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THE SURVEY OF ORDER ISOPTERA III : ON ASWAN BOTANICAL ISLAND AND CONTROL OF *AMITERMES DESERTORUM* BY CRUDE EXTRACT AND SOME PURE COMPOUNDS ISOLATED FROM *ARTEMISIA ARGENTEA* L'HER.

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ABSTRACT :

A study of the trees on Botanical Island at Aswan recorded seven species belonging to four families which were infested by the subterranean termite *Amitermes desertorum* (Desneux). This termite was recorded as the only species in this island representing the order Isoptera.

Many structurally different compounds from the root bark of *Artemisia argentea* L' Her (*Asteraceae*), including sesquiterpene lactones, arborescin and argentiolid β [1,2], a group of lignan compounds especially sesamine and yangambin and the crude extract were tested against the workers of the subterranean termite, *A. desertorum* (Desneux). The crude extract showed significant insecticidal activity against either feeding or survival after one week at all tested levels, and the compounds argentiolid β and sesamine gave a high effect at concentration level 25% after two days.The crude extract was applied on two species of trees on this island.

INTRODUCTION :

In connection with our interest in biologically active natural products [3], we investigated the chemical constituents of the root bark of *Artemisia argentea* L' Her . A large number of sesquiterpene lactones and tetrahydrofurofuran lignans were previously reported from over hundred species of *Artemisia* [1,2,4-9]. Argentiolid β, sesamine, yangambin and arborescin were evaluated against *Amitermes desertorum* which damage trees and woods in Upper Egypt .

The subterranean termite species are increasing in its importance in temperate regions [10,11], especially those belonging to family Termitidae [12]. Some researchers [13,14] have observed that the most destructive termites belong to the genera *Amitermes* and the frequently most recorded termite in Aswan Governerate is *A. desertorum* (Desneux) which builds its nests underground or in the heart of trees and attacks both dead wood and live trees. In 1982, Ali et al, [15] stated that this species is very adaptable and has a wide distribution on Egyptian timber. Plant extractives have been bioassayed for one or more antitermitic effects, including toxicity to the insects and/or gut symbionts, feeding deterrency, non-preference or repellency, against one or more termite species .

Aswan Botanical Island is situated in the middle of the river Nile in Aswan, Egypt, and covers an area of 17 feddans. In this garden there are many different species of tropical and subtropical plants. The present study indicated that *A. desertorum* infested many trees species specially *Eugenia jambolana*, Family *Myrtaceae* (mambosia) and *Roystonia regia*, Family *Palamaceae* (Royal Palm).

The aim of this work is to determine the biological value of the root bark extract of *A. argentea* and some pure compounds against the subterranean termite *A. desertorum* in the laboratory and field.

EXPERIMENTAL :

Materials and Methods :

Plant material :

The root bark of *Artemisia argentea* plants cultivated in the experimental station of medicinal plants, Faculty of Pharmacy, Assiut University was collected during April and May 1996.

Extraction and isolation :

See reference [9].

Field visits :

Twenty-four field visits were carried out during one year from April 1997- April 1998. The number and species of infested trees were recorded. Superficial examination of the trees was made in order to discover any symptoms due to termites infestation.

Laboratory investigation:

Wood samples of termite-infested trees were collected from the close vicinity of roots and transferred to the laboratory. The

termites species were identified by the Plant Protection Department, Faculty of Agriculture, Assiut University.

Termites :

A colony of the *A. desertorum* was collected from infested mambosia trees.

Force-feeding test :

A round plastic container of five cm in diameter and 3.5 cm in height was packed with 50 gm. sterile sand moistened with 7 ml. distilled water to keep the relative humidity near saturation. Five levels of crude extracts were tested (5,10,25,50 and 100 conc. %). Filter papers (1 cm in diameter) were dipped in the methanolic extracts for each level for 10 seconds, and dried at room temperature for evaporation of the solvent. The treated papers were placed on the sand and 100 worker termites were added to each container. Untreated filter papers were supplied to termites as a control. The containers were incubated at 25±1°C for five weeks and the number of surviving termites were recorded in each replicate. Filter papers treated with five concentration levels of the isolated compounds of *Artemisia argentea* (10, 15, 20, 25 and 30 concentration %), were evaluated against termites and the number of surviving termites were taken at 2, 6, 10 and 14 days, respectively.

