THE IMPACT OF VARIATIONS IN TEMPERATURE AND RELATIVE HUMIDITY OF SOIL ON GEOGRAPHICAL DISTRIBUTION OF SUBTERRANEAN TERMITES AT SOME EGYPTIAN GOVERNORATES

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Abstract

Data showed that, the subterranean termite *Psammotermes hypostoma* (Desn.), recorded in most variable temperatures degrees ranged from 21.9-32.1C° of Egyptian Governorates, while the subterranean termite, *Anacanthotermes ochraceus* (Borm.), was found in most areas with temperature degrees ranged from 21.9-31.3C°. But the subterranean termite *Amitermes desertorum* (Desn.), was the least spread, and found only in high temperature degrees 28.2 and 31.3. According to obtained data the *P. hypostoma*, was more existent at most temperature degrees, followed by *A. ochraceus*, which distributed in lower temperatures of soil, but the subterranean termite *A. desertorum,* was very limited and confined with high soil temperature degrees. On the other hand obtained data clarified that, the subterranean termite *P. hypostoma* found in most variable relative humidity degrees of soil ranged from 27.5-80.5Rh, while the subterranean termite, *A. ochraceus* was found in some areas with variable Rh degrees of soil ranged from 49.5-66.9. Also the subterranean termite *A. desertorum* was found with Rh degrees of soil ranged from 41-49.5. According to obtained data the *P. hypostoma*, was more existent at most Rh degrees, followed by *A. ochraceus*, but the subterranean termite *A. desertorum,* was very limited and confined with low range of Rh degrees of soil. As a general trend there is relationship between termite distribution and the tested factors and the subterranean termite can be life in long rang of temperatures and relative humidity.

INTRODUCTION

Three species of subterranean termites defined and distributed in most of Egyptian desert. Termites are social insects life in tunnels and can be able to adapt in a wide range of environments (temperatures and relative humidity). Also subterranean termites can be able to life in the most of soil types (sand silt, sandy clay, sandy loam and loamy clay), and are found in the arid and semi-arid region (El-Bassiouny *et. al*. 2009). In Egypt, subterranean termites *P. hypostoma*

(Rhinotermitidae), *A. ochraceus* (Hodotermitidae) and *A. desertorum* (Termitidae) are distributed in most of Lower, Middle and Upper Egypt. Subterranean termites cause a dangerous damage for buildings and crops all over the world. El-Bassiouny (2001), mentioned that, the termite activities were affected by soil conditions in which subterranean termite live. Effects of environmental factors on the subterranean termite were studied by many authors e.g., Said (1979); Abou-Ghadir & Khalifa (1982); Khalifa (1982); Morsy *et. al*. (1982); Abdel-Wahab *et. al.* (1983); Rizk *et. al.* (1985) and Salman *et. al* . (1987).

Present work was conducted to study the effect of soil temperatures and relative humidity degrees on subterranean termite distribution at some Egyptian Governorates.

MATERIALS AND METHODS

Chosen test areas:

The tested areas were chosen in some governorates of lower, middle and upper Egypt which has subterranean termite and a variable weather condition (temperature and relative humidity). In Cairo, one area; El-Nozha district, Heliopolis, Qalubia, one area; Abu Zaabal, Alexandria, one area; Justice habitations, Smouha district, Al-Behera, one area; Nubaria, Ismailia, two areas; Agric., Res., Station at Ezz El-Deen district and El-Kassasen city, Sharqia, one area; Sangha village, Kafr Sakr, South Sinai, one area; Wadi-Feran, Sant catereen, North Sinai, one area; El-Shaikh Zouied city, Fayoum, two areas; Al-Masatly village, Kom-Oshim, Tamia and Al-Saidia village, Sennoures, Bani-Suef, one area; Sedmant El-Gabal monastery, Ehnasia almadina, Al-Minya, one area; Absuan manor, Samallout, Assuit, one area; Experiment Station, Assuit University, Sohag, one area; El-Kawla Village, Akhmeem district, Asswan, one area; Abu El-Rish kibli, M. Matrouh, one area; Abu Bakr El-Seddeek district, Siwa oasis and New valley, one area; mut village.

Data obtained source:

Data of temperatures and relative humidity were obtained from Central Lab., of Agricultural Climate, Agric., Res., Center, Dokki, Giza., Egypt. Data were calculated as mean of 10 months throughout 10 years from year 2000-2010.

