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A First Study on the Effect of Some Physical Barriers to Prevent Termite Attack in Egypt

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ABSTRACT

Field experiment was conducted in year 2016 for the first time in Egypt, at Sangha, Kafr Saqr, Sharkia Governorate, to study some physical barriers " Metal shield, breaking glass, thick plastic bags, gravel and gravel with termiticide " against subterranean termite, *Psammotermes hybostoma* (Desneux). Data showed that, metal shields (Galvanized iron) and gravel with termiticide were strong barriers prevent termite attack, followed by thick plastic bags barrier which prevent the termite crossing for five months; then breaking glass barrier where the termite was able to creative some tunnels from which, while the gravel barrier failed to prevent the termite from crossing and creative the tunnels. Highly significant differences were recorded between the tested treatments.

INTRODUCTION

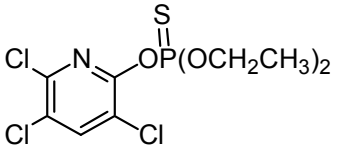
The physical barriers are important means to exclude subterranean termites attack on wooden structures. Three treatments types against termite by using termiticide; soil termiticide treating down and round infested homes, that can expel and toxic barriers for insects or treating with chemical and foam formulations. Injecting infested wood by termiticide directly and third one using of physical barrier treated with chemical. In Egypt, the chemicals used commonly to protect houses against termite infestation for long time, and then termite attack the homes again, so, we need to treatment the houses again periodically. The physical barrier system destined to inhibit the block of this insect into homes and is not commonly used in Egypt. There are some physical barrier materials suitable with environment of Egypt, such as, gravel, metal sheets, breaking glasses and thick plastic sheets, these materials can be putted beneath the wooden planks or parquet flooring for prevent termite attack. Pesticides can be mixed with physical materials as effective control method. Mode of action for common pesticides used includes chlorpyrifos affect as a nervous system and deathly after 24 hrs. to eleven days, such chemicals can help control entire colony termite in houses. El-Bassiouny (2007&2012), used termiticides include chlorpyrifos against termite and data showed good results. Several studies were conducted to study evaluate some physical barriers with termiticides Logan and Buckley (1991) and Yates *et al*. (2000).

The present work was conducted in 2016 at Sangha, Kafr Saqr, Sharkia Governorate.; this work aims to study the effect of some physical barrier materials; metal shield, breaking glass, thick plastic bags, gravel and gravel with termiticide, to prevent the termite, *Psammotermes hybostoma* (Desneux), for attacking wooden structure in buildings, and to know any of this material is able to prevent termite attack.

MATERIALS AND METHODS

Physical barriers used:

a. Shields metal barriers or iron sheets; the panels were made in workshop measure (1m in length×1m in width×1mm in thickness), at city of Mit Ghamr, Daqahlia Gov.
b. Glass breaking or splinters of glass; mix from breaking glass undefined size.
c. Sheets thick plastic; (1m in width×1m in length×1mm in thickness), made in plastic factory at Al-Mansoura city, Daqahlia Gov.
d. Gravel; the barrier was chosen from medium size of stone, and washed from accurate plankton sandy.
e. Gravel barrier with chlorpyrifos; gravel treated with termiticide chlorpyrifos (Organophosphorus: Dursban 48%) according to recommended rate (2%).



Field experiment:

