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# ECOLOGICAL STUDIES OF ANTS (HYMENOPTERA, FORMICIDAE) IN BASRA PROVINCE, IRAQ

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## Abstract

The ecological study of ant species was conducted during 2008-2009 for seven district of Basrah province: Qurna, Al-zubair, Center of city, Abo Al khaseeb, Marshes, Shatt al-Arab and Al-fao. Through this study, it was found that there are thirteen of ant species, which originated for two subfamilies were Myrmicinae and Formicinae, in addition to that, five of ant species were newly in Iraq. Sub family Myrmicinae includes the following: *Triglyphothrix lanuginosa* *Mayr. *Messor rufotestaceus** *Forster Monomorium* schultzei Forel. *Tetramorium caldarium** *Roger Tetramorium deprssiceps* Menozzi. *Gremat*ogaster luctans* Forel. While sub family *Anopiolepis anopiolepis**Menozzi. *Plagioepis pygmaea* *Latreill *Plagioepis tumidula* Emery. *Camponotus xerxes* Forel *Polyrhchis simplex* Mayr *Paratrechina jaegerskjoeldi* Mayer *Acantholepis dolabellae* Forel. The results of the study showed that the highest population density of ant workers was in February, reaching 93.06 workers, but less density during November was 66.64 workers. Also the present study was explained that *P. pygmaea* was the most present by 94.9 of workers, as well as, Alzubair area possessed high density of workers by 107 workers. Furthermore, by studying the shape of ant species rooms, it was found that the room opening numbers were the highest in June reaching 8.46 room openings, while the lowest average was during November reaching 4.00 room openings. When compared to the number of openings in the studied areas, it was found that the Shatt Al-Arab was the most areas where the number of ant's species room openings increased reaching 4.56 openings. As for the diameter of room's openings, the maximum in July was 0.59 cm, while the lowest diameter in October was 0.35 cm as a minimum. When comparing the diameter of room opening in the study areas, it is found that the highest average of openings diameter was 0.55 cm in Al Fao . The study showed that the openings depths of an ant's species room reached the maximum in July of 26.04 cm, while the lowest average of openings depth was in November, reaching 15.98 cm, and when compared to the openings depths in the study areas the highest average depths were found in Abo Al cohesive area, reaching 23.23 cm.

***Keywords*:** Ants, Hymenoptera, Formicidae, Basra

## Introduction

The ants belong to the Formicidae family within Hymenoptera. Characterized by a social life in the form of colonies, where one of its important features is the existence of castes within the system of one colony, which consists of three layers are queens, workers and males (Jargis *et al.*, 2000). The ancestors of the ants back to ancient times since the Cretaceous period that given the sequential evolution of the genetic system and the biological field, and the ants appear to be within the Haplodiploidy genetic system (Tail, 200). Most ants usually build their houses below the surface of the soil and rocks in the form of different rooms containing straight and zigzag tunnels, depending on the distribution of food places and appropriate conditions. As well as, some species found in the stems of dead and rotting plants and sometimes in living plants (Abu al-Hob, 1972; Hess and Tschinkel, 1999). Ants have adapted in different environments on land, as the vegetation and animal cover as well as the diversity of terrain, including forests, grassland, deserts, cultivated land and residential areas of numerical superiority and their reproduction has led to their deployment in tropical areas and up to the border of the Arctic (Lin, 1977; Georges *et al.*, 2000). Furthermore, due to the biocoenosis and its variety made ants enter into a community with complex nutritional relationships, as a result, the species exceeded 12,000 species, and with a biomass reaching more than 20% of living organisms (Anon, 2006). Moreover, the characteristics of soil, including the texture and balance between heat gained and heat lost from the soil surface and interfere with the moisture and the availability of organic materials, as well as water content, drainage and soil texture have a significant role in the diversity and increase the preparation of insects. (Awwad, 1986). Many researchers are interested in ants because they have beneficial and harmful activities, where some ant species build their rooms around fruit trees (Crocker *et al.*, 1995). Additionally, it plays an important role in cleaning the environment from insects and dead organisms (Robinson, 1996). As for the ants' harmful activity, it was found that the ants destroy insect and animal groups preserved in museums and scientific institutions, as well as they feed on the seeds and roots of plants (Abu al-Hob, 1972). Finally, the study aimed to carry out an ecological study of ant species for seven areas of Basrah province in Iraq

## Materials and Methods

**Sampling sites:** The study was conducted in seven permanent sites in Basra province: Alzubair (Al-Marbad Al-Jadeed), Abo Al khaseeb (Bab Al-Midan), Qurna (Al-Ameeq river), Shatt alarab (Al-Jibasi), Center of city (Old Basra), Marshes (Al-Khor) and Alfao (Haouz Al-Ashar). Three sites were identified in each area with an area of one dunum in each replicate. The sites were chosen divergent to cover the largest possible area of the province, which characterized by a varied environmental variability.

**Methods of collecting and preserving samples:** Multiple samples were collected from ant's insect workers during the field survey by digging the soil with a shovel and small digging tools, and then the workers was pulled by the Aspirator. Random samples were taken from the beginning of November to the end of October (2008-2009) and over twelve months. The samples were collected monthly and into two periods by three replicates at each site, and were stored in glass bottles of 3 x 8 cm diameter and height respectively.

Then, ethanol alcohol has been added by 75%, and the bottle nozzle was well covered by a rubber cap to prevent evaporation of alcohol. Finally, the following information was recorded: sample number, collection location, region of insect collection and date of collection, then samples were kept in the laboratory until conducting the diagnosis. Taxonomic keys were used (Collingwood, 1996 and Krupp, Buttiker, 1985 and Wheeler, 1986), and the samples were diagnosed at the University of Basra - College of Science by Prof. Kazam. S. Hassan, then used a digital camera to take a picture of the colony shape from the outside.

