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FORAGING ACTIVITY PARAMETERS OF THE SAND SUBTERRANEAN TERMITE, PSAMMOTERMES HYBOSTOMA DESNEUX (ISOPTERA: RHINOTERMITIDAE) AND ITS ASSOCIATED FUNGUS METARHIZIUM ANISOPLIAE UNDER THE FIELD CONDITIONS AT EL-FAYOUM GOVERNORATE, EGYPT

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ABSTRACT

The foraging activity study of the subterranean sand termite *P. hybostoma* was carried out during two successive years extended from the 1st of January 2010 until the 31st of December 2011 at El-Hashtra village, Yousef El-Sadek district, El-Fayoum governorate. Newly designed trap, a perforated plastic rectangular box of 25cm L. x 15cm W. X 12cm h. and plastic lid; were used to estimate termites foraging activity as, food consumption, soil translocation, number of infested traps and number of captured termites; additional to seasonal activity and percentage of traps infected with fungus *Metarhizium anisopliae* associated with *P. hybostoma* under field conditions. Results indicated that food consumption was low in winter recorded 227.9g/trap/m^2 and 534.5 g/trap/$m^2$for 2010 and 2011, respectively. The total amounts of soil translocation throughout 2010 and 2011 were 464.22 and 1714.95 g/m^2, respectively. The highest mean weight of soil translocation took place in spring (76.8g/m^2), representing 49.7 % of the total annual soil translocation in 2010; while in 2011 the highest mean weight was in summer (235.63g/m^2, representing 41.2 % of the total annual soil translocation). The workers presented 99.5% of the total captured castes throughout the two study years. The rest of caste population consisted of 0.07, 0.41,0.05 and 0.02 % for larvae, soldiers, alates and supplementary reproductives, respectively. The mean numbers of captured workers were 4609.6 and 6790.9 individuals/trap/m^2 during the two study years, respectively. There were two peaks of infested traps with *P. hybostoma* in both 2010 and 2011, one in May (47.6%) and the second in October (57.1and 76.2 %, respectively).

Infection with fungus appeared only in October 2010 recorded 3726 infected workers with 72.8% of total captured workers of 5116 individuals and the percentage of traps infected was 33.3%. In 2011, there were two periods of fungus activity, the first was extended from January (8 infected workers) until March (2643 infected workers). The second period extended from October (2155 infected workers) until December (2574 infected workers). Total number of infected workers was 3611 during winter season while it was higher during autumn season (10316 infected workers). No workers were infected with *M. anisopliae* between the beginning of April till end of September.The means of number of workers infected with fungus/21traps were 3726 and 13927 in 2010 and 2011, respectively. The total annual percentage of termite's infection was 3.85 in 2010 and 9.77% in 2011, whereas this fungus *Metarhizium anisopliae* considered the first record on *P. hybostoma* in Egypt.

Key Words: Subterranean termites, *Psammotermes hybostoma*, Foraging activity parameters, Meteorological factors, Caste composition, Entomopathogenic fungus, *Metarhizium anisopliae***.**

INTRODUCTION

Termites are a group of soil insects that belong to order Isoptera. Among the predominant subterranean termites in Egypt is *Psammotermes hybostoma* Desneux which cause considerable damage to timber structures in many

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governorates in Egypt such as Giza, El-Fayoum, Minia, Assuit and Aswan as well as Kharga, Dakhla and Baharia oases (Harris, 1961 and Kaschef & El-Sherif, 1971). Termites are differentiated into various morphological forms or castes that live in highly organized societies or colonies (Harris, 1961; Brain, 1978; Rizk and Salman, 1984 and El-Sherif, *et al*. 2009).

Several scientists used various materials of baits such as wooden blocks, wooden stakes, toilet paper and corrugated cardboard paper roll traps which are either presented on soil surface or completely or partially buried for measuring the foraging activity of subterranean termites (Lafage, *et al*., 1973; Brain, 1978; Wood,1978; Ali, *et al.,* 1982; Abdel Wahab, *et al*. 1983; Salman *et al*. 1987; El Sebay, 1991; Ahmed, 1997;Abd El-Latif, 2003 and El Sherif, *et al*. 2009.

The isolation of entomopathogenic fungi from termite species and study their efficacy on the subterranean termites were conducted by Zoberi and Grace, 1990; Zoberi, 1995; Jones, 1996; Moino, *et al*. 2002; Sun, *et al*. 2003; and Rsundararaj & Meenakshi, 2013.

The present investigation aimed to study the foraging activity as food consumption, soil translocation, number of infested traps and number of captured termites; caste composition and the effect of some meteorological factors on foraging activity of *P .hybostoma* throughout two successive years in addition to the seasonal activity and natural relative efficacy of the pathogenic fungus *Metarhizium anisopliae* associated with termite *P. hybostoma* under natural field conditions at El-Fayoum governorate using newly designed trap.

