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EFFECT OF SIX WOOD EXTRACTS FROM FAMILY MELIACEAE AGAINST *Psammotermes hybostoma* (DESNEUX) (ISOPTERA: RHIMOTERMITIDAE). A - EFFECT OF WINTER WOOD EXTRACTS

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ABSTRACT

This study aimed to study the toxic effects of wood extracts from some timber trees belong to Family Meliaceae against *Psammotermes hybostoma* at the Tropical Farm, Aswan Botanical Garden and Faculty of Science, Aswan Univ. during winter 2011 and 2012. The meliaceous trees were *Khaya senegalensis, K. ivorensis, Swietenia mahagoni, S. macrophylla, Azadirachta indica* and *Melia azedarach*. Results pointed out that *S. macrophylla* followed by *A. indica* produced the highest values of total extractives while, *M. azedarach* produced the lowest one in the two seasons. Using water as a solvent produced the highest values of all wood extractives compared to the other solvents. Moreover, increasing concentrations of the different wood extracts up to 350 mg/l in winter resulted in a gradual increasing of mortality percentage for the 3rd instars of termite. Using alcohol + benzene as a solvent extract for *K. senegalensis* followed by *M. azaderach* caused the highest values of mortality percentage for *P. hybostoma* compared to the other wood extracts. On the other hand, wood extract by benzene alone for *M. azaderach* followed by *K. senegalensis* led to the most toxic effects, while *S. mahogany* benzene extract led to the lowest one compared to the other treatments. According to LC 90 and LC 50 values, results revealed that alcohol + benzene extract or benzene alone of the tested trees at 300 and 150 ppm, respectively was highly toxic to *P. hybostoma* 3rd instars worker.
Keywords: Wood Extracts, Family Meliaceae, Termite, Toxic Effects.

INTRODUCTION

The six successful woody trees widely grown in Egypt are *Khaya senegalensis, K. ivorensis, Swietenia mahagoni, S. macrophylla, Azadirachta indica* and *Melia azedarach* which belong to Family Meliaceae, which are high quality timber species (mahogany group), many uses for this wood from the fact that it combines such desirable characteristics as attractive appearance, good dimensional stability, excellent finishing qualities, and a high degree of natural durability. These valuable trees contain certain components which have some biological activity as insect's antifeedant (Nakatani *et al.,* 2000) against several insects. Moreover, phytochemical analysis as crude methanolic seed extract of *Khaya* species will be used for preliminary qualitative screening of phytochemicals such as alkaloids, flavonoids, glycosides, lignins, phenols, saponins, sterols, terpenes and tannins (Sumitra *et al.,* 2006).

Extractives are the compounds present in trees that can be extracted by organic solvents. They are found in higher concentrations in the bark of most woods and are generally considered to be biosynthesized in order to slow or

prevent pathogen invasion. Their production is under strict genetic control, and some individual compounds are limited to individual species. Such compounds are broadly classified as secondary metabolites. Feeding damage and transmission of plant diseases by sucking insects and mites are some of the major causes of crop loss worldwide. Estimation on a world scale suggests that elimination of insect pests would increase crop production by about one third (Soliman, 2006). On the other hand, the lack of novel insecticides, the high cost of synthetic pyrethroids, environment and food safety concerns the unacceptability and toxicity of many organophosphates and organochlorines, and increasing insecticide resistance on a global scale are prompting some researchers to reconsider botanical insecticides in their search to address some of these problems.

Subterranean termites are the most destroyers in arid and semi- arid ecosystems (Krishmo, 1989). The sand termite, *Psammotermes hybostoma* (Desneux) is considered a serious pest in Aswan Province (Risk *et al.*, 1982, Abdel Wahab and Rizk, 1998 and Abdel Wahab *et al.*, 1998). Termites mostly feed on dead plant material, generally in the form of wood, leaf litter, soil or animal dung, and many species of termites are economically significant as pests that can cause serious structural damage to buildings, crops or plantation forests (Shaalan *et al.*, 2006). The various effects of the extractives on these insects included, attractively, repellence, toxicity, stimulation or inhibition of feeding and growth (Carter, 1976 and Hanif *et al.*, 1988). Therefore, this study was designed to examine the effects of winter wood extracts for some Meliaceae trees against *Psammotermes hybostoma* (Desneux).

