CASTE COMPOSITION OF TWO SUBTERRANEAN TERMITE SPECIES, *Anacanthotermes ochraceus* (Burmeister) (ISOPTERA: HODOTERMITIDAE) AND *Psammotermes hybostoma* (Desneux) (ISOPTERA : RHINOTERMITIDAE)

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ABSTRACT:

The caste composition of the two subterranean termite species, *Anacanthotermes ochraceus* (Burmeister) (Isoptera: Hodotermitidae) and *Psammotermes hybostoma* (Desneux) (Isoptera: Rhinotermitidae) was studied throughout two successive years at El-Fayoum Governorate in a clay soil for the former species and at Ismailia Governorate in a sandy soil for the latter species. For *A.ochraceus*, the mean percentages of cast composition were 1.80, 97.60, 0.20, 0.40 and 0.00% for larvae, workers, soldiers, nymphs and alates, respectively. The corresponding respective percentages for *P.hybostoma* were 1.28, 93.20, 4.81,0.54 and 0.17%. For both considered termite species, workers prevailed all the year round and formed the vast majority of the caste composition. Larvae occurred in very few numbers throughout spring, autumn and winter but entirely disappeared during summer. Soldiers were of limited occurrence all the year round in the case of *P.hybostoma* and only during autumn and winter in that of *A. ochraceus*. For both species also, nymphs occurred in relatively few numbers during winter only. No alates of *A. ochraceus* were seen and very few alates of *P.hybostoma* occurred in autumn and winter.

Key words: Caste composition, *Anacanthotermes ochraceus, Psammotermes Hybostoma*

INTRODUCTION:

Termites are a group of social insects that belong to the order Isoptera. They are important pests in many countries particularly in the arid tropics and subtropics **(Emerson, 1955 and Harris, 1961 & 1967)**. Termites are differentiated into various morphological forms or castes that live in highly organized societies or colonies **(Rizk and Salman, 1984; Ahmed, 1997; and El-Bassyoni, 2001). Snyder (1949), Coaton (1958), Kassab *et al*.(1960) and Hafez (1980)** reported that there are – at least - 11 species of termites in Egypt eight of which are "ground-nesting" or "subterranean" and three are "dry-wood" or "non-subterranean". Among the predominant subterranean termites in Egypt are *Anacanthotermes ochraceus* (Burmeister) (Isoptera: Hodotermitidae) and *Psammotermes hybostoma* (Desneux) (Isoptera : Rhinotermitidae) which cause considerable damages to any cellulose containing materials **(El-Sherif, 1969; Kaschef and El-Sherif, 1971; Said, 1979; Ali, 1980; Khalil *et al*., 1982; Rizk *et al*., 1982; Ahmed, 1997).**

In previous papers, the current authors **(El-Sherif *et al*., 2009a and 2009b)** investigated the foraging activity of *A. ochraceus* at El-Fayoum Governorate and *P.hybostoma* at Ismailia Governorate, Egypt, and observed that the vast majority of the foragers of those two termite species were workers. Such observation brought to light the significance of a further study of caste

composition in termite colonies with special emphasis on both *A.ochraceus* and *P.hybostoma*. As a matter of fact, several authors contributed to caste composition in certain other termite species **(Noirot, 1959; Nutting, 1970; Nutting *et al.* 1973, King and Spink, 1974, Mednikova, 1977; Fontana *et al.*, 1982 and Huang and Chen,1984).** In Egypt, preliminary observations on caste composition in termite colonies were given by **Ahmed (1997)** for *A.ochraceus* at El-Fayoum Governorate, **Rizk and Salman (1984)** for *P.hybostoma* at New Valley Governorate and **El-Bassyoni (2001)** for *P.hybostoma* at Ismailia Governorate. In an effort to add to the knowledge on termites in Egypt, the present investigation aimed at a detailed study of the caste composition of *A.ochraceus* in a clay soil at El-Fayoum Governorate and *P.hybostoma* in a sandy soil at Ismailia Governorate.

MATERIALS AND METHODS:

The study of termites' caste composition was carried out at two ecologically different locations; one at El-Saidia village, Senoures district, El-Fayoum Governorate for *A.ochraceus* and the other at "Ismailia Regional Agricultural Research Station", Agricultural Research Center, Ministry Of Agriculture, Ismailia Governorate for *P.hybostoma*. This study covered a period of two complete years extending from the 1st of January, 1997 to the 31st of December, 1998 for El-Fayoum location and from the 1st of April, 1997 to the 31st of March. 1999 for Ismailia location. Soil class was clay at El-Fayoum location and sand at Ismailia location. A summary of the mechanical analyses of soil in both chosen locations is shown in **Table (1).**

Table1: Mechanical analysis of the soil at the two study locations.