MATERIALS AND METHODS:

The study of the foraging activity of the subterranean sand termite *P. hybostoma* was carried out during two successive years extendinged from the 1st of January 2010 until the 31st of December 2011 at El-Hashtra village, Yousef El-Sadek district, Fayoum governorate. This particular village is commonly known to be severely infested with *P. hybostoma* and no termite control measures are practiced in it. An experimental area of 32 square meters (8 meters long x 4 meters wide) was chosen for the study and carefully cleaned up as far as possible of any existing cellulose materials. Newly designed trap consisted of a perforated plastic rectangular box measuring 25cm L. x 15cm W. X 12cm h.and plastic lid was used. The box sides were punctured with 10 small holes, 3 for each length and 2 for each width of the box. Holes diameter were about 1cm. Each trap was totally filled with clean 8 corrugated cardboard rolls dried at 105 ˚C for 24 hr in an electric oven, weighted (200g/trap) and soaked in water until saturation as shown in plate (1). The corrugated cardboard rolls were used in this trap as the termite feeding substrate and enough nutritive requirements throughout month to measure actually foraging activity of *P. hybostoma* with abundance of food. 21 traps were distributed in 7 rows by 3 columns with 1 m distance between each. Traps were buried into the soil at 30 cm depth. Every trap occupied the same position throughout the whole period of the experiment (two years). At the beginning of every month, the soil covering traps was removed, then they were lifted with the aid a shovel,the plastic traps were opened to take off all contains of rolls remnants and translocated soil by workers then introduced in a separate plastic bag and transferred to the laboratory for through examination. New 8 cardboard rolls were introduced in every plastic trap and held back in the soil at the same position. Every plastic bag was examine to determine the percentage of traps visited by the termite species under investigation, caste composition by cardboard rolls were gently unrolled, then the existing termite individuals were separated and classified into different castes (larvae, soldiers, workers, supplementary and alates) and counted as shown in plate (1).. Soil particles sticking separately collected in aluminum trays, cardboard roll remnants were also separately collected in similar aluminum trays. Trays containing soil or cardboard remnants were dried at 105 ˚C for 24 hr in an electric oven then weight to estimate

food consumption and soil translocation. The termite individuals existing in every trap (8 rolls) were separately collected and kept into Petri dish with small piece of moistened corrugated cardboard paper as food and moister source. Petri dishes were maintained under laboratory conditions. The observation were carried out daily until appearance of mycelia growth or not on termite individuals to estimate seasonal activity of fungus and percentage of traps infected with fungus *Matrizium anisopliae* under field conditions (plate.2). Fungus was isolated from a diseased subterranean termite individuals, *P. hybostoma.* The potato dextrose agar media (200g. potato, 20g dextrose, 20g agar and 1liter distilled water) was used for fungal isolation and culture then identified, whereas this fungus considered the first record on *P. hybostoma* in Egypt.

Statistical analysis:

Data of food consumption, soil translocation, number of infested traps, number of captured workers and number of workers infected with fungus *Matrizium anisopliae* were correlated with each of the considered metrological factors; max., min. and mean air temp.; max., min. and mean soil temp. at 5, 10 and 20 depths and mean of R.H. % to determine the direct effect of every factor, the simple correlation and simple regression coefficient values were deduced

