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FOOD CONSUMPTION AND SOIL TRANSLOCATION OF THE SAND TERMITE, *PSAMMOTERMES HYBOSTOMA*, DESN. (FAM. RHINOTERMITEDAE)

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ABSTRACT: *The highest mean consumption of Psammotermes hybostoma, recorded during summer (11.46 g /trap in 2012) and in autumn (08.29 g /trap in 2013), while the lowest mean observed during winter in both years (03.74 g /trap and 05.09 g /trap respectively). Monthly consumption detected that, the peak of consumption occurred during July 2012 (14.29 g /trap) and October 2013 (11.12 g /trap), while the minimum rate of consumption detected during March 20012 (03.56gm/trap) and January 2013 (04.12 g /trap). Highest mean of soil translocation observed during summer (32.84gm in 2012 and 27.42 g /trap in 2013), while the lowest mean appeared during winter (09.90 g and 12.39 g /trap in 2012 and 2013 respectively). The peak of soil translocation occurred during July 2012 (38.77 g /trap) and October 2013 (36.18 g /trap), while the minimum rate recorded during January of both years (09.46gm in 2012 and 09.13gm/trap in 2013). Highest ratios between food consumption and soil translocation were 01.00 : 3.70 in November 2012 and 01.00 : 04.39 in April 2013, while the lowest ratios were 1.00 : 2.39 in June 2012 and 01.00 : 02.17 in December 2013. On the other hand, the increasing in temperature degree caused increasing in food consumption and soil translocation, Highly positive significant correlation was detected between food consumption and soil translocation for P. hybostoma during 2012 and 2013, and the soil temperature was positive significant with it. The increase in consumption by 01.00 g gave increase in soil translocation by gave 02.80 g in 2012 and 04.04 g in 2013. Estimated value indicated that 01.00 g consumption caused 03.09 g soil translocation in 2012, and 01.001 g consumption caused 01.561 g soil translocation in 2013*

Key words : *Psammotermes hybostoma,* sand termite, food consumption, soil translocation, temperature degrees.

INTRODUCTION

It is necessary to understand and investigate the reaction between the termites and the surrounding conditions, such as soil temperature, soil structure and moisture etc. Effects of environmental factors on the subterranean termite were studied by many authors e.g., Harverty *et al*. (1975), Morsy *et al*. (1982), Abdel-Wahab *et al*. (1983), Abou-Ghadir and Khalifa (1982), Khalifa (1982), Shahid and Akhtar (1992). Kofoid (1934) and Kemp (1955). Various species of termites were widely distribution in Egypt Hafez (1980), reported that, there are at least 11 species of termites. Among these species 8 are ground-nesting or subterranean termites and 3 species are dry wood or non-subterranean termites. Termite feed on any material containing cellulose, causes considerable damage too wooden structures and other different materials. Termite food consumption varies according to species and natural food Nel and Hewitt (1969), Nel (1969), Ohiagu and Wood (1976), Wood (1978), Brian (1978), Crawford and Seely (1994). In Egypt, some investigators (Ahmed 1997, Ali *et al.,* 1982, Abdel-Wahab *et al* .,1983, Salman *et al.,* 1987, El-Bassiouny 2001 and Abd El-Latif 2003) contributed to estimation the food consumption and soil translocation of subterranean termites, *Anacanthotermes ochraceus*, Burm., and *Psammotermes hybostoma*, Desn.

This work was carried out at Ismailia Research Station, Ezz El-Deen district, Ismailia governorate and aims to study ecological aspects for sand subterranean termite *P. hybostoma,* represented by food consumption and soil translocation in two successive years 2012 and 2013, and relation with temperature degrees.

MATERIALS AND METHODS

Termite trap:

PVC traps were used, it was as El-Sebay modified trap (El-Sebay 1991), which consists of corrugated card-board wrapped in a roll shape, 7-10 cm in diameter and 12 cm in length, covered by PVC penetrated cover closed from bottom and above, Fig.(1).