Preliminary experiment was carried out to discovery and definition of termite territories enter the selected location to this study which extended during the period from Jan. to Dec. 2016 using El-Sebay modified traps (El-Sebay 1991). 90 traps were distributed within infested area, aligned in 15 rows and 6 columns at 2 meters^2 intervals between traps (where each trap subtended an area of 4m^2). The experimental area divided to positions comprises four tested barriers beside termiticide with gravel, each represented with three replicates. These positions arranged as follows; Position no. 1, 2 and 3 were occupied for test of metal shields, measured (1m Length × 1m width × 1mm in thickness). Position no. 4, 5 and 6 were devoted for test of breaking glass brushed in square measured (1m Length × 1m width × 10cm height). Position no. 7, 8 and 9 occupied for test of thick plastic bags, measured (1m Length × 1m width × 1mm thickness), and furnished one sheet. Position no. 10, 11 and 12 occupied for test of gravel, brushed in square measured (1m Length × 1m width × 10cm height), the gravel of middle size was randomly chosen and washed from the particles before used. Position no. 13, 14 and 15 were devoted for test of gravel barrier with chlorpyrifos, (look Fig. 1). All the tested barriers putted at 15cm depth in soil down concrete-slab measured (1m Length × 1m width × 15cm thickness) holed from the center where the moistened trap placed. The termiticide treated at the rate of 2% (20cm/litter of water), every position treated with 13.33 litter termiticide solution, (4 litter/linear meter in width 30cm), according to termite

control protocol of Plant Protection Research Institute, Egypt. Control (15 traps) were moistened and putted in the hole center of concrete-slab, the suitable amount of added water to El-sebay-modified trap in sandy soil reached about ½ liter for behavioral activity of *P. hybostoma*. El-Bassiouny (2015). The check trap distributed beside every treated position at a distance of one meter from treatment center.

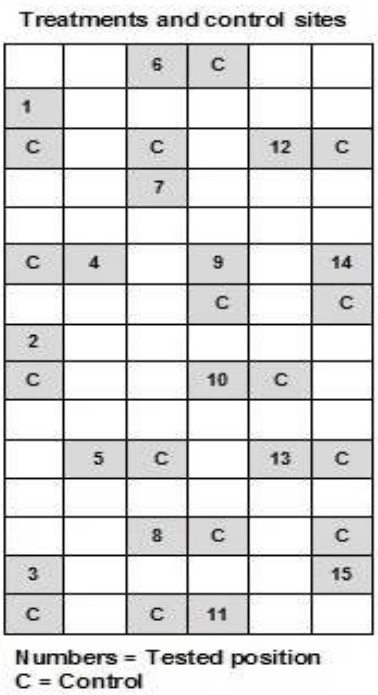


Fig. 1. Diagram for treatments and control sites in the tested area.

Data was analyzed by the variance (ANOVA), the means of treatments compared with LSD test in SAS program (SAS Institute 1988). Numbers of crossed termites were corrected according Abbott's formula, (Abbott, 1925).

RESULTS AND DISCUSSION

Impact of tested barriers on prevent and passing of termites:

1. Metal shields (Galvanized iron):

Data in Table (1) and Fig.(2) recorded that average numbers or crossed termites was zero of all tested replicates, this barrier prevented termites to attack of trap; that means the tested termites did not succeed to crossing through the tested metal shields or iron sheets during the tested year. The tested barrier caused rerouting insects to control attack. Average numbers of crossed termites to control traps recorded during the different months 650, 1071.3, 1390.6, 1515, 1277, 1766.6, 1723.6, 2257, 2317.6, 2657.3, 2278 and 1480.6 termites in Jan., Feb., Mar., April, May, Jun, July, Aug., Sept., Oct., Nov., and Dec., respectively with total (20513 termites/year), such results because of the availability of the source of cellulose on the suitable distance from the treatment (center of the colony).

Grace *et al*. (1996): mentioned that, the physical barrier stainless steel mesh are gaining in popularity worldwide as method of preventing subterranean termites penetration and attack on structures and they report results of a one year field test in Hawaii to evaluate the ability of stainless steel to prevent penetration by the termites, *Coptotermes formosanus* Shiraki, and the results indicated that the barrier is effective in excluding the termite. Lina and Nobre (2001), mentioned that, the barriers, stainless steel and stone changed termite resistant system and reduced the use of pesticides in buildings and wooden structures, also reduced the moisture problems in the wood and prevented direct transit through the soil to be protected places. Partho Dhang (2012): in the Philippine, mentioned that, the physical barriers such as, aluminum; stainless steel mesh with special cement grades and mixtures of resin, the barriers are used to prevent termite-proof construction attack through the slabs, edge, cracks and gaps in and around penetrations, this an attempt to use the physical barrier with grade mixture of cement-resin in residential structures.