MATERIALS AND METHODS

This study was carried out at the Tropical Farm, Kom- Ombo, Aswan Botanical Garden, Hort. Res. Inst., Agric.Res. Center and Zoology Dept., Fac. of Science Aswan Univ. during the seasons of 2011 and 2012 to study the effect of wood extracts of some tree species on *Psammotermes hybostoma* termite.

1-Botanical Extracts:

1-1.Wood species:

Six wood tree species i.e. *Khaya senegalensis, K. ivorensis, Swietenia mahagoni, S. macrophylla, Azadirachta indica,* and *Melia azedarach* at age of 15 were investigated in the present study.

1-2.Extraction technique:

Wood samples from the main branches (at least 10 cm in diameter) in the winter (15th January) were dried at 70 °c and milled then ground with 40-60 mech. Three solvent were used i.e., Ethyl alcohol + benzene (1:2 by volume) for 4 h. wood residue were air dried then extracted by Benzene for 4 h. Wood residues were air dried then extracted by water for 4 h. according to ASTM D- 1107 – 56 (1989). Wood sample were weighed before and after each extraction then each was calculated as percentage of wood in both seasons.

2-Termite species:

***Psammotermes hybostoma* termite** was used in the present study. These termites are abundant in arid and semi- arid regions of Upper Egypt, and the highly infested places are those of high moisture content.

Collection and preparation for tests: *P. hybostoma* individuals were collected from several cardboard baits buried in the Saddaka, El- Shallal district, Aswan Province, Egypt. The termite colony was kept in a large plastic container for three months. The container was filled with corsage cardboard as termite feeding. One day prior to test termite workers as externally undifferentiated insects beyond the 3rd instars were counted (50 individuals) and transferred to the test plastic container and starved for 24 h. before the test.

3-Bioassay:

Preliminary screening and toxicological tests:

For testing termite workers in both preliminary and LC 50 investigations, a stock solution of crude extract was prepared at 1 gm in 10 ml of absolute ethyl alcohol (100.000 ml/ l) and required concentrations were prepared in ethyl alcohol for preliminary screening and toxicological tests. Crude extracts were screened at descending series of concentrations (10, 50, 100, 200 and 300 mg/ l) to determine the LC 50.

Extracts that caused 100% mortality at 200 ppm were only selected and permitted for testing at the next concentration and so on. Termite workers were subjected to different concentration (at least five concentrations) of crude botanical extracts (paper pads treated with each conc.) fixed in plastic containers to determine LC 50. About 50 healthy workers beyond the 3rd instars were starved for 24 h. before testing and released into plastic containers containing 50 gm sterile sand and 1 ml distilled water. Containers were incubated at room temperature and mortality percent was recorded after 24 h. Abbott's formula (1925) was used to correct mortality percentage if the control mortality percent was between 5 and 20%.

4-Statistical analysis:

Data analysis was performed using ANOVA according to Snedecor (1965), and L.S.D. mentioned by Little and Hills (1978). The probate analysis statistical method and Litchified and Wilcoxon (1949) was used to calculate the logarithmic concentration probate line (LC- P lines) and the medium lethal concentration (LC 50), also the high lethal concentration (LC 90) values for each tested extracts.

RESULTS

1 - Wood extracts:

Obtained data in Table (1) illustrate that the mean values of winter wood extract percentages of 2011 and 2012 for the studied trees as affected by alcohol and benzene, benzene and water as solvents. This study has shown that the differences between meliaceous trees were significant and the highest extract percentages in wood can be obtained by *S. macrophylla* in the two seasons. Also, there were significantly differences between the solvents

used and the values of wood extract percentages for the studied trees were increased due to using water as a solvent compared to the other applied solvents. Meanwhile, using benzene alone as a solvent resulted in the lowest values of wood extract percentage in the two seasons.

