



Morphometric analysis of soldier cast of *Odontotermes obesus* (Rambur) and *Microtermes obesi* (Holmgren) (Blattodea: Termitidae; Macrotermitinae) from three localities of Potohar region, Pakistan

Asma Ashraf^{1*}, Naveeda Akhtar Qureshi², Saima Qadeer¹, Muhammad Farhan Nisar¹, Abdur Rehman Azam³, and Sana Ullah¹

¹Department of Zoology, Division of Science and Technology, University of Education, Lahore-54000, Pakistan

²Department of Animal Sciences, Faculty of Biological Science, Quaid-i-Azam University Islamabad-45320, Pakistan

³University of Central Punjab, Lahore, Pakistan

Abstract

A great diversity of termite species is found all over the world, among these 53 species are identified from Pakistan. The knowledge about morphological features in soldier cast of termites is proved to be a technical tool for taxonomy and identification. In the present studies, the morphometric variations of external morphology in soldier caste of *Odontotermes obesus* (Rambur) and *Microtermes obesi* (Holmgren) from three different areas i.e. Gujar Khan (A), Rawalpindi (B) and Islamabad (C) were studied. About 36 characters like body, thorax, abdomen, from head to mandible tip, head, pronotum, postmentum, mandible, antenna (scape, pedicle, flagellum), and legs parts were used for morphometric measurements. The data were statistically analyzed for significant differences in their mean, standard deviation, standard error, 95% confidence interval, coefficient of variability and analysis of variance. "Student t-test" was used for the comparison of mean values using Minitab version 16. The results of the present study revealed no significant differences among the population samples collected from various localities. However little variations were observed in a few characters like antennal segments (pedicle, scape) and legs (trochanter, tibia) among the soldier cast which are adaptive in nature to survive in the environment.

Keywords: Morphometric analysis, soldiers cast, *Odontotermes obesus*, *Microtermes obesi*

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*Corresponding Author:

asma.ashraf@ue.edu.pk

1. INTRODUCTION

Termites are eusocial insects, live in colonies and exhibit polymorphism among the colony members i.e. reproductive (king, queen) and sterile (soldiers, workers) (Barbosa and Constantino, 2017)¹. Termites are distributed everywhere in nature, they are cosmopolitan with their high abundance in tropical and

subtropical areas (Wikantyo et al., 2021)². Ecologically more prevalent termite species in the Potohar plateau (Gujar Khan, Rawalpindi and Islamabad) are *Odontotermes obesus* (*O. obesus*) and *Microtermes obesi* (*M. obesi*). Very little taxonomic information about these termite species was present in described areas. Only a few studies or morphometric variation in termites have been carried out previously³⁻⁸.

In the study of external morphology, measurements form a very technical tool, especially for the identification of species. However, the consistency of the measurements depends on the extent of unevenness among the parameters of species between defined localities⁷. It also helps us to trace evolutionary changes and adaptations of species according to their environmental changes⁹.

However, the information about this termite species is very inadequate, while on the other hand the prevalence in defined localities is too much high and it damages very seriously to resident, government and private buildings. Therefore, statistics and facts on all features associated with *O. obesus* and *M. obesi* including morphometry of external anatomy are needed to be discovered in demand for the effective control and prevention of its damage. These two termite species (*O. obesus* and *M. obesi*) are not only pest of agricultural crops, but also the major destructive pests of vegetables i.e. potatoes¹⁰ so it is important to know about their behavior and morphological parameters for their effective control.

The morphometric analysis of *O. obesus* and *M. obesi* in the present study will provide a base for comparison between specimens collected from three different localities and it will also help to determine whether these termite species from different populations are statistically different or not. The main objective of this study was to contribute toward taxonomic knowledge of *O. obesus* and *M. obesi* by studying the variations in morphological features of soldier cast collected from three localities.

2. MATERIALS AND METHODS

2.1. Termite collection

The samples of *O. obesus* and *M. obesi* were collected from three different sites of the Potohar regions including the vegetation area of Govt. Sarwar Shaheed College Gujar Khan (Site A), The Resident area of Arid Agriculture University Rawalpindi (site B) and the Residential colony of Quaid-i-Azam University, Islamabad (Site C). Termites were collected by using a collection trap unit¹¹ with some modifications and identified with the help of taxonomic keys¹². Specimens were preserved in 70% ethanol prior to laboratory analysis.

Fig. 1. Map of Pakistan' capital and its surrounding territory from where samples of termites were collected: Site A (Gujar Khan), Site B (Rawalpindi) and Site C (Islamabad).

2.2. Variable Observation

Specimens from preserved samples were picked up randomly and observed under a stereoscopic binocular microscope with a built in magnification changer. The external morphology including 36 parameters, i.e. (1) body (2) head (3) thorax (4) abdomen (5) antenna (6) and legs length was measured with the help of calibrated ocular and stage micrometer. Diagrams of these variables were also taken with the help of the Olympus binocular attached camera.

2.3. Data Analysis

Data of external morphometric variables were analyzed by applying "student t-test" in Minitab version 16.1. The resulted parameters such as mean, standard deviation, standard error, confidence interval and coefficient of variance determined the variations among different parameters.

3. RESULTS

3.1. External morphometric analysis of *O. obesus*

3.1.1. Full body length

Length of whole body of *O. obesus* varied from 4.50-5.04mm. The mean values of samples collected from three sites were 4.81, 4.71 and 4.83mm respectively. Values of coefficient of variability of samples varied

between 3.09-3.55mm (Fig. 2). No significant difference was observed among samples collected from various sites.

3.1.2. Length of abdomen

Length of abdomen varied from 1.2-1.90mm and mean values was 1.69, 1.69 and 1.81mm respectively collected from three localities. Values of coefficient of variability of samples varied between 1.73-1.99mm. No significant difference was found amongst the termite samples (Fig. 2).

3.1.3. Length of thorax (prothorax, mesothorax and metathorax)

In case of length of prothorax variations, observed values, range from 0.18-0.36mm. Three population samples i.e. A, B and C had mean values of 0.27, 0.28 and 0.31mm respectively. Values of coefficient of variability of three samples sites were 0.63-0.78mm. Length of mesothorax varied from 0.18-0.3mm. Three samples had mean values of 0.27, 0.28 and 0.27mm. Values of coefficient of variability of sample varied between 0.63-0.91mm. Length of metathorax varied from 0.22-0.40mm and mean values were 0.31, 0.34 and 0.31mm. Values of coefficient of variability of three samples varied between 1.73-1.99mm (Fig. 2). There was no significant difference in the length of thorax of termite samples taken from various localities.

Fig. 2. Variations in full body length (FBL) (mm), length of thorax (LT) (Prothorax, mesothorax, metathorax), length of abdomen (LA), length from head to mandible tip(LHMT), length of head (LH) and width of head (WH) of soldiers cast of *O. obesus* from site A (Gujar khan), site B (Rawalpindi) and site C (Islamabad).

3.1.4. Length from head to mandible tip

Similarly length from head to mandible tip varied from 1.89-2.05mm. Three samples had mean values of 1.95, 2.01 and 2.01mm respectively. Values of coefficient of variability of samples varied between 3.05-6.46mm (Fig. 2). No significant difference was observed among them.

3.1.5. Length and width of head

Length of head varied from 0.96-1.39mm. Three population samples i.e. A, B and C had mean values of 1.18, 1.21 and 1.06mm respectively. Values of coefficient of variability of samples varied between 1.04-3.38mm. Width of head varied from 0.82-1.05mm. Three population samples i.e. A, B and C had mean values of 0.97, 1.00 and 0.97mm. Values of coefficient of variability of samples varied between 1.99-3.15mm (Fig. 2). No significant difference was present.

3.1.6. Length and width of pronotum

Length of pronotum varied from 0.82-1.05mm. Three population samples i.e. A, B and C had mean values of 0.92, 0.92 and 0.92mm respectively. Values of coefficient of variability of sample varied between 1.39-1.89mm. Width of pronotum varied from 0.41-0.53mm. Three population samples i.e. A, B and C had mean values 0.45, 0.47 and 0.47mm respectively. Values of coefficient of variability of sample varied between 0.76-1.26mm (Fig. 3). No significant difference was observed.

Fig. 3. Variations in length (mm) of pronotum (LP), width of pronotum (WP), postmentum length (PL) and postmentum width (PW) of soldiers cast of *O. obesus* from site A (Gujar khan), site B (Rawalpindi) and site C (Islamabad).

3.1.7. Length and width of postmentum

Length of postmentum varied from 0.64-1.18mm. Three population samples i.e. A, B and C had mean values of 1.17, 0.68 and 0.98mm. Values of coefficient of variability of sample varied between 0.77-3.62mm. Similarly, width of postmentum varied from 0.77-1.01mm. Mean values range between 0.86, 0.82 and 0.77mm. Values of coefficient of variability varied between 2.36-2.68mm (Fig. 3). No significant difference was found among them.