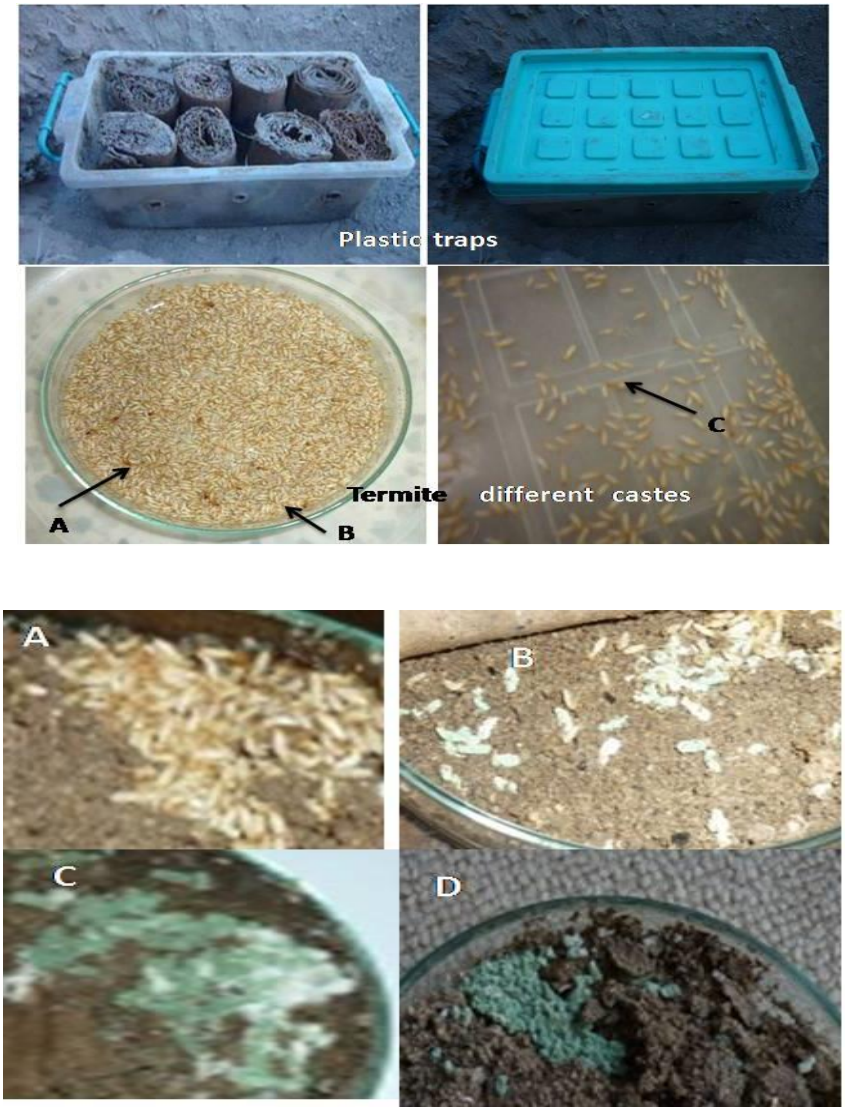

Plate (1): Plastic trap and different castes of termite (A,B&C)

A:-Soldiers, B:-Workers &C:- Supplementary reproductive plate 2.A) Dead termite, B) Mycelia growth; C) White Mycelia land green conidia growth ; D) Conidiospores with green color.

RESULTS AND DISCUSSIONS:

Termite foraging activities parameters considered were food consumption, soil translocation (construction activity), visited traps % and number of captured workers.

1-Foraging activity parameters:

1.1-Food consumption: Data in Tables (1&2) show the means of monthly and seasonal food consumption represented by the actual dry weight of consumed corrugated cardboard rolls trap in grams (Abd El-Latif, 2003). In 2010, food consumption was low in winter and increased to a 1st peak of about 65.7 g/trap in May; decrease gradually and then dropped to 5.2 g/trap in July and 9.2 g/trap in August. The second peak of 33.2 g/trap was recorded in October after that it declined to about 1.7 and 0.1 g/trap throughout remained autumn months (November and December). In 2011, food consumption was low in winter and increased to reach the 1st peak of 59.6 g/trap in May; while the 2nd one of about 90.7 g/trap was recorded in September after that it declined slightly to record 77.9 and 88.7g/trap throughout October and November, respectively.

Table (1): Monthly and seasonal means of food consumption and soil translocation by P. hybostoma at El-Fayoum location in 2010 year.

Year	Season	Month	Food consumption (g/trap/m^2)	%	Soil translocation (g/trap/m^2)	%
2010	Winter	Jan.	0.06	0.3	0.08	0.02
		Feb.	0.95	0.42	2.73	0.59
		March	8.3	3.64	50.11	10.79
		Mean	3.1	4.09	17.64	11.4
	Spring	April	49.1	21.5	109.13	23.51
		May	65.7	28.8	92.66	19.96
		June	36.3	15.9	28.78	6.19
		Mean	50.4	66.2	76.86	49.66
	Summer	July	5.02	2.2	7.59	1.64
		Aug.	9.2	4.0	14.96	3.22
		Sept.	18.5	8.1	49.69	10.70
		Mean	10.9	14.3	24.08	15.56
	Autumn	Oct.	33.2	14.6	100.69	21.69
		Nov.	1.7	0.75	7.55	1.63
		Dec.	0.1	0.04	0.25	0.05
		Mean	11.6	15.4	36.16	23.37
	Grand Total		227.9		464.22	

Table (2): Monthly and seasonal means of food consumption and soil translocation by *P. hybostoma* at El-Fayoum location in 2011 year.

