwait media. This situation has prompted the present work, the main objectives of which were to study the resistance to termite damage to the types of wood usually imported, and the effect of two commonly used insecticides on the control of subterranean termites in Kuwait. This is considered to be a prerequisite for any future control programme.

The foraging activity of subterranean termites in the Kuwait desert was investigated in a recent study (Abushama & Al-Houty 1988): *Psammotermes hybostoma* Desneux and *Anacanthotermes vagans* (Hagen) were found to be the dominant species. Two peaks of termite activity were recorded: one in February and the other in September. There was a positive correlation between termite activity and soil moisture content. Analysis of physical and chemical soil properties revealed some relationship between these and the dominant termite species.

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Harvester termites (*Anacanthotermes* sp.) have been reported damaging buildings in Egypt (Kassab *et al.* 1960) and Libya (Harris 1970). The sand desert termite *P. hybostoma*, on the other hand, is more widespread in the Palaearctic region causing appreciable damage to buildings in Egypt (Kassab *et al.* 1960) and the Sudan (Abushama & Abdel Nur 1973). According to Harris (1970), damage to buildings has occurred as far to the east as Bahrain.

The susceptibility of domestic and imported wood to subterranean termites (especially *P. hybostoma*) has been investigated in many countries of the region including the Sudan (Abushama & Abdel Nur 1978), Egypt (Rizk *et al.* 1982) and Saudi Arabia (Badawi *et al.* 1984). The effectiveness of various wood preservatives and insecticides against subterranean termites has also been reported (Helal & Maher 1982; Badawi *et al.* 1985; Salman *et al.* 1982).

The insecticides chlordane and dursban, used in the present work, are also widely and frequently used throughout the world. They are among the termiticides most commonly used in the United States (Mauldin 1985). Chlordane is a chlorinated hydrocarbon, moderately toxic to mammals, with an oral LD50 for rats of about 250 mg/kg. Dursban (or chloropyrefos) is an organophosphate with a broad spectrum for the control of ornamental plant and turf pests, household pests, and mosquitoes. Its oral LD50 for male rats is 163 mg/kg (Pfadt 1978).

MATERIALS AND METHODS

Field experiments were carried out in the Kabad area about 30 km southwest of Kuwait City (29°08′N 47°40′E; altitude about 127 m above sea level). The soil in the study area is composed of calcareous gypsiferous sand and sandstone with numerous pebbles. The experiments were conducted in the reserve area of the Kuwait Institute for Scientific Research.

The resistance of four types of imported wood to subterranean termites was tested. Blocks, 10 × 10 × 2 cm, of white pine wood; 10 × 10 × 2·8 cm, of red hard wood, 10 × 10 × 1·8 cm each of plywood and blockboard, were prepared. The blocks were sanded, oven dried at 120°C for 24 h and weighed. They were then set as baits in alternating rows of five, each in an area of 20 m^2. Four such plots were arranged 2 m apart. A total of 20 blocks of each type of wood were thus tested. The blocks were fixed to the soil with long iron nails. They were inspected weekly (at 10.00 h) for a complete year. The numbers of foraging termites encountered under each block were recorded. If any damage was observed, the block was taken to the laboratory, cleaned, dried and reweighed. This weight was then subtracted from the original dry weight in order to estimate the weight of wood consumed. The blocks removed were replaced with new blocks.

Bioassay of chlordane and dursban using termite workers was carried out in the laboratory. Workers of both *P. hybostoma* and *A. vagans* were tested. Three concentrations of chlordane (0.1%, 0·5% and 1%) and two concentrations of dursban (0·1% and 0·05%) were bioassayed. Filter papers (Whatman No. 1) of 9 cm diameter soaked in the insecticide and air dried were offered to termites in Petri dishes placed in complete darkeness at 24°C inside an incubator (Gallenkamp INA-300). Ten workers were tested in each treatment and the experiment replicated five times. This was repeated for each concentration of the two insecticides and the number of dead workers was recorded every half hour until all of them had died.