Location	Texture class	Mechanical analysis		
		Sand%	Silt%	Clay%
El-Fayoum	Clay	17.2	34.5	**48.3**
Ismailia	Sand	**97.0**	1.8	1.2

Experimental design, termite trapping technique and data handling were quite similar for both locations with the exception that the number of experimental plots was 100 at El-Fayoum and 222 at Ismailia. At El-Fayoum, an area of 400 square meters (20 meters long x 20 meters wide) was carefully cleaned up – as far as possible – of any existing weeds or cellulose materials, then divided into 100 square-shaped plots (10 rows x 10 columns) each measuring 4 square meters (2meters long x 2 meters wide). At Ismailia location, an area of 888 square meters (74 meters long x 12 meters wide) was carefully cleaned up – as far as possible – of any existing weeds or cellulose materials then divided into 222 square-shaped plots (37rows x 6 columns) each measuring 4 square meters (2 meters long x 2 meters wide). For both locations, a termite trap **(El-Sebay, 1991)** was buried in a horizontal position to a depth of 30 cm. into a hole at the center point of every square-shaped experimental plot at the beginning of the experiment then covered with soil to ground level. Trap locations were marked with small red plastic flags (2 meters apart from each other from all directions).

Every trap consisted of a perforated Polyvinyl Chloride cylinder (15cm. in diameter and 20 cm. in height) totally filled up with a clean roll of corrugated cardboard paper and covered from both open ends with polyethylene sheets of suitable size fitted to the outside wall of the cylinder with rubber bands. **Su *et al.* (1991) and Ahmed (1997)** reported that corrugated cardboard is quite suitable for

the nutritive requirements of termites as it provides them with cellulose, enough moisture and a site similar to the natural tunnels where the different castes live.

As a monthly routine, buried traps were carefully taken off the soil with the aid of a shovel and replaced with new ones. Removed traps were treated as follows: a) every trap was introduced into a separate plastic bag and transferred to the laboratory for thorough examination. There, the cardboard roll (or its remnants) was/were carefully taken off the P.V.C. cylinder. b) cardboard rolls showing symptoms of termite visits were gently and patiently unrolled, the termite individuals existing in them were separated with the aid of a fine camel-hair brush, classified into different castes [larvae, nymphs, soldiers, workers and alates (according to the descriptions given by **Harris, 1961 and El-Sherif and Kaschef, 1973)**] then counted.

To generalize findings and, in the meantime, avoid expected monthly discrepancies due to unavoidable experimental errors, data on caste composition were compared on a "two-years total" seasonal basis. Every study year was divided into four seasons as winter (January-March), spring (April-June), summer (July-September) and autumn (October-December), and the total number of captured individuals representing each termite caste was worked out for every season. As a further step, the corresponding seasonal totals for the two study years were summed together to give the 'seasonal grand totals" for the different castes. Such handling of the collected data resulted in summarizing results as shown in Table (2) for *A.ochraceus* and Table (4) for *P.hybostoma.* Seasonal grand totals for every caste were then transformed to percentages as shown in Tables (3) and (5), respectively.

RESULTS:

1-The different castes:

The termite colony consists of six different castes namely: larvae, workers, soldiers, nymphs, primary reproductives (alates or winged adults) and supplementary reproductives (neuterics). Larvae hatch from eggs and differentiate into one of three forms; workers, soldiers or nymphs. Nymphs, in turn, differentiate into either primary reproductives or supplementary reproductives (neuterics). Primary reproductives or alates are winged adults. Detailed morphological descriptions of the different castes of termites are given in the works of **Harris (1961) and El-Sherif and Kaschef (1973).** The different castes of *A.ochraceus a*nd *P.hybostoma* are illustrated in **Fig. (1) and Fig. (2)**, respectively.

2-Caste composition:

2.1-*Anacanthotermes ochraceus*:

The seasonal caste composition of *A.ochraceus* is shown in **Table (2)** and the seasonal percentages of cast composition of the same species are presented in **Table (3). Table (2)** shows that larvae occurred in few numbers during autumn, winter and spring seasons and entirely disappeared throughout summer season. The highest number of larvae was captured in winter season and the lowest number in spring. The maximum numbers of workers took place in both autumn and winter seasons and their minimum number occurred in spring season while no workers could be traced throughout summer season. Soldiers disappeared during spring and summer seasons and very few of them could be trapped throughout autumn and winter seasons. Nymphs occurred during autumn season only and

disappeared throughout the rest of the year. No alates visited the traps all the year round.