Year	Season	Month	Food consumption (g/trap/m^2)	%	Soil translocation (g/trap/m^2)	%
2011	Winter	Jan.	0.11	0.02	0.23	0.01
		Feb.	0.25	0.05	1.56	0.09
		March	10.23	1.91	19.8	1.16
		Mean	3.53	1.98	7.2	1.26
	Spring	April	38.6	7.22	133.58	7.79
		May	59.6	11.15	163.48	9.53
		June	20.5	3.8	56.66	3.30
		Mean	39.57	22.21	117.9	20.62
	Summer	July	61.25	11.46	224.82	13.11
		Aug.	76.1	14.23	199.65	11.64
		Sept.	90.7	16.97	282.41	16.47
		Mean	76.02	42.66	235.63	41.22
	Autumn	Oct.	77.9	14.57	372.74	21.73
		Nov.	88.7	16.59	240.45	14.02
		Dec.	10.6	1.98	19.57	1.14
		Mean	59.07	33.14	210.92	36.86
	Grand Total		534.54		1714.95	

Generally, foraging activity, as food consumption, was relatively low in winter throughout the two study years, more or less moderate during both autumn and summer and relatively high throughout spring in 2010. In 2011 the highest food consumption was observed in summer followed by autumn then the spring.

Data in tables (1 and 2) indicated that during the first year of investigation, the seasonal means of food consumption were 3.1, 50.4, 10.9 and 11.6 g/trap representing 4.1, 66.2, 14.3 and 15.4 % of the total annual consumption for winter, spring, summer and autumn, respectively.In the second year, the corresponding consumption means were 3.5, 39.6, 76.0 and 59.1 g/trap, representing 1.9, 22.2, 42.7 and 33.1 % of the total annual consumption. The estimated total food consumption was 227.9g/trap and 534.5 g/trap for 2010 and 2011,respectively.

These results are in partial agreement with Ali *et al*. (1982) who studied the foraging activity and wood consumption of *Psammotermes hybostoma* in Sohag and the New Valley governorates and reported that the foraging activity continued all the year round and recorded two peaks of activity, the 1st one at spring and the 2nd at mid-summer. At the same trend Abd El-Wahab *et al.* (1983) investigated the surface activity of *P. hybostoma* at Kom-Ombo, Aswan governorate; mentioned smellier trend for activity and recorded highest wood consumption at April and August. Also, Salman *et al*. (1987) in the New Valley found that foraging level of *P. hybostoma* was higher in summer with three peaks recorded during June, July and September. While lower foraging levels were recorded from December to February. Anyway, each of EL-Bassyoni (2001) in Ismailia governorate and Abd El-Latif (2003) mentioned the same trend of previous authors results of *P. hybostoma* food consumption.

1.2- Soil translocation:

Tables (1 and 2) show the monthly and seasonal means of soil translocation by *P. hybostoma* and represented by the actual dry weight of translocated soil/trap in g (AbdEl-Latif, 2003). The changes in soil

translocation were almost similar to those previously described for food consumption for both years of investigation.This phenomena seems quiteunderstood as the increase or decrease of food consumption is correlated to subsequent increase or decrease of soil translocation whereas, the relationship was positive and highly significant between food consumption and soil translocation (r=0.85** and 0.94** in 2010 and 2011, respectively) these weights were taken as a second index of foraging activity. In 2010 tables (1&2) show that soil translocation was low in January (0.08g/trap) and February (2.7g/trap), then increased to 50.1 g/trap in March. In spring, soil translocation jumped to a first peak of 109.1 g/trap in April followed by a slight decline to 92.7 g/trap in May, then dropped to 28.8, 7.6 and 14.96g/trap in June, July and August, respectively. Soil translocation increased to 49.7g/trap in September then continued to record a second peak of 100.7 g/trap in October and declined to reach 7.6 g/trap in November and further declined to 0.25 g/trap in December.

As well, the lowest of the seasonal mean of soil translocation was during winter (17.64 g/trap) representing 11.4 % of the total annual translocated soil. The highest mean of soil translocation took place in spring (76.8g/trap) representing 50 % of the total annual soil translocation. In 2010, there were two peaks of soil translocation, the first in April (109.1g/trap) the second in October (100.7 g/trap), representing 23.5 and 21.7 %, respectively of the total annual translocation.

In 2011, there were three peaks the first in May (163.5g/trap, representing 9.5% of the total annual soil translocation and the second in July (224.8 g/trap, representing 13.11 % of the total annual translocation). While the third peak was in October with 372.7 g/trap, representing 21.7 % of the total annual translocation.

So, the lowest of the seasonal means of soil translocation was during winter (7.2 g/trap, representing 1.26 % of the total annual soil translocation), while the highest mean was in summer (235.63g/trap, representing 41.2 % of the total annual soil translocation). The seasonal means of soil translocation were 117.9 and 210.9 g/trap, representing 20.6 and 36.9 % of the total annual soil translocation for spring and autumn, respectively.