To test the effectiveness of the two insecticides in the field, 1% chlordane and 0·05% dursban were used respectively in three different treatments. In the first, a trench, 12–15 cm deep, was dug around a 25 m^2 plot: 48 litres of insecticide were poured evenly along the trench and covered with earth. The area inside the covered trench was then divided into 1 m grids, and 25 white soft-wood blocks were placed within, one meter apart, each fixed to the soil as described above. In the second treatment, the wood blocks were soaked in the insecticide for 24 h, air dried and then placed 1 m apart in a 25 m^2 plot. In the third treatment, the experimental plot (25 m^2) was sprayed with 48 litres of the insecticide to be tested. The soil was then left to dry out for one day before untreated wood blocks were placed on it in the manner described above. A fourth untreated plot with untreated wood blocks, was kept as control. The four plots for each of the two insecticides were laid out in a row 1 m apart, and 6 m distance was left between parallel rows. The number of foraging termite workers and the amount of wood consumed were recorded weekly as described above.

RESULTS

Infestation of the four types of wood by termites in the field is shown in Fig. 1. The total amount of wood consumed and the total number of foraging workers was estimated every month for a full year. Soft white wood (*Pinus* sp.) was attacked by termites throughout the year with two peaks of activity, one at the end of winter in February and March, and the other at the end of summer in September and October (Fig. 1A). This agrees with a previous finding by Abushama & Al-Houty (1988). Damage was caused only by *P. hybostoma*. Blockboard was damaged less than pine wood (Fig. 1B). Some wood was consumed during the months of the year when no foraging workers were recorded. However, the attacks observed were typically those of *P. hybostoma*. Plywood, on the other hand, was only damaged during February (Fig. 1C) while red hard wood was not attacked by termites during the experimental period. This demonstrates different degrees of resistance to *P. hybostoma*. While soft wood (*Pinus* sp.) proved to be highly susceptible, reconstituted blockboard wood was moderately susceptible and plywood seemed to be reasonably resistant. Red hard wood was highly resistant to infestation.

The results of the bioassay of chlordane and dursban using *P. hybostoma* and *A. vagans* are shown in Fig. 2A and B. A linear increase in the number of dead termites as a result of exposure to 1%, 0.5% and 0·1% chlordane, respectively, was recorded at increasing periods of time (Fig. 2A). Using a regression test, this positive linear correlation was found to be significant for all experiments with correlation coefficient (r) values $>0{\cdot}90$. There were, however, variations in the mortality rate of the two termite species; *A. vagans* proved more susceptible to chlordane than *P. hybostoma*. In the case of the former species, LD50 was recorded after about 6 h while the LD50 for the latter species was reached after 8 h at all the chlordane concentrations tested.

A significant linear correlation between the number of dead termite workers and increasing time of exposure to 0·01% and 0·05% dursban was recorded (correlation coefficient (r) value $> 0{\cdot}85$) (Fig. 2B). The mortality rates of the two species exposed to dursban were not significantly different ($P = 0{\cdot}9$). The LD50 of the two species was recorded after 1·5 to 2·5 h of exposure.