Table (2): Seasonal caste composition of *A.ochraceus* throughout two successive Years (1997-1998).

SEASON	YEAR	Number of castes in 100 P.V.C traps					TOTAL
		Larvae	Workers	Soldiers	Nymphs	Alates	
WINTER	1st	46	959	2	0	0	1007
	2nd	55	2750	6	0	0	2811
	Total	**101**	**3709**	**8**	**0**	**0**	**3818**
SPRING	1st	5	305	0	0	0	310
	2nd	7	284	0	0	0	291
	Total	**12**	**589**	**0**	**0**	**0**	**601**
SUMMER	1st	0	0	0	0	0	0
	2nd	0	0	0	0	0	0
	Total	**0**	**0**	**0**	**0**	**0**	**0**
AUTUMN	1st	27	1677	5	12	0	1721
	2nd	18	2576	4	26	0	2624
	Total	**45**	**4253**	**9**	**38**	**0**	**4345**
GRAND TOTAL		**158**	**8551**	**17**	**38**	**0**	**8764**

Table (3) refers that the frequency of occurrence of larvae was generally low but relatively greater in winter and spring (2.65 and 2.00%, respectively) than in autumn (1.04%). The frequency of occurrence of workers was quite high and almost similar during winter, spring and autumn seasons (97-98% of the total termite population). The rate of occurrence of soldiers was too low and almost similar in both autumn and winter (0.20- 0.21%). Nymphs occurred during winter only and formed a very small portion of the termite's population (0.43%).No alates occurred all the year round.

Table (3): Seasonal percentages of caste composition of *A. ochraceus* throughout two successive years (1997-1998). .

SEASON	% castes					TOTAL
	Larvae	Workers	Soldiers	Nymphs	Alates	
Winter	2.65	97.15	0.20	0.00	0.00	100.00
Spring	2.00	98.00	0.00	0.00	0.00	100.00
SUMMER	0.00	0.00	0.00	0.00	0.00	000.00
AUTUMN	1.04	97.88	0.21	0.87	0.00	100.00
TOTAL	**1.80**	**97.60**	**0.20**	**0.43**	**0.00**	100.00

2.2- *Psammotermes hybostoma*:

Table (4) shows the seasonal caste composition of *P.hybostoma* and **Table (5)** shows the seasonal percentages of cast composition of the same species. As seen in **Table (4)**, larvae occurred in few numbers in spring then disappeared throughout summer season to reappear in relatively larger numbers in autumn and winter seasons. In general, the highest numbers of larvae were trapped in winter and the lowest numbers in spring season. Workers' foraging was minimal throughout summer season, moderate in spring but considerably high in autumn and maximal in winter season. Soldiers occurred all the year round with minimum numbers in summer, maximum numbers in winter, relatively low numbers in

spring and relatively high numbers in autumn season. Nymphs occurred during winter season only and disappeared throughout the rest of the year. Alates disappeared during both spring and summer seasons then appeared in very few numbers in autumn and comparatively larger numbers in winter season.

Table (5) shows that the seasonal frequencies of occurrence of larvae were generally too small but comparatively higher in autumn and winter (1.08-1,69% 0) than in spring (0.12%). For all seasons, the frequency of occurrence of workers was evidently high and almost similar (about 93-98% of the total termite population). The maximum occurrence of soldiers took place in autumn (6.2%) and their minimum occurrence was in summer (1.79%) while their occurrence in winter and spring was intermediate (4.10- 4.65%). As in nymphs occurred during winter only and formed a very small portion of the termite's population (0.54%).The occurrence of alates was quite limited in both autumn (0.06%) and winter (0.27%).

DISCUSSION:

A glance to **Tables (3) and (5)** emphasizes that, on the average, workers prevailed all the year round and formed the vast majority of the caste composition of both considered termite species; *A. ochraceus* and *P.hybostoma* (about 98% and 93%, respectively).For both species, larvae occurred in very few numbers throughout spring, autumn and winter seasons and entirely disappeared during summer. Soldiers were of limited occurrence all the year round in the case of *P.hybostoma* and only during autumn and winter in that of *A. ochraceus*. For both species also, nymphs were captured in the termite traps in relatively few numbers during the autumn season in the case of *A. ochraceus* and in winter season in that of *P.hybostoma*. As for alates, absolutely none of them visited the traps in the case of *A. ochraceus* while in that of *P.hybostoma* very few of them visited the traps in autumn and winter seasons (0.06 and 0.27% of the total count of the different castes, respectively.