**Population density of worker insect ants:** The study was conducted for a period of twelve months from the beginning of November until October after determining the sites; samples were taken by a metal mold with dimensions of (10 × 10 × 10) cm, respectively. This mold was closed from the top and its end is sharp so that it is easy to enter in soil after carefully digging the room up to a depth of 60 cm. Moreover, the pits filled with water until the ants float to the top, so as to push the mold easily in the soil, then lift carefully, and the soil is then placed in polyethylene bags, and transferred to the laboratory to separate the ants from the soil. Finally, an anatomy microscope was used to calculate the number of worker ants was (Al-Shazili and Ibrahim, 2000).

**The calculation of the colony depth:** The depths of the insect room's colonies were calculated in all the study sites from the soil surface until the end of the room by digging the soil carefully, and follow up the external tunnels of the room and its trends vertically or horizontally. The diameter of the external opening was calculated and measured by a measure tape, as well as, the number of external openings of the tunnels per room by three replicates for each site.

**Soil characteristics of study sites:** Soil samples were taken for each site of the study sites mentioned above at different depths (10, 30 and 60) cm per sample with the amount of (3) kg soil. Each sample was placed in a poly-ethylene plastic bag with a card stating the name of the area, site and date, then the soil has been separated on white papers in a place with good ventilation and sunny to dry, and then it soften and returned to the bags again. Afterward, the chemical analyses were then conducted, including; Calculate pH and Electrical Conductivity degree EC, after preparing the samples as mentioned above, a weight of (1) kg was taking of soft soil and (1000) ml of distilled water put on it in a glass jar, then put them in the blender for half an hour. Subsequently, the water filtered in a glass paper for one day, and then the pH has been estimated using pH-meter after calibrate it with puffer solution, and the degree of the electrical conductivity was also calculated using electrical conductivity device in ds / m (Jacob and Tajuddin, 1988). Secondly, Determination the organic matter; The basis of the estimation method of organic carbon was to determine the reduction extent of dichromate $Cr_2O_7$ ions by treated with organic matter, and then estimating the amount of non-reductive dichromate by titration, i.e. oxidation of organic matter by dichromate and adding some materials to accelerate the oxidation such as sulfuric acid. The amount of remaining dichromate is then estimated by titration with ferrous sulfate solution using the Diphenylamine to determine the end point by weighing 50 g of air dry soil and placing it in a conical flask. 1 $cm^3$ of (1) N potassium dichromate $K_2Cr_2O_7$ was added, then added to it 20 $cm^3$ of concentrated sulfuric acid containing silver sulfate $Ag_2SO_4$ slowly on the walls of the flask by a graduated cylinder, and then the mixture was shacked for one minute, and the flask left for half an hour. Furthermore, for the purpose of dilution, 200 $cm^3$ of distilled water has been added (it observed that the temperature of the flask was increase so left until be cool), and 10 $cm^3$ of concentrated $H_3PO_4$ acid was added by a graduated cylinder. Afterwards, 1 $cm^3$ of the Piphenyl amine was added to change the mixture color to blue, and then it was titrated with the 19 N ferrous sulfate until the color changed from blue to green (Jacob and Tajuddin, 1988). Finally, determination of soil texture; The hydrometer method was used by weighted a 50 g of dry soil and placed in the beaker, and it was added 200 $cm^3$ of distilled water to it, then the suspension was mixed, and added 15 $cm^3$ of hydrogen peroxide by a concentration of 30%. The mixture then heated on a 70°C heat source for 2 hours with continuous mixing to complete the organic matter oxidation, and the mixture was left to the second day, the soil was transferred to a vial of centrifuge with 250 $cm^3$ of distilled water, then mixed for 5 minutes. The soil was separated from the suspension by centrifugation. 250 $cm^3$ distilled water was added to the soil and mixed for 5 minutes. Then the suspension was separated and the process was repeated three times to get rid of the dissolved salts. Then the soil was transferred to the beaker by a small amount of water, and then 10 $cm^3$ of the calgon was added at a concentration of 5%. Then the mixture was mixed by Stirrer for 6 minutes for sandy soil, 15 minutes for loamy soil and 20 minutes for clay soil. (Jacob and Tajuddin, 1988) as shown in Table 1.

**Table 1 :** Soil Characteristics of the studied sites

| Sites<br>Species | Qurna | Alzubair | Center of city | Abo Al khaseeb | Marshes | Shatt alarab | Alfao |
|---|---|---|---|---|---|---|---|
| **Texture** | **Clay** | **Sand** | **Clay** | **Clay loam** | **Clay** | **Clay loam** | **Sandy loam** |
| PH | 7.09 | 8.15 | 8.05 | 7.90 | 8.15 | 7.67 | 7.84 |
| ds\m EC | 10.21 | 4.93 | 8.46 | 10.73 | 11.40 | 7.33 | 11.56 |
| Organic matter | 0.53 | 0.21 | 0.26 | 2.01 | 0.67 | 0.40 | 0.18 |

**Statistical Analysis**

The Completely Randomized Design (C.R.D) was used for the factorial experiment and the comparison between the averages using the least significant difference R.L.S.D under a probability level of 0.05 for all study trials and simple correlation coefficient (Al-Rawi and Khalaf Allah, 1980).