Table (1): Wood extract percentages for six species of family Meliaceae in the two seasons of 2011 and 2012.

Species	Wood extract (%) by 3 different solvents							
	First season (2011)				Second season (2012)			
	Alcohol & benzen	Benzene	Water	Total extract	Alcohol & benzene	Benzene	Water	Total extract
Khaya senegalensis	2.25	0.59	2.29	5.13	2.10	0.55	2.13	4.78
K. ivorensis	1.32	0.54	3.36	5.22	1.25	0.51	3.18	4.94
Azadirachta indica	2.92	0.28	2.69	5.89	2.77	0.26	2.52	5.55
Melia azedarach	1.14	0.25	1.76	3.15	1.07	0.24	1.63	2.94
Swietenia mahagoni	1.58	0.61	3.31	5.50	1.49	0.57	3.14	5.20
S.macrophylla	2.68	0.69	2.72	6.09	2.53	0.65	2.57	5.75
L.S.D. at 1 %	0.60	0.12	0.25	0.66	0.58	0.12	0.16	0.61
at 5 %	0.42	0.08	0.17	0.46	0.41	0.08	0.12	0.43

2 - Preliminary screening of the wood extracts in winter against *P. hybostoma*:

Table (2) shows that the preliminary screening of different crude wood extracts against 3rd instars of *P. hybostoma*. It indicated that increasing concentrations of the different crude winter wood extracts resulted in gradual increases of mortality percentage for the 3rd instars of termite. However, 10 and 50 mg/l concentrations were the lowest effective for all the tree species, while 300 and 350 mg/l were the most effective treatments when compared to the other treatments. *A. indicia*, *S. mahagoni* and *K. senegalensis* alcohol+ benzene extracts at 250 mg/l were the most effective treatments, compared to the other tree species at the same concentrations. Water extract for all tree species was not effective on the 3rd instars of *P. hybostoma*.

Table (2): Preliminary screening of different crude winter wood extracts against 3ed instars individuals of *Psammoterms hybostoma* (24 hr)

Winter wood extracts	Extraction solvent	Mortality (%) at concentration mg/ l							
		10	50	100	150	200	250	300	350
Khaya Senegalensis	Alcohol&benzene	1	4	15	17	25	66	84	100
	Benzene	2	7	8	9	13	38	73	100
K. ivorensis	Alcohol&benzene	2	9	22	24	39	44	98	100
	Benzene ext.	1	3	21	22	34	35	81	100
Azadirachta indica	Alcohol&benzene	0	12	23	28	36	68	82	100
	Benzene	0	9	28	37	45	63	79	100
Melia azaderach	Alcohol&benzene	0	6	13	25	36	49	98	100
	Benzene	0	6	10	13	28	37	71	100
Swietenia mahagoni	Alcohol&benzene	0	6	17	21	42	65	95	100
	Benzene	0	2	10	12	33	56	88	100
S. macrophylla	Alcohol&benzene	0	8	11	14	18	41	86	100
	Benzene	0	3	8	9	17	38	77	100
Control	Alcohol&benzene	0	0	3	12	5	17	18	25
	Benzene	0	0	1	3	7	8	13	20
	Water	0	0	0	0	0	0	0	0

3 - Toxicity of winter wood extract by alcohol and benzene:

Results of toxicity and mortality percentage of winter wood extract by alcohol and benzene tested against 3rd instars of *P. hybostoma* were presented in Table (3). The tested trees were significantly differed in their toxicity and mortality percentage. However, the highest mortality percentage was recorded with *K. senegalensis*, while, using *S. macrophylla* extract resulted in the lowest one. On the other hand, toxicity and mortality percentage were significantly affected by the used concentrations. The increasing of concentration resulted in highly significant increasing in the mortality percentage. In relation to the interaction between the used woody trees and extract concentrations, it is evident that, using 300 ppm of *K. ivorensis, M. azaderach* and *K. senegalensis* significantly increased mortality percentage when compared to the other interactions.