2. Breaking glass:

The obtained results in Table (1) and Fig.(2) recorded that the average numbers of crossed termites were 2, 0, 21.3, 24.3, 12.3, 19.6, 40, 70, 51.3, 75, 53 and 76.3 termites during Jan., Feb., Mar., April, May, Jun, July, Aug., Sept., Oct., Nov., and Dec., respectively with total (445.3 termites/year). While the tested barrier caused rerouting the termites workers to control attack, and the average of crossed termites numbers were 1132, 1560, 1802.6, 1973.3, 1789, 912, 1119, 1345, 1687.3, 2194.3, 2245 and 1753.3 termites during the twelve months, respectively with total (19513 termites/year), the termite was able to creative some tunnels in breaking glass down the trap; It was observed mixing some particle of sand between the tested barrier, but a few were somewhat rates and also the tested barrier caused rerouting termites to control attack.

Menandro and Heherson (2005), mentioned that, the field evaluations using mixed particle sizes 1.18 to 2.36 mm from physical barrier of volcanic debris were effective in preventing tunneling and penetration against the Philippine milk termite workers. Menandro (2013), studied the mixed sandy aggregate of volcanic debris barrier beneath the floors and concrete foundation walls for five years to prevent termite Philippine subterranean termites, attack for wooden houses structures, and the obtained results indicated that tested termites were unable to penetrate the 5 cm thick particles layer in underground soil. This study indicated that, the sandy aggregate of volcanic debris barrier could be used to prevent crossed of termites to wooden structures.

Table 1. Number of crossed termites through physical barriers during season of year 2016

Barriers	Position	Crossed termites during months												Total
		Jan.	Feb.	Mar.	Apr.	May	Jun	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
M. shields	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0
	Av.	0	0	0	0	0	0	0	0	0	0	0	0	0
Control	1	1235	1304	1190	1637	2100	1300	1040	1410	2061	2180	2312	2006	19775
	2	0697	1018	2090	1698	1003	2100	2120	3014	3112	4301	2509	1215	24877
	3	0018	0892	1276	1210	0728	1900	2011	2347	1780	1491	2013	1221	16887
	Av.	650	1071.3	1390.6	1515	1277	1766.6	1723.6	2257	2317.6	2657.3	2278	1480.6	20513
B. glass	4	4	0	11	0	0	0	40	15	22	21	93	102	308
	5	0	0	53	73	12	16	0	101	87	104	0	0	446
	6	2	0	0	0	25	43	80	94	45	100	66	127	582
	Av.	2	0	21.3	24.3	12.3	19.6	40	70	51.3	75	53	76.3	445.3
Control	4	1266	2345	2497	1675	2033	1180	1645	1433	2144	3218	2239	1146	22821
	5	2000	1803	2112	3005	2224	0944	1245	1704	1351	2131	2707	3114	24340
	6	0130	0532	0799	1240	1110	0612	0467	0898	1567	1234	1789	1000	11378
	Av.	1132	1560	1802.6	1973.3	1789	912	1119	1345	1687.3	2194.3	2245	1753.3	19513
P. bags	7	0	0	0	0	0	0	17	13	21	107	122	178	458
	8	0	0	0	0	0	13	21	33	103	112	142	202	626
	9	0	0	0	0	0	90	68	134	106	100	89	217	804
	Av.	0	0	0	0	0	34.3	35.3	60	76.6	106.3	117.6	199	629.3
Control	7	2035	2314	2990	1937	2000	1001	0940	1210	1061	2980	2511	3806	26846
	8	3121	3010	3116	2760	1206	1031	0857	1100	2149	2307	2536	3018	26211
	9	0765	0930	1523	1400	1132	0813	0698	0790	0655	1117	1329	1064	12216
	Av.	1973.6	2084.6	2543	2032.3	1446	948.3	831.6	1033.3	1288.3	2134.6	2125.3	2629.3	21757.6
Gravel	10	0	0	34	37	115	111	117	13	221	167	252	300	1367
	11	0	0	12	97	134	100	101	133	153	214	224	211	1379
	12	42	0	55	154	165	190	188	104	126	208	297	317	1846
	Av.	14	0	33.6	96	138	133.6	135.3	83.3	166.6	196.3	257.6	276	1530.6
Control	10	1144	2004	2132	2027	1203	1044	1112	0911	1621	1001	2014	2400	18613
	11	2003	1709	2080	2330	2021	1251	0980	0765	1228	2004	2818	1791	20980
	12	0430	1324	2111	2120	1978	1600	0972	1045	1276	1407	2023	2015	18301
	Av.	1192.3	1679	2107.6	2159	1734	1298.3	1021.3	907	1375	1470.6	2285	2068.6	19298
Gr. + Ch.	13	0	0	0	0	0	0	0	0	0	0	0	0	0
	14	0	0	0	0	0	0	0	0	0	0	0	0	0
	15	0	0	0	0	0	0	0	0	0	0	0	0	0
	Av.	0	0	0	0	0	0	0	0	0	0	0	0	0
Control	13	2017	1304	0932	1022	1100	0793	1000	0311	0721	1202	1471	2225	14098
	14	1073	1603	1093	1553	1601	2030	1868	2011	1841	2017	2124	2312	21126
	15	1331	1257	1028	1377	1520	2016	2051	2107	1902	1810	2041	1551	19991
	Av.	1473.6	1388	1017.6	1317.3	1407	1613	1639.6	1476.3	1488	1676.3	1878.6	2029.3	18405