## Results and Discussion

The study results which included the ant species found in Basrah province showed that there are thirteen species of ants, which originated for two sub families were Myrmicinae and Formicinae: Triglyphothrix lanuginos *Mayr, Messor rufotestaceus* Forster Monomorium schultzei Forel. Tetramorium caldarium *Roger, Tetramorium deprssiceps Menozzi. Grematogaster luctans Forel. While sub family

*Anopiolepis anopiolepis* *Menozzi. *Plagioepis pygmaea* *Latreill *Plagioepis tumidula* Emery. *Camponotus xerxes* Forel *Polyrhchis simplex* Mayr, *Paratrechina jaegerskjoeldi* Mayr, *Acantholepis dolabellae* Forel

**Population density of workers for ant species during the year months**

The results of the statistical analysis in Table 2 showed that there was a significant difference between species, where the (*P. pygmaea*) recorded the highest density of 94.9 workers followed by *G. luctans* of (93.3) workers. While the *P. simplex* and *M. schultzei* were close in their averages of (91.6 and 90.3) workers respectively, while the lowest density of the workers was in *P. jaegerskjoeldi* which it reached 48.2 workers, either in terms of the presence during February reached 93.06 workers. However, the lowest density of workers was during November of 66.64 workers, and through the interaction, it was found that the *G. luctans* recorded the highest density of workers in February 120.2 workers, while *P. jaegerskjoeldi* recorded the lowest in May by 21.33 workers. It was observed that the differences in population density of ant workers might be due to queen fertility and workers activity (Chapman, 1987; Abu al-Hob, 1986), as well as determining the caste system through the primer pheromones, which have a significant effect on increasing the workers activity (Daily *et al.*, 1998). While in terms of the temperature effect and the associated changes in relative humidity, it was observed that the high density of the workers during the winter months, especially in February, which the average temperature and relative humidity were 15.7 °C and 59%, respectively. This may be due to the gathering of workers in the room, as well as their limited work in the maintenance of the room and associated work in the construction of corridors and tunnels with maintaining food stocks inside the room (Mustafa, 2008). Moreover, it was observed that the population density of workers in most species has decreased during May, and then increased during the summer, this may be due to the length of light period, which has an interaction effect with temperature and relative humidity (Maalif and Hilal, 1991).

**Number of ant's species room openings diagnosed during the year**

The results of statistical analysis in Table 3 showed that there were significant difference between the species workers. It was found that T. lanuginose had the highest average in the number of the room opening reached 7.68 room openings, and the lowest average in opening number was in *P. jaegerskjoeldi* reached 2.36 room openings. During the months, it was found that the highest average in openings number was during June by 8.46 room opening, while the lowest average was during November of 4.00 room openings. Through the interaction, it was observed that the highest average number of openings in *T. lanuginose* during July by 15.80 room openings. While the lowest average was in the *P. jaegrskjoeldi* during October reached 1.1 room openings. The increases in number room opening that workers exit from, during summer may be due to the prevention of crowding of workers during their work and moving to other places, as well as increasing the cooling of the colony through the movement of air. (Mustafa, 2008) pointed out that the architectural system in the ant rooms is varied by many meandering, and the increasing the number of openings according to climatic conditions. (Sabeeh 2007) also indicated that *C. xerxes* had the highest number room openings, which workers exit from it during April, and June compared to the year months.

**Table 2 :** Average population density of workers for ant species diagnosed during the year months

| Months / Species | Nov. | Dec. | Jan. | Feb. | Mar | April | May | June | July | Aug. | Sep. | Oct. | Av. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***M. rufotestaceus*** | 48 | 78.24 | 68 | 54.19 | 75 | 60.1 | 74.38 | 54 | 66.1 | 54.1 | 77 | 65 | 64.5 |
| ***P. jaegerskjoeldi*** | 36 | 67.8 | 34.2 | 49.71 | 30 | 60.47 | 21.33 | 53.12 | 60.12 | 74 | 57.76 | 34 | 48.2 |
| ***C. xerxes*** | 60.44 | 77.2 | 75.1 | 46.11 | 87.1 | 86.71 | 65.14 | 77.1 | 85.11 | 88 | 81.14 | 72.16 | 75.10 |
| ***M.schultzei*** | 70 | 96.3 | 87.38 | 113 | 86.8 | 89.2 | 96.42 | 88 | 92.85 | 87 | 90.71 | 86 | 90.3 |
| ***P. pygmaea*** | 99.82 | 102 | 84.33 | 99.5 | 99.81 | 98.85 | 97.23 | 82.5 | 98.66 | 89.4 | 86.71 | 100 | 94.9 |
| ***T.caldarium*** | 84.11 | 95.2 | 81 | 87.2 | 87.2 | 98.66 | 69.14 | 88.12 | 80 | 77 | 89 | 99 | 86.3 |
| ***T. depressiceps*** | 70 | 95 | 84 | 94 | 72 | 85 | 73 | 86 | 73 | 77 | 68 | 86 | 80.2 |
| ***G. luctaus*** | 74 | 91.28 | 75 | 120.2 | 97.71 | 97.95 | 94.04 | 99 | 88.6 | 98.9 | 83.76 | 99.2 | 93.3 |
| ***P. simplex*** | 72.4 | 78.2 | 72 | 112.5 | 99.19 | 97.76 | 94.38 | 100 | 95.76 | 97.74 | 80.14 | 99.2 | 91.6 |
| ***P. tumidula*** | 68.99 | 85.28 | 69.4 | 115.2 | 95.95 | 97.24 | 76.9 | 88.88 | 95 | 100 | 82 | 80 | 87.9 |
| ***A. anoplolepis*** | 64.86 | 82 | 66.04 | 100 | 96.04 | 91.71 | 91.71 | 116 | 100 | 95.1 | 72 | 79.4 | 87.9 |
| ***A. dolabellae*** | 60.86 | 79.28 | 61.7 | 119.2 | 96.33 | 91.95 | 95.71 | 99 | 93.28 | 94.5 | 60 | 80.19 | 86 |
| ***T. lanuginose*** | 56.86 | 76.28 | 57.71 | 99 | 93.86 | 92.19 | 85.9 | 99.2 | 90.9 | 93.43 | 64.14 | 60.2 | 80.8 |
| Average | 66.64 | 84.92 | 70.45 | 93.06 | 85.92 | 88.29 | 79.63 | 86.99 | 86.10 | 86.62 | 76.33 | 80.02 | |

*The least significant difference (R.LSD) at the level of 0.05 for species = 3.16, for months = 3.04, for interaction = 10.96.

