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STUDIES ON FORAGING ACTIVITIES OF HARVESTER TERMITE, *ANACANTHOTERMES OCHRACEUS*, BURM. (FAM. HODOTERMITIDAE)

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ABSTRACT: *Foraging activities of Anacanthotermes ochraceus were represented by food consumption and soil translocation during 2012 and 2013 years. The highest mean consumption of A. ochraceus, was recorded during summer (36.51 g/trap in 2012 and 34.97 g/trap in 2013), while the lowest mean was observed during winter (05.93 g/trap in 2012 and 15.48 g/trap in 2013). Monthly food consumption showed that, the highest rate was recorded during August 2012 (38.33 g/trap) and September 2013 (39.32 g/trap), while the lowest rate was detected during January in both years (2.91 and 12.56 g/trap respectively). The highest mean of soil translocation also recorded during summer (276.45 g in 2012 and 350.09 g/trap in 2013), while the lowest mean occurred during winter (36.89 g and 97.41 g/trap in 2012 and 2013 respectively). Monthly soil translocation showed that, the rate occurred in August 2012 (289.16 g/trap) and September 2013 (390.43 g/trap, respectively). The highest ratios between food consumption and soil translocation were 1.00 : 8.34 in May 2012 and 1.00 : 10.20 in July 2013, while the lowest ratios were 1.00 : 5.93 in February 2012 and 1.00 : 5.74 in January 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 A. ochraceus 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 07.95 g in 2012 and 12.49 g in 2013. Estimated value indicated that 02.29 g consumption caused 01.006 g soil translocation in 2012, and 07.06 g consumption caused 01.06 g soil translocation in 2013.*

Key words: *Anacanthotermes ochraceus, harvester subterranean termite, food consumption, soil translocation, temperature degrees.*

INTRODUCTION

Various species of termites were widely distribution in Egypt Hafez (1980), who 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 (1970), Ohiagu and Wood (1976), Wood (1978), Brian (1979), Grawford and Seely (1994). In Egypt, the 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 aims to study foraging activities for harvester subterranean termite *A. ochraceus,* and the relation between food consumption and soil translocation rates as influenced with temperature degrees.

MATERIALS AND METHODS

Termite trap:

The termite traps of El-Sebay modified trap (El-Sebay 1991), were used, it was consisted of corrugated card-board wrapped in a roll shape, 7-10 cm in diameter and 12 cm in length, covered with polyethylene sack except 1-2 cm at the end position fixed with rubber band, Fig.(1).

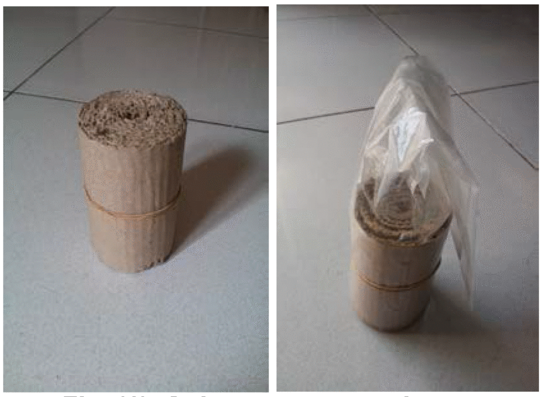

Fig. (1): Subterranean termite trap

Locations and field work:

Locations:

Location for current investigation were chosen at infested areas with species of termite*, Anacanthotermes ochraceus*, Burm., at Sangha village, Kafr Sakr, Sharkeia governorate during the period from January 2012 to December 2013. The experimental area was carefully cleaned-up from any cellulose materials or wood.

Field work:

One hundred of El-Sebay modified traps, (El-Sebay 1991), were prepared in Termite Laboratory of PPRI. Traps were distributed throughout 400 m^2 of infested area and aligned in 10 rows and 10 columns, to determine the infested positions. Traps were soaked in water to provide it with moisture and was buried vertically underground at 12 : 15 cm depth with 2 m intervals between traps, this means each trap subtended an area of 4 m^2. Monthly, ten traps of corrugated card-board for 10 infested positions detected in 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 numbered and occupied the same position throughout two successive years. Traps were renewed monthly by other traps. Collected traps were carried back to the laboratory to examine following points:

- Food consumption rates:

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

Monthly food consumption (Actual dry weight of consumed/trap in g) was calculated by the following formula:

$$\text{Food Consumption FC} = {}_{W}TB - {}_{W}TA$$

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 (Lafage *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.