The above conclusions coincide with the findings of several authors in relation to different termite species. In that respect, **Nutting (1970)** stated that the caste composition of *Heterotermes aureus* includes 4% soldiers and 96% non-soldiers. **Nutting *et al*. (1973)** reported that the foraging individuals of *Gnathamitermes preplexus* are mainly workers with only 0.4% soldiers. **Fontana *et al*. (1982)** reported that in *Reticultitermes luecifugus* workers averaged 85.76 % of the combined population, larvae 8.8%, soldiers 1.3% and supplementary reproductives 0.23%. However, current results seem to contradict with those given by **Ahmed (1997)** who stated that, in Egypt, the caste composition of *A. ochraceus* at El-Fayoum Governorate consisted of 66.5-77.1% workers, 21.7-32.4% nymphs, 0.2- 0.7% soldiers and 0.4-0.9% alates. Meanwhile, results more or less agree with those of **El-Bassyoni (2001)** who found that at Ismailia Governorate, Egypt, the cast composition of *P.hybostoma* consisted of 92.4-93.2%, 2.20- 0.68%, 4.80-4.07% and 1.78- 0.47% workers, larvae, soldiers and alates, respectively.

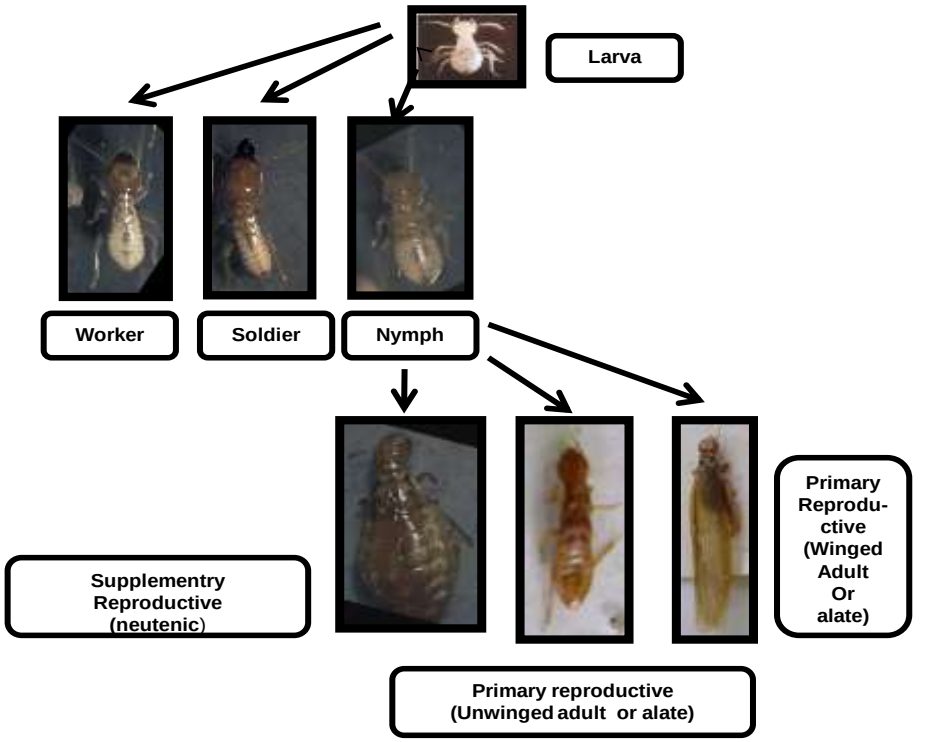

Fig.(1): The different castes of *Anacanthotermes ochraceus*

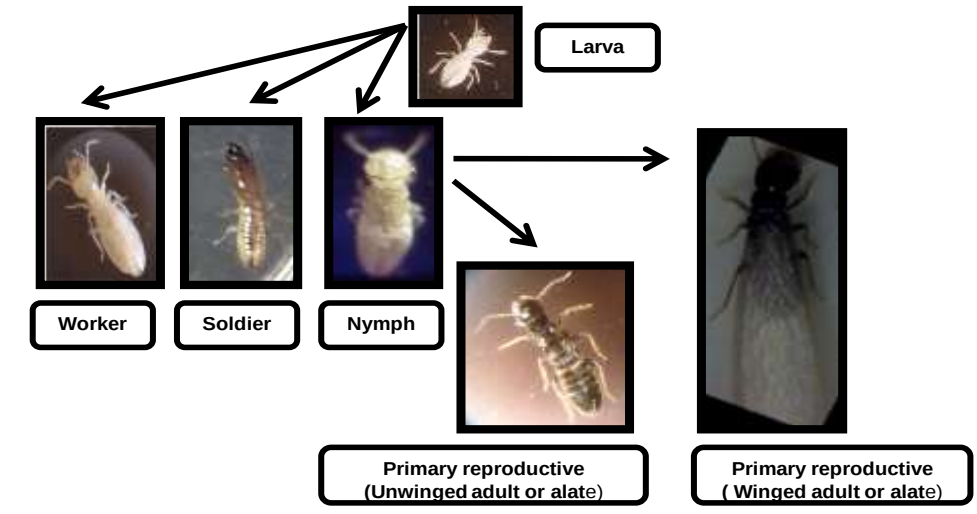

Fig. (2): The different castes of *Psammotermes hybostoma*

Table (4): Seasonal caste composition of *P. hybostoma* throughout two successive Years (1997-1999).

SEASON	YEAR	Number of castes in 222 P.V.C traps					TOTAL
		Larvae	Workers	Soldiers	Nymphs	Alates	
SPRING	1st	24	8432	158	0	0	8614
	2nd	0	10641	658	0	0	11299
	Total	**24**	**19073**	**816**	**0**	**0**	**19913**
SUMMER	1st	0	7731	121	0	0	7852
	2nd	0	990	38	0	0	1028
	Total	**0**	**8721**	**159**	**0**	**0**	**8880**
AUTUMN	1st	167	24151	1491	0	0	25809
	2nd	283	14445	1090	0	25	15843
	Total	**453**	**38596**	**2581**	**0**	**25**	**41652**
WINTER	1st	467	50060	2300	0	129	52956
	2nd	1249	43700	2415	919	146	48429
