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Laboratory Evaluation of Some Physical Barriers Against Subterranean Termites For The First Time in Egypt

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ABSTRACT

Data in metal shield revealed, that termites failed to cross through the metal shield of Galvanized iron throughout the tested period, recorded that zero%. Termite tunneled in the sand layer during seven days and individual died inside the tunnels, and showed an inability to move in the tunnels after the first week. In case of test breaking glass barrier data showed crossed termites recorded 3 individual at rate of 0.6 and 7 individual after 30 days at the rate of 1.4 with average 0.4% and one tunnel created on body of transparent box from the inside. Data of thick plastic bags after 15 days crossed termite counted 11 individuals at rate of 2.2 and 19 individual at the rate of 3.8 after 30 days, with average 1.2% of all tested replicates, termites crossed through the tunnels created in sand layer directly, and also the other horizontal showed from the bottom of transparent box. Data of gravel after 15 days calculated 53 termites crossed at rate of 10.6 and 105 after 30 days at rate of 21.0, the average% for crossed termite counted 6.32%, tested barrier did not cause monitoring tunnels which created vertically. It is worth to mention that, few of horizontal tunnels numbers of termites were detected in the bottom of transparent box.Totally; the four tested physical barriers showed differences between them to prevent the termites from crossing through the barrier. The metal shield was better to prevent termites from passing through it, followed by breaking glass, thick plastic bags and gravel. Data in control counted 71.6% crossed termites from total of tested replicates. Statistical analysis showed no significant differences for all tested physical barriers but, there were strong significant differences with control, and the differences between the tested times 15 and 30 days were significant. The physical barriers can be used down wood and regular floors.

INTRODUCTION

The subterranean termite attack the houses to feed on the wooden furniture's components, carpets, papers and parquet, and caused heavy losses to the owners of these houses, and it spreads in all types of land, including sandy and muddy and attacking facilities built on those lands. Chemicals commonly used in Egypt, to protect the house for a temporary period until the expiration of the effectiveness of these pesticides, and then resume the pest attack again, from this point, we need to treatment the houses repeatedly periods causing a partial loss of the foundations and the cash losses each period. The termite physical barrier system is not commonly used in Egypt and designed to prevent the crossing of termites into homes components. Termites used fine soil particles for the manufacture of tunnels heading to the sources of attraction and is no alternative to him, all these tunnels to move through it up and down from the colony to the food source, and vice versa. There are many materials that can be used natural barriers suit the Egyptian environment and low cost, such as, gravel, sheets iron barrier (Galvanized iron) and plastic bags… etc., which can be placed under the parquet and wooden cladding are effective and which is characterized by long-term.

Some researches were conducted on the termite physical barriers and they get up good results, such as, Ebeling and Pence (1957), Wedding and Gaynor (1961) Ebeling and Forbes (1988), French (1991), Pallaske and Igarashi (1991), Su N.Y. *et al* (1991), Su and Scheffrahn (1992), Myles (1997), Yates and Reinhardt (2000) French *et al* (2003) and TC Keefer *et al* (2013).

This work was conducted in Egypt for first time, in termite Lab, Plant Protection Research Institute, Agric., Res., Center (ARC), Dokki, Giza. The work aims for test of four physical barrier materials treated under small concrete slab as a model to prevent the termite *Psammotermes hybostoma* (Desneux), for attacking house furniture.

MATERIALS AND METHODS

Physical barrier materials:

1- Metal shield barrier (Galvanized iron) (1m Length×1m width×1ml thickness), it had obtained and prepare in the workshop galvanized shield in Mit-Ghamr city, Dakahlia Gov.
2- Breaking glass (glass splinters) were crushed in a pot metal.
3- Thick plastic bags. (1m Length×1m width×1ml thickness), it had obtained from plastic factory in Mansoura city, Dakahlia Gov. and prepare in lab.
4- Gravel (Pepples) or stone barrier, which using in concrete was chosen from the medium size, and washed from the soil particle and plankton sandy.

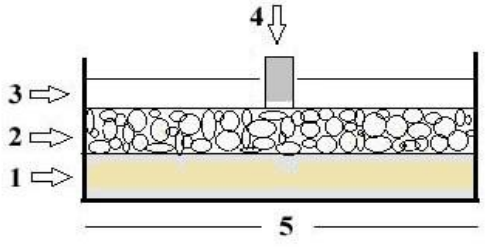
Termite collection:

Subterranean termite *Psammotermes hybostoma*, (Desneux) was collected from, Kasr Al-Gebaly region, Youssef El-Sediek district, Fayoum Governorate, the region severe injury by termite *Psammotermes hybostoma*. The area was cleaned from any source cellulose to prevent any nutrient interference with the applied traps. El-Sebay modified trap (El-Sebay 1991), used in termite catching. The caught termites were separated from the trap by small brush and maintained good for one week in plastic case contained soil and moistened carton corrugated card-board for screening and using healthy termites. The healthy workers were used directly in the treatments.