Temperature obtained source:

Data of temperature degrees 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.

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

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 *A. ochraceus* during 2012 and 2013, (Snedecor and Cochran, 1990).

RESULTS AND DISCUSSION

Foraging activities of subterranean termites, *Anacanthotermes ochraceus* are represented by food consumption and soil translocation.

1. Activities of *A. ochraceus*.

Monthly and seasonal means of food consumption and soil translocation by subterranean termite *A. ochraceus*, at Sharkeia location in 2012 and 2013 are presented in Table (1).

1.1. Food consumption:

In 2012 the actual dry weight of consumed/ g /trap indicated that, the highest mean of consumption recorded in summer (36.51 g/trap) followed by spring (26.97 g/trap), autumn (20.71 g/trap) and winter (5.93 g/trap). Monthly food consumption showed that, highest food consumed recorded during August (38.33 g/trap), while the lowest consumption detected during January (2.91 g/trap). The percentages of seasonal food consumption were 6.58, 29.93, 40.50 and 22.99% during winter, spring, summer and autumn respectively, of the total annual consumption (270.39 g/trap). In 2013 the mean rates of seasonal food consumption were 15.48, 16.07, 34.97 and 20.46 g/trap during winter, spring, summer and autumn respectively. The percentages of seasonal food consumption were 17.80, 18.87, 40.21 and 23.52% of the total annual consumption (260.93 g/trap), respectively. The peak of food consumption recorded during September (39.32 g/trap), while the minimum was (12.56gm/trap) detected in January. These results are in harmony with those of Ahmed (1997), who found that foraging activity of *A. ochraceus*, estimated by the food consumption which recorded 36.9 g/m^2 or 154.98 kg/feddan.

1.2. Soil translocation:

The weight of soil translocation was taken as a second index of foraging activity, where according to Collins and Nutting (1973), and Said (1979), they found that the workers of *A. ochraceus*, exchange a load of soil for a bit of food material. Results in Table (1), indicated that, the rate of soil translocation by A*. ochraceus*, varied during different months and seasons of same year. In 2012 the highest mean of translocation recorded in Summer (276.45 g/trap) followed by Spring (199.33 g/trap), Autumn (135.41 g/trap) and Winter (36.89 g/trap). Monthly soil translocation indicated that, the highest rate of soil translocation appeared during August (289.16gm/trap), while the lowest rate recorded during January (20.90 g/trap). The percentages of seasonal soil translocation were 5.69, 30.7, 42.66 and 20.89% during winter, spring, summer and autumn respectively, of the total annual soil translocation (1944.25 g/trap). In 2013 the seasonal rates of soil translocation were 97.41, 113.62, 350.09 and 176.51 g/trap during winter, spring, summer and autumn respectively, percentages were 13.21, 15.40, 47.46 and 23.93% of the total annual translocation (2212.89 g/trap), respectively. The peak of soil translocation observed during September (390.43gm/trap), while the minimum translocation was (72.13 g/trap) appeared in January.

Table (1): Means of food consumption (F.C.) and soil translocation (S.T.) by harvester termite *A. ochraceus*, in conjunction with soil temperature degrees at Sharkeia location during 2012 and 2013 years.