Locations:

Location for current investigation was chosen at infested areas with species of termite*, Psammotermes hybostoma*, Desn., at Ismailia research station, Ezz El-Deen district, Ismailia governorate for during the period from January 2012 until December 2013. The experimental area of location was carefully cleaned-up from any cellulose materials or wood.

Field work:

One hundred of El-Sebay modified traps, (El-Sebay 1991), for each location were prepared in Termite Laboratory of PPRI. Traps were distributed throughout 400m2 of infested area and aligned in 10 rows and 10 columns, for determined 10 infested positions for each location. Trap were soaked in water to provide with moisture and buried vertically underground at 12 : 15 cm depth with 2m intervals between traps, this means each trap subtended an area of $4m^2$. Monthly, 10 traps of corrugated card-board for 10 infested positions/location were dried in an electrical oven at 105 C° for 24 hours until the weight was stable for calculation of consumption losses (dried weight/trap), and sent to the experimental area. Each trap was taken number and occupied the same position throughout two successive years. Traps were renewed monthly by other traps. Collected traps were carried back to the laboratory for examined of the following points;

Food consumption rates:

After removing insects and soil translocated, traps were placed in an oven at 105C° for 24 hours and re-weight to determine the loss of weight due to termites consumption. Data were recorded for each trap.

Translocation soil rates:

The translocated soils were removed from each infested trap separately, placed in Petri-dishes and dried at 105 C° for 24 hours, consumed traps and translocated soil illustrated in Fig. (2), and then the weight of dried soils was recorded for each trap after separating the individuals, (Collins and Nutting 1973, Said 1979 and El-Bassiouny 2001) were estimated.

Fig. (1): PVC Subterranean termite trap

Fig. (2): Termite, consumed trap and translocated soil.

Monthly food consumption (Actual dry weight of consumed/trap in gm) was calculated by the following formula: $FC = {}_{W}TB - {}_{W}TA$

FC = Food Consumption in gm
${}_{W}TB$ = weight trap before treatment in gm
${}_{W}TA$ = weight trap after treatment in gm

The weight of consumed food materials was used as an index for termite foraging activity (La Fage *et. Al.* 1973). The weight of soil translocation was taken also as a second index of foraging activity. The relation between consumed food and translocated soil was determined.

Data obtained of temperature:

Data of temperatures source were obtained from Central Lab., of Agricultural Climate, Agric., Res., Center, Dokki, Giza., Egypt. Data were calculated as mean of each 3 months (4 seasons/year), throughout the years 2012-2013.

Statistical analysis:

Simple correlation "r" and regression "b" coefficient, critical coefficient "r^2" and estimated values corresponding for food consumption F.C. and soil translocation S.T. of *P. hybostoma,* during 2012 and 2013, (Snedecor and Cochran, 1990).

RESULTS AND DISCUSSION

Foraging activities of subterranean termites are represented by food consumption and soil translocation.

1. Aspects of *P. hybostoma*.

Monthly and seasonal means of food consumption and soil translocation by subterranean termite *P. hybostoma*, at Ismailia location in 2012 and 2013 are illustrated in Table (1).

1.1. Food consumption:

In 2012 the actual dry weight of consumed in gm/trap indicated that, the highest mean of consumption indicated that, in summer (11.46 g/trap) followed by autumn (07.12 g/trap), spring (06.75 g /trap) and winter (03.74 g /trap). Monthly food consumption showed that, highest food consumed recorded during July (14.29 g /trap), while the lowest appearing during March (03.56 g /trap). The percentages of seasonal food consumption recorded 12.85, 23.21, 39.45 and 42.49% during winter, spring, summer and autumn respectively, of the total annual consumption (87.21 g /trap). In 2013 the mean rates of seasonal food consumption were 05.09, 06.61, 07.76 and 08.29 g /trap during winter, spring, summer and autumn respectively. Percentages of seasonal food consumption were 18.36, 23.81, 27.97 and 29.86% of the total annual consumption (83.25 g/trap), respectively. Peak of food consumption recorded during October (11.12 g/trap), while the minimum recorded (04.12 g /trap) detected in January. Ahmed (1997), found that foraging activity of *A. ochraceus*, estimated by the food consumption which recorded 36.9 g /m^2 or 154.98 kg/feddan. Ali *et. al.* (1982), mentioned that, the foraging activity of *P.*