3.1.8. Length of mandibles

Length of right mandible varied from 0.73-0.86mm and mean values of 0.77, 0.53 and 0.79mm respectively. Values of coefficient of variability varied between 0.16-2.36mm. Length of left mandible varied from 0.73-0.86mm. Three population samples i.e. A, B and C had mean values of 0.77, 0.79 and 0.53mm. Values of coefficient of variability of samples varied between 1.05-4.27mm (Fig. 4). No significant difference was observed among them.

3.1.9. Length of tooth on left mandible

Length of tooth varied from 0.27-0.36mm and mean values varied between 0.35, 0.32 and 0.32mm respectively. Values of coefficient of variability of samples varied between 0.79-1.55mm (Fig. 4). No significant difference was found among the three termite samples.

Fig. 4. Variations in length (mm) of left mandible (LLM), length of right mandible (LRM) and length of tooth on left mandible (LTLM) of soldiers cast of *O. obesus* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad).

Fig. 5. Variations in length (mm) of antenna (LA) (scape, pedicle, flagellum) of soldiers cast of *O. obesus* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad)

3.1.10. Length of antenna (scape, pedicle and flagellum)

Length of different segments of antenna like scape, pedicle and flagellum also exhibit small differences. Observed range in scape was 0.18-0.27mm. Three population samples i.e. A, B and C had mean values of 0.26, 0.19 and 0.23mm respectively and values of coefficient of variability varied between 0.47-1.00mm. Observed range in pedicle was 0.04-0.09mm and mean values were 0.08, 0.05 and 0.06mm respectively. Values of coefficient of variability of samples varied between 0.18-1.00mm. Observed range in flagellum was 1.36-1.73mm and mean values were 1.46, 1.44 and 1.58mm respectively. Values of coefficient of variability of samples varied between 1.18-3.06mm (Fig. 5). No significant difference was observed in different segments of antenna.

3.1.11. Length of front leg (coxa, trochanter, femur, tibia, tarsus, claw)

Length of different segments of front leg like coxa, trochanter, femur, tibia, tarsus and claw also exhibit small differences. Observed range in coxa was 0.50-0.59mm. Three population samples i.e. A, B and C had mean values of 0.55, 0.55 and 0.55mm. Values of coefficient of variability of samples varied between 1.57-2.23mm. Observed range in trochanter was 0.18-0.32mm and mean values were 0.24, 0.28 and 0.27mm respectively. Coefficient of variability of samples varied between 0.63-0.92mm. Observed range in femur was 0.68-0.91mm and mean values were 0.82, 0.82 and 0.79mm. Coefficient of variability varied between 1.67-2.51mm. Observed range in tibia was 0.64-0.82mm and mean values varied between 0.81, 0.77 and 0.77mm respectively. Values of coefficient of variability varied between 2.36-3.10mm. Observed range in tarsus was 0.18-0.36mm and mean values were 0.28, 0.26 and 0.31mm respectively. Values of coefficient of variability varied between 0.79-1.27mm. Observed range in Claw was 0.09-0.12mm and mean values were 0.13, 0.14 and 0.14mm respectively. Values of coefficient of variability varied between 0.15-0.16mm (Fig. 6). No significant difference was found in different parts of front leg of termite samples.

Fig. 6. Variations in length (mm) of front leg (coxa (LC), trochanter (LT), femur (LF), tibia (LTi), tarsus (LTa) and claw (LCI) of soldiers cast of *O. obesus* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad).

3.1.12. Length of middle leg (coxa, trochanter, femur, tibia, tarsus, claw)

In middle legs, length of different segments of middle leg like coxa, trochanter, femur, tibia, tarsus and claw also exhibit small differences. Observed range in coxa was 0.45-0.59mm and sample A, B and C had mean values of 0.50, 0.53 and 0.45mm. Values of coefficient of variability of samples varied between 0.99-1.45mm. Observed range in trochanter was 0.18-0.27mm and mean values were 0.23mm. Values of coefficient of variability of samples varied between 0.31-0.47mm. Observed range in femur was 0.73-

0.86mm and mean values were 0.77, 0.79 and 0.77mm. Values of coefficient of variability varied between 1.58-2.36mm. Observed range in tibia was 0.68-0.82mm and mean values of 0.73, 0.73 and 0.77mm respectively. Values of coefficient of variability varied between 2.20-2.36mm. Observed range in tarsus was 0.21-0.32mm and mean values were 0.26, 0.27 and 0.28mm. Values of coefficient of variability varied between 0.63-0.91mm. Observed range in claw was 0.07-0.14mm and mean values were 0.14, 0.14 and 0.12mm. Values of coefficient of variability varied between 0.16-0.18mm (Fig. 7). No significant difference was recorded in middle leg length.

Fig. 7. Variations in length (mm) of middle legs coxa (LC), trochanter (LT), femur (LF), tibia (LTi), tarsus (LTa) and claw (LCI) of soldiers cast of *O. obesus* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad).

3.1.13. Length of hind leg (coxa, trochanter, femur, tibia, tarsus, claw)

Length of different segments of hind leg like coxa, trochanter, femur, tibia, tarsus and claw also show small differences. Observed range in coxa was 0.36-0.50mm. Samples A, B and C had mean values of 0.45, 0.47 and 0.44mm. Values of coefficient of variability of samples varied between 0.79-2.27mm. Observed range in trochanter was 0.13-0.23mm and mean values were 0.18, 0.18 and 0.17mm. Values of coefficient of variability varied between 0.17-0.31mm. Observed range in femur was 0.64-0.83mm and mean values were 0.77, 0.82 and 0.76mm. Values of coefficient of variability varied between 1.51-2.52mm. Observed range in tibia was 0.77-0.95mm. Three population samples i.e. A, B and C had mean values of 0.86, 0.91 and 0.84mm respectively. Values of coefficient of variability of samples varied between 1.90-3.15mm. Observed range in tarsus was 0.23-0.36mm and mean values of 0.27, 0.32 and 0.32mm respectively. Values of coefficient of variability of samples varied between 0.36-0.79mm. Observed range in claw was 0.09-0.18mm and mean values of 0.11, 0.13 and 0.14mm respectively. Values of coefficient of variability of varied between 0.15-0.17mm (Fig. 8). No significant difference was found amongst the termite samples taken from various localities.

Fig. 8. Variations in length (mm) of hind leg coxa (LC), trochanter (LT), femur (LF), tibia (LTi), tarsus (LTa) and claw (LCI) of soldiers cast of *O. obesus* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad).

3.2. External morphometric analysis of *M. obesi*

3.2.1. Full body length

Whole body length varied from 3.54-4.00mm. Three population samples i.e. A, B and C had mean values of 3.86, 3.64 and 3.74mm (Fig. 9). Values of coefficient of variability varied between 4.90-6.08mm. No significant difference was observed among samples collected from various sites.

3.2.2. Length of abdomen

Length of abdomen varied from 1.36-2.00mm and had mean values of 1.95, 1.62 and 1.77mm. Values of coefficient of variability varied between 0.96-3.72mm. No significant difference was found amongst the termite samples (Fig. 9).

3.2.3. Length of thorax (prothorax, mesothorax and metathorax)

Length of prothorax varied from 0.22-0.31mm and mean values of 0.25, 0.30 and 0.25mm. Values of coefficient of variability of sample was 1.00mm. Length of mesothorax varied from 0.18-0.36mm and mean values were 0.27, 0.28 and 0.27mm. Values of coefficient of variability of sample varied between 1.00-1.27mm. Length of metathorax varied from 0.22-0.40mm. They had mean values of 0.31, 0.34 and 0.31mm. Values of coefficient of variability of samples varied between 0.78-1.54mm (Fig. 9). No significant difference was found amongst the termite samples taken from various localities.

Fig. 9. Variations in full body length (FBL) (mm), length of thorax (LT) (Prothorax, mesothorax, metathorax), length of abdomen (LA) and length from head to mandible tip (LHMT), length of head (LH) and width of head (WH) of soldiers of *M. obesi* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad).

3.2.4. Length from head to mandible tip

Length from head to mandible tip varied from 1.09-1.27mm. The mean values were 1.09, 1.15 and 1.17mm. Values of coefficient of variability of samples varied between 1.20-2.44mm (Fig. 10). No significant difference was observed among them.

Fig. 10. Variations in length (mm) of pronotum (LP), width of pronotum (WP), postmentum length (PL) and postmentum width (PW) of soldiers cast of *M. obesi* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad).