Laboratory experiments:

The experiments were carried out in termite Lab. at Plant Protection Research Institute, Agric. Res. Center (ARC), Dokki, Giza. The living condition and materials of termites included transparent plastic box (27cm in Length × 20cm in width × 16.5cm in height), divided into three layers. The 1st layer from the plastic box base filled with 5cm height of sand soil moistened with a little water to ensure the survival of the termites alive and can tunneling. The 2nd layer filled with 5cm height of physical tested materials in cases of breaking

glasses and gravel, while in case of metal shields (Galvanized iron) and thick plastic bags (27cm in Length × 20cm in width). The barrier layers were put between the sand and concrete (put down a concrete layer and top of sand layer). In the 3rd layer, a small piece of concrete was put as a model (27cm in Length × 20cm in width × 5cm height) holed from center to accommodate a roll of corrugated cardboard (Miniature model of El-Sebay modified trap, El-Sebay 1991) as the sole source of cellulose. 500 healthy casts of termites were liberated in the 1st layer (sand soil layer). Every treatment was replicated 3 times; (Fig.1). The tests were conducted throughout two days, in 1st day, wetting of sand layer with little water to stimulate the termites build tunnels, 500 healthy termites were liberated inside the sand layer for 24 hr to termite adaptability. In 2nd day, the tested physical barrier layer and small model piece of concrete quietly with wet roll of corrugated cardboard as a source of cellulose. Control contained soil sand down the concrete model with wet roll of corrugated cardboard and replicated 5 times. The experiments were noticed daily and data were recorded after 30 days and tabulated.



1= Sand layer
2= Physical barrier
3= Concrete layer
4= El-Sebay modified trap
5= Transparent Plastic Box

Fig (1): Illustration of arrangement put layers tested

Statistical analysis:

A computer program of Proc ANOVA in SAS (SAS Institute 1988). Was used to find the differences between the treatments.

RESULTS AND DISCUSSION

1. Number of termites that were able to cross the tested barriers:

Data in (Table 1), and (Fig. 2), showed that the numbers of termites crossing throughout the tested physical barriers during 15 to 30 days. El-Bassiouny A. R. and H. M. Ahmad, mentioned that, termite can be live for 6 months in moisten sand soil with source of cellulose.

Metal shields (Galvanized iron):

Metal shields (Galvanized iron) were applied under concrete and the five replicates were has been observed daily for thirty days. Data in table (1) and fig. (2), recorded that zero% of all tested replicates, that means that the termites failed to cross through the sheets of corrugated iron throughout the tested period. Tested termites were made tunnels in the 1st layer (sand layer) during seven days and died inside it, therefore, it had for its inability to move in the tunnels during the first week, as a result of the lack of alternative sources of cellulose, which was very evident in the base of the transparent plastic box from the outside, on the contrary, when there are termites in their natural environment with the availability of many sources of cellulose.

Partho Dhang (2012): studied the physical barriers, marine grade aluminum, stainless steel mesh and special grades of cement and resin mixtures, against termite market in the Philippines. These products are used to prevent termite attack for constructions, such as the edge of slabs, gaps and cracks in and around service penetrations when skillfully installed. This work a trial to use Novithor physical barrier consisting of a special grade of cement-resin mixture in termite-proofing in structures.

Breaking glass:

Data in (Table 1), and (Fig. 2), illustrated the number of termites that have been able to penetrate the barrier breaking glass after 15 days from the beginning of the experiment was 3 individual at the rate of 0.6 and the crossed numbers after 30 days was 7 individual at the rate of 1.4, the average% for crossed termite during the month counted 0.4% from total of tested termites in the five replicates. Termites crossed through the one vertical tunnel created on the body of the transparent box from the inside, and the tested termites appear vitality with a normal movement of the horizontal tunnels seemed clear from the bottom of transparent box during the month.