**Diameter of room openings for diagnosed ants**

The results of statistical analysis in Table 4 showed that there were significant difference between the workers in ant species. The *A. dolabellae* had the highest average of room openings diameter where it reached 0.51 cm, while the *P. jaegerskjoeldi* had the lowest average of 0.26 cm. When comparison between the year, months, it is found that the highest average in July was 0.59 cm, while the lowest average of room openings diameter was recorded in October of 0.35 cm. Through the interaction, it was observed that *T. depressiceps* recorded the highest average of room openings diameter in July of 0.86 cm, while *P. jaegerskjoeldi* recorded

the lowest average in November was 0.19 cm. The differences in diameters of the room openings that workers exit from, may be due to the different size of the workers and their ability to collect food, especially in July, when the temperature was 36.6 °C and 24% humidity, respectively. (Allen 2006) pointed out that room opening of the *Monomorium spp*. were very small, because of its workers size was small and their needs less than other species. While (Robinson 1996) observed that the *Camponotus compressus* its workers had a large size and active at night and day, so opening size of the rooms is large to facilitate the food collection.

**Table 3 :** The averages number of room openings for ant species diagnosed during the year months

| Months / Species | Nov. | Dec. | Jan. | Feb. | Mar | April | May | June | July | Aug. | Sep. | Oct. | Av. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***M. rufotestaceus*** | 2.4 | 4.5 | 4.2 | 3.4 | 4.3 | 3.2 | 5 | 7.2 | 4.5 | 3.8 | 3 | 4 | 4.12 |
| ***P. jaegerskjoeldi*** | 2.1 | 1.2 | 2 | 2 | 1.11 | 2.6 | 3 | 4 | 3.1 | 4.12 | 2.1 | 1.1 | 2.36 |
| ***C. xerxes*** | 3.1 | 4.1 | 4 | 4.1 | 6 | 2 | 5.3 | 7.7 | 5 | 3.9 | 2 | 4.2 | 4.28 |
| ***M.schultzei*** | 3.3 | 5.5 | 5 | 5 | 3 | 3.2 | 2.2 | 8.2 | 4.6 | 4 | 4.3 | 5.5 | 4.48 |
| ***P. pygmaea*** | 4.1 | 5.6 | 4.3 | 3.2 | 4 | 2.1 | 5 | 7.2 | 3.4 | 4.1 | 4.2 | 6.4 | 4.46 |
| ***T.caldarium*** | 4.3 | 2.1 | 6.2 | 3 | 7.1 | 5 | 3.1 | 7 | 4.6 | 7.1 | 4.1 | 7.3 | 5.07 |
| ***T. depressiceps*** | 5.1 | 4.2 | 5.2 | 3.8 | 12 | 7.4 | 4.1 | 11.7 | 5.5 | 6.6 | 2.1 | 7.2 | 6.24 |
| ***G. luctaus*** | 5.3 | 6.5 | 5.9 | 4.4 | 9.2 | 6.9 | 3.4 | 10.4 | 6.4 | 6.6 | 6 | 6.2 | 6.43 |
| ***P. simplex*** | 4.5 | 7.2 | 6.9 | 5.4 | 13 | 6.7 | 4.3 | 9.8 | 7.3 | 5.2 | 5.4 | 6.2 | 6.82 |
| ***P. tumidula*** | 3.9 | 6.9 | 7.2 | 6.2 | 7.9 | 6.8 | 5.1 | 9.2 | 9.4 | 9.4 | 6.2 | 4.3 | 6.87 |
| ***A. anoplolepis*** | 3.6 | 6.5 | 8.4 | 7.4 | 5 | 6.8 | 5.7 | 12.3 | 11.6 | 6.9 | 8.5 | 4.2 | 7.24 |
| ***A. dolabellae*** | 4.5 | 6.4 | 9.3 | 7.9 | 6.7 | 7.7 | 2.9 | 8.5 | 8.4 | 4.8 | 10 | 9.2 | 7.19 |
| ***T. lanuginose*** | 5.9 | 6.9 | 6.8 | 9.8 | 8.8 | 10.8 | 3.9 | 6.9 | 15.8 | 1.9 | 8.9 | 5.8 | 7.68 |
| Average | 4.00 | 5.2 | 5.8 | 5.04 | 6.77 | 5.47 | 4.07 | 8.46 | 6.89 | 5.26 | 5.13 | 5.50 | |

*The least significant difference (R.LSD) at the level of 0.05 for species = 0.42, for months = 0.40, for interaction = 1.46.

