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Indoor and outdoor controlling evaluation on the subterranean termite, *Psammotermes hybostoma* (*Isoptera: Rhinotermitidae*) using some unordinary natural oils and others

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ABSTRACT

The present work was conducted to evaluate controlling the subterranean sand termite, *Psammotermes hybostoma* using some unordinary natural oils and others in the laboratory and field as indoor and outdoor investigations, respectively. The results were analyzed statistically by T-test.

Ten kinds of oils [Caraway, Onions, Garlic, Clove, Peppermint, Basil, Eucalyptus (Camphor), Sesame, Tar and Fenugreek] and three other substances [Neem seeds extraction, gum bees powder (Propolis) and aluminum sulphate powder (Alum)] were used. These materials have been observed under laboratory conditions, and field conditions at two regions namely; El-Konooz region and the farm land of South Valley University during the period from January to December 2011, and in three infected buildings at El-Konooz region during the period from February till June 2012 in Qena city.

Laboratory results showed that, the highest mortality rate was recorded by using caraway oil (100 workers per hour). In contrast, the lowest mortality rate was observed when propolis and neem seeds extraction used (0.26 workers per hour) equally.

On the other hand, the outdoor field results agreed with the laboratory investigations. Thus, the highest ratio of sand termite individuals, caught in corrugated cardboard traps allover one complete year, was in the traps treated with propolis (95.6 %). In contrast, the lowest was (0.24 %) with clove oil. The ratio was (0.0 %) in the presence of the following oils (caraway, basil, camphor, garlic, peppermint and tar) at El-Konooz region.

Moreover, field results of the farm land of South Valley University showed that the highest ratio of sand termites individuals was in the traps treated with propolis (92.7 %). Inversely, the ratio was (0.0 %) in the cases of the following oils (caraway, basil and garlic).

On the other hand, statistical analysis on the feild results showed highly significant differences between the mean numbers of the individuals caught in traps treated with all oils and their control. Whereas, no significant differences were recorded in the case of propolis and neem seeds extraction and their control.

In relation to the results on infected buildings, the total numbers of individuals obtained from corrugated cardboard pieces were zero in the doors and windows frames that treated with the following oils (caraway, basil and camphor), despite continuing injury in the control case (2070 and 1424 individuals from doors and windows frames, respectively).

Thus, it is recommended using the most effective repellent oils (caraway, basil, camphor, garlic, peppermint, tar and clove) in subterranean termite control inside buildings by spraying infected timber or injection in the ground or by traps in the soil

instead of chemical pesticides with harmful impact on the environment and health.

Keywords: Subterranean Sand Termite, *Psammotermes hybostoma*, Controlling, Evaluate, Unordinary Natural Oils, Repellent.

INTRODUCTION

Termite is an exopterygotous insects which belong to the order *Isoptera* and it is one of the numerous organisms that inhabit the soil. Termites are commonly called "White ants". However, not all species of termites are white, and not termite is a true ant. Termites are social insects, feed primary on cellulose and organized into colonies (Assem, 1980).

The sand subterranean termite, *Psammotermes hybostoma* (Desneux) (Fam. *Rhinotermitidae*) has become a major urban pest and is considered as a great economic importance in Egypt. It cause a great damage to the rural buildings constricted with mud bricks as well as furniture and farmed wood within new buildings (Beal, 1979; and Ahmed & El-Sebay, 2008).

The subterranean termite species is a widely dispersed all over the two sides of the River Nile and all Oases in both Eastern and Western deserts (Rizk *et al.,* 1985). Abushama and Al-Houty (1988) found that *P. hybostoma* prefers soil of high sand content, where it builds deep subterranean nests, this make difficulty in collecting any behavioral data. Forschler and Townsend (1996) reported that, studies on the natural foraging behavior of subterranean termites are complicated by their small size, cryptic nature and behavior.

Concerning the susceptibility of different wooden materials to damage by sand termites, Bultman *et al*. (1979) found that, the resistance of wood against termite may be attributed to the physical factors such as wood density, which influence the termite ability to fragment the wood mechanically with its mandibles. Ali *et al.,* (1982) arranged the Egyptian timber into 4 groups according to the damage of termite. They classified the Gum - tree from non - damage group, *Zizyphus* and *Tamarix* from slight damage group, date palm from moderate damage group and bombax tree from heavy damage group. Aly *et al.* (2007) found that under controllable laboratory conditions, carton and date palm (*Phoenix dactylisfera* L.) had the highest number of survivals and consumed weight of food, while the minimum duration period of *P. hybostoma* population was recorded on sidder (*Zizyphus spina-christi* Willd) and Nile acacia (*Acacia nilotica* L).

Because of increasing restrictions on the use of conventional termiticides, attention is focused on finding safer alternative methods for termite management. Verma *et al*. (2009) reviewed that the plants show good insecticidal properties against termites. These botanicals can be used for termite control singly and in combination. The active component from biomass can be extracted to prepare efficacious and potent biocidal formulations.Sindhu *et al*. (2011) mentioned that termite control in agricultural crops is usually done by adopting suitable cultural practices or by preventing termite infestations through application of physical and chemical insecticidal barriers. However, due to long persistence of residual chemical insecticides in soil and their possible entry in food chain, recently there is more emphasis on characterization of biocontrol agents for control of termites that are safer and environment friendly.