3.2.5. Length and width of head

Length of head varied from 0.77-0.86mm and had mean values of 0.81, 0.80 and 0.78mm respectively. Values of coefficient of variability varied between 1.57-4.18mm. Width of head varied from 0.63-0.81mm. Three population samples had mean values of 0.68, 0.75 and 0.72mm. Values of coefficient of variability varied between 2.04-4.00mm. No significant difference was observed in three population samples.

3.2.6. Length and width of pronotum

Length of pronotum varied from 0.54-0.86mm. The mean values were 0.65, 0.75 and 0.62mm. Values of coefficient of variability of samples varied between 0.29-2.20mm. Width of pronotum varied from 0.54-0.86mm and mean values of 0.65, 0.75 and 0.62mm respectively. Values of coefficient of variability of samples varied between 0.29-2.20mm (Fig. 10).

3.2.7. Length and width of postmentum

Length of postmentum varied from 0.63-0.81mm and had mean values of 0.71, 0.68 and 0.72mm. Values of coefficient of variability of samples varied between 2.20-7.50mm. Width of postmentum varied from 0.50-0.72mm and mean values of 0.65, 0.63 and 0.56mm respectively. Values of coefficient of variability of samples varied between 2.61-3.36mm (Fig. 10). No significant difference was present among the termite samples.

3.2.8. Length of mandibles

Length of right mandible varied from 0.45-0.64mm. Three population samples had mean values of 0.53, 0.55 and 0.53mm respectively. Values of coefficient of variability varied between 1.57-2.63mm. Length of left mandible varied from 0.45-0.81mm. Three population samples i.e. A, B and C had mean values 0.2, 0.57 and 0.55mm respectively. Values of coefficient of variability of samples varied between 1.09-3.18mm (Fig. 11). No significant variations were present.

Fig. 11. Variations in length (mm) of left mandible (LLM), length of right mandible (LRM) and length of tooth on left mandible (LTLM) of soldiers cast of *M. obesi* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad).

3.2.9. Length of antenna (scape, pedicle and flagellum)

Length of different segments of antenna like scape, pedicle and flagellum also exhibit small differences. Observed range in scape was 0.09-0.16mm and mean values of 0.10, 0.10 and 0.11mm respectively. Values of coefficient of variability of samples varied between 0.02-0.36mm (Fig. 12). Observed range in pedicle was 0.04-0.09mm and mean value was 0.05mm. Values of coefficient of variability of samples varied between 0.36-0.59mm. Observed range in flagellum was 0.45-0.68mm and mean value of 0.05mm. Values of coefficient of variability varied between 0.96-1.73mm. No significant difference was present in different termite samples.

Fig. 12. Variations in length (mm) of antenna (LA) (scape, pedicle, flagellum) of soldiers cast of *M. obesi* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad).

3.2.10. Length of front leg (coxa, trochanter, femur, tibia, tarsus, claw)

Length of different segments of front leg like coxa, trochanter, femur, tibia, tarsus and claw also exhibit small differences. Observed range in coxa was 0.27-0.45mm and had mean values of 0.36, 0.41 and 0.34mm respectively. Values of coefficient of variability varied between 0.58-1.10mm. Observed range in trochanter was 0.13-0.25mm. Three population samples i.e. A, B and C had mean values of 0.16, 0.22 and 0.19mm respectively. Values of coefficient of variability of samples varied between 0.45-0.55mm. Observed range in femur was 0.48-0.59mm. Three population samples i.e. A, B and C had mean values of 0.54, 0.54 and 0.53mm respectively as shown in Fig. 13. Values of coefficient of variability of sample varied between 1.29-1.57mm. Observed range in tibia was 0.31-0.41mm. Three population samples i.e. A, B and C had mean value of 0.36mm. Values of coefficient of variability of samples varied between 0.94-1.33mm. Observed range in tarsus was 0.18-0.31mm. Three population samples i.e. A, B and C had mean values of 0.24, 0.19 and 0.27mm respectively. Values of coefficient of variability of three population samples varied between 0.63-0.91mm. Observed range in Claw was 0.02-0.09mm. Three population samples i.e. A, B and C had mean values of 0.08, 0.06 and 0.60mm respectively. Values of coefficient of variability of three population samples varied between 0.04-0.18mm. No significant difference was found amongst the termite samples taken from various localities.

Fig. 13. Variations in length (mm) of front leg (coxa (LC), trochanter (LT), femur (LF), tibia (LTi), tarsus (LTa) and claw (Lcl) of soldiers cast of *M. obesi* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad).

3.2.11. Length of middle leg (coxa, trochanter, femur, tibia, tarsus, claw)

Length of different segments of middle leg like coxa, trochanter, femur, tibia, tarsus and claw also exhibit small differences. Observed range in coxa was 0.31-0.41mm. Three population samples i.e. A, B and C had mean values of 0.36, 0.34 and 0.36mm respectively. Values of coefficient of variability of samples varied between 0.58-0.94mm. Observed range in trochanter was 0.09-0.25mm. Three population samples i.e. A, B and C had mean values 0.16, 0.13 and 0.17mm respectively. Values of coefficient of variability of samples varied between 0.15-0.48mm. Observed measurements in femur were 0.50-0.64mm. Three population samples i.e. A, B and C had mean values of 0.59, 0.54 and 0.53mm respectively. Values of coefficient of variability of three population samples varied between 1.27-1.73mm. Observed range in tibia was 0.40-0.54mm. Three population samples i.e. A, B and C had mean value of 0.50mm respectively. Values of coefficient of variability of samples varied between 0.71-1.45mm. Observed range in tarsus was 0.09-0.16mm. Three population samples i.e. A, B and C had mean values of 0.13, 0.13 and 0.11mm respectively (Fig. 14). Value of coefficient of variability of samples was 0.16mm. Observed range in Claw was 0.04-0.07mm. Three population samples i.e. A, B and C had mean values of 0.05, 0.05 and 0.03mm respectively. Values of coefficient of variability of samples varied between 3.61-8.50mm. No significant difference was present.

Fig. 14. Variations in length (mm) of middle legs coxa (LC), trochanter (LT), femur (LF), tibia (LTi), tarsus (LTa) and claw (Lcl) of soldiers cast of *M. obesi* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad).

3.2.12. Length of hind leg (coxa, trochanter, femur, tibia, tarsus, claw)

Length of different segments of hind leg like coxa, trochanter, femur, tibia, tarsus and claw also exhibit small differences. Observed range in coxa was 0.31-0.45mm. Three population samples i.e. A, B and C had mean values of 0.36, 0.37 and 0.40mm respectively. Values of coefficient of variability of samples varied between 0.94-1.35mm. An observed measurement in trochanter was 0.16-0.23mm. Three population samples i.e. A, B and C had mean values of 0.19, 0.19 and 0.22mm respectively. Values of coefficient of variability of samples varied between 0.48-0.63mm. An observed range in femur was 0.36-0.50mm. Three

population samples i.e. A, B and C had mean values of 0.50, 0.41 and 0.47mm respectively. Values of coefficient of variability of samples varied between 0.85-1.26mm. An observed range in tibia was 0.72-0.86mm. Three population samples i.e. A, B and C had mean values of 0.81, 0.80 and 0.77mm respectively (Fig. 15). Values of coefficient of variability of samples varied between 1.61-2.52mm. Observed range in tarsus was 0.09-0.25mm. Three population samples i.e. A, B and C had mean values of 0.18, 0.19 and 0.22mm respectively. Values of coefficient of variability of sample varied between 0.31-0.56mm. Analysis of variance showed that there were non-significant differences among the samples collected from different localities. Observed range in claw was 0.02-0.07mm. Three population samples i.e. A, B and C had mean values of 0.05, 0.04 and 0.04mm respectively. Values of coefficient of variability of samples varied between 0.39-0.59mm. Analysis of variance showed that there were non-significant differences among the samples collected from different localities.

Fig. 15. Variations in length (mm) of hind leg coxa (LC), trochanter (LT), femur (LF), tibia (LTi), tarsus (LTa) and claw (Lcl) of soldiers cast of *M. obesi* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad).