Termite collections:

Termites were collected from areas known to the injury of published research by two methods; first; El-Sebay modified traps (El-Sebay 1991) were used in survey and collecting of subterranean termite individuals in open infested areas at the tested Governorates. (Fig. 1), showed used trap for catch of termites. The traps were soaked

in water and buried in the ground at 15 cm depth. 25 traps were distributed throughout infested area and aligned in 5 rows × 5 columns under the ground level with 2m intervals between the traps (Fig. 2). Traps were collected after two weeks for each tested area and sent to the termite laboratory at Plant Protection Research Institute, Dokki, Giza for separating of individuals; El-Sebay (1993); El-Bassiouny (2001); Abdel-Latif N. A. (2003) and Ahmed (2003), in Egypt, used the same traps method in termite collection. Second; in infested buildings, termites were collected from infested wood pieces by small brush in plastic box contained moistened carton pieces and sent to the termite laboratory for work completion. Samples were labeled and classified to its species in Wood boring Division and checked in Taxonomy Department, Plant Protection Research Institute, Dokki, Giza, Egypt

Fig. (1): El-Sebay modified trap

1	6	11	16	21
2	7	12	17	22
3	8	13	18	23
4	9	14	19	24
5	10	15	20	25

Fig. (2): Traps distribution in infested area.

RESULTS AND DISCUSSION

Effect of soil temperature on termite distribution:

Table (1), clarified that, the subterranean termite *P. hypostoma* was the most distributed species; it was recorded in 13 areas of 13 Governorates of variable temperature degrees ranged between 21.9-32.1C°. The subterranean termite *A. ochraceus* was in the second rank, whereas it found in 6 areas in 6 governorates at variable temperatures degrees ranged between 21.9-31.3C°. While the species *A. desertorum*, was rare in the tested areas and found only in two governorates at temperature degrees ranged between 28.2 and 31.3**.**

Generally, the subterranean termite *P. hypostoma*, prefer wide range of soil temperatures, followed by subterranean termite *A. ochraceus*, while the termite *A. desertorum*, was found rarely, commonly in areas at low range of soil temperatures, so, we can say that, the three species of Egyptian subterranean termite is openly related to the soil weather.

Morsy *et. al*. (1982), resulted that temperature is one of the determining factors in survival and food consumption. The living period of the tested workers of *P. hypostoma*, was very low when they were maintained under the low or high constant temperature. The most favorable temperature for surviving was around 30ºC, whereas it was around 25ºC for food consumption.

Abdel-Wahab *et. al*. (1983), in Egypt, reported that, the relation between termite activity and temperature and relative humidity revealed that 60% of the *Psammotermes hypostoma* (Desn.) activity were attributed to the meteorological variables, the minimum relative humidity seems to be the most effective variable followed by the maximum temperature.

Salman *et. al*. (1987), in Egypt, stated that, the climatic variation (minimum and maximum air temperature) at 5 cm above the soil surface accounted for 73% of the termite activity of *P. hypostoma*, with minimum air temperature having the greatest effect.

Shahid and Akhtar (1992), found that, the largest population of *Odontotermes feae* was abundant in May (30^{o}C and 64% RH).

El-Bassiouny *et. al.* (2009), mentioned that, the subterranean termite *P. hypostoma,* was distributed in all types of soil (sandy silt, sandy clay and rarely in loamy clay soil types), followed by the *A. ochraceus* which occupied most of the governorates in lower Egypt and distributed specially in sandy loam soil and rarely in sandy clay and loamy sand soil types, while the termite *A. desertorum* was only find in Asswan and New Valley Gov., and frequent in locations where all types of vegetation present mainly palm plantations, shrubs and ornamental trees which are cultivated in soils rich of organic matter with high moisture content.

Table 1. the mean of soil temperatures and recorded termites at some Egyptian governorates throughout years 2000 to 2010 compared with termite distribution