Then, the main purpose of the present research is to overcome or reduce the current problem of termite *P. hybostoma* and forge ahead in the improvement of

termite control practices without any damage to human health and environment. Therefore, the present field study was carried out to study theeffect of thirteen natural oils and substances against subterranean sand termite, *P. hybostoma.*

MATERIALS AND METHODS

Qena Governorate is one of the most infested localities with subterranean sand termites *Psammotermes hybostoma* (*Isoptera*: *Rhinotermitidae*) which is the most destructive insect pest.The present work was carried out during the period from January 2011 till June 2012.

Trials were experimented using thirteen natural oils and substances against the subterranean sand termite, *P. hybostoma*. These 13 natural oils and substances are:

Caraway oil	*Carum carvi*
Onion oil	*Allium cepa*
Garlic oil	*Allium sativum*
Clove oil	*Syzygium aromaticum*
Peppermint oil	*Mentha*
Basil oil	*Ocimum basilicum*
Sesame oil	*Sesamum indicum*
Camphor oil	*Eucalyptus globules*
Tar oil	*Juniperus Procera*
Fenugreek oil	*Trigonella foenum – graecum*
Neem seeds extraction	*Azadirachta indica*
Propolis	Gum bees
Alum	Aluminum sulphate

A) Laboratory experiments:

Corrugated cardboard were cut into small pieces (3×4cm) and wetted with water spray as a source of moisture for the treatment of the natural substances.

Two ml/gm from each natural oils and substances were taken.

Each sample was distributed on the pieces of corrugated card board.

Pieces of cardboard were put in Petri dishes with four replicates for each treatment.

For the control treatment, pieces of corrugated cardboard were treated with water only.

Fifty healthy workers of *P. hybostoma* with the same size were exposed to each Petri dish.

All treatments were kept under laboratory conditions (temp. 26±2 and relative humidity 60%±2).

Daily observations were carried out for eight days of feeding and dead individuals were counted.

B) Field experiments:

After the examination of each natural oil and substance in the laboratory as mentioned before, the same compounds were tested in the field using the termite trap* (El-Sebay).

The studied areas:

An area about (300 m2) at two regions namely; El-Konooz region and the farm land of South Valley University in Qena Governorate were chosen for this study. These two regions are known to be commonly infested with subterranean termites. The experimental area carefully cleaned from any cellulose materials (superficial and

partially buried debris of dead wood) to prevent any nutrient interferences with the applied trap.

Termite trap:

The present field study was performed by the modified El-Sebay's trap (1991). It is consisted of corrugated cardboard paper wrapped in rolls of 5-7 cm diameter and 12 cm height all were covered with polyethylene sheath except the lower 2 cm which were uncovered and wetted with water. The polyethylene sheath was used to keep the moisture at the traps and was fixed in position with the aid of rubber band.

Seventy eight (78) of corrugated card board were prepared in the laboratory and numbered by a marker pen.

Traps were treated with each natural sample with three replicates for each treatment.

For the control treatment, the corrugated cardboard was treated with water only.

Traps were distributed in the studied area* with 2 m intervals between each ones and buried in holes (30 cm depth in soil and 10 cm in diameter) and marked by metal stacks.

Traps were examined monthly after transferred to the laboratory (each trap was removed from its hole, put in a plastic container and transferred to the laboratory) and replaced by new ones.

Individuals of subterranean termite handing to the bottom and inside of the traps were removed by using a fine brush then counted.

Obtained data were recorded, tabulated and subjected to the statistical analysis. Suitable statistical procedures were chosen to clarify results of the work using T- test (Gomez and Gomez, 1999).

C) Effect of some repellent oils in infected buildings:

After the examination of the natural oils and substances in the laboratory and in the field as mentioned before, some compounds were tested in three buildings by using Caraway oil,Basil oil,andCamphor oil (the most effective oils against termite).

1. three buildings were chosen that have a large damage caused by subterranean termite at El-Konooz region. Photo (1, 2, 3).
2. each natural oil was sprayed in the frames of doors and windows (three replicates for each) in every building. Photo (4).
3. pieces of cardboard were put in the frames of doors and windows. Photo (5, 6, 7).
4. The buildings were carefully examined monthly to detect the infestation.
5. The pieces of cardboard were transferred to the laboratory and replaced by new ones. The number of termite were counted.

RESULTS AND DESCUSSION

A) Laboratory experiments:

Table (1) and Fig. (1) showed the mean and average of mortality of the subterranean sand termite, *Psammotermes hybostoma,* workers depending on thirteen natural materials.

The highest average of workers mortality was recorded in caraway oil (100 workers per hour), followed by basil oil (16.67 workers per hour), then camphor oil (10 workers per hour), then Garlic and peppermint oils (2.08 workers per hour), then tar and clove oils (1.39 workers per hour), then Alum and onion oil (0.83 workers per hour), then fenugreek oil (0.69 workers per hour), then sesame oil (0.60 workers per

hour). In contrast,the least average of workers mortality was recorded in propolis and neem seeds extraction in addition to the control case(0.26 workers per hour) equally.