4. DISCUSSION

Morphometric analysis plays an important role in termite identification, classification and taxonomy. In the present study, soldier cast of two termite species (*O. obesus* and *M. obesi*) were examined morphometrically collected from three different localities of Potohar plateau i.e. Gujar Khan (site A), Rawalpindi (site B) and Islamabad (site C). Results of "student t-test" revealed non-significant variations in different morphological features of the selected samples, collected from three different sites. A little variation was observed among a few morphological traits, however, most of the features showed overlapping values. The observed variations in body length, length of thorax (prothorax, mesothorax and metathorax) pronotum, length of left and right mandible were non-significant among the collected samples of described sites. Samples collected from site C (Islamabad) were observed larger in their abdominal length when compared with the samples collected from site A (Gujar Khan) and B (Rawalpindi). A slight variation was observed in the size of the head (length and width) in samples collected from site C (Islamabad). However, length of postmentum and tooth (present on left mandible) was found slightly greater among the samples collected from site A (Gujar Khan) as compared to the samples of rest of the two sites i.e. site B (Rawalpindi) and C (Islamabad). Among the antennal segments (pedicle, scape and flagellum) pedicle showed the variations from 0.04-0.9mm in pooled data and most of the sample values were overlapping. These antennal variations can be used as a taxonomic feature because termites use antenna as a sensory tool for sensing changes in environmental stimuli as well as a support for predatory activities i.e. prey capture⁹. Similarly, variations in different segments of leg (coxa, trochanter, femur, tibia, tarsus and claw) can also be used as a taxonomic tool for termite identification because these are adaptive traits and they use legs for foraging and traveling long distances for the sake shelter and food⁹. In the present study, among the samples of site A (Gujar Khan), coxa length of front leg is slightly larger while trochanter length is smaller as compared to the samples of other sites under investigation. Rest of the parts i.e. tibia and tarsus have non-significant differences except the shape of the claw, which is significantly different among the samples of all described sites. Femur length is larger than tibia in case of front and middle legs among all the samples of described sites whereas in the hind legs, an inverse trend was observed and tibia length was found to be larger than the femur length. Similarly length of tarsus and claw was also found slightly larger in the hind legs. The findings of the present study support the results of Arif et al.⁹ i.e. variations in different segments of length of termites samples collected from three sites (A, B and C) are due to difference in their habitat and these variations are the results of adaptations that enable the termites to survive in their environment. Similar studies were conducted by Wikantyo et al.² on morphometric analysis of *Coptotermes* spp. based on the head capsule shape of soldier cast collected from various localities of Indonesia and evaluated that the differences among the various character of head capsule shape are sensitive to the changes in their environmental conditions and might be associated with the stress and defensive labour of mandibles.

Similarly, slight variations were observed in morphometric measurements among the soldier cast of *M. obesi* collected from three different described sites (A, B and C). The observed range of full body length was 3.50-4.00mm in pool data with the exception of samples collected from site A (Gujar Khan) where slight variation was observed. Similarly, a little larger length of abdomen was observed among the samples of site A (Gujar Khan) when compared with samples from the other two sites (B and C). Non-significant differences were observed in length of thorax (prothorax, mesothorax and mesothorax), length from head to mandible tip, length of mandibles, pronotum, postmentum and antennal segments (pedicle and scape) among the samples of under study sites. However, coxa and trochanter of front leg showed bit variations and larger length of 0.09mm was observed among the samples of site B (Rawalpindi). Similarly, significant variations were observed in femur and tibia of hind legs among the collected samples. These variations are adaptive and are in accordance with Arif et al. ⁹. A similar study was conducted by Sheikh et al. ⁶ on morphometric variations of *Microtermes mycophagous* (fungus growing termite) collected from different geographical areas of Pakistan to identify the distributional range of *M. mycophagous*. Similarly, the results of the present study highlighted the variations in morphological features of *O. obesus* and *M. obesi* from different sites and provide sufficient taxonomic knowledge about them in the Pothohar Plateau of Pakistan.

5. CONCLUSIONS

From the present study, it is concluded that morphological character could be a good choice for termite identification. Samples of two termite species (*O. obesus* and *M. obesi*) collected from three different localities (site A, B and C) were not significantly different from each other. However adaptive modifications were observed that might help the termites to face environmental stress and able them to acclimatize to that area.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Table S1: Morphometric analysis in general characteristics of *Odontotermes obesus* in sites A, B, C.

Sites	N	O.R	X	SD	SE	95% CI	CV
Full body length (mm) P<0.05							
A	10	4.77-5.04	4.81	2.65	1.53	4.22-5.41	3.09
B	10	4.50-4.72	4.71	2.25	1.30	4.20-5.22	3.55
C	10	4.77-4.91	4.83	1.76	1.01	4.43-5.23	3.55
Length of prothorax (mm) P<0.05							
A	10	0.18-0.36	0.27	0.50	0.28	0.15-0.20	0.63
B	10	0.20-0.31	0.28	0.36	0.20	0.15-0.20	0.63
C	10	0.22-0.36	0.31	0.50	0.28	0.20-0.42	0.78
Length of mesothorax (mm) P<0.05							
A	10	0.18-0.36	0.27	0.50	0.28	0.15-0.38	0.63
B	10	0.21-0.31	0.28	0.36	0.20	0.20-0.36	0.91
C	10	0.22-0.31	0.27	0.50	0.28	0.51-0.38	0.63
Length of metathorax (mm) P<0.05							
A	10	0.22-0.40	0.31	0.45	0.26	0.21-0.42	0.85
B	10	0.27-0.40	0.34	0.25	0.14	0.28-0.39	1.73
C	10	0.22-0.36	0.311	0.40	0.23	0.22-0.40	0.94
Length of abdomen (mm) P<0.05							
A	10	1.62-1.77	1.69	1.52	0.88	1.34-2.05	1.82
B	10	1.62-1.77	1.69	1.60	0.92	1.33-2.05	1.73
C	10	1.72-1.90	1.81	1.50	0.86	1.47-2.15	1.99

Table S2: Morphometric analysis in general characteristics of *Odontotermes obesus* in sites A, B, C.

Sites	N	O.R	X	SD	SE	95% CI	CV
Length from head to mandible tip (mm) P<0.05							
A	10	1.95-2.00	1.95	0.50	0.28	1.84-2.07	6.46
B	10	1.89-2.05	2.01	0.76	0.44	1.84-2.19	4.36
C	10	1.89-2.05	2.01	0.76	0.44	1.69-2.19	3.05
Length of head(mm) P<0.05							
A	10	1.12-1.23	1.18	0.50	0.28	1.07-1.29	3.38
B	10	1.17-1.39	1.21	1.04	0.60	0.98-1.37	1.87
C	10	0.96-1.09	1.06	1.60	0.92	0.69-1.42	1.04
Width of head (mm) P<0.05							
A	10	0.82-1.02	0.97	0.64	0.37	0.83-1.12	2.38
B	10	0.96-1.05	1.00	0.50	0.28	0.89-1.11	3.15
C	10	0.91-1.05	0.97	0.76	0.44	0.79-1.14	1.99
Length of pronotum (mm) P<0.05							
A	10	0.86-1.00	0.92	0.76	0.44	8.26-12.06	1.89
B	10	0.82-1.002	0.92	1.04	0.60	7.58-12.75	1.39
C	10	0.82-1.05	0.92	0.76	0.54	0.75-1.09	1.89
Width of pronotum (mm) P<0.05							
A	10	0.41-0.5	0.45	0.50	2.89	0.34-0.37	1.26
B	10	0.41-0.53	0.47	0.76	0.44	0.29-0.64	0.86
C	10	0.041-0.53	0.47	0.76	0.44	0.25-0.59	0.76
Length of postmentum (mm) P<0.05							
A	10	1.09-1.18	1.17	0.50	0.28	1.02-1.25	3.62
B	10	0.64-0.77	0.68	0.50	0.28	0.57-0.79	0.05
C	10	0.91-1.09	0.98	2.02	1.17	0.53-1.44	0.77
Width of postmentum (mm) P<0.05							
A	10	0.82-1.01	0.86	0.50	0.28	0.75-0.98	2.68
B	10	0.77-0.86	0.82	0.50	0.28	0.70-0.93	2.52
C	10	0.77-0.86	0.77	0.50	0.28	0.66-0.89	2.36
Length of right mandible (mm) P<0.05							
A	10	0.73-0.82	0.77	0.50	0.28	0.66-0.88	2.36
B	10	0.73-0.86	0.53	4.65	2.68	0.52-1.58	0.16
C	10	0.73-0.82	0.79	0.76	0.44	0.61-0.96	1.58
Length of left mandible (mm) P<0.05							
A	10	0.73-0.82	0.77	0.50	0.28	0.66-0.89	1.55
B	10	0.75-0.86	0.79	1.15	0.66	0.53-1.05	1.05

C	10	0.73-0.86	0.53	0.28	0.16	0.74-0.87	4.27
Length of tooth on left mandible (mm) P<0.05							
A	10	0.32-0.36	0.35	0.28	0.16	0.28-0.41	1.55
B	10	0.27-0.36	0.32	0.50	0.28	0.20-0.43	0.79
C	10	0.29-0.36	0.32	0.50	0.28	0.20-0.70	0.79
Length of antenna (scape) (mm) P<0.05							
A	10	0.23-0.27	0.26	0.28	0.16	0.19-0.30	1.00
B	10	0.18-0.23	0.19	0.31	0.20	0.11-0.27	0.48
C	10	0.18-0.27	0.23	0.50	0.28	0.11-0.34	0.47
Length of antenna (pedicle) (mm) P<0.05							
A	10	0.04-0.09	0.08	0.28	0.16	0.01-0.10	1.00
B	10	0.04-0.08	0.05	0.17	0.10	0.02-0.09	0.36
C	10	0.04-0.07	0.06	0.28	0.16	0.004-1.83	0.18
Width of antenna(flagellum) (mm) P<0.05							
A	10	1.55-1.73	1.64	1.00	0.57	0.16-1.16	2.68
B	10	1.36-1.45	1.44	0.76	0.44	1.27-1.61	3.06
C	10	1.5-1.67	1.58	2.08	1.20	1.1-2.02	1.18

Table S3: Morphometric analysis in general characteristics of *Odontotermes obesus* in sites A, B, C.