Gov	The mean of soil temperatures / months throughout years 2000 to 2010												Mean	Termite species
	Jan.	Fib.	Mar.	Apr.	May	Jun	Jul	Aug.	Sept.	Oct.	Nov.	Dec.		
1- Cairo	17.7	17.0	19.1	23.2	27.4	30.4	33.5	34.0	33.2	27.3	26.1	19.7	25.7	*P. hypostoma*
2-Qalubia	16.5	16.5	17.1	20.3	23.7	27.4	30.9	32.2	32.2	25.6	27.1	19.3	24.1	*P. hypostoma*
3- Alexandria	15.0	14.5	15.9	21.6	27.0	31.1	33.8	33.5	31.5	27.5	21.9	15.4	24.1	*P. hypostoma*
4- Al-Behera	20.9	17.8	18.3	19.1	28.6	25.5	30.8	31.1	29.7	21.9	18.6	17.8	23.4	*A. ochraceus*
5- Ismailia	14.1	14.2	15.2	20.9	25.2	28.2	28.5	28.9	28.2	24.7	19.9	14.5	21.9	*P. hypostoma* *A. ochraceus*
6- Sharqia	17.6	16.5	17.6	23.0	27.7	29.8	32.0	32.5	31.4	24.7	25.9	21.1	25	*A. ochraceus*
7- South Sinai	14.4	14.6	16.1	22.0	26.5	29.6	30.6	31.0	29.7	25.9	21.0	15.0	23.1	*P. hypostoma*
8- North Sinai	14.6	15.0	17.0	23.2	27.9	31.1	32.8	33.0	31.2	27.1	22.2	15.5	24.3	*P. hypostoma*
9- Fayoum:	18.9	17.5	21.2	26.2	31.2	33.4	36.0	35.7	34.1	29.1	25.1	20.2	27.4	*P. hypostoma* *A. ochraceus*
10- Bani-Suef	16.9	17.3	19.2	24.0	26.7	28.9	32.1	33.7	31.5	28.2	24.0	18.8	25.2	*P. hypostoma*
11- Al-Minya	13.3	14.1	16.8	21.7	23.6	28.6	33.1	34.2	31.2	28.4	24.6	19.3	24.1	*P. hypostoma*
12- Assuit	23.6	24.3	27.7	33.1	38.0	39.5	40.9	40.7	39.4	35.7	24.9	24.1	32.7	*P. hypostoma*
13- Sohag	20.6	22.3	24.7	30.4	36.3	35.9	38.1	37.9	39.4	32.7	24.8	21.9	30.4	*P. hypostoma*
14- Asswan:	17.7	20.3	21.7	27.6	34.5	32.3	35.2	35.1	39.4	29.6	24.7	19.7	28.2	*P. hypostoma* *A. desertorum*
15- M. Matrouh	18.0	16.1	17.1	20.4	27.8	28.3	32.3	32.3	30.6	24.7	20.2	16.6	23.7	*A. ochraceus*
16- New valley	20.6	21.1	24.8	32.8	37.2	38.8	39.7	39.6	37.2	33.7	27.8	22.1	31.3	*P. hypostoma* *A. ochraceus* *A. desertorum*

Effect of soil relative humidity on termite distribution:

Data in Table (2), showed that, the subterranean termite *P. hypostoma* was the most distributed species; it was recorded in 13 areas of 13 Governorates of variable relative humidity ranged between 27.5-80.5 RH., while the species of subterranean termite *A. ochraceus* was follow and it found 6 areas in 6 governorates at variable relative humidity degrees ranged between 49.5-66.9 RH., but the species of *A. desertorum*, was rare and found in 2 areas in 2 governorates at relative humidity degrees ranged between 41.0 and 49.5 RH.

In general, subterranean termite *P. hypostoma*, prefer the wide range of relative humidity, followed by subterranean termite *A. ochraceus*, while the termite *A. desertorum* was found at low range of relative humidity, so, we can see, the Egyptian subterranean termite is openly related to the soil weather.

Data in tables (1&2), showed that, there is a relationship between temperatures and relative humidity with termite distribution in different areas at some Egyptian governorates.

Abou-Ghadir and Khalifa (1982), in Egypt, studied the foraging activity of desert subterranean termite, *Psammotermes hypostoma* (Desn.) in relation to the recycling of the superficial wood available in the desert ecosystem, as well as the soil environmental factors, the results indicated that the termite infestation is confined to rich in moisture content at deep layers near the soil surface, beside to the availability of the superficial wood and surface weed vegetation.

Khalifa (1982), in Egypt, determined the moisture of soil layers is the limiting factor for *Psammotermes hypostoma* (Desn.), food consumption and survival under constant and variable temperature and the results revealed that the living period of the tested workers was very low when they were under the low or high constant temperature.

Rizk *et. al*. (1985), in Egypt, showed that, soil moisture had affected the flight of *Psammotermes hypostoma* (Desn.).

Table 2. the mean of relative humidity of soil and recorded termites at some Egyptian governorates throughout years 2000 to 2010 compared with termite distribution