Table (3): Toxicity and mortality percentage of winter wood extracts by alcohol & benzene against 3rd instar of *P. hybostoma*

Wood extracts	Concentration (ppm)						
	50	100	150	200	250	300	Mean (A)
Khaya senegalensis	14.25	26.25	37.75	60.25	82.00	92.75	52.21
K. ivorensis	7.00	16.50	35.50	54.50	86.75	95.00	49.20
Azadirachta indica	5.75	16.00	43.75	59.25	70.50	89.50	47.46
Melia azaderach	15.25	26.75	37.00	56.75	68.50	94.50	49.79
Swietenia mahagoni	11.25	17.00	38.00	51.75	66.25	71.75	42.67
S. macrophylla	13.25	28.50	36.00	44.00	50.00	64.25	39.33
Mean (B)	11.13	21.83	38.00	54.42	70.67	84.63	
LSD at 1%	A : 5.11	B : 3.42	AB : 8.39				
at 5%	A : 3.70	B : 1.41	AB : 3.46				

A = Wood extracts B = Concentration (ppm) AB = interaction

4 - Toxicity of winter wood extracts by benzene:

Significant increases were observed in mortality percentage for *P. hybostoma* instars due to applying the different wood extract treatments. The highest values of mortality percentage (53.58 %) resulted from using *M. azaderach* extract against 3rd instars of *P. hybostoma* (Table, 4). Concerning the general effect of the tested concentrations on the 3rd instars of *P. hybostoma* regardless of tree species, it is obvious that the differences between concentrations effect were significant. The highest value (78.79 %) of mortality percentage resulted from using 300 ppm, and the lowest one (11.46 %) was with 50 ppm. In regard to the interaction between tree species and the used concentrations on mortality percent of *P. hybostoma*, it was significant. Maximum mortality (94.00 %) was recorded in 300 ppm of *K. ivorensis*, while the lowest mortality was recorded with 50 ppm of *A. indica* (6.0 %).

Table (4): Toxicity and mortality percentage of winter wood extract by benzene against 3rd instars of *P. hybostoma*.

Wood extracts	Concentration (ppm)						
	50	100	150	200	250	300	Mean (A)
Khaya senegalensis	11.50	20.25	36.50	60.25	84.50	93.75	51.13
K. ivorensis	8.75	22.75	34.00	47.25	75.50	94.00	47.04
Azadirachta indica	6.00	17.25	39.25	56.75	71.00	88.75	46.50
Melia azaderach	21.25	36.00	45.50	56.00	69.50	93.25	53.58
Swietenia mahagoni	9.50	15.50	25.00	29.25	35.50	40.75	25.92
S. macrophylla	11.75	32.25	35.50	42.00	53.25	62.25	39.50
Mean (B)	11.46	24.00	35.96	48.58	64.88	78.79	
LSD at 1%	A : 2.33	B : 3.00	AB : 7.35				
5%	A : 1.68	B : 1.24	AB : 3.03				

A =Wood extracts B = Concentration (ppm) AB = interaction

5 - Toxicity of winter wood extract by water:

Mean mortality percentages for the 3rd instars of *P. hybostoma* as affected by winter wood extracts are given in Table (5). The tested meliaceous trees up to 150 ppm are not affective. Using water as solvent for *K. senegalensis* extract resulted in the highest values of mortality percentage for *P. hybostoma* compared to the other trees. Meanwhile, the lowest values of mortality resulted due to using water extract of *S. macrophylla* and *K. ivorensis*. According to the data shown in this table, application of 350 ppm gave the highest value of mortality compared to the other concentrations. On the other hand, the combined effect of wood extract and the used concentration showed that the highest value of mortality percentage (24 %) was due to *M. azaderach* at 350 ppm.