	Total	**1713**	**93760**	**4715**	**919**	**275**	**101385**
GRAND TOTAL		***2190***	***160150***	***8271***	***919***	***300***	***171830***

Table (5): Seasonal percentages of caste composition of *P.hybostoma* throughout two successive years (1997-1999).

SEASON	% castes					TOTAL
	Larvae	Workers	Soldiers	Nymphs	Alates	
SPRING	0.12	95.78	4.10	0.00	0.00	100.00
SUMMER	0.00	98.21	1.79	0.00	0.00	100.00
AUTUMN	1.08	92.66	6.20	0.00	0.06	000.00
WINTER	1.69	92.48	4.65	0.91	0.27	100.00
TOTAL	**1.28**	**93.20**	**4.81**	**0.54**	**0.17**	100.00

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التركيب الطبقى لنوعى النمل الأبيض
Anacanthotermes ochraceus (Burmeister)
(ISOPTERA: HODOTERMITIDAE)
و
Psammotermes hybostoma (Desneux)
(ISOPTERA : RHINOTERMITIDAE)

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درس التركيب الطبقى لنوعين من النمل الأبيض هما : *Anacanthotermes ochraceus* (Burmeister) خلال عامين كاملين متتاليين فى تربة طينية بمحافظة الفيوم بالنسبة *Psammotermes hybostoma* (Desneux) و كانت متوسطات *A. ochraceus* للنوع الأول، وفى تربة رملية بمحافظة الإسماعلية بالنسبة للنوع الثانى. فى حالة النوع النسب المئوية لليرقات والشغالات والجنود والحوريات والافراد المجنحة ١.٨٠ و ٩٧.٦٠ و٠.٢٠ و ٠.٤٠ و٠.٠٠%، ١.٢٨و ٩٣.٢٠ و٤.٨١ و٠.٥٤ و *P.hybostoma* على الترتيب، بينما كانت النسب المئوية المناظرة فى حالة النوع ٠.١٧%، على الترتيب. وفى كلا نوعى النمل الأبيض محل الدراسة وجدت الشغالات على مدار العام ومثلت الغالبية العظمى للأفراد المتواجدة. وتواجدت اليرقات بأعداد قليلة جدا خلال الربيع و الخريف والشتاء فى حين إنعدم وجودها تماما.

وخلال فصلى *P.hybostoma* خلال فصل الصيف. أما الجنود فقد كان وجودها محدودا على مدار العام فى حالة النوع. وتواجدت حوريات كلا النوعين بأعداد قليلة نسبيا خلال فصل الخريف فى حالة النوع *A. ochraceus* وفى فصل الشتاء فى حالة النوع فى حالة النوع *P.hybostoma* ولم يسجل وجود أى افراد مجنحة للنوع *A. ochraceus* بينما سُجل ظهور أعداد بسيطة من الافراد المجنحة للنوع *P. hybostoma* خلال فصلى الخريف والشتاء.