Table 1 : Average of *P. hybostoma* workers mortality (number of individuals / hour) depending on each natural oil and substance during detrmined period in laboratory.

Time (after treatment)	Mean numbers of dead workers that responded to the different natural oils and substances													
	Caraway oil	Basil oil	Camphor oil	Garlic oil	Peppermint oil	Tar oil	Clove oil	Alum	Onion oil	Fenugreek oil	Sesame oil	Propolis	Neem seeds extraction	Control
½ hour	50	0	0	0	0	0	0	0	0	0	0	0	0	0
3 hours	----	50	0	0	0	0	0	0	0	0	0	0	0	0
5 hours	----	----	50	0	0	5	0	0	0	0	0	0	0	0
24 h. (day)	----	----	----	50	50	38	25	17	9	10	5	0	1	0
36 h.	----	----	----	----	----	7	25	13	9	7	1	0	0	0
48 h. (2 days)	----	----	----	----	----	----	----	14	12	8	4	2	1	1
60 h.	----	----	----	----	----	----	----	6	20	15	8	1	2	2
72 h. (3 days)	----	----	----	----	----	----	----	----	----	10	14	1	0	2
84 h.	----	----	----	----	----	----	----	----	----	----	18	0	0	0
96 h. (4 days)	----	----	----	----	----	----	----	----	----	----	----	1	2	1
5 days	----	----	----	----	----	----	----	----	----	----	----	2	2	1
6 days	----	----	----	----	----	----	----	----	----	----	----	7	6	8
7 days	----	----	----	----	----	----	----	----	----	----	----	8	10	9
8 days	----	----	----	----	----	----	----	----	----	----	----	28	26	26
Average	100	16.67	10	2.08	2.08	1.39	1.39	0.83	0.83	0.69	0.60	0.26	0.26	0.26

(Based on 50 workers and four replicates)]

These results agreed with those of Zhu *et al*. (2001), who evaluated the repellency and toxicity of 8 essential oils against the Formosan subterranean termite, *Coptotermes formosanus* Shiraki. Clove bud was the most toxic, killing 100% of termites in 2 days at 50 mg/cm^2.Park and Shin (2005), who tested plant essential oils from 29 plant species for their insecticidal activities against the Japanese termite, *Reticulitermes speratus* Kolbe, using a fumigation bioassay. *Allium cepa*, clove bud, and garlic gave 100% mortality within 2 days of treatment at 2.0 microL/L of air concentration. Seo *et al.* (2009), who tested plant essential oils from 26 plant species for their insecticidal activities against the Japanese termite, *Reticulitermes speratus* Kolbe, using a fumigation bioassay. Responses varied with source, exposure time, and concentration. Among the essential oils tested, strong insecticidal activity was observed with the essential oil caraway (*carum carvi*).

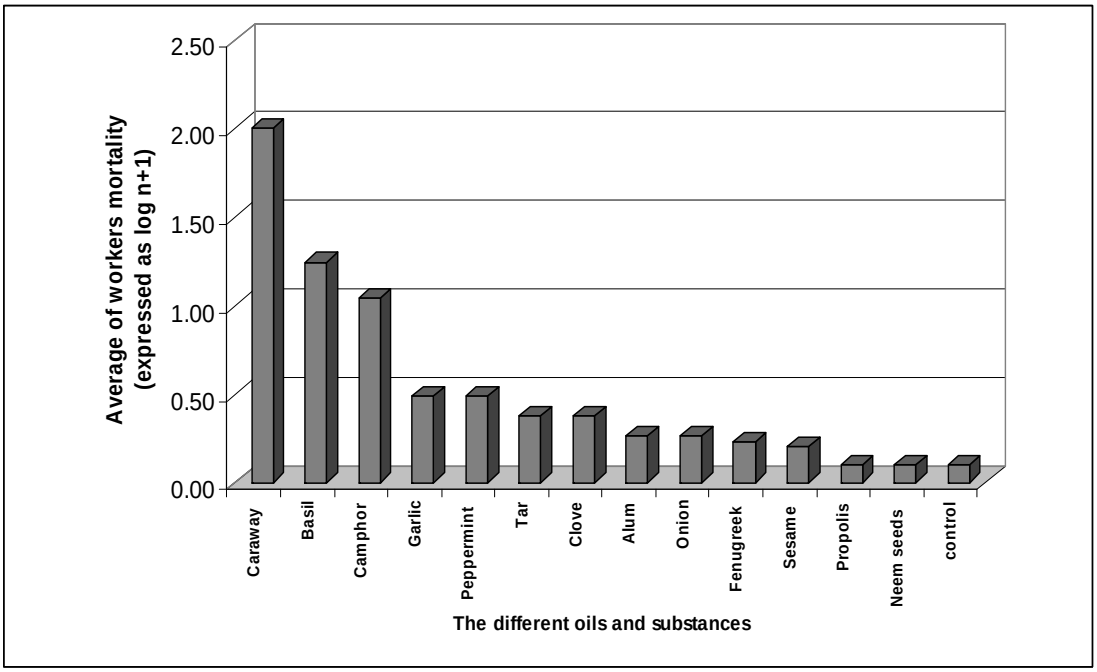

Fig. 1: Average of *P. hybostoma* workers mortality (number of individuals / hour) depending on each natural oil and substance during determined period in laboratory.