Table (5): Preliminary screening of water plant extracts in winter by water against 3rd instars individuals of *Psammoterms hybostoma* (24 hr)

Water wood extracts	Mortality (%) at concentration (ppm)							
	10	50	100	150	200	250	300	350
Khaya Senegalensis	0	0	0	0	13	17	19	21
K. ivorensis	0	0	0	0	1	3	4	13
Azadirachta indica	0	0	0	0	5	8	10	12
Melia azaderach	0	0	0	0	1	2	8	24
Swietenia mahagoni	0	0	0	0	2	4	6	8
S. macrophylla	0	0	0	0	0	1	4	5
Control	0	0	0	0	0	0	0	0

Toxicity of winter water extracts against the 3rd instars of *P. hybostoma* is presented in Table (6). It is worthy to notice that the differences between meliaceous trees were significant. Maximum mortality (45.83 %) was obtained due to using *K. senegalensis* extract. On the other hand, using 800 ppm of water extract resulted in the highest value (45.50 %) of toxicity compared to the other concentrations. Data in this

table represented the combined effect of the woody extract and the tested concentrations; it was obvious that, there were significant differences between water extracts and their concentrations. Maximum mortality (61.00 %) was recorded from using 800 ppm of *K. senegalensis* water extract.

Table (6): Toxicity and mortality percentage of winter wood extract by water against 3rd instars of *P. hybostoma*.

Wood extracts	Concentration (ppm)						
	300	400	500	600	700	800	Mean (A)
Khaya senegalensis	17.00	37.25	45.50	56.25	58.00	61.00	45.83
K. ivorensis	3.00	15.50	18.75	22.50	31.75	37.25	21.50
Azadirachta indica	5.75	12.75	23.00	26.50	30.00	34.00	22.00
Melia azaderach	14.00	21.25	27.00	35.75	38.25	42.25	29.75
Swietenia mahagoni	11.25	20.75	26.50	35.25	40.25	44.25	29.70
S. macrophylla	15.00	31.00	37.00	44.50	51.50	54.25	38.88
Mean (B)	11.04	23.08	29.63	36.79	41.63	45.50	
LSD at 1%	A : 4.83	B : 2.99	AB : 7.32				
5%	A : 3.49	B : 1.23	AB : 3.02				

A = Wood extracts B = Concentration (ppm) AB = interaction

6 - LC_{30} , LC_{50} , LC_{90} and slope data of winter wood – alcohol + benzene extracts:

Data shown in Table (7) represented LC 30, LC 50 and LC 90 values and slope data of winter plant- alcohol + benzene tested against 3rd instars larva of *Psammotermes hybostoma*. According to LC 90 values data showed that, *K. ivorensis, A. indica, M. azaderach, S. mahagoni, S. macrophylla* and *K. senegalensis* alcohol + benzene extract (300 ppm) was highly toxic to *P. hybostoma* 3rd instars worker. The slope values of LC 90 in *K. senegalensis* and *K. ivorensis*, alcohol + benzene extracts were the same (0.12 for each), also in *A. indica* and *M. azaderach* (0.11 for each) and in *S. mahagoni* and *S. macrophylla* (0.10 for each).

According to LC 50 values, Table (7) showed that, alcohol + benzene extract of the tested meliaceous trees was highly toxic against termite workers at 150 ppm. On the other hand, the highest slope value (18.22) of the tested trees was due to *M. azaderach* extract, while the lowest one (0.10) resulted from *S. macrophylla*.

Table (7) : LC_{30} , LC_{50} , LC_{90} and slope data of winter wood – alcohol + benzene extracts against 3rd instars larva of *Psammotermes hybostoma*

Wood extracts	L.C. 30			L.C. 50			L. C. 90		
	p.p.m	95%	Slop±S.E	p.p.m	95%	Slop±S.E	p.p.m	95%	Slop±S.E
Khaya senegalensis	100	30.26	8.33 ± 0.56	150	50.57	11.41 ± 0.95	300	60.00	0.12 ± 46176.64
K. ivorensis	100	30.02	10.59 ± 0.74	150	50.17	13.98 ± 1.10	300	90.00	0.12 ± 46952.11
Azadirachta indica	100	30.74	6.75 ± 0.46	150	50.26	11.02 ± 1.32	300	90.00	0.11 ± 44394.70
Melia azaderach	100	30.08	8.76 ± 0.71	150	50.00	18.22 ± 2.53	300	90.00	0.11 ± 44659.48
Swietenia mahagoni	100	30.89	5.46 ± 0.44	150	50.32	8.06 ± 1.18	300	90.00	0.10 ± 35499.21
S. macrophylla	100	30.68	4.74 ± 0.65	250	50.11	0.10 ± 0.25	300	90.00	0.10 ± 38906.62