Sites	N	O.R	X	SD	SE	95% CI	CV
Length of front legs (coxa) (mm) P<0.05							
A	10	0.55-0.59	0.55	0.36	0.20	0.47-0.64	2.23
B	10	0.5-0.59	0.55	0.50	0.28	0.43-0.66	1.57
C	10	0.5-0.59	0.55	0.50	0.28	0.43-0.66	1.57
Length of front legs (trochanter) (mm) P<0.05							
A	10	0.18-0.27	0.24	0.36	0.20	0.24-0.32	0.69
B	10	0.23-0.32	0.28	0.36	0.20	0.2-0.36	0.92
C	10	0.23-0.32	0.27	0.50	0.28	0.16-0.39	0.63
Length of front legs (femur) (mm) P<0.05							
A	10	0.73-0.91	0.82	0.50	0.28	0.70-0.93	2.51
B	10	0.73-0.91	0.82	0.50	0.28	0.70-0.93	2.51
C	10	0.68-0.82	0.79	0.76	0.44	0.61-0.46	1.67
Length of front legs (tibia) (mm) P<0.05							
A	10	0.77-0.82	0.81	0.40	0.23	0.72-0.90	3.1
B	10	0.64-0.73	0.77	0.50	0.28	0.66-0.89	2.36
C	10	0.64-0.77	0.77	0.50	0.28	0.66-0.89	2.36
Length of front legs (tarsus) (mm) P<0.05							
A	10	0.23-0.31	0.28	0.25	0.14	0.22-0.33	1.27
B	10	0.18-0.31	0.26	0.28	0.16	0.19-0.32	1.00
C	10	0.27-0.36	0.31	0.50	0.28	0.20-0.43	0.79
Length of front legs (claw) (mm) P<0.05							
A	10	0.09-0.12	0.13	0.40	0.23	0.04-0.22	0.16
B	10	0.09-0.12	0.14	0.50	0.28	0.02-0.25	0.15
C	10	0.09-0.12	0.14	0.50	0.28	0.05-0.25	0.15
Length of middle legs (coxa) (mm) P<0.05							
A	10	0.45-0.54	0.50	0.50	0.28	0.39-0.61	1.45
B	10	0.50-0.55	0.53	0.76	0.44	0.36-0.70	0.99
C	10	0.50-0.59	0.45	0.50	0.28	0.34-0.57	1.26
Length of middle legs (trochanter) (mm) P<0.05							
A	10	0.18-0.27	0.23	0.50	0.28	0.11-0.34	0.47
B	10	0.18-0.27	0.23	0.50	0.28	0.07-0.29	0.31
C	10	0.18-0.27	0.23	0.50	0.28	0.11-0.29	0.47
Length of middle legs (femur) (mm) P<0.05							
A	10	0.73-0.82	0.77	0.50	0.28	0.61-0.89	2.36
B	10	0.73-0.86	0.79	0.76	0.44	0.61-0.96	1.58
C	10	0.73-0.82	0.77	1.50	0.28	0.66-0.89	2.36
Length of middle legs (tibia) (mm) P<0.05							
A	10	0.68-0.77	0.73	0.50	0.28	0.61-0.84	2.20
B	10	0.68-0.77	0.73	0.50	0.28	0.61-0.84	2.20
C	10	0.72-0.82	0.77	0.50	0.28	0.66-0.89	2.36
Length of middle legs (tarsus) (mm) P<0.05							

A	10	0.23-0.32	0.26	0.36	0.20	0.18-0.34	0.83
B	10	0.21-0.27	0.27	0.50	0.28	0.16-0.39	0.63
C	10	0.23-0.32	0.28	0.36	0.20	0.20-0.36	0.91
Length of middle legs (claw) (mm) P<0.05							
A	10	0.09-0.13	0.14	0.50	0.28	0.02-0.25	0.16
B	10	0.09-0.13	0.14	0.50	0.28	0.02-0.25	0.16
C	10	0.07-0.14	0.12	0.28	0.16	0.56-0.19	0.18
Length of hind legs (coxa) (mm) P<0.05							
A	10	0.41-0.50	0.45	0.50	0.28	0.34-0.57	1.26
B	10	0.45-0.5	0.47	0.28	0.16	0.40-0.53	2.27
C	10	0.36-0.45	0.44	0.76	0.44	0.27-0.61	0.79
Length of hind legs (trochanter) (mm) P<0.05							
A	10	0.18-0.23	0.18	0.76	0.44	0.005-0.34	0.17
B	10	0.13-0.23	0.18	0.50	0.28	0.07-0.29	0.31
C	10	0.13-0.18	0.17	0.56	0.44	0.83-0.29	0.23
Length of hind legs (femur) (mm) P<0.05							
A	10	0.64-0.73	0.77	0.50	0.28	0.66-0.89	2.36
B	10	0.77-0.83	0.82	0.50	0.28	0.66-0.89	2.52
C	10	0.73-0.82	0.76	0.76	0.44	0.58-0.93	1.51
Length of hind legs (tibia) (mm) P<0.05							
A	10	0.77-0.86	0.86	0.50	0.28	0.75-0.98	2.67
B	10	0.86-0.95	0.91	0.45	0.26	0.81-1.01	3.15
C	10	0.77-0.86	0.84	0.68	0.39	0.69-0.99	1.90
Length of hind legs (tarsus) (mm) P<0.05							
A	10	0.23-0.32	0.27	0.50	0.28	0.16-0.41	0.36
B	10	0.27-0.36	0.32	0.50	0.28	0.20-0.43	0.79
C	10	0.27-0.36	0.32	0.50	0.28	0.20-0.43	0.79
Length of hind legs (claw) (mm) P<0.05							
A	10	0.09-0.14	0.11	0.25	0.14	0.05-0.17	0.15
B	10	0.36-0.18	0.13	0.40	0.23	0.04-0.22	0.17
C	10	0.09-0.18	0.14	0.50	0.28	0.02-0.25	0.16

Table S4: Morphometric analysis in general characteristics of *Microtermes obesi* in site A, B, C.

Sites	N	O.R	X	SD	SE	95% CI	CV
Full body length (mm) P<0.05							
A	10	3.77-4.00	3.86	1.32	0.76	3.56-4.16	4.94
B	10	3.54-3.77	3.64	1.25	0.72	3.36-3.84	4.90
C	10	3.64-3.82	3.74	1.04	0.62	3.51-3.94	6.08
Length of prothorax (mm) P<0.05							
A	10	0.22-0.27	0.25	0.28	0.16	0.19-0.31	1.00
B	10	0.22-0.31	0.30	0.16	0.16	0.19-0.31	1.00
C	10	0.22-0.27	0.25	0.28	0.16	0.19-0.31	1.00
Length of mesothorax (mm) P<0.05							
A	10	0.18-0.36	0.27	0.28	0.16	0.22-0.35	1.18
B	10	0.21-0.31	0.28	0.28	0.16	0.23-0.36	1.00
C	10	0.22-0.31	0.27	0.28	0.16	0.23-0.36	1.27
Length of metathorax (mm) P<0.05							
A	10	0.22-0.40	0.31	0.28	0.16	0.28-0.41	1.54
B	10	0.27-0.40	0.34	0.50	0.16	0.20-0.43	0.78
C	10	0.22-0.36	0.31	0.28	0.16	0.26-0.39	1.45
Length of abdomen (mm) P<0.05							
A	10	1.86-2.00	1.95	0.86	0.50	1.75-2.15	3.72
B	10	1.36-1.81	1.62	2.57	1.59	0.99-2.24	0.96
C	10	1.68-1.90	1.77	1.32	0.86	1.47-2.07	2.20

Table S5: Morphometric analysis in general characteristics of *Microtermes obesi* in site A, B, C.