Season & year	Months	Mean of F.C. in gm/trap	%	Mean of S.T. in gm/trap	%	Ratio between F.C. & S.T.	Mean soil temperature	
Winter 2012	Jan.	2.91	1.08	20.90	1.07	1:7.18	Max. 23.63	Min. 13.73
	Feb.	5.30	1.96	31.44	1.62	1:5.98		
	Mar.	9.58	3.54	58.34	3.09	1:6.04		
	Mean	5.93	6.58	36.89	5.69	1:6.22	18.68	
Spring 2012	Apr.	25.17	9.31	165.15	8.50	1:6.56	Max. 32.86	Min. 25.88
	May	34.84	12.8	290.67	14.8	1:8.34		
	June	20.91	7.73	142.17	7.31	1:6.80		
	Mean	26.97	29.9	199.33	30.76	1:7.39	29.37	
Summer 2012	July	36.43	13.4	262.34	13.4	1:7.20	Max. 34.85	Min. 26.15
	Aug.	38.33	14.1	289.16	14.8	1:7.54		
	Sept.	34.76	12.8	277.81	14.3	1:7.99		
	Mean	36.51	40.5	276.45	42.6	1:7.57	30.5	
Autumn 2012	Oct.	29.71	10.9	201.38	10.3	1:6.78	Max. 23.12	Min. 17.09
	Nov.	19.54	7.2	122.15	6.28	1:6.25		
	Dec.	12.90	4.7	82.71	4.25	1:6.41		
	Mean	20.71	22.9	135.41	20.8	1:6.54	20.10	
Total/year		270.38	100	1944.25	100	1:7.19		
Winter 2013	Jan.	12.56	4.8	72.13	3.2	1:5.74	Max. 26.70	Min. 19.22
	Feb.	15.24	5.8	88.92	4.0	1:5.83		
	Mar.	18.64	7.4	131.18	5.9	1:7.04		
	Mean	15.48	17.8	97.41	13.2	1:6.29	22.96	
Spring 2013	Apr.	16.19	6.2	112.50	5.0	1:6.95	Max. 34.16	Min. 25.97
	May	17.36	6.7	124.44	5.6	1:7.06		
	June	14.38	5.5	103.91	4.7	1:7.23		
	Mean	16.07	18.4	113.62	15.4	1:7.07	30.06	
Summer 2013	July	31.76	12.1	324.10	14.6	1:10.20	Max. 35.46	Min. 27.44
	Aug.	33.84	12.9	335.75	15.1	1:9.92		
	Sept.	39.32	15.0	390.43	17.6	1:9.93		
	Mean	34.97	40.2	350.09	47.4	1:10.01	31.45	
Autumn 2013	Oct.	20.19	7.7	181.75	8.2	1:9.00	Max. 23.85	Min. 16.83
	Nov.	21.75	8.3	205.60	9.2	1:9.45		
	Dec.	19.43	7.4	142.18	6.4	1:7.32		
	Mean	20.46	23.5	176.51	23.9	1:8.63	20.34	
Total/year		260.93	100	2212.00	100	1:8.48		

The monthly ratio between food consumption and soil translocation indicated that, the highest ratios were 1: 8.34 and 1: 10.20, obtained in May 2012 and July 2013, while the lowest ratios were 1: 5.93 and 1: 5.74 observed during February 2012 and January 2013, respectively.

These findings was similar to those of Said (1979) who stated in Egypt 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.

Furthermore, 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.

1.3. Effect of temperature:

At the 1st year 2012, data in Table (1), clarified that, the highly rates of food consumption and soil translocation (36.51 and 276.45 respectively) were recorded during summer, when the rate of temperature degrees recorded 30.5 C°, followed by spring (26.97 and 199.33), autumn (20.71 and 135.41) and winter (5.93 and 36.89) for F.C. and S.T. when rates of temperature degrees were 29.37, 20.10 and 18.68 C°, respectively.

At the 2nd year 2013, data in Table (1), clarified that, the highly rates of food consumption and soil translocation (34.97 and 350.09, respectively) were recorded during summer, when the rate of temperature degrees recorded 31.45 C°, followed by autumn (20.46 and 176.51), spring (16.07 and 113.62) and winter (15.48 and 97.41) for F.C. and S.T. when rates of temperature degrees were 20.34, 30.06 and 22.96 C° , respectively.

These results are confirmed by those of El-Bassiouny (2001), who found that, highly positive significant correlation between maximum and minimum temperature with food consumption and soil translocation of *Anacanthotermes ochraceus*.

2. Relationship between food consumption and soil translocation of *Anacanthotermes ochraceus*.

The statistical analysis of the obtained data on food consumption and soil translocation of *A. ochraceus*, during 2012 and 2013 (Table 2), indicated that, there are highly positive significant correlation between food consumption and soil translocation ("r" = 0.998 and 0.992 in 2012 and 2013, respectively). Regression coeffecience values indicated that, the increase of food consumption by 1gm led to increase in soil translocation by 7.95 g in 2012 and 12.49 g in 2013. Estimated values for consumption and translocation detected that, 2.29 g consumption caused 1.006 g soil translocation in 2012, while 7.006 g consumption caused 1.06 g soil translocation. The critical efficient values ("r^2") were 0.977 and 0.985 in 2012 and 2013, respectively. 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" = 0.72 and 0.26) and ("b" = 19.23 and 21.50) in 2012 and 2013, respectively, while the minimum temperature calculated ("r" = 0.88 and 0.82) and ("b" = 26.76 and 26.27) in 2012 and 2013, respectively.