7 - LC_{30} , LC_{50} , LC_{90} and slope data of winter plant – benzene extracts:

Data in Table (8) indicated that, LC 50 values of the tested meliaceous trees benzene extract was highly toxic to termite (150 ppm). Also, LC 50 values of the trees were nearly similar (50.00). The highest slope values were obtained with *K. ivorensis* and *M. azaderach* (16.70 and 15.84, respectively) while; the lowest value (0.38) was obtained from *S. mahagoni.* According to LC 90 values of the tested trees, tabulated data pointed out that, benzene extract tested against 3rd larva of termite was highly toxic (300 ppm) and was similar (90.00). The slope values of *K. ivorensis*, *A. indica* and *M. azaderach* were typical (0.11), also *S. mahagoni* and *S. macrophylla* gave typical slope values (0.10).

Table (8) : LC_{30} , LC_{50} , LC_{90} and slope data of winter plant – benzene extract against 3rd instars larva of *Psammotermes hybostoma* .

Wood extracts	L.C. 30			L.C. 50			L. C. 90		
	p.p.m	95%	Slop±S.E	p.p.m	95%	Slop±S.E	p.p.m	95%	Slop±S.E
Khaya senegalensis	100	30.14	9.02 ± 0.58	150	50.55	11.91 ± 0.94	300	90.00	0.12 ± 40553.94
K. ivorensis	100	30.00	11.38 ± 0.90	150	50.00	16.70 ± 1.57	300	90.00	0.11 ± 43582.78
Azadirachta indica	100	30.37	7.29 ± 0.52	150	50.16	11.56 ± 1.32	300	90.00	0.11 ± 43435.19
Melia azaderach	100	30.90	6.66 ± 0.63	150	50.01	15.84 ± 2.16	300	90.00	0.11 ± 37369.47
Swietenia mahagoni	200	30.81	7.25 ± 2.57	300	50.00	0.38 ± 0.69	300	90.00	0.10 ± 38430.50
S. macrophylla	100	30.85	4.52 ± 0.65	200	50.08	12.84 ± 4.79	300	90.00	0.10 ± 38802.67

8 - LC_{30} and slope data of winter plant – water extracts:

Results in Table (9) revealed that, water extracts of the tested woody trees were different in their effect on *P. hybostoma* as *K. senegalensis* and *S. macrophylla* were more effective (LC 30= 300 and 350 ppm, respectively), while the slight effect (LC 30= 700 ppm) was with *K. ivorensis*. The slope values were different among the six tree species extractives and the highest value (16.46) was obtained with *K. ivorensis*, while the lowest one (5.30) was with *K. senegalensis*.

Table (9): LC_{30} and slope data of winter plant – water extracts against 3rd instars larva of *Psammotermes hybostoma* .

Wood extracts	L.C. 30		
	ppm	95%	Slop±S.E
Khaya senegalensis	300	30.97	5.30 ± 0.37
K. ivorensis	700	30.95	16.46 ±10.14
Azadirachta indica	600	30.16	9.62 ± 6.09
Melia azaderach	500	30.75	6.84 ± 1.48
Swietenia mahagoni	500	30.79	7.46 ± 1.44
S. macrophylla	350	30.65	5.83 ± 0.58