Generally, the total amounts of soil translocation by *P. hybostoma* throughout 2010 and 2011 were 464.22 and 1714.95 g/m^2, respectively this amount represented 8-30 folds which were mentioned in previously studies Abd El-Latif (2003) who estimated the total dry weight of soil translocation with 58.39-58.12 g/m^2 using corrugated cardboard trap containing one roll.

These results are in agreement with El-Bassyoni (2001) who estimated that the maximum quantity of soil translocation by *P. hybostoma* occurred in September and October while the minimum translocation occurred in January. Also, Abd El-Latif (2003) found that the least annual soil translocation rates occurred in winter (6.35-7.57 g/m^2) while the highest rates took place in summer (17.6-25.89 g/m^2).

1.3 – Percentage of infested traps:

Data in Table (3) showed the monthly percentage of plastic traps infested with *P. hybostoma* at El-Fayoum location in 2010 and 2011.This percentage considered the third parameter to estimate termite foraging activity where the termite visited traps all the years round and recorded two peaks of infested traps in both 2010 and 2011, one in May (47.6%) and the second in October (57.1and 76.2 %, respectively). Data in tables (1, 2 and 3) showed that the correlation between the number of infested traps and each of the monthly values of other foraging activity parameters (soil translocation, food consumption and number of captured workers) was positive and highly significant for soil translocation (r=0.73); positive and significant for food consumption (r=0.63) while it was positive and insignificant for the number of captured workers (r=0.25) in 2010. The same trend was mentioned at 2011 with highly significant and positive correlation for soil translocation (r=0.77) and food consumption (r=0.79) while it was insignificant for the number of captured workers (r=0.46).

Table (3): Annual activity of subterranean termite *P. hybostoma* population and fungus *M. anisopliae* associated with it at El-Fayoum location in 2010 and 2011.

Season	Month	% infested traps with termites	% infected trap with fungus	No. of captured workers/21 traps	No. of infected workers with fungus/21traps	% infection	No. of termite castes			
							L	S	A	Su
	2010									
winter	Jan.	4.76	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0
	Feb.	9.5	0.0	15.0	0.0	0.0	0.0	0.00	0.00	0.0
	March	38.1	0.0	53206	0.0	0.0	0.0	101.0	21.0	0.0
	Total			53226	0.0	0.0	0.0	101.0	21.0	0.0
Spring	April	38.1	0.0	1588	0.0	0.0	0.0	21.0	0.0	0.0
	May	47.6	0.0	2614	0.0	0.0	0.0	37.0	0.0	0.0
	June	38.1	0.0	13824	0.0	0.0	0.0	8.0	0.0	0.0
	Total			18026	0.0	0.0	0.0	66.0		0.0
Summer	July	33.3	0.0	125.0	0.0	0.0	0.0	25.0	00.0	0.0
	Aug.	14.3	0.0	5903.0	0.0	0.0	55.0	57.0	0.0	0.0
	Sept.	42.9	0.0	14309	0.0	0.0	0.0	4.0	0.00	0.0
	Total			20067	0.0	0.0	0.0	86.0	0.0	0.0
Autumn	Oct.	57.1	33.3	5116	3726	72.83	0.0	56.0	0.0	0.0
	Nov.	42.9	0.0	313	0.0	0.0	0.0	9.0	0.0	0.0
	Dec.	4.8	0.0	53	0.0	0.0	0.0	0.0	0.0	0.0
	Total			5482	3726	67.97	55.0	65.0	0.0	0.0
General total				96801	3726	3.85	55.0	318.0	21.0	0.0
	2011									
Winter	Jan.	9.5	4.8	83.0	8.0	9.64	0.0	0.0	0.0	0.0
	Feb.	9.5	4.8	1015	960.0	94.58	0.0	6.0	11.0	0.0
	March	42.9	19.0	5037	2643	52.47	0.0	19.0	0.0	0.0
	Total			6135	3611	58.86	0.0	19.0	11.0	0.0
Spring	April	42.9	0.0	9232	0.0	0.0	0.0	42.0	0.0	0.0
	May	47.6	0.0	15166	0.0	0.0	0.0	22.0	0.0	0.0
	June	42.9	0.0	28506	0.0	0.0	68.0	87.0	2.0	8.0
	Total			52904	0.0	0.0	68.0	151.0	2.0	8.0
Summer	July	61.9	0.0	8855	0.0	0.0	11.0	44.0	0.0	65.0
	Aug.	61.9	0.0	20705	0.0	0.0	36.0	140.0	85.0	94.0
	Sept.	71.4	0.0	25803.0	0.0	0.0	3.0	209.0	0.0	75.0
	Total			55363	0.0	0.0	50.0	393.0	85.0	234.0
Autumn	Oct.	76.2	14.3	12261	2155	17.58	0.0	54.0	0.0	7.0
	Nov.	76.2	38.1	6701	5587	83.38	0.0	5.0	0.0	0.0
	Dec.	66.7	14.3	9245	2574	27.84	0.0	36.0	0.0	0.0
	Total			28207	10316	36.57	0.0	95.0	0.0	7.0
Grand total				142609	13927	9.77	118.0	658.0	98.0	249.0