Sites	N	O.R	X	SD	SE	95% CI	CV
Length from head to mandible tip (mm) P<0.05							
A	10	1.00-1.18	1.09	1.00	0.57	0.86-1.34	1.73
B	10	1.00-1.27	1.15	1.52	0.82	0.96-1.33	1.20
C	10	1.09-1.22	1.17	0.76	0.44	0.26-0.39	2.44
Length of head (mm) P<0.05							
A	10	0.77-0.86	0.81	0.50	0.28	0.70-0.93	1.57
B	10	0.77-0.86	0.80	0.57	0.33	0.67-0.93	2.13
C	10	0.72-0.81	0.78	0.28	0.16	0.72-0.85	4.18
Width of head (mm) P<0.05							
A	10	0.63-0.72	0.68	0.50	0.28	0.56-0.76	2.04
B	10	0.72-0.77	0.75	0.28	0.16	0.69-0.82	4.00
C	10	0.63-0.81	0.72	0.50	0.28	0.61-0.84	2.20
Length of pronotum (mm) P<0.05							
A	10	0.59-0.68	0.65	0.50	0.28	0.56-0.76	2.20
B	10	0.77-0.86	0.75	0.57	0.28	0.25-0.47	0.94
C	10	0.54-0.68	0.62	0.76	0.44	0.44-0.79	0.29
Width of pronotum (mm) P<0.05							
A	10	0.59-0.68	0.65	0.50	0.28	0.56-0.76	2.20
B	10	0.77-0.86	0.75	0.57	0.28	0.25-0.47	0.94
C	10	0.54-0.68	0.62	0.76	0.44	0.44-0.79	0.29
Length of postmentum (mm) P<0.05							
A	10	0.68-0.81	0.71	0.28	1.16	0.64-0.77	3.72
B	10	0.63-0.77	0.68	0.50	0.28	0.57-0.79	7.50
C	10	0.63-0.81	0.72	0.50	0.28	0.61-0.84	2.20
Width of postmentum (mm) P<0.05							
A	10	0.59-0.68	0.65	0.28	0.16	0.58-0.71	3.36
B	10	0.54-0.72	0.63	0.50	0.28	0.61-0.74	2.61
C	10	0.50-0.63	0.56	0.28	0.16	0.58-0.71	3.36
Length of right mandible (mm) P<0.05							
A	10	0.50-0.59	0.53	0.28	0.16	0.46-0.59	2.63
B	10	0.45-0.64	0.55	0.50	0.82	0.43-0.65	1.57
C	10	0.50-0.59	0.53	0.28	0.16	0.46-0.59	2.63
Length of left mandible (mm) P<0.05							
A	10	0.55-0.68	0.62	0.28	0.16	0.56-0.68	3.18
B	10	0.50-0.64	0.57	0.67	0.44	0.40-0.80	1.09
C	10	0.45-0.64	0.55	0.50	0.28	0.43-0.65	1.57
Length of antenna (scape) (mm) P<0.05							
A	10	0.09-0.13	0.10	0.17	0.10	0.06-0.13	0.09
B	10	0.09-0.16	0.10	0.28	0.16	0.04-0.17	0.36
C	10	0.09-0.13	0.11	0.25	0.14	0.05-0.16	0.02
Length of antenna (pedicle) (mm) P<0.05							
A	10	0.04-0.07	0.05	0.11	0.06	0.02-0.08	0.59
B	10	0.04-0.09	0.05	0.17	0.10	0.01-0.09	0.36
C	10	0.04-0.07	0.05	0.11	0.06	0.02-0.08	0.59
Width of antenna(flagellum) (mm) P<0.05							
A	10	0.45-0.54	0.05	0.50	0.28	0.38-0.43	1.45
B	10	0.50-0.64	0.05	0.76	0.44	0.34-0.68	0.96
C	10	0.54-0.68	0.05	0.50	0.28	0.45-0.70	1.73

Table S6: Morphometric analysis in general characteristics of *Microtermes obesi* in site A, B, C.

Sites	N	O.R	X	SD	SE	95% CI	CV
Length of front legs (coxa) (mm) P<0.05							
A	10	0.27-0.31	0.36	0.50	0.28	0.25-0.47	0.94
B	10	0.36-0.45	0.41	0.50	0.28	0.29-0.52	1.10

C	10	0.31-0.41	0.34	0.76	0.44	0.17-0.52	0.58
Length of front legs (trochanter) (mm) P<0.05							
A	10	0.13-0.22	0.16	0.28	0.16	0.10-0.23	0.45
B	10	0.18-0.25	0.22	0.40	0.23	0.12-0.31	0.55
C	10	0.16-0.22	0.19	0.36	0.20	0.10-0.27	0.48
Length of front legs (femur) (mm) P<0.05							
A	10	0.52-0.59	0.54	0.50	0.28	0.25-0.47	1.57
B	10	0.54-0.59	0.54	0.50	0.28	0.25-0.47	1.57
C	10	0.48-0.59	0.53	6.00	0.34	0.39-0.67	1.29
Length of front legs (tibia) (mm) P<0.05							
A	10	0.36-0.41	0.36	0.50	0.28	0.25-0.47	0.94
B	10	0.31-0.41	0.36	0.50	0.28	0.25-0.47	0.94
C	10	0.32-0.39	0.36	0.35	0.20	0.28-0.43	1.33
Length of front legs (tarsus) (mm) P<0.05							
A	10	0.18-0.27	0.24	0.26	0.16	0.17-0.30	0.91
B	10	0.18-0.22	0.19	0.28	0.16	0.13-0.26	0.63
C	10	0.22-0.31	0.27	0.50	0.21	0.15-0.38	0.63
Length of front legs (claw) (mm) P<0.05							
A	10	0.02-0.09	0.08	0.36	0.20	0.00-0.16	0.04
B	10	0.04-0.09	0.06	0.28	0.16	0.00-0.12	0.18
C	10	0.04-0.09	0.06	0.28	0.16	0.00-0.12	0.18
Length of middle legs (coxa) (mm) P<0.05							
A	10	0.31-0.40	0.36	0.50	0.28	0.25-0.47	0.94
B	10	0.27-0.41	0.34	0.76	0.44	0.17-0.52	0.58
C	10	0.31-0.41	0.36	0.50	0.28	0.25-0.47	0.94
Length of middle legs (trochanter) (mm) P<0.05							
A	10	0.13-0.18	0.16	0.25	0.14	0.10-0.22	0.48
B	10	0.09-0.18	0.13	0.50	0.28	0.02-0.25	0.15
C	10	0.13-0.25	0.17	0.40	0.23	0.07-0.26	0.33
Length of middle legs (femur) (mm) P<0.05							
A	10	0.59-0.64	0.59	0.50	0.28	0.47-0.70	1.73
B	10	0.50-0.59	0.54	0.50	0.28	0.43-0.66	1.56
C	10	0.50-0.59	0.53	1.04	0.60	0.29-0.76	1.27
Length of middle legs (tibia) (mm) P<0.05							
A	10	0.45-0.54	0.50	0.50	0.28	0.38-0.61	1.45
B	10	0.45-0.54	0.50	0.50	0.28	0.38-0.61	1.45
C	10	0.40-0.54	0.50	1.00	0.57	0.27-0.73	0.71
Length of middle legs (tarsus) (mm) P<0.05							
A	10	0.09-0.16	0.13	0.40	0.23	0.03-0.22	0.16
B	10	0.09-0.16	0.13	0.40	0.23	0.03-0.22	0.16
C	10	0.09-0.13	0.11	0.25	0.14	0.05-0.17	0.16
Length of middle legs (claw) (mm) P<0.05							
A	10	0.04-0.04	0.05	0.20	0.12	0.00-0.09	0.32
B	10	0.04-0.07	0.05	0.17	0.10	0.01-0.09	0.36
C	10	0.02-0.05	0.03	0.11	0.06	0.01-0.06	0.77
Length of hind legs (coxa) (mm) P<0.05							
A	10	0.31-0.40	0.36	0.50	0.28	0.25-0.47	0.94
B	10	0.34-0.40	0.37	0.36	0.20	0.29-0.45	1.35
C	10	0.31-0.45	0.40	0.50	0.28	0.29-0.52	1.11
Length of hind legs (trochanter) (mm) P<0.05							
A	10	0.18-0.23	0.19	0.28	0.16	0.13-0.26	0.63
B	10	0.16-0.23	0.19	0.36	0.20	0.11-0.27	0.48
C	10	0.18-0.25	0.22	0.40	0.23	0.12-0.31	0.56
Length of hind legs (femur) (mm) P<0.05							
A	10	0.40-0.50	0.50	0.50	0.28	0.34-0.56	1.26
B	10	0.40-0.48	0.41	0.65	0.37	0.27-0.29	0.86
C	10	0.36-0.50	0.47	0.76	0.44	0.29-0.64	0.85
Length of hind legs (tibia) (mm) P<0.05							
A	10	0.80-0.86	0.81	0.50	0.28	0.70-0.93	2.52
B	10	0.81-0.86	0.80	0.76	0.44	0.63-0.97	1.61