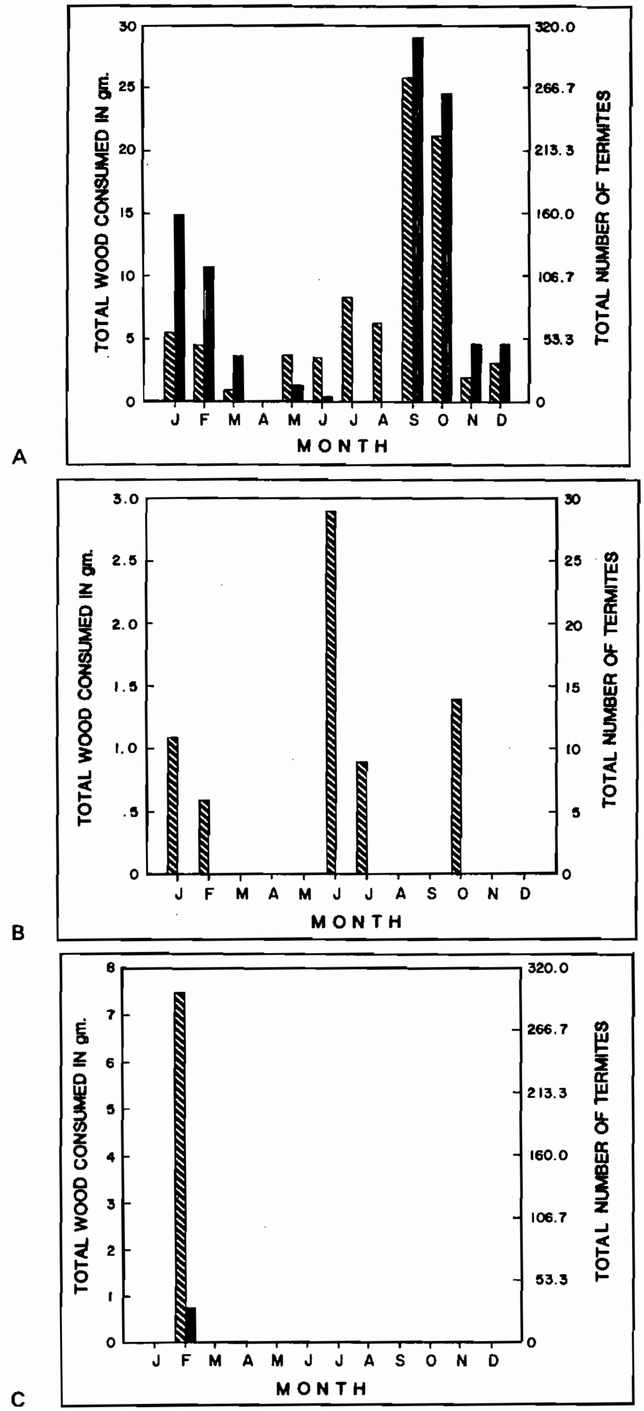

Fig. 1. Termite infestation of wood baits in field experiments: A. Soft white wood (*Pinus* sp.); B. Block-board reconstituted wood; C. Film-faced shuttering plywood.