*Larvae(L), Soldiers (S), Alatae (A) and Supplementary (Su)

1.4 – Number of captured workers:

This number of captured workers considered the fourth parameter to estimate termite foraging activity. Table (3) shows the monthly and total annual traps catches of *P. hybostoma* throughout 2010 and 2011 at El-Fayoum location.

Data in table (3) indicated that the vast majority of the trapped individuals of *P. hybostoma* were workers. In 2010, there was three peaks of captured workers, recorded at March (53226/21 traps), June (13824/21traps) and September (14309/21 traps). In 2011,the same number of peaks were recorded but at June (28506/21 traps), September (25803/21 traps) and December (9245/21 traps). In 2010, a considerable portion of the total annual captured workers took place during the winter season (53226/21traps). In contrast, the results of 2011 cleared that the maximum number of *P. hybostoma* workers occurred during summer (55363/21traps) followed by spring (52904/21 traps) and autumn (28207/21 traps), while the lowest number was found during winter.

The results of 2010 year found in agreement with Rizk *et al*. (1985) stated that the workers of *P. hybostoma* have two peaks in February/March and August/September and two bottoms in May/July and November/December. Abd El-Latif (2003) indicated that in 1997/98, there was only one peak of captured *P. hybostoma* workers in February (28731/222 traps) while in 1998/99 two peaks were drown in January (16836/222 traps) and March (16832 /222 traps). El-Bassyoni (2001) reported that, the maximum number of *P. hybostoma* workers occurred during winter while the lowest number was found during summer. Abd El-Latif (2003) found that, a considerable portion of the total annual captured *P. hybostoma* workers took place during the winter season (43700-50060/222 traps).

Data in table (3) refer that the population of *P. hybostoma* workers/21 traps evidently higher in 2011 than in 2010. The mean number of captured workers/ trap/ m^2 was 4609.6 in the former year and 6790.9 in the latter one. Abd El-Latif (2003) found that worker population/m^2 was 101.8 and 78.6 for 1997/98 and 1998/99, respectively. El-Bassyoni (2001) stated that, the average forging population of *P. hybostoma* was 117.8 and 59.4/m^2 in 1995 and 1996, respectively using one corrugated cardboard roll trap.

2- Caste composition:

The numbers of *P. hybostoma* castes are tabulated in table (4) cleared that the total population of the different castes captured throughout the two years of investigation, approximately 99.5 % were workers. The rest of caste population consisted of 0.07, 0.41. 0.05 and 0.02 % larvae, soldiers, alates and supplementary reproductives, respectively.

Table (4): Composition of *P.* hybostoma caste catch in plastic traps at El-Fayoum location throughout the two study years.

%	No. of individuals	Caste
	2010 & 2011	
99.46	239410	Workers
0.07	173	Larvae
0.41	976	Soldiers
0.05	119	Alates
0.02	37	Supplementary Reproductives
	240715	Total

3- Effect of some meteorological factors on the foraging activity of termite:

The simple correlation (r) and simple regression (b) coefficients values between considered meteorological factors and each of the four foraging activity parameters are shown in tables (5&6).

Table (5): Simple correlation (r) and simple regression (b) coefficients for the relationship between some meteorological factors and the foraging activity parameters of *P. hybostoma* at Fayoum governorate in 2010.

year	Meteorological factors	DF (n-2)	Foraging activity parameters							
			No. of				Food consumption		Soil translocation	
			Infested traps		Captured workers					
			r	b	r	b	r	b	r	b
2010	Max air temp.	10	0.686*	2.16	.006	16.7	0.505	1.96	0.398	2.904
	Min. air temp.	10	0.602*	1.90	.045	-119.3	0.327	1.28	0.260	1.906
	Mean air temp.	10	0.648*	2.06	-.017	-44.98	0.418	1.64	0.331	2.439
	Mean RH	10	-0.404	-2.69	-.066	-370.1	-.0.85**	-6.94	-.695*	-10.69
	Max. soil T/5cm	10	0.729**	1.91	.002	3.44	0.614*	1.98	0.518	3.139
	Min. soil T/5cm	10	0.645*	1.95	-.032	-81.2	0.434	1.615	0.338	2.366
	Mean soil T/5cm	10	0.697*	1.98	-0.02	-37.45	0.535	1.870	0.438	2.876
	Max. soil T/10cm	10	0.715**	1.85	0.04	89.08	0.555	1.77	0.449	2.686
	Min. soil T/10cm	10	0.663*	1.91	-.006	-14.85	0.451	1.601	0.364	2.425
	Mean soil T/10cm	10	0.692*	1.89	0.02	45.43	0.509	1.71	0.411	2.601
	Max. soil T/20cm	10	0.719**	2.31	0.08	205.34	0.525	2.08	0.437	3.246
	Min. soil T/20cm	10	0.693*	2.40	0.06	180.43	0.500	2.13	0.414	3.322
	Mean soil T/20cm	10	0.706*	2.36	0.07	201.75	0.512	2107	0.425	3.286