DISCUSSION

Extracts are the compounds present in trees that can be extracted by water or organic solvents. They are found in higher concentrations in the bark and wood of most timber trees and are generally considered to be biosynthesized in order to slow or prevent pathogen invasion. Their production is under strict genetic control, and some individual compounds are limited to individual species. Such compounds are broadly classified as secondary metabolites. In this respect, this investigation confirmed the presence of these compounds and the toxic effects of meliaceous trees as botanical extracts on instars of *P. hybostoma*. However, there were differences in their effects as reported by Alfazairy *et al.* (1994); Badshah *et al.* (2004);Shaalan *et al.* (2006) and Olufemi *et al.* (2011). Also, mortality percentages due to the used wood extracts were significantly different from control, suggesting the toxic effect of this family against termites. The present study found that *S. macrophylla* and *A. indica* were superior in total extracts compared to the other trees. Moreover, toxicity and mortality percentages of winter wood extract by alcohol + benzene were superior to that of the other solvents. According to the results of sublethal concentrations (LC 30, LC 50 and LC 90) of the tested extracts, organic solvents were surprisingly better than water extract one. These results were in accordance with that of Alfazairy *et al.* (1994); Winks and Schimmer (1999) and Shaalan *et al.* (2006). Findings suggested that meliaceous wood extracts may produce larvicidal effects (behaving like general toxicants) against *P. hybostoma*. On the other hand, slope value for each of the tested extracts was quite different; which suggested the presence of different compounds and/ or sites of activity rather than differences in compound concentration.

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تأثير مستخلصات ستة أنواع خشبية تابعة لعائلة الماهوجنى على النمل الأبيض
أ- تأثير المستخلصات المنتجة فى الشتاء

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أجريت الدراسة بالمزرعة الاستوائية بكوم أمبو- الحديقة النباتية بأسوان ، وكلية العلوم بأسوان خلال عامي ٢٠١١ ، ٢٠١٢ بغرض دراسة تأثير مبيدات الحشرات نباتية الأصل والناتجة عن أشجار الكايا السنغالى، الكايا ايفورنسس، سويتنيا ماهوجنى، سويتنيا ماكروفيلا، النيم، والزنزلخت.

وكان أهم النتائج المتحصل عليها ما يلى:

أعطت أشجار سويتنيا ماكروفيلا أعلى القيم الخاصة بالمستخلصات الكلية فى الشتاء، يليها أشجار النيم، ثم أشجار سويتنيا ماهوجنى، بينما نتج عن أشجار الزنزلخت أقل القيم. و قد تفوق الاستخلاص باستخدام الماء فى كل الأشجار على الاستخلاص بالمذيبات العضوية المستخدمة.

وتؤدى المستخلصات الناتجة باستخدام الكحول+ البنزين أو البنزين بمفرده الى سمية شديدة للنمل الأبيض خاصة عند مستوى تركيز ٣٥٠ جزء فى المليون الذى أدى الى ١٠٠ % موت، و كانت مستخلصات أشجار الكايا ايفورنسس وأشجار الزنزلخت بالكحول والبنزين عند مستوى ٣٠٠ جزء فى المليون أكثر سمية للنمل الأبيض عن باقي الأشجار عند نفس التركيز.

و كانت المستخلصات الناتجة عن أشجار الكايا السنغالى يليها الزنزلخت باستخدام الكحول و البنزين أكثر سمية للنمل الأبيض مقارنة بباقى الأشجار، وكان أقلها سمية أشجار سويتنيا ماكروفيلا.

كما كانت المستخلصات الناتجة عن أشجار الزنزلخت يليها الكايا السنغالى باستخدام البنزين فقط أكثر سمية للنمل الأبيض مقارنة بباقى الأشجار، وكان أقلها سمية أشجار سويتنيا ماهوجنى.

و كانت المستخلصات الناتجة بالاستخلاص المائى أقل سمية من المستخلصات العضوية المستخدمة، ولحدوث سمية متوسطة يجب زيادة التركيزات المستخدمة حتى ٨٠٠ جزء فى المليون، و تنتج أعلى سمية عن أشجار الكايا السنغالى يليها سويتنيا ماكروفيلا، بينما تنتج السمية الأقل عن أشجار كايا ايفورنسس.

بناء على قيم LC 90، LC 50 الخاصة بالاستخلاص باستخدام الكحول+ البنزين أو البنزين بمفرده فان النتائج تبين أن تركيز ٣٠٠ جزء فى المليون فى حالة LC90 وتركيز ١٥٠ فى حالة LC50 يؤدى لحدوث سمية شديدة للنمل الأبيض.

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