C	10	0.72-0.81	0.77	0.50	0.28	0.66-0.88	1.91
Length of hind legs (tarsus) (mm) P<0.05							
A	10	0.13-0.23	0.18	0.50	0.28	0.06-0.29	0.31
B	10	0.09-0.23	0.19	0.36	0.20	0.11-0.27	0.48
C	10	0.18-0.25	0.22	0.40	0.23	0.12-0.31	0.56
Length of hind legs (claw) (mm) P<0.05							
A	10	0.04-0.06	0.05	0.11	0.06	0.02-0.07	0.59
B	10	0.04-0.07	0.04	0.15	0.08	0.00-0.07	0.55
C	10	0.02-0.06	0.04	0.20	0.11	0.002-0.081	0.39

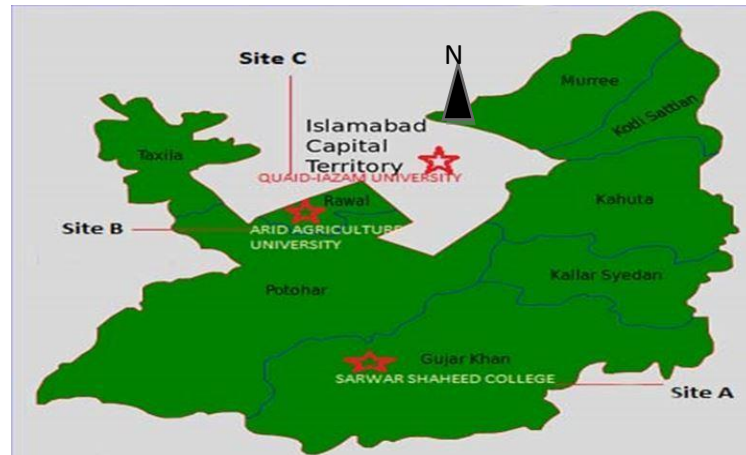


Figure 1. Map of Pakistan' capital and its surrounding territory from where samples of termites were collected Site A (Gujar Khan), Site B (Rawalpindi) and Site C (Islamabad).

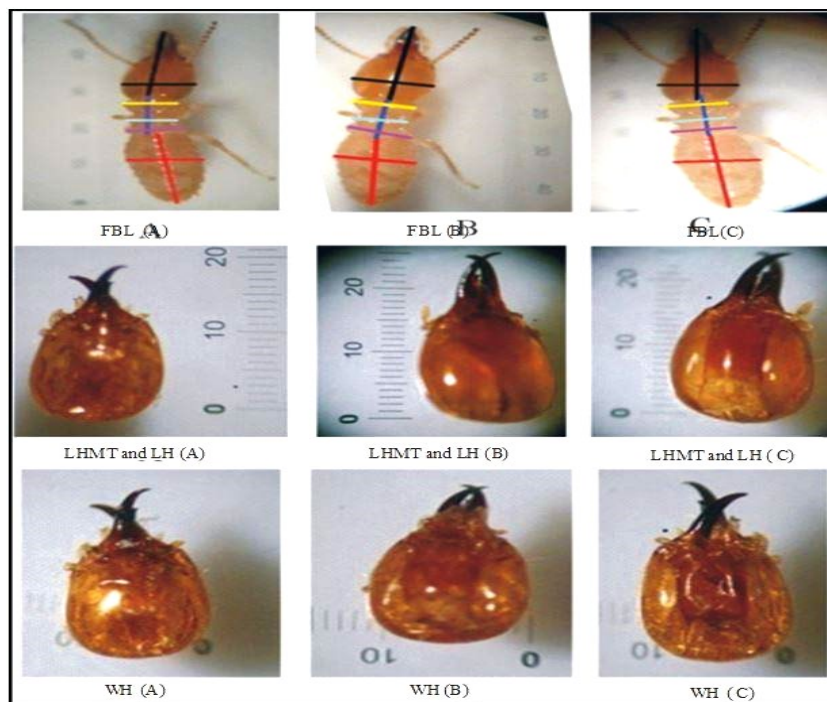


Figure 2. Variations in full body length (FBL), length of thorax (LT) (Prothorax, mesothorax, metathorax) (μm), length of abdomen (LA) (μm) and length from head to mandible tip (LHMT) (μm), length of head (LH) (μm) and width of head

(WH) (μm) of soldiers of *O. obesus* from site A (Gujar khan), site B (Rawalpindi) and site C (Islamabad).

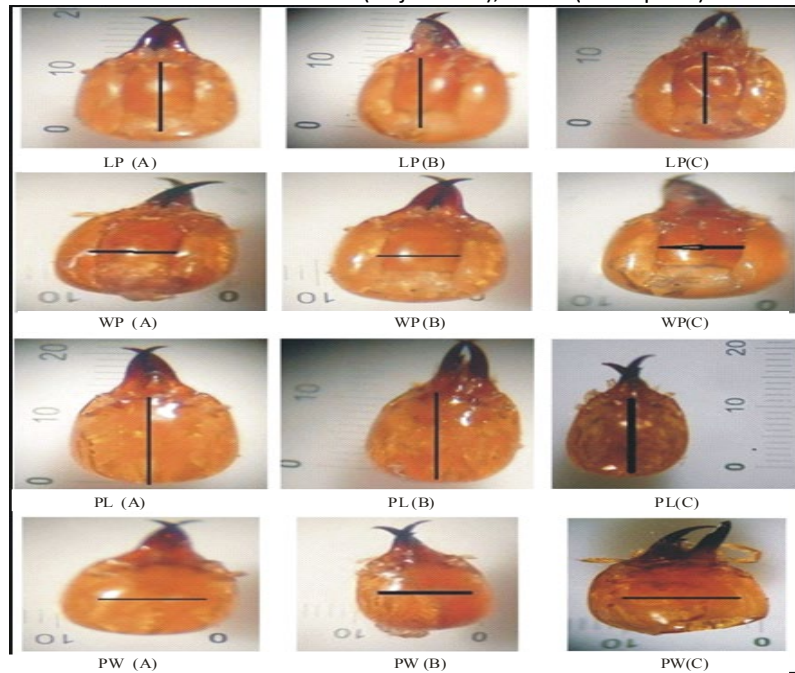


Figure 3. Variations in length of pronotum (LP) (μm), width of pronotum (WP) (μm), postmentum length (PL) (μm) and postmentum width (PW) (μm) of soldiers of *O. obesus* from site A (Gujar khan), site B (Rawalpindi) and site C (Islamabad).

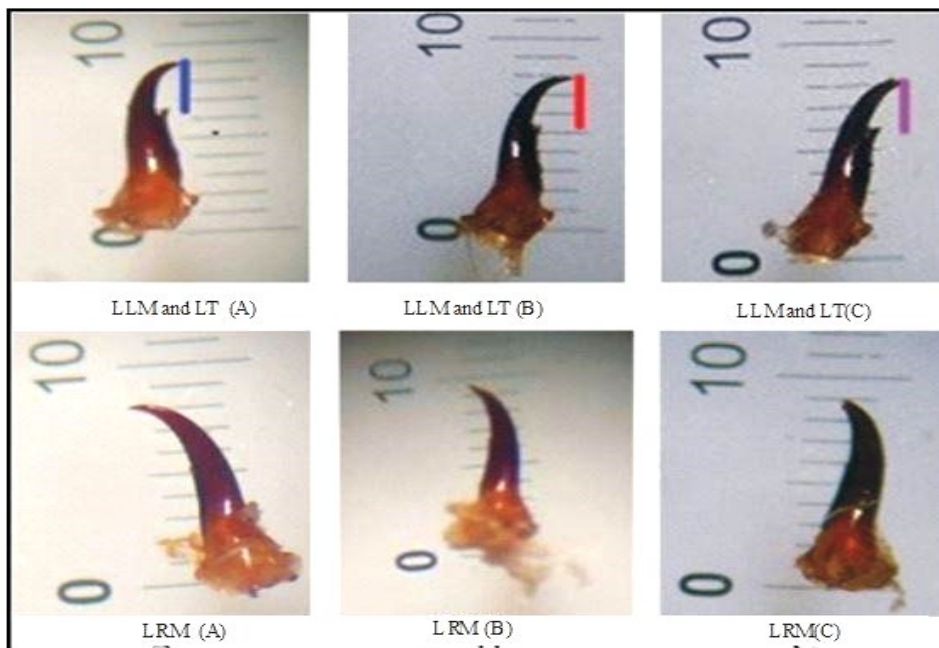


Figure 4. Variations in length of left mandible (LLM) (μm), length of right mandible (LRM) (μm) and length of tooth on left mandible (LTM) (μm) of soldiers of *O. obesus* from site A (Gujar khan), site B (Rawalpindi) and site C (Islamabad).