Table (6): Simple correlation "r" and simple regression "b" coefficients between some meteorological factors and the foraging activity parameters of *P. hybostoma* at El-Fayoum governorate in 2011.

year	Meteorological factor	DF (n-2)	Foraging activity parameters							
			No. of				Food consumption		Soil translocation	
			Infested traps		Captured workers					
			r	b	r	b	r	b	r	b
2011	Max air temp.	10	0.445	1.64	0.718**	1046.7	0.649*	79.6	0.614*	256.7
	Min. air temp.	10	0.541	2.45	0.745**	1337.5	0.731**	106.2	0.713**	367.0
	Mean air temp.	10	0.489	2.0	0.737**	1193.6	0.691*	90.5	0.663*	308.1
	Mean RH	10	-0.35	-1.9	- 0.535	-1177.7	-0.579*	-103.2	-0.503	-317.7
	Max. soil T/5cm	10	0.302	0.82	0.709**	762.6	0.512	44.5	0.475	146.5
	Min. soil T/5cm	10	0.473	1.7	0.737**	1050.8	0.667*	76.9	0.646*	264.3
	Mean soil T/5cm	10	0.376	1.2	0.728**	901.7	0.582*	58.3	0.552	196.1
	Max. soil T/10cm	10	0.380	1.1	0.721**	825.7	0.575	53.3	0.537	178.4
	Min. soil T/10cm	10	0.444	1.8	0.870**	1421.2	0.654*	68.4	0.606*	284.1
	Mean soilT/10cm	10	0.422	1.4	0.731**	944.3	0.615*	64.3	0.585*	216.9
	Max. soil T/20cm	10	0.065	0.15	0.598*	552.0	0.158	11.8	0.243	64.3
	Min. soil T/20cm	10	0.539	2.0	0.728**	1072.8	0.722**	86.1	0.693*	293.1
	Mean soilT/20cm	10	0.510	1.9	0.734**	1069.9	0.702*	82.8	0.668*	279.3

T/ (5, 10 and 20cm) =deep of temperature measurement under soil surface.

The simple correlation coefficient (r) values between considered meteorological factors and number of captured workers were insignificant in 2010, while in 2011 it was highly significant except for maximum soil temperature at 20cm depth which was significant (b= 552.0 & r = 0.598) and insignificant for R. H. % (b= -1177.7 & r = -0.535).

The simple correlation (r) values demonstrate that the effect relation between considered meteorological factors and food consumption was insignificant in 2010 except for R. H. % it was highly significant and negative (b= -6.94 & r = -0.85). While in 2011 the effect was significant except for min. air temp. and min. soil at 20cm. depth was highly significant (b= 106.2 & r= 0.731), (b= 86.1 & r= 0.722), respectively.

The simple correlation and regression coefficients values between the considered meteorological factors and the rate of soil translocation, in 2010, were insignificant except for R.H. % it was significant and negative (b= -10.69 & r= -0.695). In 2011, the coefficients values were significant except for maximum soil temperature at 5, 10 and 20 depths; mean soil temperature at 5 depths where it was insignificant, while it was highly significant for min. air temperature only (b= 367.0 & r= 0.713).

4- Annual activity of fungus *M. amisopliae* associated with subterranean termites *P. hybostoma* under field conditions.

Data in table (3) indicated that the traps were infected with fungus only in October throughout 2010 year present 33.3% of total inspected traps. At the same inspection the number of workers infected with fungus were 3726 individuals with percentage of infection 72.8% of total number of captured workers (5116 individuals).

In 2011, there were two periods of activity, the 1st extended from January recorded 8 infected workers presented 9.63% infected traps until March (2643 infected workers presented 19.0 % of traps catch). The 2nd extended from October (2155 infected workers presented 17.6%) until December (2574 infected workers presented 27.8% of traps catch). The total numbers of infected workers were 3611 individuals during winter season while it was higher during autumn season (10316 infected workers), in spite of the percentage of infection was high in winter (52.86%) than autumn (36.57%).