▧ Amount of wood consumed ■ Number of foraging termites

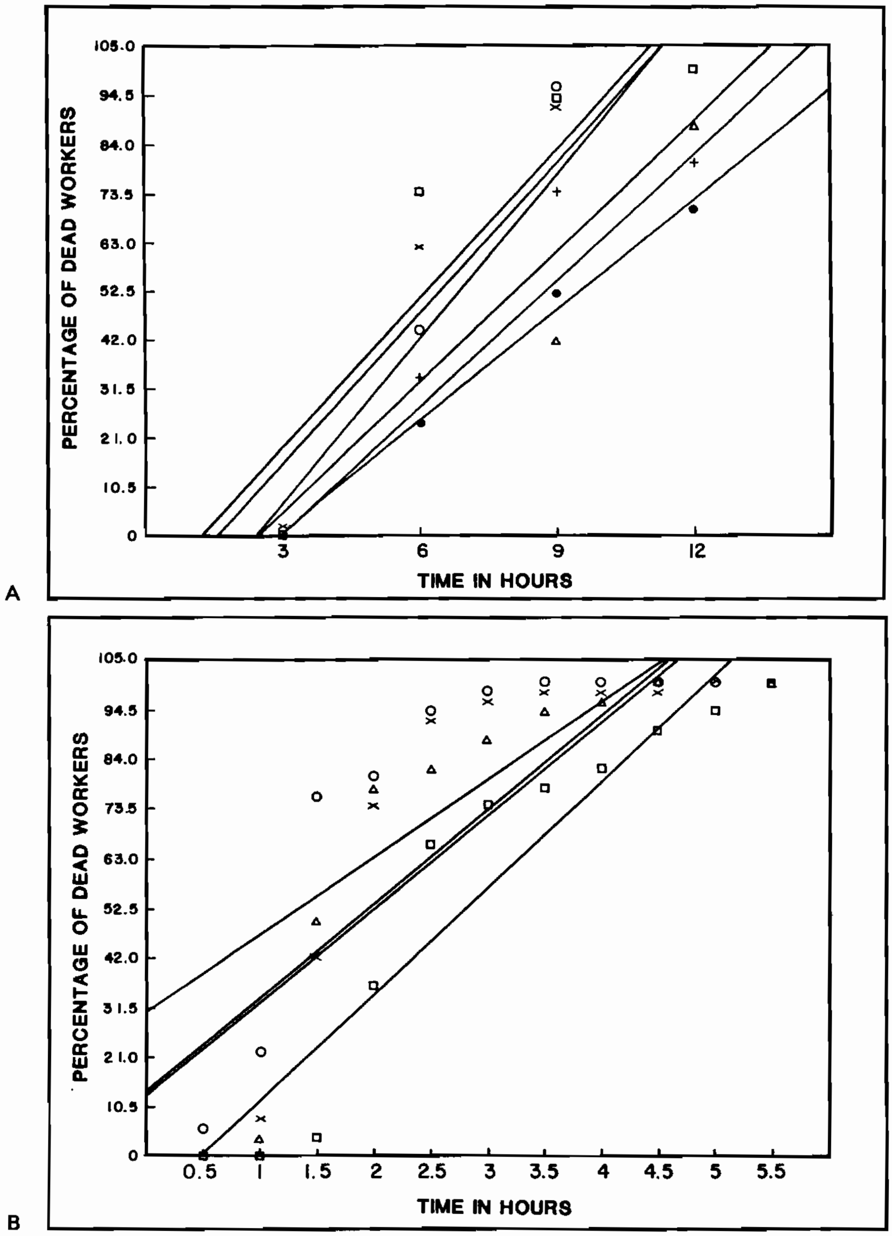

Fig. 2. Mortality rate of termites exposed to various concentrations of chlordane and dursban for increasing periods of time:

A. Tests on chlordane:
- × *A. vagans* at 1·0% concentration
- ○ *A. vagans* at 0.5% concentration
- □ *A. vagans* at 0·1% concentration
- △ *P. hybostoma* at 1·0% concentration
- + *P. hybostoma* at 0·5% concentration
- ● *P. hybostoma* at 0·1% concentration

B. Tests on dursban:
- × *A. vagans* at 0·01% concentration
- ○ *A. vagans* at 0·05% concentration
- □ *P. hybostoma* at 0·01% concentration
- △ *P. hybostoma* at 0·05% concentration