hybostoma, (in Sohage and New Valley governorates), take place the all year round, but the minimal activity was during winter. Abdel-Wahab *et. al.* (1983), determined the surface activity of *P. hybostoma*, at Kom-ombo (Aswan gov.), and mentioned that the minimal level of food consumption was during April and August. Salman *et. al.* (1987), reported that the activity of *P. hybostoma*, (in New Valley gov.), was higher in summer with peaks during 1st half of September, while the lower foraging levels were recorded from December to February.

1.2. Soil translocation:

In 2012 the highest mean of translocation soil observed during summer (32.84gm/trap) followed by autumn (22.86gm/trap), spring (17.11gm/trap) and winter (09.90gm/trap). Monthly means of soil translocation indicated that, the highest rate appeared during July (38.77gm/trap), while the lowest rate observed during January (09.46gm/trap). Seasonal percentages of soil translocation were 11.67, 20.69, 39.70 and 27.69% during winter, spring, summer and autumn respectively, from the total amount soil translocation (248.12gm/trap). In 2013 the rates of soil translocation were 12.35, 27.30, 27.42 and 24.01gm/trap during winter, spring, summer and autumn respectively, percentages recorded 13.56, 29.97, 30.11 and 26.36% from the total amount of soil translocation (273.24gm/trap), respectively. The peak of soil translocation occurred during October (36.18gm/trap), while the minimum was appeared during January (09.13gm/trap). El-Bassiouny (2001), found that, the maximum quantity of soil translocation by *P. hybostoma*, occurred in September and October, while the minimum translocation occurred in January. Collins and Nutting (1973), the workers of *A. ochraceus*, exchange a load of soil for a bit of food material. Said (1979), in Egypt stated that, the foraging activity of *A. ochraceus*, (measured as soil translocation) was minimal between mid-December and early April and maximal in the summer months of July, August and September.

The monthly ratio between food consumption and soil translocation indicated that, the highest ratios were 1: 3.70 and 1: 4.39, recorded in November 2012 and April 2013, while the lowest ratios were 1: 2.35 and 1: 2.17 obtained in June 2012 and December 2013, respectively.

1.3. Effect of soil temperature degrees:

At the 1st year 2012, data in Table (1), clarified that, the highly rates of food consumption and soil translocation recorded (11.46 and 32.84) during summer respectively, when the rate of temperature degrees recorded 30.33°c, followed by autumn (7.12 and 22.86), spring (6.75 and 17.11) and winter (3.74 and 09.90) for F.C. and S.T. when rates of temperature degrees were 20.51, 30.10 and 18.62°c respectively.

At the 2nd year 2013, data in table (1), clarified that, the highly rates of food consumption and soil translocation recorded (7.76 and 27.42) during summer respectively, when the rate of temperature degrees recorded 32.02°c, followed by autumn (8.29 and 24.01), spring (6.61 and 27.30) and winter (5.09 and 12.35) for F.C. and S.T. when rates of temperature degrees were 20.85, 30.23 and 23.20°c respectively.

2. Relationship between food consumption and soil translocation.

The statistical analysis for obtained data on food consumption and soil translocation of *P. hybostoma*, during 2012 and 2013 (Table 2), indicated that, obtained values for "r" showed highly positive significant correlation between food consumption and soil translocation of *P. hybostoma*, during 2012 ("r" = 0.967) and 2013 ("r" = 0.880). Regression coefficient values revealed that, the increase of consumption by 1 g led to increase in soil translocation by 2.806 g in 2012 and 4.049 in 2013. Estimated values for consumption and translocation indicated that 1gm consumption caused 3.09gm soil translocation in 2012, while 1.001 g consumption caused 1.561 g soil translocation. The critical coefficient values ("r^2") were 0.935 and 0.775 in 2012 and 2013 respectively.