Table (2): Simple correlation coefficient "r" simple regression coefficient "b" critical coefficient "r^2" and estimated values corresponding for food consumption F.C. and soil translocation S.T. of *A. ochraceus* influenced with 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	0.98	7.95	0.97	2.29	1.006	0.72	21.23	0.88	26.27
2013	0.99	12.49	0.98	7.06	1.06	0.26	19.50	0.82	26.76

REFERENCES

Abdel-Latif N. A. (2003). Ecological and control studies on certain subterranean termite species. Ph.D. Thesis, Fac. Agric. Cairo University. 260 p

Abdel-Wahab, A. M., M. R. Rizk, M. H. Hussin, T. K. Abd El-Raof and M. S. El-Taib (1983). Surface activity of sand termites *Psammotermes hypostoma* Desneux in Aswan. Assuit J. Agric. Sci., 14(3): 99-108.

Ahmed, H. M. (1997): Ecological studies and control of harvester subterranean termite, *Anacanthotermes ochraceus* (Burm.), at Fayoum Gov. M.Sc.Thesis, Fac. Agric. Cairo University, Fayoum branch, 77pp.

Ali, A. M., M. F. Abou-Ghadir and N. A. Abdel-Hafez (1982). Surface activity of termite in the New Valley. Assiut J. Agric. Sci., 13 (3): 73-78.

Brian, M. V. (1979). Production ecology of ants and termites, Cambridge Univ., Press. London = 409 pp.

Collins, M. S. and W. L. Nutting (1973). High-temperature tolerance in two species of subterranean termites from the sonoran desert in Arizona. Environ., Entomol., 2 (6): 1122-1123.

El-Bassiouny, A. R. (2001). A study on the ecology and biological control of subterranean termites M. Sc. Thesis, Fac. Agric. Al-Azhar University, 145 pp.

El-Sebay, Y. (1991). A modified trap for El-Sebay subterranean termite. Fourth Arab Cong. of Plant Protection, Cairo, 1-5 Dec. 1991, 245-247.

Grawford, C. S. and M. A. Seely (1994). Detritus mass loss in the Namib desert dune field influence of termites gerbils and exposure to surface conditions (*Gerbillus paeba*, *Psammtermes allocerus*), J. African, Zoology (Belgium), 108 (1): 49-54.

Hafiz M. (1980). High lights of termite problem in Egypt sociobiology, 5 (2): 147-154.

Lafage, J. P., W. L. Nutting and M. Z. Haverty (1973). Desert subterranean termites: A method for studying foraging behavior, Environ. Entomol., 2: 954-956.

Nel, J. J. C. (1970). Aspects of the behavior of worker of harvester termite *Hodotermes mossambicus* (Hagen) in the field (Isoptera: Hodotermitidae), J. Entomol., Society of Southern Africa, 33: 23-34.

Nel, J. J. C. and P. H. Hewitt (1969). A study the food eats by a field population of harvester termite *Hodotermes mossambicus* (Hagen) and its relation to population density, Entomol., Society of Southern Africa, 32: 123-131.

Ohiaqu, C. E. and T.G. Wood (1976). A method for measuring rate of grass harvesting by *Trinivitermes giminatus*, Wasmann (Isoptera: Nasutitermitinal) and observation on its foraging behavior in Southern Guinea, Savanna, Nigeria, J. of Applied Ecology, 13: 705-713.

Said, W. A. (1979). Ecological and toxicological studies on Fam. Hodotermitidae, M. Sc. Thesis, Fac. of Agric., Ain-Shams Univ., Egypt.

Salman, A. G. A., M. A. A. Morsy and A. A. Sayed (1987). Foraging activity of the sand termite, *Psammtermes hypostoma* Desn. In the New Valley, Egypt. Assuit J. Agric. Sci., 18 (4): 51-57.

Snedecor, W. and A. Cochran (1990). Statistical Methods. The Iowa State Univ. press, Ames, Iowa, USA.