**The room's depth of workers for ant species during the year months**

The results of statistical analysis in Table 5 showed that there were significant difference between species. The P. simplex recorded the highest average depth of the room from the soil surface of 25.06 cm, and followed by *A. anoplolepis, P. tumidula* and *G. luctans* where it reached 24.7, 24.48 and 24.45 cm, respectively. While the lowest average depth of the room was in *P. jaegerskjoeldi* of 10.32 cm. When comparison between the year months, it was observed that the highest average in July of 26.04 cm. While the lowest average depth of the room was in November reached 15.98 cm. Through the interaction between the ant species and year months, it was found that *P. tumidula* had the highest average during June reached 36.66 cm, and through the interaction also, *P. jaegrskjoeldi* was found to have the lowest average of 7.61 cm in May. (Tschinel2005) pointed out that the room size of ants in the soil and its surface area depends mainly on the preparation and size of the workers, as some species have large and small size of workers. (Sabeeh 2007) also indicated that *M. rufitarsis* recorded the highest average depth of its room in February of 27.54 cm. (Drees and Vinson 1990) also reported that the rooms and tunnels of some ant species reached to a depth of 91.44 cm.

**Table 4 :** Opening diameter of ant species diagnosed during the year months

| Months / Species | Nov. | Dec. | Jan. | Feb. | Mar | April | May | June | July | Aug. | Sep. | Oct. | Av. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***M. rufotestaceus*** | 0.32 | 0.25 | 0.22 | 0.53 | 0.28 | 0.25 | 0.49 | 0.32 | 0.31 | 0.43 | 0.3 | 0.27 | 0.32 |
| ***P. jaegerskjoeldi*** | 0.19 | 0.24 | 0.22 | 0.37 | 0.19 | 0.24 | 0.37 | 0.24 | 0.22 | 0.37 | 0.23 | 0.26 | 0.26 |
| ***C. xerxes*** | 0.31 | 0.45 | 0.35 | 0.46 | 0.62 | 0.68 | 0.48 | 0.66 | 0.35 | 0.56 | 0.35 | 0.35 | 0.46 |
| ***M.schultzei*** | 0.4 | 0.38 | 0.45 | 0.4 | 0.42 | 0.38 | 0.45 | 0.4 | 0.44 | 0.34 | 0.42 | 0.4 | 0.40 |
| ***P. pygmaea*** | 0.39 | 0.4 | 0.38 | 0.48 | 0.29 | 0.43 | 0.63 | 0.43 | 0.53 | 0.58 | 0.34 | 0.4 | 0.44 |
| ***T.caldarium*** | 0.39 | 0.4 | 0.46 | 0.59 | 0.5 | 0.52 | 0.48 | 0.46 | 0.79 | 0.42 | 0.44 | 0.38 | 0.48 |
| ***T. depressiceps*** | 0.5 | 0.28 | 0.42 | 0.44 | 0.49 | 0.48 | 0.47 | 0.28 | 0.86 | 0.54 | 0.44 | 0.24 | 0.45 |
| ***G. luctaus*** | 0.53 | 0.57 | 0.3 | 0.31 | 0.45 | 0.44 | 0.46 | 0.46 | 0.53 | 0.46 | 0.48 | 0.42 | 0.45 |
| ***P. simplex*** | 0.39 | 0.21 | 0.42 | 0.51 | 0.55 | 0.35 | 0.68 | 0.54 | 0.80 | 0.65 | 0.52 | 0.43 | 0.50 |
| ***P. tumidula*** | 0.5 | 0.2 | 0.31 | 0.51 | 0.55 | 0.53 | 0.43 | 0.62 | 0.84 | 0.49 | 0.67 | 0.24 | 0.49 |
| ***A. anoplolepis*** | 0.6 | 0.68 | 0.41 | 0.3 | 0.3 | 0.4 | 0.3 | 0.68 | 0.83 | 0.30 | 0.33 | 0.31 | 0.45 |
| ***A. dolabellae*** | 0.48 | 0.54 | 0.38 | 0.52 | 0.49 | 0.45 | 0.51 | 0.66 | 0.85 | 0.48 | 0.31 | 0.49 | 0.51 |
| ***T. lanuginose*** | 0.24 | 0.42 | 0.4 | 0.62 | 0.54 | 0.45 | 0.63 | 0.42 | 0.42 | 0.43 | 0.43 | 0.44 | 0.45 |
| Average | 0.40 | 0.38 | 0.36 | 0.46 | 0.43 | 0.43 | 0.49 | 0.47 | 0.59 | 0.45 | 0.40 | 0.35 | |

*The least significant difference (R.LSD) at the level of 0.05 for species = 0.04, for months = 0.03, for interaction = 0.13.

**Population density of workers for ant species diagnosed in the study sites**

The results of statistical analysis in Table 6 showed that there were significant differences between the study sites. The highest average of workers density was recorded in Alzubair with 95.17 workers, while the lowest average was in Shatt alarab with 70.46 workers, and through the interaction between the species of diagnosed ants and study sites, it was found that *P. pygmaea* had the highest average in Alzubair with 107 workers. However, *T. depressiceps* recorded the lowest average in Abo Al khaseeb with 38.7 workers, and the *M. rufotestaceus* did not appear in Shatt alarab and Alfao. Similarly, *P. jaegerskjoeldi* did not appear in Qurna, Center of city and Shatt alarab. And also *C. xerxes* did not appear in Qurna. Species that did not appear in any study sites, due to the competition that may have a significant role in this, and thus the competition factor is in favor of the most species having the carrying capacity, as well as the effect of reproduction rate (Abdul and Younis, 1981). While (Al-Haj 1999) pointed out that, the nature of soil components has a significant effect on the biological and behavioral activity of ants. The nature of the response to the medium varies between the ant species, so some species have a heavy presence in Alzubair, while other species have a greater presence in Abo Al khaseeb, where organic matter is available in a larger amount. While the acidic medium of the soil and soil salinity had no significant effect through the treatments of correlation coefficients which reached (0.417 and 0.197), respectively.