M = Metal B = Breaking P = Plastic Gr = Cravel Ch = chlorpyrifos

3. Thick plastic bags:

Data in Table (1) and Fig.(2) recorded that the average of crossed termites was zero during five months, Jan., Feb., Mar., April, May, and counted 34.3, 35.3, 60, 76.6, 106.3, 117.6 and 199 termites during Jun, July, Aug., Sept., Oct., Nov. and Dec., respectively with total (629.3 termites/year). While the data in tested barrier in control recorded 1973.6, 2084.6, 2543, 2032.3, 1446, 948.3, 831.6, 1033.3, 1288.3, 2134.6, 2125.3 and 2629.3 termites during the twelve months, respectively with total of (21757.6 termites/year), the plastic bags barrier was perforated, abraded and adherent with layer of sand and concrete-slab, and the trap was attacked through these holes.

El-Bassiouny (2016), in laboratory evaluation, found that, the physical barriers, shield of metal gave the good result to prevent crossing of termites through it, followed by glass breaking, thick plastic bags and gravel, while the termites in control were able to passed through the sand and tunnels made after 15 days from the test beginning.

4. Gravel:

Data in Table (1) and Fig.(2) revealed that in average numbers of crossed termites were 14, 0, 33.6, 96, 138, 133.6, 135.3, 83.3, 166.6, 196.3, 257.6 and 276 termites during Jan., Feb., Mar., April, May, Jun, July, Aug., Sept., Oct., Nov., and Dec., respectively with total of (1530.6 termites/year). While the tested gravel barrier caused rerouting the termites workers to control attack, and the data in average recorded 1192.3, 1679, 2107.6, 2159, 1734, 1298.3, 1021.3, 907, 1375, 1470.6, 2285 and 2068.6 termites during the twelve months, respectively with total of (19298 termites/year), the termites were able to building tunnels in gravel barrier under the traps; It was observed mixing some particle of sand between the gravel tested barrier, and the tested barrier caused rerouting termites to control attack.