Table (1): Values of food consumption (F.C.) and soil translocation (S.T.) by sand termite *P. hybostoma*, in conjunction with soil temperature degrees at Ismailia location during years 2012 and 2013

Season & year	Month	Mean of F.C. g/trap	%	Mean of S.T. g/trap	%	Ratio between F.C. & S.T.	Mean soil temperature C°	
Winter 2012	Jan.	03.74	4.29	09.46	3.81	1:2.53	Max. 23.56	Min. 13.69
	Fib.	03.91	4.48	10.29	4.15	1:2.63		
	Mar.	03.56	3.56	9.95	4.01	1:2.79		
	Mean	3.74	12.8	09.90	11.67	1:2.65	18.62	
Spring 2012	Apr.	05.12	5.87	14.80	5.96	1:2.89	Max. 35.76	Min. 24.45
	May	06.71	7.69	16.69	6.73	1:2.49		
	June	08.75	4.65	19.85	8.00	1:2.35		
	Mean	06.75	23.21	17.11	20.69	1:2.53	30.10	
Summer 2012	July	14.29	16.3	38.77	15.6	1:2.71	Max. 34.16	Min. 26.50
	Aug.	09.54	10.9	27.93	11.2	1:2.93		
	Sept.	10.56	12.1	31.81	12.8	1:3.01		
	Mean	11.46	39.45	32.84	39.70	1:2.87	30.33	
Autumn 2012	Oct.	09.13	10.4	29.87	12.0	1:3.27	Max. 23.33	Min. 17.69
	Nov.	04.91	5.6	18.15	7.32	1:2.81		
	Dec.	07.32	8.3	29.87	8.28	1:3.70		
	Mean	7.12	24.49	22.86	27.64	1:3.21	20.51	
Total/year		87.21	100	248.12	100	1:7.85		
Winter 2013	Jan.	04.12	4.95	09.13	3.34	1:2.21	Max. 27.14	Min. 19.27
	Fib.	05.25	6.31	13.61	4.98	1:2.59		
	Mar.	05.91	7.10	14.32	5.24	1:2.42		
	Mean	05.09	18.36	12.35	13.56	1:2.43	23.20	
Spring 2013	Apr.	07.33	8.80	32.18	11.78	1:4.39	Max. 36.41	Min. 27.63
	May	07.12	8.55	29.14	10.66	1:4.09		
	June	05.38	6.46	20.57	7.53	1:3.82		
	Mean	06.61	23.81	27.30	29.97	1:4.13	30.23	
Summer 2013	July	06.91	8.30	25.51	9.34	1:3.69	Max. 34.55	Min. 25.91
	Aug.	06.44	7.74	21.82	7.99	1:3.39		
	Sept.	09.93	11.93	34.92	12.7	1:3.52		
	Mean	07.76	27.97	27.42	30.11	1:3.53	32.02	
Autumn 2013	Oct.	11.12	13.3	36.18	13.2	1:3.25	Max. 24.47	Min. 17.24
	Nov.	07.82	9.39	22.99	8.41	1:2.94		
	Dec.	05.92	7.11	12.87	4.71	1:2.17		
	Mean	08.29	29.86	24.01	26.36	1:2.90	20.85	
Total/year		83.85	100	273.24	100	1:3.28		

Table (2): Simple correlation coefficient "r" simple regression coefficient "b" critical coefficient "r^2" and estimated values of food consumption F.C. and soil translocation S.T. of *P. hybostoma* as influenced by temperature degree during 2012 and 2013.

Year	Value of coefficient			Estimated value		Max. temp.		Min. temp.	
	"r"	"b"	"r^2"	F.C.	S.T.	"r"	"b"	"r"	"b"
2012	0.967	2.806	0.935	1.00	3.09	0.676	135.6	0.87	172.89
2013	0.880	4.049	0.775	1.001	1.561	0.514	119.5	0.47	127.03

On the other hand there are highly positive significant correlation between maximum and minimum temperature with food consumption and soil translocation. The maximum temperature values were ("r" = 0.70 and 0.28) and ("b" = 20.93 and 21.05) in 2012 and 2013 respectively, while the minimum temperature calculated ("r" = 0.90 and 0.85) and ("b" = 30.02 and 29.54) in 2012 and 2013 respectively.