**Table 5 :** Average rooms depth of diagnosed ant's species during the year months

| Months / Species | Nov. | Dec. | Jan. | Feb. | Mar | April | May | June | July | Aug. | Sep. | Oct. | Av. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***M. rufotestaceus*** | 13.32 | 14.18 | 15.32 | 9.2 | 14.18 | 12.2 | 12.18 | 13.37 | 12.7 | 9.5 | 9.56 | 9.2 | 12.07 |
| ***P. jaegerskjoeldi*** | 9.44 | 9.47 | 13.56 | 10.33 | 9.56 | 9.22 | 7.61 | 12.18 | 14.18 | 9.12 | 9.71 | 9.5 | 10.32 |
| ***C. xerxes*** | 12.3 | 15.28 | 19.61 | 14.56 | 15.33 | 13.99 | 17.37 | 17.66 | 18.04 | 9.2 | 13.85 | 16.77 | 15.33 |
| ***M.schultzei*** | 17.61 | 18.9 | 17.5 | 19.38 | 18.8 | 18.8 | 21.9 | 22.47 | 22.42 | 23.97 | 12.22 | 18.3 | 19.35 |
| ***P. pygmaea*** | 18.61 | 19.9 | 27.76 | 21.09 | 19.8 | 21.09 | 17.5 | 24.85 | 17.5 | 23.5 | 21.09 | 25.33 | 21.5 |
| ***T.caldarium*** | 19.61 | 20.9 | 24.61 | 20.99 | 20.8 | 20.47 | 25.26 | 27.47 | 26.42 | 19.6 | 19.5 | 22.3 | 22.32 |
| ***T. depressiceps*** | 18.2 | 21.9 | 19.66 | 20.1 | 21.81 | 19.66 | 27.9 | 29.99 | 28.42 | 18.2 | 18.2 | 32.61 | 23.05 |
| ***G. luctaus*** | 18.81 | 16.23 | 19.61 | 19.2 | 22.8 | 21.85 | 29.9 | 31.71 | 30.42 | 33.8 | 20 | 29.1 | 24.45 |
| ***P. simplex*** | 20.3 | 23.9 | 20.66 | 26.09 | 23.8 | 26.09 | 33.6 | 17.20 | 32.42 | 30.1 | 26.09 | 20.56 | 25.06 |
| ***P. tumidula*** | 18.5 | 24.9 | 19.04 | 17.6 | 24.8 | 25.28 | 30.2 | 36.66 | 34.42 | 19.2 | 18.2 | 25.03 | 24.48 |
| ***A. anoplolepis*** | 15.52 | 20.9 | 18.28 | 24.56 | 20.8 | 23.85 | 35.9 | 32.69 | 33.6 | 14.5 | 24.56 | 31.33 | 24.7 |
| ***A. dolabellae*** | 14.05 | 16.9 | 17.52 | 26.23 | 16.8 | 26.22 | 31.32 | 31.5 | 32.8 | 29.61 | 23.1 | 19.2 | 23.77 |
| ***T. lanuginose*** | 11.57 | 12.9 | 16.75 | 23.1 | 12.8 | 30.04 | 32.76 | 30.66 | 35.2 | 27.55 | 19.04 | 26.09 | 23.2 |
| Average | 15.98 | 18.17 | 19.22 | 19.41 | 18.62 | 20.67 | 24.87 | 25.26 | 26.04 | 20.60 | 18.08 | 21.94 | |

*The least significant difference (R.LSD) at the level of 0.05 for species = 0.72, for months = 0.69, for interaction = 2.50.

**Number of ant's species room openings diagnosed in the study sites**

The results of statistical analysis in Table 7 showed that there were significant difference between the study sites. Where the highest average was recorded in Al-zubair with 6.93 openings, while the lowest average was in Shatt al-arab, where it reached 4.56 openings, through the interaction between the diagnosed ant species with the study sites. Furthermore, it was observed that T. lanuginose appeared in all study sites, especially in Shatt al-arab with an average of 8.8 openings, while the lowest average for interaction in *M. schultzei* also in the Shatt al-arab with 2.63 openings

**Table 6 :** Average population density of workers for ant species diagnosed in the study sites

| Sites / Species | Qurna | Alzubair | Center of city | Abo Al-khaseeb | Marshes | Shatt alarab | Alfao | Average |
|---|---|---|---|---|---|---|---|---|
| ***M. rufotestaceus*** | 89.9 | 98.8 | 93 | 98.3 | 75.6 | 0 | 0 | 64.50 |
| ***P. jaegerskjoeldi*** | 0 | 87.6 | 0 | 89.9 | 72.6 | 0 | 87.2 | 48.20 |
| ***C. xerxes*** | 0 | 92 | 89.0 | 97.2 | 78.2 | 81.5 | 88 | 75.10 |
| ***M.schultzei*** | 83.9 | 95.1 | 91 | 101.4 | 81.8 | 88.5 | 90.3 | 90.30 |
| ***P. pygmaea*** | 103 | 107 | 97.7 | 104.4 | 81.7 | 85.3 | 85.4 | 94.90 |
| ***T.caldarium*** | 102 | 105.3 | 95 | 99.5 | 57 | 60.2 | 85.6 | 86.30 |
| ***T. depressiceps*** | 101 | 103.8 | 64.9 | 38.7 | 85.1 | 83.7 | 84.2 | 80.2 |
| ***G. luctaus*** | 89.9 | 94.2 | 89.7 | 101.3 | 88.3 | 91.1 | 98.5 | 93.30 |
| ***P. simplex*** | 89.2 | 93.1 | 82 | 98.2 | 86.9 | 92 | 99.6 | 91.60 |
| ***P. tumidula*** | 88.5 | 91.7 | 79.7 | 90.8 | 82.6 | 89.4 | 92.5 | 87.90 |
| ***A. anoplolepis*** | 87.7 | 90.3 | 77.7 | 94.3 | 82.8 | 87.1 | 95.1 | 87.90 |
| ***A. dolabellae*** | 88.4 | 89.6 | 78 | 92.8 | 81.9 | 84.1 | 87.6 | 86 |
| ***T. lanuginose*** | 90.4 | 88.8 | 73.3 | 88.7 | 78.2 | 73.1 | 73.2 | 80.80 |
| **Average** | 77.9 | 95.17 | 71.6 | 91.96 | 79.43 | 70.46 | 82.09 | |