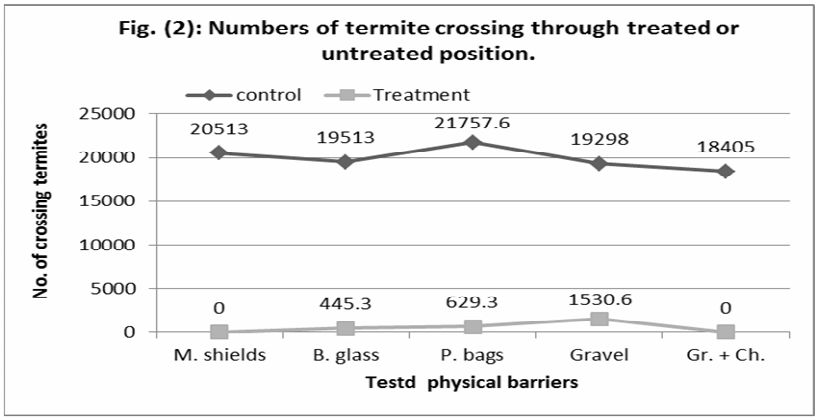
5. Gravel with termiticide:

Data in Table (1) and Fig.(2) recorded that (zero of all tested replicates) during the year, the gravel barrier with termiticide Dursban (Chlorpyrifos 48%) prevent termite to attack of trap that means that the termites failed to cross through the gravel barrier with termiticide through the tested period. While the tested

gravel barrier caused rerouting the termites workers to control attack, and the data in average recorded 1473.6, 1388, 1017.6, 1317.3, 1407, 1613, 1639.6, 1476.3, 1488, 1676.3, 1878.6 and 2029.3 termites during Jan., Feb., Mar., April, May, Jun, July, Aug., Sept., Oct., Nov., and Dec., respectively with total of (18405 termites/year), the termite was unable to building tunnels in gravel barrier with termiticide, It was observed the absence of mixing sand particle between the gravel tested barrier, and the tested barrier with termiticide caused totally rerouting termites to control attack.

TC Keefer *et al*. (2013), studied that, the physical barrier of aggregate particles to prevent termite attack into wooden foundations. The result indicated that the aggregate ratios tested of particle sizes were effective to prevent tunneling by the termites.

Logan and Buckley (1991), mentioned that the review of the control of species of *Reticulitermes*, *Coptotermes*, *Heterotermes*, *Nasutitermes* and *Psammotermes* as pests of structural timbers in buildings in various parts of the world includes notes on insecticides used before 1980, alternatives to organochlorine insecticides, and alternative control measures, including the use of microbial pesticides, resistant timber, physical barriers, and insecticidal baits. El-Bassiouny (2007&2012), mentioned that, Dursban (Chlorpyrifos 48%) best insecticide against subterranean termite in the field.



Statistical analysis:

Data in Table (2) detected the average% of crossed termites through the tested physical barriers compared with control corrected according Abbott's formula, (Abbott, 1925). At grouping analysis data showed the Metal shields (M. shields) and gravel+chlorpyrifos (Gr+Ch) gave highly percentages to prevent termite crossed (100%) followed by breaking glass (B. glass) and plastic bags (P. bags) recorded 97.71 and 96.69% respectively, while the gravel showed the lower action in prevent termite crossed recorded (91.82%).Data presented in Table (2), showed highly significant for each treatments, positions and months resulted <.0001, 0.0060 and <.0001 respectively and the LSD were 1.2582, 0.9746 and 1.9491 for each respectively.

Table 2. % average of crossed termites through physical barriers compared with control during months of 2016.