Gov.	The mean of relative humidity / months throughout years 2000 to 2010												Total	Termite species
	Jan.	Fib.	Mar.	Apr.	May	Jun	Jul	Aug.	Sept.	Oct.	Nov.	Dec.		
1- Cairo	57.4	57.9	60.9	55.5	36.1	50.3	56.8	57.4	56.8	58.8	58.1	59.8	55.8	*P. hypostoma*
2-Qalubia	62.5	57.0	53.0	53.5	54.0	50.5	59.5	62.0	51.0	52.0	54.0	63.0	56.0	*P. hypostoma*
3- Alexandria	81.5	77.5	76.0	77.0	78.0	81.5	82.0	76.5	79.0	79.0	81.0	82.0	79.5	*P. hypostoma*
4- Al-Behera	67.0	64.0	61.0	61.5	59.0	62.0	66.0	67.5	65.0	63.0	65.0	68.0	64.0	*A. ochraceus*
5- Ismailia	59.0	56.0	54.5	53.5	52.5	54.5	55.5	56.0	56.0	55.5	58.5	66.5	56.5	*P. hypostoma* *A. ochraceus*
6- Sharqia	62.5	66.5	59.5	57.0	54.5	59.5	65.5	67.0	62.5	62.0	62.0	65.0	62.0	*A. ochraceus*
7- South Sinai	68.2	66.5	68.0	64.2	40.2	68.5	69.6	70.8	70.2	71.3	69.8	69.8	66.4	*P. hypostoma*
8- North Sinai	79.0	79.5	76.5	78.0	81.5	83.5	83.5	80.0	82.5	80.0	78.5	81.5	80.5	*P. hypostoma*
9- Fayoum:	56.5	54.5	55.0	50.5	48.5	50.5	52.0	52.5	52.0	54.0	54.0	59.0	53.5	*P. hypostoma* *A. ochraceus*
10- Bani-Suef	54.0	50.5	48.5	49.0	49.5	45.0	49.0	49.5	45.0	49.0	53.5	56.0	50.0	*P. hypostoma*
11- Al-Minya	36.5	32.5	26.5	22.0	18.5	22.0	24.5	24.0	21.0	27.5	34.5	39.0	27.5	*P. hypostoma*
12- Assuit	53.5	50.5	47.5	43.0	38.0	41.5	45.0	47.0	44.5	43.0	47.5	48.5	45.5	*P. hypostoma*
13- Sohag	50.9	47.3	43.3	36.2	28.0	38.5	40.8	42.1	43.4	47.8	50.8	49.5	43.3	*P. hypostoma*
14- Asswan:	45.5	39.2	34.0	28.0	26.7	29.0	34.5	36.2	37.5	45.0	45.5	43.5	41.0	*P. hypostoma* *A. desertorum*
15- M. Matrouh	68.5	69.3	67.8	65.8	41.0	68.8	70.8	72.0	69.3	63.8	74.8	72.3	66.9	*A. ochraceus*
16- New valley	60.0	53.5	46.0	41.5	39.5	43.0	41.0	43.5	48.0	54.5	65.5	60.2	49.5	*P. hypostoma* *A. ochraceus* *A. desertorum*

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تأثير إختلافات درجات الحرارة والرطوبة النسبية للتربة على التوزيع الجغرافى للنمل الأبيض تحت أرضى فى بعض محافظات مصر

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أثبتت النتائج المتحصل عليها أن نوع النمل الأبيض تحت أرضى " ساموترمس هيبوستوما " هو الأكثر إنتشارا وتوزيعا فى معظم مناطق درجات الحرارة المختلفة حيث وجد فى 13 منطقة / 13 محافظة والتى تراوحت درجات الحرارة ما بين 32.1C° – 21.9 ودرجات الرطوبة نسبية التى تراوحت ما بين 80.5 RH – 27.5 . بينما كان النوع " أناكانثوترمس أوكريشيس " هو الأقل إنتشارا حيث وجد فى 6 مناطق / 6 محافظات وقد تراوحت درجات الحرارة فيها ما بين 31.3C° - 21.9 ودرجات رطوبة نسبية ما بين 66.9 RH – 49.5 . أما نوع النمل الأبيض " أميترمس ديزرتوروم " كان هو الأقل وجودا وإنتشارا حيث وجد فقط فى 2 مناطق / 2 محافظات بدرجات حرارة تراوحت ما بين – 28.2 31.3C° ودرجات رطوبة نسبية 49.5 RH – 41.0 . ومن خلال النتائج وجد النمل الأبيض تحت أرضى " ساموترمس هيبوستوما " وهو أكثر الأنواع إنتشارا فى مناطق مختلفة ومدى أوسع لدرجات الحرارة والرطوبة النسبية ، ثم كان نوع النمل " أناكانثوترمس أوكريشيس " فى المرتبة الثانية ، أما النوع " أميترمس ديزرتوروم " قد كان الأقل انتشارا وتوزيعا حيث وجد فى مدى ضيق من درجات الحرارة والرطوبة النسبية ، وعموما فإنه من خلال النتائج وجد أن التوزيع الجغرافى لأنواع النمل الأبيض تحت أرضى له علاقة بإختلافات درجات الحرارة والرطوبة النسبية للتربة .