Field application of *Artemisia* extract:

An observation of the trees revealed the existence of tunnels on their surface. These tunnels were removed and cleaned, then the trees were painted with the extract solution (extract soluble in water). The quantity of crude extract which was brushed on each tunnels (7 m. length) equals 260 mg. and observed weekly. After two months the experiment was repeated. To spread the crude extract solution through the colony or the nest of the termites a frame of wood (20×20 cm) full of blocks (1×1×2 cm) of the same treated trees was burried beneath the tree near its root after dipping in the plant extract solution for ten seconds. The frame was also observed after two months.

Statistical analysis:

Data were statistically analyzed using F-test.

RESULTS AND DISCUSSION :

This paper is the third of a series on the insect distribution of *Isoptera* species in Aswan Botanical Island [16,17]. The pest infested 7 tree species with subterranean termite *A. desertorum*. This higher termite (Termitidae) was the only species that represents order Isoptera (Table 1). The first part of this work shows the bioassay of crude extract with four pure compounds from *Artemisia argentea* L' Her on feeding and survival of *Amitermes desertorum* which depend in their digestion on some symbiotic organisms (bacteria), living in their gut.

Table 1: A list of wooden trees in the Botanical Island, Aswan and the number of infested trees by *Amitermes desertorum*

Family	Species name	Common name	Total number of trees	Number of infested trees	Infested trees %
Palmaceae	*Borassus flabelliformis*	Deiolib palm	6	1	16.7
Palmaceae	*Phoenix dactylifera*	Date palm	48	2	4.2
Palmaceae	*Roystonia regia*	Royal palm	143	2	1.4
Myrtaceae	*Eucalyptus rostrata*	Kafour	3	1	33.3
Myrtaceae	*Eugenia janbolana*	Mambosia	34	15	44.1
Anacardiaceae	*Mangifera indica*	Mangoes	14	2	14.3
Moraceae	*Pleiogynium solandri*	Gambosia	2	1	50

Tables 2 and 3 show the mean survival of *A.desertorum* feeding on filter papers treated with different levels (%) of crude extract during five weeks and the pure compounds during two weeks. It was observed that the percentage of survival was level and exposure dependent. The results represented in table 2 guide to the range of compounds concentration, these ranged between 10-30%. Table 3 indicated that the termites lived approximately two weeks only after feeding on arborescin and yangambin at two levels (10 and 15%) and the remaining were dead within 10 days for both argentiolid β and sesamine. The activity of sesamine and argentiolid β started from the concentrations 20-30% after two days and increased gradually until becoming maximum at 25% after six days. But all levels (10-20%) showed a weak anti-termitic effect similar to untreated samples and the survival was not significantly different after two days except for compounds argentiolid β and sesamine which gave significant effect .

Table 2 : Mean survival of workers of *Amitermes desertorum* after exposure to *Artemisia argentea* as a crude root extract for five weeks at five concentrations

% Conc. (ppm)	1 week	2 weeks	3 weeks	4 weeks	5 weeks
5 (15)	73	42	13	2	1
10 (30)	14	3	0.0	0.0	0.0
25 (75)	17	0.3	0.0	0.0	0.0
50 (150)	6	0.0	0.0	0.0	0.0
100 (300)	0.0	0.0	0.0	0.0	0.0
Control	100	96	81	69	61

Table 3 : The survival of *Amitermes desertorum* workers fed on filter papers with five concentrations of four compounds isolated from *Artemisia argentea* root bark .