Menandro N. Acda and Heherson B. Ong (2005), tested the Philippine milk termite (*Coptotermes vastator* Light) for their abilities to tunneling and penetration, the physical barrier of mixed particles of lahar, the diameter range prevented *C. vastator* from penetrating were 1.18 to 2.36 mm. Data of repellency tests resulted, the lahar particles were no repellency and no toxic to *C. vastator*, while the sizes range 1.18 to 2.36 in diameter when mixed with resultant barrier was effective and prevented penetration by termites. Also the evaluations in the construction site using mixed particle sizes 1.18 to 2.36 mm inhibit and prevent tunneling of termite *C. vastator*.

Thick plastic bags:

Data in (Table 1), and (Fig. 2), showed that, the number of termites which were able to crossed throughout the tested barrier of thick plastic bags after 15 days counted 11 individual at the rate of 2.2 and the crossed numbers after 30 days were 19 individual at the rate of 3.8, the average% for crossed termite during the month counted 1.2% from total of tested termites in all replicates. Termites crossed through the tunnels created in sand layer directly, and also the other horizontal showed from the bottom of transparent box during the month.

Lina Nunes and Tania Nobre (2001), mentioned that plastic barriers (6 mill) against subterranean termite were effective for prevention and controlling of termite entry into homes, the controlling termites and reducing moisture can be help to get inside homes. The plastic sheet barriers not absorb water and it work as a waterproof, these sheets when treated with termite insecticides or repellents down slab of concrete before construction. The plastic sheet product use one and the others used two sheets with termiticides between the two sheets. On the

other hand the plastic sheeting itself prevents and protect for termite crossing, and the termites cannot consume of plastic sheets and termiticides treated with plastic can protect more than twenty years. The plastic used enter home walls and floors.

Gravel:

Data showed in (Table 1), and (Fig. 2), illustrated that, numbers of termites which able to crossed barrier Gravel after 15 days from the experiment beginning calculated 53 termites at the rate of 10.6 and the crossed numbers after 30 days calculated 105 termites at the rate of 21.0, the average% for crossed termite during the month counted 6.32% from total of tested termites in the five replicates. Termites crossed through the one vertical tunnel created throughout tested physical barrier, and the tested barrier did not cause monitoring tunnels. It is worth to mention that, few of horizontal tunnels appear with a normal movement seemed from the bottom of transparent box during the month.

Wedding and Gaynor (1961). Used crushed gravel as the coarse and fine aggregate as physical barrier and gave protection against termites.

TC Keefer *et al* (2013), used aggregate particles as a physical barrier to termite crossing into structures. Such physical barriers are more effective when apply with chemical termiticides in soil. Glass-tube bioassays of individual aggregate particle sizes retained on American standard sieve sizes 8, 10, and 12 were optimal for inhibiting subterranean termite crossing into structures. Engineering analysis of the aggregate particles (numbers 8, 10, and 12) indicated that the variables sizes led to success of physical particle barriers against subterranean termites. This study showed that all aggregate ratios of particle sizes 8, 10, and 12 (angularity, weighted particle size, and fineness modulus) were effective in tunneling inhibition by termites, there was zero penetration.

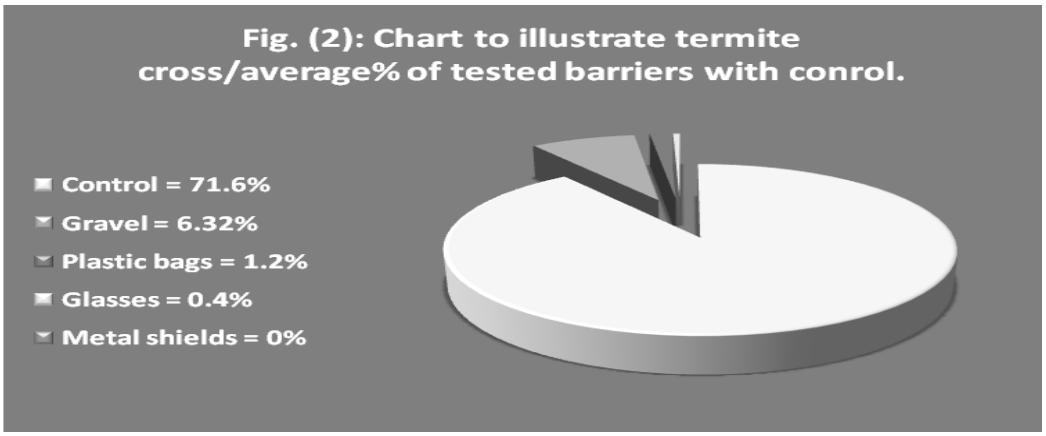
Generally, data in (Table 1), and (Fig. 2), indicated that, the four tested physical barriers showed differences between them to prevent the termites from crossing through the barrier. The metal shield was better to prevent termites from passing through it, followed by breaking glass, thick plastic bags and gravel. Data in control showed numbers of termites were able to crossed sandy barrier after 15 days from the beginning of experiment calculated 569 termites at the rate of 113.8 and the crossed numbers after 30 days calculated 1221 termites at the rate of 244.2. The average% for crossed termite during the month counted 71.6% from total of tested termites in the five replicates.