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الاستهلاك الغذائى ونقل التربة لنمل الرمال " ساموترمس هيبوستوما "

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الملخص العــربى

أجريت هذه الدراسه على نوع النمل الأبيض تحت أرضى نمل الرمال " ساموترمس هيبوستوما " خلال عامى ٢٠١٢ و ٢٠١٣ وشملت الدراسة نشاط الغزو والعلاقة بين معدلات الأستهلاك الغذائى ونقل التربة وكانت النتائج كالآتى :

سجل أعلى معدلات الإستهلاك الغذائى لنمل الرمال " ساموترمس هيبوستوما " خلال الصيف ١١,٤٦ جم/المصيدة عام ٢٠١٢ وفى الخريف ٨,٢٩ جم/المصيدة عام ٢٠١٣ وسجل أقل معدلات خلال الشتاء ٣,٧٤ جم/المصيدة و ٥,٠٩ جم/المصيدة خلال العامين على التوالى . بلغ أعلى استهلاك شهرى ١٤,٢٩ جم/المصيدة

خلال يوليو عام ٢٠١٢ و ١١,١٢ جم/المصيدة خلال أكتوبر عام ٢٠١٣ ، بينما وجد أقل إستهلاك ٣,٦٥ جم/المصيدة خلال مارس عام ٢٠١٢ و ٤,١٢ جم/المصيدة خلال يناير عام ٢٠١٣ . وقد سجل أعلى معدلات نقل التربة خلال الصيف ٣٢,٨٤ جم/المصيدة عام ٢٠١٢ و ٢٧,٤٢ جم/المصيدة عام ٢٠١٣ . وبلغ أعلى معدلات نقل التربة الشهرى ٣٨,٧٧ جم/المصيدة خلال يوليو عام ٢٠١٢ و ٣٦,١٨ جم/المصيدة خلال أكتوبر عام ٢٠١٣ ، بينما وجد أقل معدل شهرى خلال يناير لكلا العامين ٩,٤٦ جم/المصيدة عام ٢٠١٢ و ٩,١٣ جم/المصيدة عام ٢٠١٣ . وكانت أعلى نسبة بين معدلات الإستهلاك ونقل التربة ١ : ٣,٧٠ خلال نوفمبر ٢٠١٢ و ١ : ٤,٣٩ خلال إبريل ٢٠١٣ ، بينما كانت النسب الأقل ١ : ٢,٣٥ خلال يونيو ٢٠١٢ و ١ : ٢,١٧ خلال ديسمبر ٢٠١٣ . وسببت الزيادة فى درجات الحرارة زيادة فى النشاط التحت سطحى وزيادة معدلات الإستهلاك الغذائى ونقل التربة .

وجد ارتباط معنوى موجب بين معدلات الإستهلاك الغذائى ونقل التربة لنمل الرمال " ساموترمس هيبوستوما " خلال عامى ٢٠١٢ و ٢٠١٣ ، وأظهرت النتائج وجود ارتباط معنوى موجب بين هذه المعدلات ودرجات حرارة التربة . وقد أظهر معدل الإنحدار البسيط أن الزيادة فى معدلات الإستهلاك الغذائى لنمل الرمال بمقدار ١ جم أعطى زيادة فى نقل التربة بمقدار ٢,٨٠٦ جم عام ٢٠١٢ و ٤,٠٤٩ جم عام ٢٠١٣ . وتشير القيم المقدرة لنقل التربة مقابل الإستهلاك أن ١ جم إستهلاك سبب نقل تربة بمعدل ٣,٠٩ عام ٢٠١٢ فى حين أن استهلاك ١,٠٠١ جم سبب نقل تربة بمعدل ١,٥٩١ جم عام ٢٠١٣.