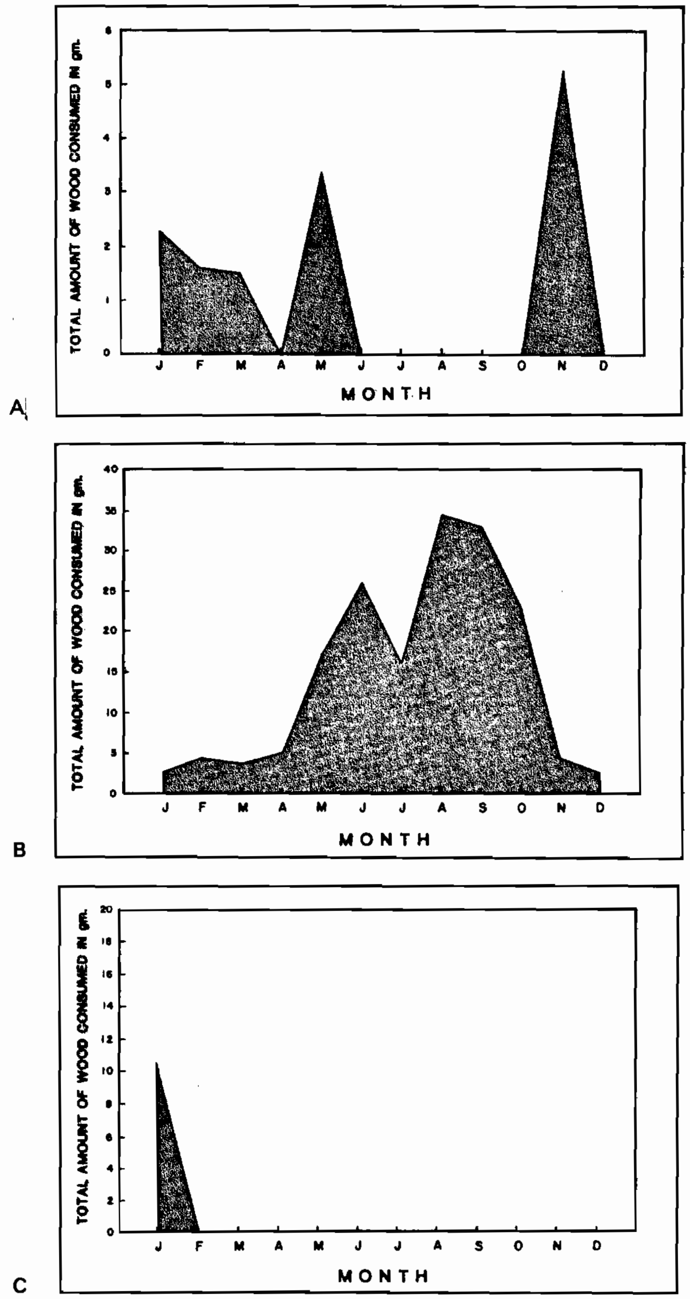

Fig. 3. Resistance of white soft wood baits to termite infestation in field experiments after various treatments with chlordane and dursban: A. Control experiments; B. Trenching with 0·05% dursban; C. Trenching with 1·0% chlordane

These results demonstrate that *P. hybostoma* was less susceptible than *A. vagans* to chlordane at low concentrations, but the two species were equally susceptible to dursban, even at a concentration as low as 0·01%.

Results of field treatments with 1% chlordane and 0·05% dursban respectively, as described above, are shown in Fig. 3. These indicate that no termite infestation was recorded in plots where the soil was sprayed with the insecticide before setting the wood baits. Soaking the wood blocks with any of the two insecticides prior to exposure had effectively prevented termite infestation. However, appreciable infestation by *P. hybostoma* was recorded in the plot trench-treated with 0·05% dursban (Fig. 3B). A slight damage at the beginning of the trenching treatment with 1% chlordane was recorded (Fig. 3C). It was thus evident that spraying the soil with 1% chlordane or 0·5% dursban could stop the attack by subterranean termites in Kuwait for a complete year. The same effect was obtained by soaking the wood in the insecticide prior to exposure. Trench treatments at 12–15 cm depth did not prevent termite infestations.

DISCUSSION

It was observed that the wood baits in the field experiment were attacked only by *P. hybostoma. A. vagans*, although available in the test area in noticeable numbers, did not contribute to the damage inflicted. However, the experiments were conducted in an open desert area with sparse cover of vegetation, considered a more favourable habitat for *P. hybostoma. A. vagans* seemed to limit itself to spots of richer vegetation and soils with some amount of silt. This was usually furnished in some depressions where rain water accumulated and silt was deposited after the water dried out. The activity of *A. vagans* was exhibited in such habitats by the small soil piles resulting from their excavation of horizontal galleries from vertical shafts.

White soft wood (*Pinus* sp.), which is widely used in scaffolding, roofs, furniture and packing in Kuwait, proved to be highly susceptible to *P. hybostoma*. However, chlordane and dursban at low concentration (1% chlordane and 0·05% dursban) were effective in preventing termite infestation for up to a year. Spraying the soil or soaking the wood in insecticides were more effective than shallow trenching in preventing attack. A higher concentration of chlordane (2%) gave protection to buildings in Heliopolis, Egypt, for 28–32 months (El-Hemaesy *et al.* 1982). Trenching with chlordane (75% at the rate of 15 ml/litre) and dursban (40% at the rate of 25 ml/litre) has also checked infestation by *P. hybostoma* in Egypt (Salman *et al.* 1982). Chlordane was found to be effective in protecting wood against termite attack for a period of one year in Saudi Arabia (Badawi *et al.* 1985).