Wood, T. G. (1978). Food and feeding habits of termites, pp 55-80. In "Production ecology of ants and termites" Brian M. V. (ed.) Cambridge University, Press, London.

دراسات على نشاط السروح للنمل الحاصد " أناكانثوترمس اكريشيس "

أيمن رمضان البسيونى ، محمد عبدالغنى بط ، عبد الغنى محمد بط
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الملخص العــربى

أجريت هذه الدراسه على نوع النمل الأبيض التحت أرضى هو النمل الحاصد " أناكانثوترمس اكريشيس " خلال عامى ٢٠١٢ و ٢٠١٣ وشملت الدراسة نشاط الغزو والعلاقة بين معدلات الأستهلاك الغذائى ونقل التربة وكانت النتائج كالآتى :

سجل أعلى معدلات الإستهلاك الغذائى لهذا النمل الحاصد خلال الصيف ٣٦,٥١ جم/المصيدة عام ٢٠١٢ و ٣٤,٩٧ جم/المصيدة عام ٢٠١٣ وسجل أقل معدلات خلال الشتاء ٥,٩٣ جم/المصيدة عام ٢٠١٢ و ١٥,٤٨ جم/المصيدة عام ٢٠١٣ . بلغ أعلى استهلاك شهرى ٣٨,٣٣ جم/المصيدة خلال أغسطس عام ٢٠١٢ و ٣٩,٣٢ جم/المصيدة خلال سبتمبر عام ٢٠١٣ ، بينما وجد أقل إستهلاك ٢,٩١ جم/المصيدة خلال يناير عام ٢٠١٢ و ١٢,٥٦ جم/المصيدة عام ٢٠١٣ . وقد سجل أعلى معدلات نقل التربة خلال الصيف ٢٧٦,٤٥ جم/المصيدة عام ٢٠١٢ و ٣٥٠,٠٩ جم/المصيدة عام ٢٠١٣ ، بينما سجل أقل معدلات خلال الشتاء ٣٦,٨٩ جم/المصيدة عام ٢٠١٢ و ٩٧,٤١ جم/المصيدة عام ٢٠١٣ . بلغ أعلى معدلات نقل التربة الشهرى ٢٨٩,١٦ جم/المصيدة خلال أغسطس عام ٢٠١٢ و ٣٩٠,٤٣ جم/المصيدة خلال سبتمبر عام ٢٠١٣ ، بينما وجد أقل معدل شهرى ٢٠,٩٠ جم/المصيدة خلال يناير عام ٢٠١٢ و ٧٢,١٣ جم/المصيدة عام ٢٠١٣ . وكانت أعلى نسبة بين معدلات الإستهلاك الشهرى ونقل التربة ١ : ٨,٣٤ خلال مايو ٢٠١٢ و ١ : ١٠,٢٠ خلال يوليو ٢٠١٣ ، بينما كانت النسب الأقل ١ : ٥,٩٣ خلال فبراير ٢٠١٢ و ١ : ٥,٧٤ خلال يناير ٢٠١٣ . وسببت الزيادة الملحوظة فى درجات الحرارة زيادة فى النشاط التحت سطحى وبالتالى زيادة معدلات الإستهلاك الغذائى ونقل التربة .

وجد ارتباط معنوى موجب بين معدلات الإستهلاك الغذائى ونقل التربة للنمل الحاصد " أناكانثوترمس اكريشيس " خلال عامى ٢٠١٢ و ٢٠١٣ ، وأظهرت النتائج أيضا وجود ارتبط معنوى موجب بين هذه المعدلات ودرجات حرارة التربة . وقد أظهر معدل الإنحدار البسيط أن الزيادة فى معدلات الإستهلاك الغذائى بمقدار ١ جم أعطى زيادة فى نقل التربة بمقدار ٧,٩٥ جم عام ٢٠١٢ و ١٢,٤٩ جم عام ٢٠١٣ . وتشير القيم المقدرة لنقل التربة مقابل الإستهلاك أن ٢,٢٩ جم استهلاك يقابله نقل تربة ١,٠٠٦ جم عام ٢٠١٢ وأن ٧,٠٦ جم استهلاك يقابله نقل تربة ١,٠٦ جم عام ٢٠١٣ .