On the other hand, the highest percentage of infection was 94.6% in February followed by 83.4 % in November. The means of number of workers infected with fungus/21traps were 3726 and 13927 in 2010 and 2011, respectively. The total annual percentage of termite's infection was 3.85 in 2010 and 9.77% in 2011.

The simple correlation coefficient values for the relationship between considered metrological factors and number of workers infected with fungus were insignificant negative with air temperature (max, min. and mean); soil temperatures (max., min. and mean at 5, 10 and 20cm. depths) except for max soil temp at 20cm. death the relationship was highly significant positive (r=0.81) while it was insignificant positive for R.H. %.

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تقدير نشاط السروح لنوع نمل الرمال التحت ارضي **Psammotermes hybostoma** من عائلة **Rhinotermitidae** و رتبة متساوية الاجنحة **Order : Isoptera** وكفاءة الفطر **Metarhizium anisopliae** المرتبط به تحت الظروف الطبيعية في محافظة الفيوم- مصر

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الملخص العربي :

اجريت هذه الدراسة لمدة عامين متتاليين امتدت من اوائل يناير 2010 حتي 31 ديسمبر 2011 بقرية الهشاترة مركز يوسف الصديق بمحافظة الفيوم . استخدمت مصيدة صممت حديثا تكونت من وعاء بلاستيك مثقب مقاسه 25سم طول X 15سم عرض X 12سم ارتفاع وغطاء بلاستيك لتقدير نشاط السروح (الاستهلاك الغذائي – التربة المنقولة – نسبة المصائد المصابة وكذلك عدد النمل المصطاد) بالاضافة الى دراسة النشاط الموسمي للفطر M . anisopliae المرتبط بنمل الرمال وعدد المصائد المصابة بالفطر تحت الظروف الطبيعية. اوضحت النتائج ان الاستهلاك الغذائي كان منخفض فى الشتاء خلال عامي الدراسة 2010 و 2011 وكان الاستهلاك الكلي ب 227.9 جرام / م2 في عام 2010 و 534.5 جم / م2 في عام 02011 وكانت التربة الكلية المنقولة بواسطة نمل الرمال خلال عامي 2010 و 2011 ب 464.22 و 1714.95 جم / م2 وكان اقل متوسط للتربة المنقولة في الشتاء خلال عامي الدراسة 2010و2011 , وكان اعلي متوسط للتربة المنقولة في الربيع بمعدل 76.8 جم / م2 ويمثل 49.7 % من التربة الكلية المنقولة سنويا في عام 2010 بينما كان في عام 2011 اعلي متوسط للتربة المنقولة خلال موسم الصيف بمعدل 235.63 جم / م2 ويمثل 41.2% من التربة المنقولة الكلية. وكانت الغالبية العظمى من النمل المصطاد من الشغالات بنسبة99.5% من التعداد الكلى لعامى الدراسة0 حيث وجد ان متوسط عدد الشغالات المصطادة هو 4609.6 في السنة الاولى و6790.9 في السنة الثانية . وجدت قمتين للمصائد المصابة بنمل الرمال, قمة في مايو بنسبة 47.6% في عامي الدراسة 2011/2010 , والقمة الثانية في اكتوبر بنسبة 57.1% و76.2% على التوالي . ظهرت العدوى بالفطر في اكتوبر فقط خلال عام 2010 حيث ان عدد الشغالات المصطادة المصابة بالفطر 3726 بنسبة 72.8% من عدد الشغالات المصطادة الكلية (5116) ونسبة المصائد المصابة بالفطر 33.3% . بينما في 2011 وجدت فترتين لنشاط الفطر , امتدت الفترة الاولى من يناير (ب 8 شغالات مصابة بالفطر) حتى مارس (ب 2643 شغالة مصابة بالفطر). امتدت الفترة الثانية للنشاط من اكتوبر (ب 2155 شغالة مصابة بالفطر) حتى ديسمبر (ب 2574 شغالة مصابة بالفطر). و كان العدد الكلي للشغالات المصابة بالفطر 3611 في موسم الشتاء بينما كان اعلى في موسم الخريف (10316 شغالة مصابة بالفطر). لا توجد شغالات مصطادة مصابة بالفطر خلال الفترة من اوائل ابريل حتى نهاية سبتمبر . وكان متوسط عدد الشغالات المصابة بالفطرل 21مصيدة هو 3726 و 13927خلال عامى الدراسة 2010و2011 على التوالي وكانت النسبة الكلية للنمل المصاب بالفطر 3.85 في عام 2010 و 9.77 % في عام 2011 حيث ان هذا الفطر سجل لاول مره على النمل الرمال التحت الارضى بمصر0