B) Field experiments:

Table (2) and fig. (2) Showed the mean number of the individuals of sand termites as indicated by the numbers of castes which were caught in corrugated cardboard traps treated with the same naturals oils and substances mentioned before allover one complete year(from January to December 2011) at El-Konooz region.

The highest ratio of the individuals caught in treated traps was in propolis (95.6 %), neem seeds extraction (94.5 %), sesame oil (9.76 %), fenugreek oil (9.91 %), alum (5.26 %), onion oil (0.26 %) and clove oil (0.24 %), descending. The percentage of the individuals caught in treated traps was (0.0 %) in the following oils (caraway, basil, camphor, garlic, peppermint, tar).

Table (3) and fig. (3) Showed the mean number of the individuals of sand termites as indicated by the numbers of castes which were caught in corrugated cardboared traps treated with the same naturals oils and substances mentioned before allover one complete year(from January to December 2011) in the farm land of South Valley University.

The highest ratio of the individuals caught in treated traps was in propolis (92.7 %), neem seeds extraction (91.0 %), sesame oil (12.7 %), fenugreek oil (9.8 %), alum (6.8 %), clove oil (1.8 %), tar oil (0.6 %), onion oil (0.4 %), peppermint and camphor oils (0.1 %), descending. The percentage of the individuals caught in treated traps was (0.0 %) in the following oils (caraway, basil, garlic).

Table 2: Mean numbers of the sand termite, *P. hybostoma* caught in traps treated with natural oils and substances from January to December 2011 at El-Konooz region.

Inspection date	Mean numbers of individuals											
	Caraway oil	%	Control	Basil oil	%	Control	Camphor oil	%	Control	Garlic oil	%	Control
January	0	0	61.7	0	0	53	0	0	64.7	0	0	35.7
February	0	0	210	0	0	190	0	0	188	0	0	233
March	0	0	230	0	0	262	0	0	224	0	0	243
April	0	0	265	0	0	285	0	0	293	0	0	315
May	0	0	221	0	0	195	0	0	278	0	0	150
June	0	0	185	0	0	146	0	0	126	0	0	198
July	0	0	153	0	0	137	0	0	110	0	0	113
August	0	0	92.7	0	0	100	0	0	133	0	0	109
September	0	0	49.7	0	0	81.3	0	0	87.7	0	0	74.7
October	0	0	0	0	0	22	0	0	62.7	0	0	62.7
November	0	0	0	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0	0	0
Total	**0**	**0**	**1468**	**0**	**0**	**1471**	**0**	**0**	**1567**	**0**	**0**	**1535**
Mean	**0.0**	**0.0**	**122.3**	**0.0**	**0.0**	**122.6**	**0.0**	**0.0**	**130.6**	**0.0**	**0.0**	**127.9**
T- test	**7.420****			**7.702****			**8.103****			**7.667****		

Continue Table (2):

Inspection date	Mean numbers of individuals														
	Peppermint oil	%	Control	Tar oil	%	Control	Clove oil	%	Control	Alum	%	Control	Onion oil	%	Control
January	0	0	23	0	0	17.7	0	0	81.7	0	0	60.3	0	0	35.3
February	0	0	182	0	0	238	0	0	230	13	6.54	199	6	3.08	195
March	0	0	214	0	0	249	0	0	245	23.7	11.3	210	0	0	228
April	0	0	289	0	0	300	7.67	2.88	267	118	35.3	333	0	0	299
May	0	0	198	0	0	278	0	0	226	0	0	299	0	0	200
June	0	0	176	0	0	190	0	0	135	0	0	268	0	0	170
July	0	0	162	0	0	142	0	0	128	18	9.98	180	0	0	147
August	0	0	150	0	0	135	0	0	119	0	0	139	0	0	144
September	0	0	149	0	0	89.7	0	0	105	0	0	125	0	0	119
October	0	0	36.7	0	0	55	0	0	71.7	0	0	65	0	0	98.7
November	0	0	0	0	0	11	0	0	0	0	0	45.3	0	0	0
December	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**0**	**0**	**1579**	**0**	**0**	**1706**	**7.67**	**2.88**	**1607**	**172**	**63.1**	**1924**	**6**	**3.08**	**1636**
Mean	**0.0**	**0.0**	**131.6**	**0.0**	**0.0**	**142.1**	**0.6**	**0.24**	**133.9**	**14.4**	**5.26**	**160.3**	**0.5**	**0.26**	**136.3**
T- test	**8.438****			**7.988****			**8.815****			**7.881****			**9.02****		

Continue Table (2):