The controversy over using chlordane which erupted in the United States in 1987 (see Shabekoff 1987; Burke 1987; Russel 1987) nevertheless makes it necessary to treat the use of termiticides, especially in domestic dwellings, with great caution. Many of the chemicals available today are suspected of posing health risks if not properly used. Therefore, specialist advice should be sought as to the nature of termiticide, the appropriate concentration required and the proper method of treatment to be adopted.

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(Received 16 October 1991, revised 29 February 1992)

مقاومة بعض الأخشاب للتلف بواسطة حشرة الأرضة وطرق مكافحتها بالمبيدات في صحراء الكويت

وسمية الحوطي و فيصل أبوشامة
قسم علم الحيوان بجامعة الكويت
ص . ب . ٥٩٦٩ ، الصفاة ١٣٠٦٠ ، الكويت

خلاصة

أوضحت التجارب الحقلية التي أجريت في صحراء الكويت مدى مقاومة أربعة أنواع مختلفة من الأخشاب المستوردة للتلف بواسطة حشرة الأرضة من نوع *Psammotermes hybostoma* . وقد ثبت أن لنوعية الخشب علاقة مباشرة بدرجة تعرضه للتلف ، فالخشب الأبيض من نوع (*Pinus* sp.) ضعيف المقاومة ويمكن أن يصاب بسهولة بأضرار بالغة بينما يتفوق عليه في المقاومة الخشب « اللاتيه » المصنع والذي يمكن أن يعتبر ذا مقاومة متوسطة . اما الخشب « المدهون » والذي يحتوي على مواد صبغية ضارة للحشرات فيتميز بمقاومته العالية للاصابة بأضرار الأرضة . وأكثر أنواع الأخشاب مقاومة لحشرة الأرضة هو الخشب الأحمر الصلب من نوع « المرنتي » ، إذ تعجز الأرضة عن التغذي عليه نسبة لصلابته .

ولقد تركز الجزء الثاني من هذه الدراسة على مقارنة نوعين من المبيدات الحشرية السائدة الاستعمال لمكافحة أضرار حشرة الأرضة من نوعي (*Psammotermes hybostoma*) و (*Anacanthotermes vagans*) المنتشرين في الكويت ، باجراء تجارب في مربعات عشوائية في الصحراء ، فتبين ان مبيد الكلوردين يصلح للاستعمال في عمليات مقاومة الأرضة من نوع *A.vagans* أكثر من نوع *P. hybostoma* ، وذلك عن طريق الرش في الحقل بتراكيز منخفضة (٠,٠١٪) ، بينما يتساوى النوعان من حشرة الأرضة في المقاومة عند استعمال مبيد الدورسبان بنسب منخفضة (٠,٠١٪) . وعند رش التربة بمبيد الكلوردين بكمية ٤٨ لترا وبتركيز ١٪ أو برشها بالدورسبان بنفس الكمية وبتركيز ٠,٠٥٪ ، تتوقف الاصابة تماما لمدة عام كامل .

ولقد تم التوصل إلى نفس النتيجة في التجربة التي اعتمدت على غمس طعوم خشبية في المبيدات الحشرية آنفة الذكر قبل تثبيتها على الأرض . وقد تم أيضا وفي تجربة ثالثة حفر خندق بعمق ١٢-١٥ سم حول مربعات التجارب ثم رشه بكمية ٤٨ لترا من المبيد وتغطيته بالتراب ، فلم تنجح هذه الطريقة في وقف اتلاف الأخشاب بواسطة الأرضة مما يمكن ان يشير إلى عدم جدوى حفر خنادق مماثلة حول المباني لحمايتها من الأرضة .

ويبدو أن الطريقة المثلى للحماية من خطر حشرة الأرضة الصحراوية من نوعي *A. vagans* و *P. hybostoma* تتمثل في رش التربة بالمبيدات الحشرية وبتراكيز لا تتجاوز ٠,٠١٪ . كما يمكن أن يساعد غمس الأخشاب قبل استعمالها ولمدة قصيرة في أي من المبيدات في زيادة مقاومتها ضد حشرة الأرضة الصحراوية .