*The least significant difference (R.LSD) at the level of 0.05 for sites = 4.42, for species = 6.02, for interaction = 15.94.

It was observed that the increase in density leads to an increase in the number of room openings, where there was a significant correlation coefficient between population density and the number of openings reached 0.63**. This was due to the variation in the soil separations ratio of clay, silt and sand in soils near from the room opening, as indicated by (Wangberg *et al.*, 1980). Through studying the *Solenopsis invicta* and soil taken from 19 sites in East Texas, which included nine soils with different texture, and when compared between the soil texture of the piles existing around the room openings with the neighbouring soils, it was found that 36% of the soil piles were of different texture from another.

**Table 7 :** The averages number of room openings for ant species diagnosed in the Study sites

| Sites<br>Species | Qurna | Alzubair | Center of city | Abo Al-khaseeb | Marshes | Shatt alarab | Alfao | Average |
|---|---|---|---|---|---|---|---|---|
| ***M. rufotestaceus*** | 5.57 | 6.08 | 4.99 | 6.13 | 6.1 | 0 | 0 | 4.12 |
| ***P. jaegerskjoeldi*** | 0 | 5.65 | 0 | 4.56 | 2.96 | 0 | 3.37 | 2.36 |
| ***C. xerxes*** | 0 | 5.27 | 6.12 | 5.7 | 5.7 | 4.1 | 3.12 | 4.28 |
| ***M.schultzei*** | 4.93 | 6.09 | 5.33 | 5.33 | 4.4 | 2.63 | 2.7 | 4.48 |
| ***P. pygmaea*** | 4.59 | 5.68 | 5.12 | 5.4 | 4.6 | 2.8 | 3.03 | 4.46 |
| ***T.caldarium*** | 5.51 | 6 | 4.86 | 5.36 | 5.5 | 4 | 4.28 | 5.07 |
| ***T. depressiceps*** | 6.81 | 7.54 | 6.08 | 6.9 | 6.26 | 4.9 | 5.25 | 6.24 |
| ***G. luctaus*** | 5.94 | 7.63 | 8.02 | 6.73 | 5.9 | 5.2 | 5.65 | 6.43 |
| ***P. simplex*** | 7.19 | 7.91 | 6.82 | 6.73 | 6.93 | 6.06 | 6.16 | 6.82 |
| ***P. tumidula*** | 7.23 | 7.84 | 6.82 | 6.83 | 6.73 | 6.2 | 6.5 | 6.87 |
| ***A. anoplolepis*** | 8.1 | 8.34 | 6.56 | 7.06 | 7.66 | 6.43 | 6.53 | 7.24 |
| ***A. dolabellae*** | 6.85 | 7.81 | 7.28 | 7.06 | 6.6 | 8.16 | 6.58 | 7.19 |
| ***T. lanuginose*** | 7.29 | 8.22 | 7.31 | 7.43 | 7.2 | 8.8 | 7.52 | 7.68 |
| **Average** | 5.38 | 6.93 | 5.79 | 6.25 | 5.89 | 4.56 | 4.67 | |

*The least significant difference (R.LSD) at the level of 0.05 for sites = 0.30, for species = 0.42, for interaction = 1.11.

**Diameter of room openings for diagnosing ants in the study sites**

The results of statistical analysis in Table 8 showed that there were significant difference between the study sites. It was observed that the highest average diameter of the room openings for ant species in Alfao that reached 0.55 cm, while the lowest average was recorded in Qurna, which was 0.29 cm. Through the interaction between the diagnosed ant species with the study sites, it was found that *C. xerxes* recorded the highest average in the Alfao of 0.83 cm, while T. lanuginose in Qurna was recorded the lowest average of 0.26 cm. Through the relation between the population density of the ant workers with the diameter of the room openings, the correlation coefficient was highly significant which reached 0.816**. From this it can conclude that whenever the workers density increase, the diameters of the openings increase with the different types of study soil. (Al-Ani 1980) pointed out that social insects build their rooms in areas with a high proportion of clay so that workers can build rooms and tunnels.