Inspection date	Mean numbers of individuals											
	Fenugreek oil	%	Control	Sesame oil	%	Control	Propolis	%	Control	Neem seeds extraction	%	Control
January	15.3	23.6	65	13.3	22.1	60.3	54.7	120	45.7	65.7	113	58
February	29	15.4	189	17.3	10.3	169	153	76.6	200	198	137	144
March	34.7	12.9	268	33	13	255	299	104	287	219	73.5	297
April	43.3	15.2	286	86.7	27.8	312	354	105	339	300	85.9	350
May	40.3	15.1	267	25	7.77	322	313	109	287	291	100	290
June	0	0	245	22.3	7.8	286	298	113	263	280	97.1	288
July	0	0	198	26	13	200	253	103	245	268	116	232
August	25	14.2	176	23.3	15.4	151	260	136	191	255	116	220
September	20.7	22.5	91.7	0	0	123	118	70.8	167	199	114	175
October	0	0	48.7	0	0	88.7	135	100	135	137	91.1	150
November	0	0	29.7	0	0	37.7	107	109	98.7	99.7	90.3	110
December	0	0	0	0	0	0	0	0	0	0	0	0
Total	**208**	**119**	**1864**	**247**	**117**	**2005**	**2345**	**1147**	**2256**	**2311**	**1134**	**2315**
Mean	**17.4**	**9.91**	**155.3**	**20.6**	**9.76**	**167.1**	**195.4**	**95.6**	**188.0**	**192.6**	**94.5**	**192.9**
T- test	**8.041****			**7.983****			**0.293 ns**			**0.014 ns**		

The different oils and substances

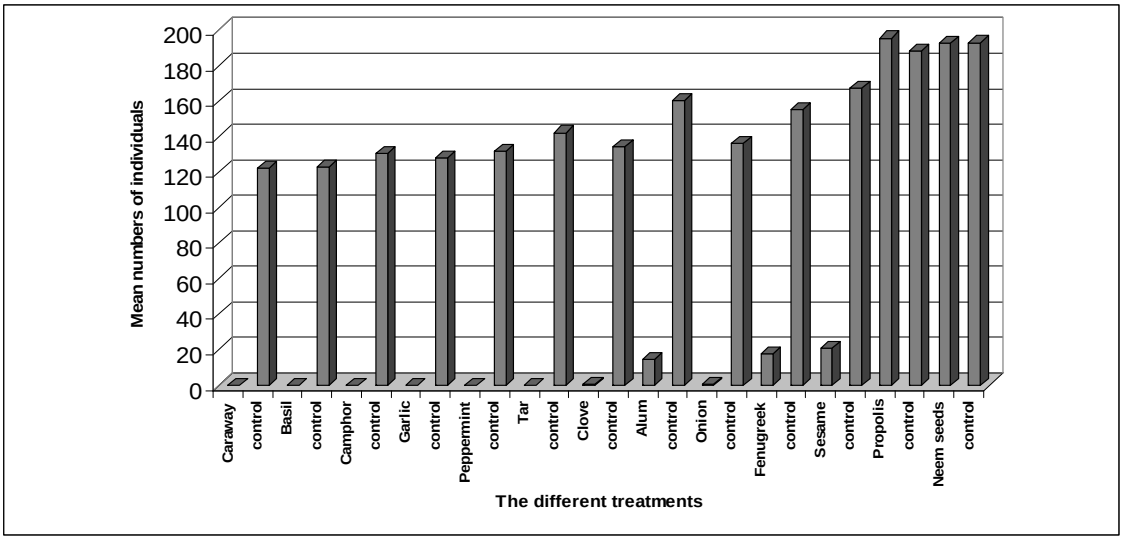

Fig. 2: Mean numbers of the sand termite, *P. hybostoma* caught in traps treated with natural oils and substances from January to December 2011 at El-Konooz region.

On the other hand, statistical analysis on the results according to tables (Table 2) and (Table 3) showed highly significant differences between the mean numbers of sand termite, *P. hybostoma* individuals caught allover one complete year in the traps treated with the following oils (caraway, Basil, camphor, garlic, peppermint, tar, onion, clove, alum, sesame, fenugreek) and their control. Whereas, no significant differences were recorded between themean numbers of the individuals caught allover one complete year in the traps treated with propolis and neem seeds extraction and their control. Concerning the natural materials, which were used for controlling sand termite, it is obvious that, most materials used gave positive results in therepellency of sand termite at different degrees. the most effective repellent oils were caraway, basil, camphor, garlic, peppermint, tar, onion and clove. The other tested materials were less

efficient (propolis, extract of neem seeds, sesame oil, fenugreek oil and alum, descending) for controlling sand termite.

Table 3: Mean numbers of the sand termite, *P. hybostoma* caught in traps treated with natural oils and substances from January to December 2011 in the farm land of South Valley University.

Inspection date	Mean numbers of individuals											
	Caraway oil	%	Control	Basil oil	%	Control	Camphor oil	%	Control	Garlic oil	%	Control
January	0	0	58.3	0	0	55	0	0	68.7	0	0	79.7
February	0	0	199	0	0	200	0	0	180	0	0	200
March	0	0	205	0	0	235	0	0	244	0	0	239
April	0	0	238	0	0	250	1.67	0.65	257	0	0	248
May	0	0	180	0	0	199	0	0	236	0	0	206
June	0	0	104	0	0	109	0	0	130	0	0	146
July	0	0	88	0	0	98.3	0	0	100	0	0	137
August	0	0	100	0	0	78.7	0	0	99.7	0	0	47.7
September	0	0	124	0	0	80.3	0	0	75	0	0	82.3
October	0	0	135	0	0	129	0	0	84	0	0	127
November	0	0	66.7	0	0	70	0	0	72	0	0	43.7
December	0	0	0	0	0	0	0	0	0	0	0	0
Total	**0**	**0**	**1498**	**0**	**0**	**1504**	**1.67**	**0.65**	**1547**	**0**	**0**	**1557**
Mean	**0.0**	**0.0**	**124.9**	**0.0**	**0.0**	**125.3**	**0.1**	**0.1**	**128.9**	**0.0**	**0.0**	**129.8**
T- test	**10.466****			**9.645****			**9.479****			**9.646****		