Compounds	ppm (conc. %)	Mean survival ± SD			
		after 2 days	after 6 days	after 10 days	after 14 days
Argentiolid β	762	100 ± 0.0	95 ± 1.26	10 ± 0.5	2.o ± 0.96
Sesamine	433 (10)	100 ± 0.0	94 ± 2.94	15 ± 3.40	3.0 ± 1.71
Yangambin	714	100 ± 0.0	91 ± 3.32	42 ± 17.17	6.0 ± 2.63
Arborescin	1300	100 ± 0.0	87 ± 7.44	59 ± 2.63	19 ± 4.32
Argentiolid β	1144	100 ± 0.0	85 ± 5.44	1.0 ± 0.5	0.0 ± 0.00
Sesamine	650 (15)	100 ± 0.0	69 ± 5.44	3.0 ± 1.26	0.0 ± 0.00
Yangambin	1071	100 ± 0.0	45 ± 2.94	12 ± 1.26	9.0 ± 1.63
Arborescin	1950	100 ± 0.0	95 ± 2.87	86 ± 4.08	14 ± 3.56
Argentiolid β	1526	77 ± 3.74	44 ± 5.35	14 ± 3.30	0.0 ± 0.00
Sesamine	867 (20)	78 ± 5.80	22 ± 3.27	9.0 ± 0.82	0.0 ± 0.00
Yangambin	1428	100 ± 0.0	80 ± 5.91	28 ± 2.45	0.0 ± 0.00
Arborescin	2600	100 ± 0.0	95 ± 2.50	84 ± 3.77	0.0 ± 0.00
Argentiolid β	1906	44 ± 4.65	20 ± 5.44	1.0 ± 0.50	0.0 ± 0.00
Sesamine	1083 (25)	35 ± 4.50	6 ± 2.50	0.0 ± 0.00	0.0 ± 0.00
Yangambin	1786	100 ± 0.0	90 ± 2.94	18 ± 5.25	0.0 ± 0.00
Arborescin	3250	100 ± 0.0	13 ± 1.89	0.0 ± 0.00	0.0 ± 0.00
Argentiolid β	2287	92 ± 4.19	7.0 ± 4.55	0.0 ± 0.00	0.0 ± 0.00
Sesamine	1300 (30)	67 ± 2.83	3.0 ± 2.06	0.0 ± 0.00	0.0 ± 0.00
Yangambin	2143	100 ± 0.0	49 ± 8.34	5.0 ± 3.20	0.0 ± 0.00
Arborescin	3900	100 ± 0.0	22 ± 3.30	7.0 ± 1.71	0.0 ± 0.00
Control	0.00	100 ± 0.0	100 ± 0.0	95 ± 3.10	89 ± 3.30

F=358.08, P=0.000 (ANOVA)

Figures 1-5 show that argentiolid β and sesamine were the most effective compounds, since a significant decrease in the survival of the termites was shown after two days at two applied levels (20-25%). After six days of treatment most of the termites died at the level of 25 - 30%. No survival was recorded after 10 days at 15-30 %. It was observed that at concentration 30% termites avoid to eat the treated papers and hide beneath sand surface.