**Table 8 :** Average diameters of room openings for diagnosing ants in the study sites

| Sites<br>Species | Qurna | Alzubair | Center of city | Abo Al khaseeb | Marshes | Shatt alarab | Alfao | Average |
|---|---|---|---|---|---|---|---|---|
| ***M. rufotestaceus*** | 0.42 | 0.46 | 0.45 | 0.5 | 0.46 | 0 | 0 | 0.32 |
| ***P. jaegerskjoeldi*** | 0 | 0.44 | 0 | 0.46 | 0.43 | 0 | 0.5 | 0.26 |
| ***C. xerxes*** | 0 | 0.48 | 0.48 | 0.53 | 0.42 | 0.53 | 0.83 | 0.46 |
| ***M.schultzei*** | 0.29 | 0.42 | 0.44 | 0.43 | 0.37 | 0.38 | 0.5 | 0.4 |
| ***P. pygmaea*** | 0.33 | 0.35 | 0.53 | 0.46 | 0.5 | 0.47 | 0.46 | 0.44 |
| ***T.caldarium*** | 0.41 | 0.38 | 0.46 | 0.43 | 0.44 | 0.49 | 0.73 | 0.48 |
| ***T. depressiceps*** | 0.29 | 0.33 | 0.43 | 0.46 | 0.49 | 0.45 | 0.73 | 0.45 |
| ***G. luctaus*** | 0.41 | 0.42 | 0.49 | 0.5 | 0.48 | 0.47 | 0.36 | 0.45 |
| ***P. simplex*** | 0.37 | 0.34 | 0.43 | 0.53 | 0.59 | 0.6 | 0.63 | 0.5 |
| ***P. tumidula*** | 0.35 | 0.32 | 0.49 | 0.53 | 0.52 | 0.57 | 0.66 | 0.49 |
| ***A. anoplolepis*** | 0.32 | 0.39 | 0.48 | 0.6 | 0.45 | 0.46 | 0.46 | 0.45 |
| ***A. dolabellae*** | 0.34 | 0.39 | 0.54 | 0.66 | 0.54 | 0.49 | 0.6 | 0.51 |
| ***T. lanuginose*** | 0.26 | 0.33 | 0.47 | 0.46 | 0.46 | 0.46 | 0.7 | 0.45 |
| **Average** | 0.29 | 0.39 | 0.44 | 0.5 | 0.47 | 0.41 | 0.55 | |

*The least significant difference (R.LSD) at the level of 0.05 for sites = 0.05, for species = 0.07, for interaction = 0.20.

**The room's depth of diagnosed ant species in the study sites**

The results of statistical analysis in Table 9 showed that there were significant difference between the study sites. It was found that the highest average in Abo Al khaseeb of 23.23 cm, followed by Marshes by 23.04 cm, while the lowest average was in Qurna reached 16.3 cm. Through the interaction between the diagnosed ant species with the study sites. As well as, it was observed that *A. anoplolepis* and *A. dolabellae* had the highest average of 27.66 cm in the Center

of city. While the lowest average for M. schultzei in Qurna, which was 15.6 cm. Through the relationship between the population density of the workers and the room's depth for ant species, the correlation coefficient was highly significant which reached 0.86 **. The room depth depends mainly on the soil porosity and the consistency of its particles. As (Awad 1986) pointed out that, the consistency of soil particles through the clotting phenomenon caused by static forces and the aggregation phenomenon through the presence of adhesives materials represented by organic matter helped to give a stable shape for the soil. (Jaber 2006) also pointed out that the soil stabilization through vegetation cover prevents erosion that destroys rooms. (Al-Ruwaishdi and Moftah 1997) indicated that Carbon dioxide increases with the increase of soil depth, particularly clay soils. (Mustafa 2008) mentioned that there are huge ant's cities in Pennsylvania in the United States of America that may reach three feet deep and an area of up to fifty acres.

**Table 9 :** Average rooms depth of diagnosed ant's species in the study sites

| Sites<br>Species | Qurna | Alzubair | Center of city | Abo Al-khaseeb | Marshes | Shatt alarab | Alfao | Average |
|---|---|---|---|---|---|---|---|---|
| ***M. rufotestaceus*** | 18.5 | 16.66 | 15.66 | 17.56 | 16.13 | 0 | 0 | 12.07 |
| ***P. jaegerskjoeldi*** | 0 | 17.66 | 0 | 17.46 | 17.26 | 0 | 19.88 | 10.32 |
| ***C. xerxes*** | 0 | 16 | 17.33 | 19.26 | 19.06 | 17.1 | 18.53 | 15.33 |
| ***M.schultzei*** | 15.6 | 20.66 | 18.66 | 21.36 | 20.83 | 18.5 | 19.9 | 19.35 |
| ***P. pygmaea*** | 17.7 | 21.33 | 19.66 | 22.76 | 25.73 | 21.4 | 21.9 | 21.5 |
| ***T.caldarium*** | 20 | 23 | 21.33 | 22.9 | 23.23 | 23.3 | 22.53 | 22.32 |
| ***T. depressiceps*** | 19.7 | 22.33 | 23.66 | 23.4 | 24.93 | 23.3 | 24.03 | 23.05 |
| ***G. luctaus*** | 20 | 23.66 | 25.66 | 25.7 | 26.83 | 24.5 | 24.83 | 24.45 |
| ***P. simplex*** | 20.1 | 22.66 | 26 | 26.03 | 27.03 | 27.6 | 26 | 25.06 |
| ***P. tumidula*** | 22.3 | 22.63 | 25.66 | 27.33 | 27.36 | 25.7 | 27.3 | 25.48 |
| ***A. anoplolepis*** | 20.6 | 22 | 27.66 | 26.93 | 24.66 | 25.7 | 25.33 | 24.7 |
| ***A. dolabellae*** | 19.5 | 20.33 | 27.66 | 26.36 | 23.9 | 25.7 | 22.93 | 23.77 |
| ***T. lanuginose*** | 17.5 | 18.66 | 26.3 | 24.96 | 22.56 | 25.1 | 27.23 | 23.2 |
| **Average** | 16.3 | 20.58 | 21.17 | 23.23 | 23.04 | 19.8 | 21.56 | |

*The least significant difference (R.LSD) at the level of 0.05 for sites = 0.57, for species = 0.78, for interaction = 2.08.

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