Continue Table 3:

Inspection date	Mean numbers of individuals														
	Peppermint oil	%	Control	Tar oil	%	Control	Clove oil	%	Control	Alum	%	Control	Onion oil	%	Control
January	0	0	38.7	0	0	22.3	0	0	17.3	0	0	55.3	0	0	43.3
February	0	0	199	0	0	240	0	0	220	12.3	5.76	214	0	0	200
March	0	0	227	0	0	266	32.7	13.3	246	43.3	15.7	276	0	0	237
April	4.33	1.62	267	22	7.61	289	24.3	8.49	287	53.7	18	298	12.7	4.34	292
May	0	0	211	0	0	216	0	0	230	36.7	18.4	200	0	0	198
June	0	0	170	0	0	91.7	0	0	142	0	0	193	0	0	138
July	0	0	133	0	0	84.7	0	0	86.7	0	0	135	0	0	131
August	0	0	91.3	0	0	98.7	0	0	79.3	0	0	117	0	0	98
September	0	0	93	0	0	163	0	0	82.7	0	0	123	0	0	123
October	0	0	117	0	0	171	0	0	178	40	24.3	165	0	0	155
November	0	0	48	0	0	52.3	0	0	47.7	0	0	94	0	0	32.7
December	0	0	6.67	0	0	16.7	0	0	0	0	0	59	0	0	0
Total	**4.33**	**1.62**	**1602**	**22**	**7.61**	**1711**	**57**	**21.8**	**1616**	**186**	**82.2**	**1928**	**12.7**	**4.34**	**1649**
Mean	**0.4**	**0.1**	**133.5**	**1.8**	**0.6**	**142.6**	**4.8**	**1.8**	**134.7**	**15.5**	**6.8**	**160.6**	**1.1**	**0.4**	**137.4**
T- test	**9.923****			**9.029****			**8.210****			**10.844****			**9.563****		

Continue Table 3:

Inspection date	Mean numbers of individuals											
	Fenugreek oil	%	Control	Sesame oil	%	Control	Propolis	%	Control	Neem seeds extraction	%	Control
January	11.3	17.2	66	12.3	18.2	67.7	50.3	105	48	60.3	114	53
February	25	9.87	253	19.3	7.58	255	234	117	200	227	88	258
March	32.7	11.7	280	28.3	10.4	274	289	96.2	300	297	103	288
April	87.3	29.4	297	95.3	31.7	300	359	102	354	366	102	360
May	22.7	10.6	215	86.3	30	288	273	104	262	298	107	278
June	0	0	188	15	7.55	199	195	98.5	198	265	113	235
July	0	0	170	25.7	13.7	187	183	101	180	134	93.1	144
August	0	0	96	32.7	33.4	97.7	162	113	144	131	83.7	157
September	0	0	53.7	0	0	115	195	101	193	178	95.4	187
October	21.7	18.5	117	0	0	133	208	99.4	210	199	96.6	206
November	17.7	19.9	88.7	0	0	72.3	146	75.5	193	144	96.7	149
December	0	0	44.7	0	0	43.7	52	0	51	44.3	0	30.3
Total	**218**	**117**	**1869**	**315**	**153**	**2032**	**2347**	**1112**	**2333**	**2344**	**1092**	**2345**
Mean	**18.2**	**9.8**	**155.8**	**26.3**	**12.7**	**169.3**	**195.6**	**92.7**	**194.4**	**195.3**	**91.0**	**195.4**
T- test	**8.975****			**8.809****			**0.056 ns**			**0.004 ns**		