Barriers	Position	Months												Grouping analysis %
		Jan.	Feb.	Mar.	Apr.	May	Jun	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
Crossed% of M. shields	1	100	100	100	100	100	100	100	100	100	100	100	100	100
	2	100	100	100	100	100	100	100	100	100	100	100	100	
	3	100	100	100	100	100	100	100	100	100	100	100	100	
B. glass of crossed%	4	99.64	100	99.38	100	99.32	100	96.42	98.88	98.69	99.04	95.85	94.18	97.71
	5	100	100	97.05	96.30	100	98.24	100	92.49	94.84	95.26	100	100	
	6	99.82	100	100	100	98.60	95.28	92.85	93.01	97.33	95.44	97.06	92.75	
P. bags of crossed%	7	100	100	100	100	100	100	97.95	98.74	98.36	94.98	94.25	93.23	96.69
	8	100	100	100	100	100	98.62	97.47	96.80	92.00	94.75	93.31	92.31	
	9	100	100	100	100	100	90.50	91.82	87.03	91.77	95.31	89.95	91.74	
Gravel of crossed%	10	100	100	98.38	98.28	93.36	91.45	88.54	98.56	83.92	88.64	88.97	85.49	91.82
	11	100	100	99.43	95.50	92.27	92.29	90.11	85.33	88.87	85.44	90.19	89.80	
	12	96.47	100	97.39	92.86	90.48	85.36	81.59	88.53	90.83	85.85	87.00	84.67	
Gr. + Ch.of crossed%	13	100	100	100	100	100	100	100	100	100	100	100	100	100
	14	100	100	100	100	100	100	100	100	100	100	100	100	
	15	100	100	100	100	100	100	100	100	100	100	100	100	
Statistical			Treatments				Positions					Months		
Pr > F			<.0001				0.0060					<.0001		
LSD			1.2582				0.9746					1.9491		

M = Metal B = Breaking P = Plastic Gr = Cravel Ch = chlorpyrifos

CONCLUSION

In general, according to Tables (1 and 2) clarified in (Fig. 2), data indicated that, the five physical barriers showed significant differences between treatments to prevent the tested insect from passing through the barriers. Metal shields (Galvanized iron) and gravel with termiticide were strong barriers prevent termite attack, this means that they are better to prevent termites from passing through it and they caused totally rerouting termite to check traps, followed by thick plastic bags barrier which prevent the termite crossing for five months from the beginning of the experiment; then breaking glass barrier where the termite was able to construction some tunnels through it, while the gravel barrier was failed to prevent termite from crossing and construction tunnels.

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الدراسة الأولى لتأثير بعض الحواجز الطبيعية لمنع الإصابة بالنمل الأبيض فى مصر

أيمن رمضان البسيونى ، حسن محمد أحمد و محمد عبدالغنى بط

مركز البحوث الزراعية - معهد بحوث وقاية النباتات - الدقى - جيزة - مصر

أجريت التجربة الحقلية لأول مرة فى مصر قرية سنجها - كفر صقر - محافظة الشرقية ، لدراسة تأثير بعض الحواجز الطبيعية "الألواح المعدنية ، كسر الزجاج ، الأكياس البلاستيكية ، الحصى ، الحصى مع المبيد" لمنع هجوم النمل الأبيض تحت أرضى "ساموترمس هيبوستوما". وقد أظهرت نتائج هذه الدراسة أن اللوح المعدنى والحصى مع المبيد كانت الحواجز القوية لصد هجوم النمل الأبيض يليها الحاجز البلاستيك والذى منع عبور النمل الأبيض لمدة خمسة شهور ، ثم كان حاجز كسر الزجاج والذى استطاع النمل تشييد بعض الأنفاق من خلاله ، بينما فشل حاجز الحصى فى منع النمل من المرور وتشييد الأنفاق خلاله . ثم أظهرت نتائج التحليل الإحصائى وجود إختلافات معنوية بين المعاملات المختبرة . ويمكن التوصية بإستخدام الحواجز المعدنية والحصى مع المبيدات تحت الأرضيات الخشبية (الباركيه) وأرضيات السراميك والرخام لمنع وصول النمل الأبيض إلى الأثاثات الخشبية .