Fig. (1). The survival percentage of *Amitermes desertorum* at conc. 10%

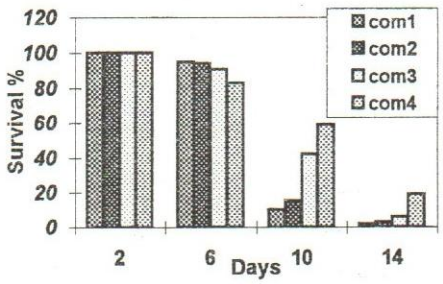


Fig. (2). The survival percentage of *Amitermes desertorum* at conc. 15%

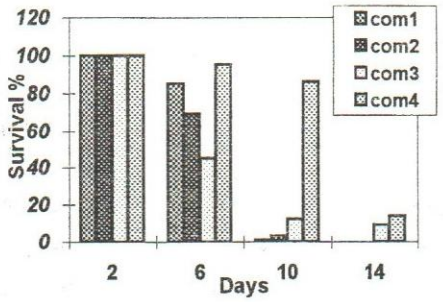


Fig. (3). The survival percentage of *Amitermes desertorum* at conc. 20%

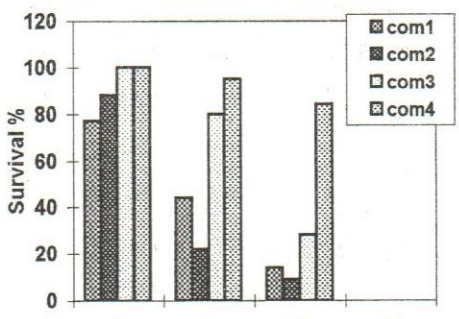


Fig. (4). The survival percentage of *Amitermes desertorum* at conc. 25%

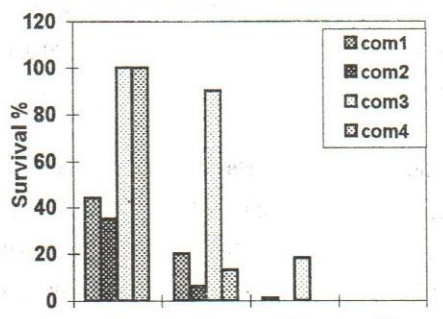
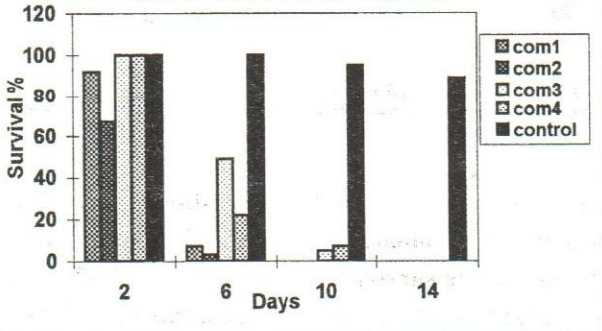


Fig. (5). The survival percentage of *Amitermes desertorum* at conc. 30%



There are three possible causes of death:

1- The effect of the crude extract and the pure compounds on the derm of the termite;
2- Death of bacteria which live in the gut of the termite;
3- A combination of the effect on the derm and on the gut bacteria.

This requires further specialized study in order to determine the exact cause. Many investigators world wide have made large screening efforts for plants possessing physiological effects on pests [3,18-22]. The large scale application of common insecticides has a great threat to the environment. The application of the plant extracts to the control of insect pests can be a possible alternative[23].

The second part of our research deals with the application of plant extracts to control of termites on *Eugenia jambolana* (mambosia) and *Roystonia regia* (Royal Palm) trees on Aswan Botanical Island. The data in Table 1 shows about 50% of mambosia trees were infested by termites and we selected also the royal palm tree because it is a rare tropical trees.

In the case of *E. jambolana* , after painting the infested trees with *Artemisia argentea* crude extract, it was observed that the crude extract protected the treated trees from termite attack for two months and prevented the formation of tunnels by termites on the surface of the trees. After two months, the tunnels appeared again, so the experiment was repeated again and the same results were obtained. That, the infestation occurred again may be due to the infestation of other trees or the crowdy nest by increasing individuals of termite [24]. But in the case of *R. regia* , the crude extract successfully prevented the return of tunnel by termites from April 1997 to April 1998.

Generally, the application of crude extracts or pure compounds derived from the root bark of *Artemisia argentea* offers a desirable alternative to chemical insecticides for the control of the subterranean termite *A. desertorum*, which infests wooden trees in Aswan city. Also of special merit is the testing of other plant extracts against insect and pests, including the termites and the microorganisms inhabiting their guts.

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حصر حشرات رتبة متساوية الأجنحة - ٣- في جزيرة النباتات بأسوان مع استخدام المستخلص الخام وبعض المركبات النقية المفصولة من نبات أرتيميزيا أرجنتيا في مقاومة النمل الأبيض أميترمس ديزرتورم

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سجلت الدراسة والفحص للأشجار فى جزيرة النباتات بأسوان سبعة أنواع تنتمى لثلاثة عائلات كانت مصابة بالنمل التحت أرضى أميترمس ديزرتورم (ديزنو) . تم تسجيل هذا النوع من النمل الراقى كنوع وحيد ممثل للرتبة متساوية الأجنحة فى هذه الجزيرة .

تم فصل العديد من المركبات المختلفة من قشرجذور نبات أرتيميزيا أرجنتيا - عائلة أستريسى، مشتملة على كل من السيسكيتربين لاكتونات (أرجنتيوليد ب و أربوريسين) ومجموعة من مركبات الليجنانز خاصة (سيسامين و يانجامبين) حيث تم تحديد تركيبهم الكيميائى عن طريق مقارنتها بعينات سبق فصلها من أوراق نفس النبات .

تم اختبار الخصائص الإبادية للمستخلص الخام للنبات وأربعة من المركبات النقية المفصولة على شغالات النمل التحت أرضى أميترمس ديزرتورم .

أوضحت النتائج أن للمستخلص الخام نشاط واضح كمبيد لحشرة النمل الأبيض فى كل من اختبارى التغذية والبقاء وذلك بعد أسبوع واحد من التجربة عند كل مستويات الاختبارات ، كما أعطى مركبى الأرجنتيوليد والسيسامين تأثيراً مرتفعاً عند مستوى تركيز ٢٥٪ وذلك بعد يومين .

كما تم التطبيق الحقلى لمستخلص نبات أرتيميزيا أرجنتيا الخام على نوعين من الأشجار فى جزيرة النبات .