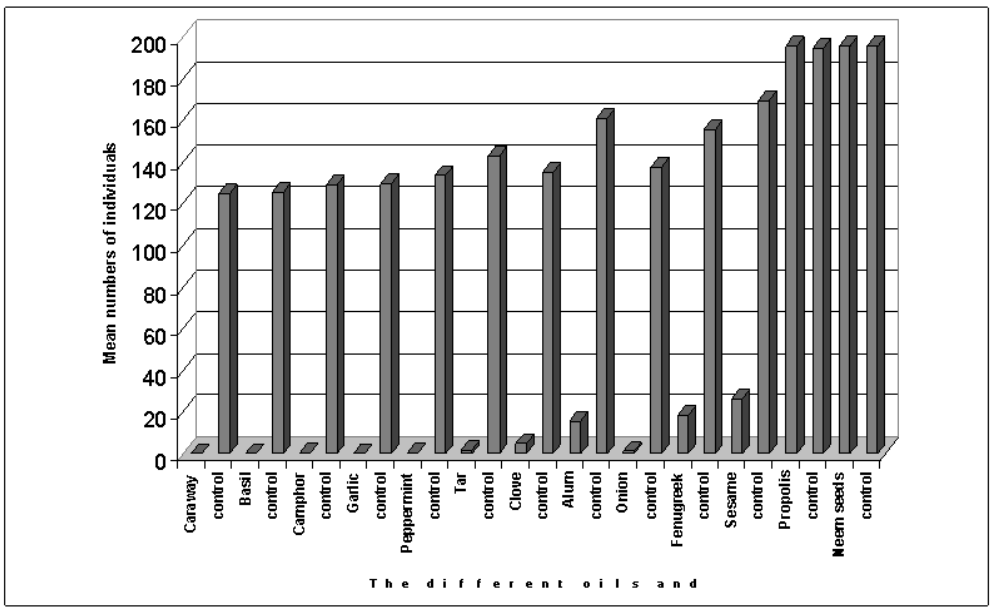

Fig. 3: Mean numbers of the sand termite, *P. hybostoma* caught in traps treated with natural oils and Substances in the farm land of South Valley Uninersity.

Thereby, it is important to notice that the number of castes attracted to the traps decreased gradually reaching zero in all treated traps and control after one complete year of applying the treated traps at El-Konooz region. That number decreased clearly in the farm land of South Valley University.

In spite of many authors used natural materials for controlling termites in the laboratory, approximately, there is no available review about using natural materials in the field.

C) Effect of some repellent oils in infected buildings:

Table (4) and fig. (4) showed thenumber of the sand termite individuals which were caught in corrugated cardboard pieces in infected buildings treated with some repellent oils from February to June 2012 at El-Konooz region.

Thetotal number of individuals were zero when collected from corrugated cardboard pieces of the infected doors frames treated with caraway, basil and camphor oils, however, 2070 individuals were collected from the control. In case of windows, thetotal number of individuals were zero in caraway, basil and camphor oils, where, 1424 individuals were captured from the control.

Then, treating the doors and windows frames with caraway, basil and camphor oils repelled the sand termite as compared with the untreated doors and windows frames where the infestation wascontinuous.

Inspite of many authors used natural materials for controlling termites in the laboratory. No available review about using the present natural materials in the infected buildings. Therefore the present results are considred as the initiative investigation to overcome problem of *P. hybostoma.*

Table 4: Mean numbers of the sand termite, *P. hybostoma* caught in Corrugated Cardboard in buildings treated with some repellent oils from February to June 2012 at El-Konooz region.

Date	Mean numbers of Individuals							
	door frame				window frame			
	Caraway oil	Basil oil	Camphor oil	Control	Caraway oil	Basil oil	Camphor oil	Control
February	0	0	0	470	0	0	0	328
March	0	0	0	476	0	0	0	335
April	0	0	0	481	0	0	0	340
May	0	0	0	318	0	0	0	208
June	0	0	0	325	0	0	0	213
Total	**0**	**0**	**0**	**2070**	**0**	**0**	**0**	**1424**
Mean	**0**	**0**	**0**	**414**	**0**	**0**	**0**	**284.8**