2. Statistical analysis

Data of statistical analysis in Table (1) showed that, not significant differences between the four physical barriers tested, but there are a highly significant differences when the tested physical barriers compared with control, also the differences between the two times 15 and 30 days were significant.

Table (1): Number of termites that crossed the tested barriers after 15 and 30 days.

Rep.	Metal shields		Glasses		Plastic bags		Gravel		Control	
	15 day	30 day	15 day	30 day	15 day	30 day	15 day	30 day	15 day	30 day
1	0	0	1	5	1	0	12	33	124	216
2	0	0	0	0	0	8	3	21	077	154
3	0	0	0	2	7	1	1	0	113	310
4	0	0	2	0	3	0	23	30	221	344
5	0	0	0	0	0	10	14	21	034	197
Total	0	0	3	7	11	19	53	105	569	1221
Average	0	0	0.6	1.4	2.2	3.8	10.6	21	113.8	244.2
% Average	0		0.4		1.2		6.32		71.6	
Pr > F Values										
Treatments (TRT)					<0.0001 ***					
Times					0.0208 *					



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دراسة معملية لإستخدام الحواجز الطبيعية ضد النمل الأبيض تحت أرضى لأول مرة فى مصر

أيمن رمضان البسيونى

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

كشفت البيانات في إختبار الحواجز المعدنية أن النمل الأبيض فشل في العبور من خلاله طوال فترة الإختبار والتي سجلت صفر٪ . والنمل الأبيض استطاع بناء الأنفاق في طبقة الرمال خلال سبعة أيام ، الحشرات أظهرت عدم قدرة على التحرك في الأنفاق بعد الأسبوع الأول ثم ماتت . وفي حالة اختبار كسر الزجاج أظهرت البيانات أن ٣ أفراد من النمل الأبيض استطاع العبور خلال الحاجز بمعدل ٠,٦ و ٧ أفراد بعد ٣٠ يوما بمعدل ١,٠٤ مع متوسط ٠,٤٪ ، عن طريق نفق واحد أنشأ على سطح الصندوق البلاستيك من الداخل . وقد أظهرت البيانات عند إختبار الأكياس البلاستيكية بعد ١٥ يوما أن عدد أفراد النمل الأبيض التى عبرت الحاجز ١١ فردا بمعدل ٢,٢ و ١٩ فرد بمعدل ٣,٨ بعد ٣٠ يوما بمتوسط ١,٢ % لجميع المكررات التى تم اختبارها خلال أنفاق تم إنشاؤها في طبقة الرمل مباشرة وقد ظهرت الأنفاق الأفقية من أسفل الصندوق البلاستيك . وفى حالة استخدام الحصى أظهرت البيانات بعد ١٥ يوما عبر ٥٣ فردا من أفراد النمل الأبيض بمعدل ١٠,٦ و ١٠٥ بعد ٣٠ يوما بمعدل ٢١ بمتوسط ٦,٣٢ ٪ ، خلال أنفاق تم إنشاؤها عموديا داخل الحاجز المختبر ، ومن الجدير بالذكر أن عدد الأنفاق الأفقية الواضحة من أسفل صندوق البلاستيك الشفاف كانت الأقل خلال هذا الإختبار . أربعة حواجز مادية اختبار الخلافات بينهما لمنع النمل من العبور عبر الحاجز .كان الصفائح المعدنية الأفضل فى منع النمل الأبيض من المرور خلاله ، يليها حاجز كسرالزجاج والأكياس البلاستيكية ثم كان حاجز الحصى فى المرتبة الأخيرة . وأظهرت النتائج فى الكنترول عبور ٧١,٦ ٪ من أفراد النمل الأبيض المختبر . وأظهرت نتائج التحليل الإحصائى الفروق بين كل معاملات الحواجز المختبرة كانت غير معنوية ولكن كان هناك معنوية عالية بين المعاملات مقارنة بالكنترول ، أيضا أظهرت نتائج التحليل معنوية بين الأوقات المستخدمة . ويمكن التوصية بإستخدام الحواجز الطبيعية أسفل المبانى والباركيه .