*Based in three replicates for each treatment

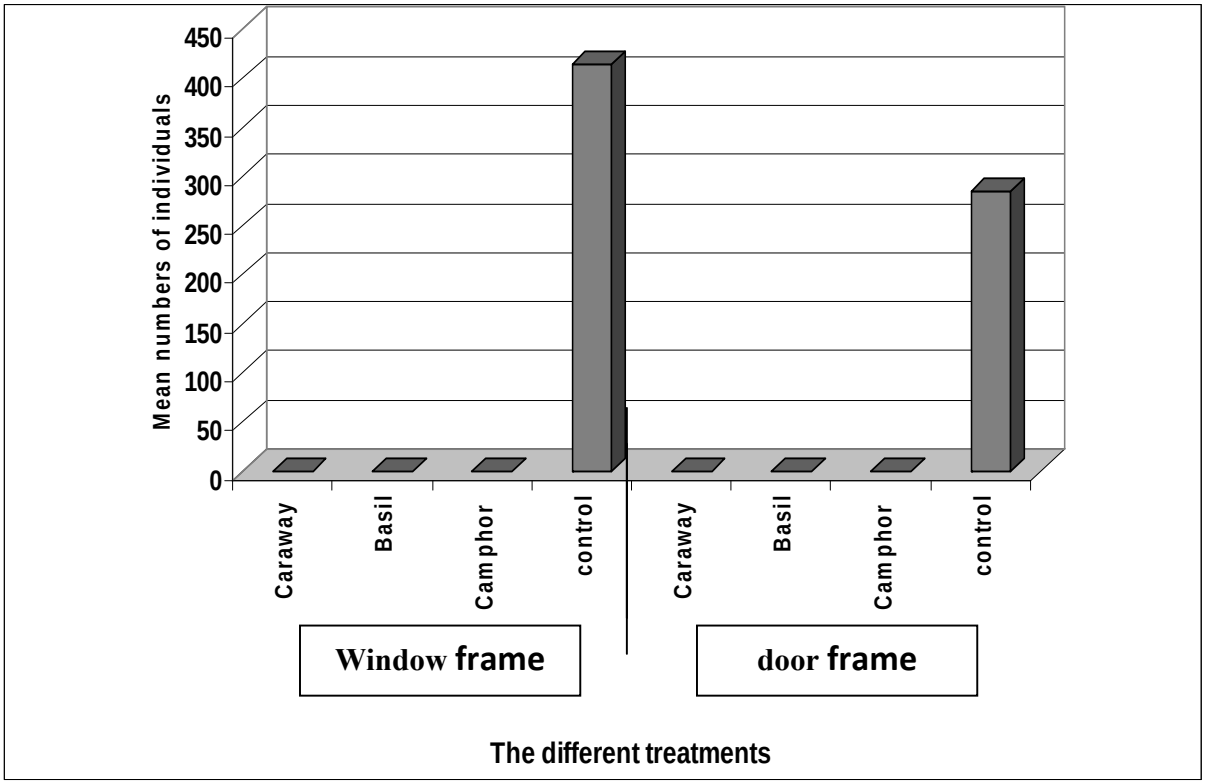

Fig. 4: Mean numbers of the sand termite, *P. hybostoma* caught in Corrugated Cardboard in buildings treated with some repellent oils from Febreuary to June 2012 at El-Konooz region.

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Photo (1), (2), (3): Some aspects of infestation in some buildings at El-Konooz region.
Photo (4): Spraying the infected door in the building with repellent oils.
Photo (5), (6), (7): Rolledpieces of cardboard which were put in the frames of doors.

ARABIC SUMMARY

تقييم مقاومة النمل الابيض، بساموتيرميس هايبوستوما (أيزوبترا: رينوتيرميتيدى) المعملية والحقلية باستخدام بعض الزيوت الطبيعية غير التقليدية و مواد اخرى

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أجرى هذاالبحث بغرض تقييم مكافحة النمل الأبيض التحت أرضى *بساموتيرمس هايبوستوما* باستخدام بعض الزيوت الطبيعية غير التقليدية و مواد اخرى معمليا وحقليا كملاحظات داخلية وخارجية.

كانت المواد المستخدمة متمثلة فى عشر زيوت [الكراوية ، البصل ، الثوم ، القرنفل ، النعناع ، الريحان ، الكافور ، السمسم ، القطران و الحلبة] وثلاث مواد أخرى [مستخلص بذور النيم ، مسحوق صمغ النحل (البروبوليس) و مسحوق كبريتات الالومنيوم (الشبه)]. وقد قيمت هذه المواد تحت الظروف المعملية و تحت الظروف الحقلية بمنطقتى الكنوز ومزرعة جامعة جنوب الوادى خلال الفترة من يناير حتى ديسمبر 2011 وفى ثلاث مبانى مصابة بمنطقة الكنوز بقنا خلال الفترة من فبراير حتى يونيو 2012.

أظهرت النتائج المعملية تقدم فعال فى معدل وفاة شغالات نمل الرمال داخل أطباق البترى المعاملة بزيت الكراوية (100 شغالة فى الساعة). وفى المقابل، أقل معدل وفاة سجل فى البروبوليس ومستخلص بذور النيم بالإضافة الى الكنترول (0,26 شغالة فى الساعة) بالتساوى.

من ناحية أخرى، اتفقت النتائج الحقلية الخارجية مع الملاحظات المعملية حيث كانت أكبر نسبة مئوية لأفراد النمل الأبيض (المتحصل عليها من المصائد الكرتونية المضلعة خلال عام كامل) فى المصائد المعاملة بالبروبوليس (95,6 %). فى المقابل، كانت أقل نسبة فى زيت القرنفل (0,24 %). هذه النسبة كانت (0,0 %) فى زيوت الكراوية ، الريحان ، الثوم ، الكافور، النعناع و القطران فى منطقة الكنوز.

وعلاوة على ذلك، النتائج الحقلية فى مزرعة جامعة جنوب الوادى أظهرت أن أكبر نسبة مئوية لأفراد النمل الأبيض كانت فى المصائد المعاملة بالبروبوليس (92,7 %). وعلى العكس، النسبة المئوية كانت (0,0 %) فى حالة زيوت الكراوية ، الريحان و الثوم.

من ناحية أخرى، أظهرالتحليل الإحصائيعلىالنتائج الحقلية فروق معنويةعالية بين متوسطات أعداد الأفراد المتجمعة فى المصائد المعاملة بجميع الزيوتوالكنترول لكل منها. بينما،لا يوجدفروق معنوية في حالة البروبوليس و مستخلص بذور النيم والكنترول لكل منهما.

فيما يتعلق بالنتائج على المباني المصابة، الأعداد الإجمالية للأفراد المتحصل عليها من قطع الكرتون المضلع كانت صفر في إطارات الأبواب و النوافذ المعاملةبالزيوت التالية (كمون، ريحان و كافور)، على الرغم من استمرار الاصابة في حالة الكنترول (2070 و 1424 فرد منإطارات الأبواب و النوافذ، بالترتيب).

وبالتالى، فمن المستحسن استخدام الزيوت الطاردة الاكثر فعالية (الكراوية، الريحان، الكافور، الثوم ، النعناع ، القطران و القرنفل) فى مكافحة النمل الأبيض التحت أرضى داخل المبانى بالرش على الأخشاب المصابة أو بالحقن فى الأرض أو بواسطة المصائد فى التربة بدلا من المبيدات الكيميائية ذات الأثر الضار على البيئة والصحة.