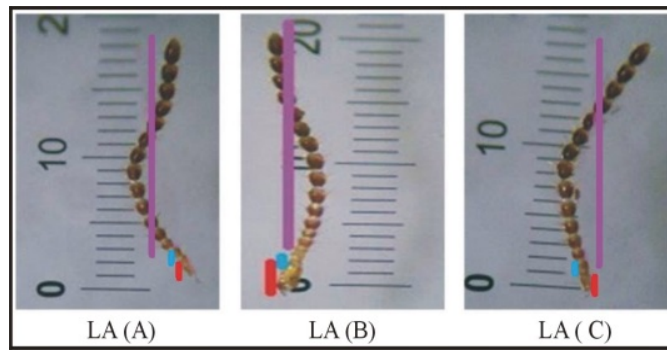


Figure 5. Variations in length of antenna (LA) (scape, pedicel, flagellum) (μm) of soldiers of *O. obesus* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad)

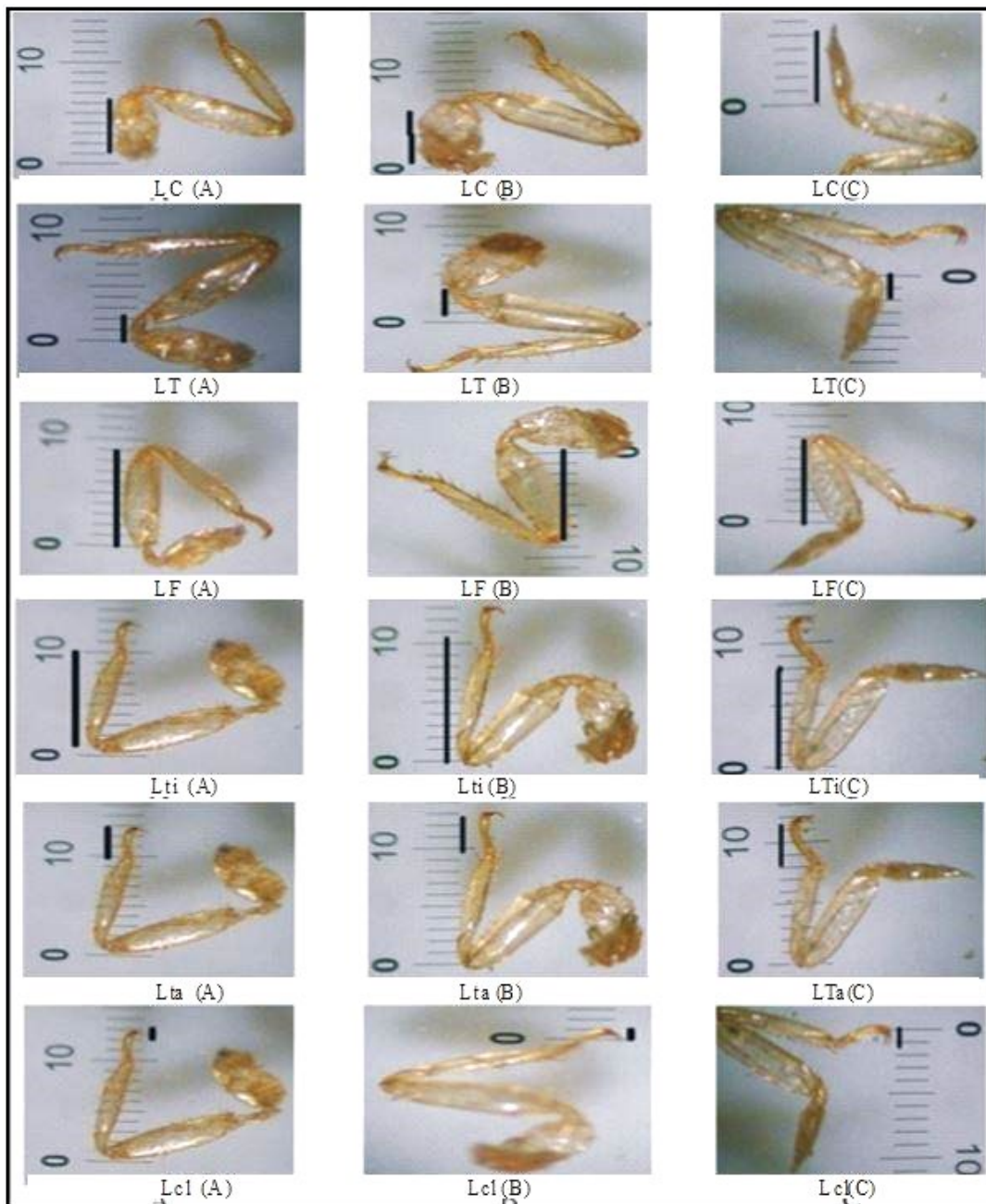


Figure 6. Variations in length of front leg (coxa (LC), trochanter (LT), femur (LF), tibia (LTi), tarsus (LTa), claw (LCI) (μm) of soldiers of *O. obesus* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad).

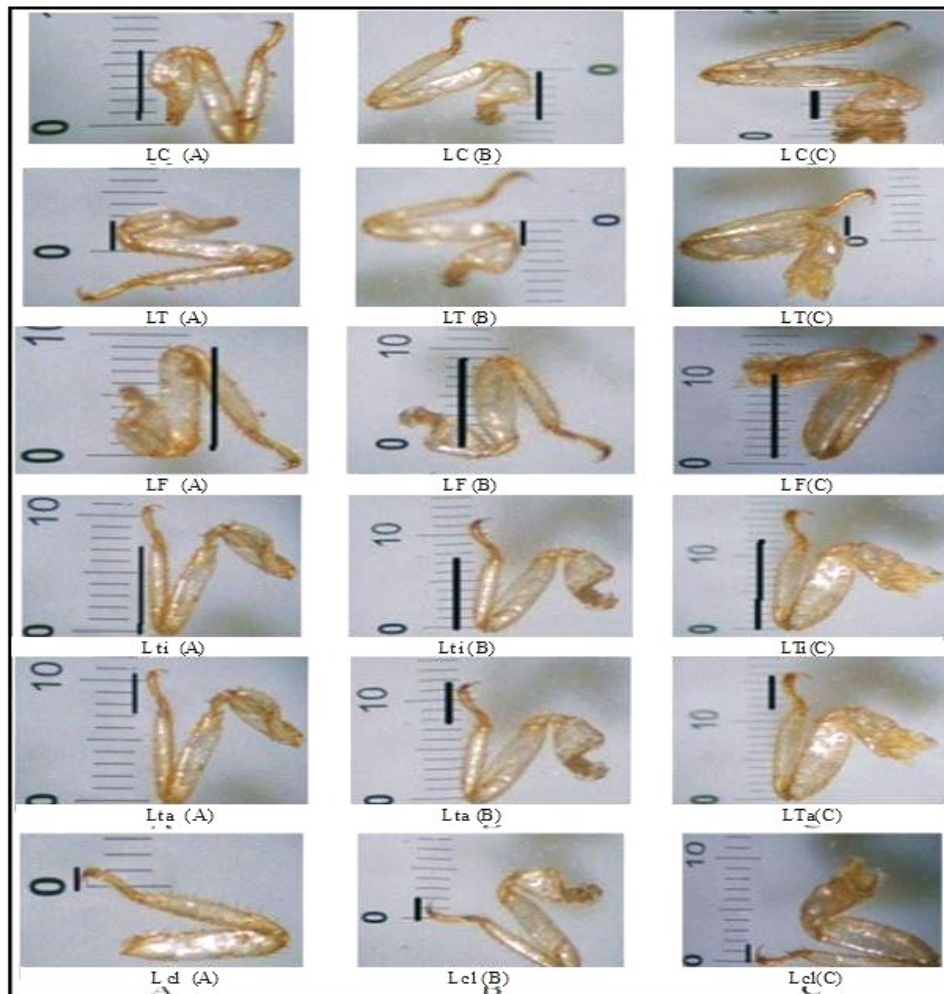


Figure 7. Variations in length of middle legs coxa (LC), trochanter (LT), femur (LF), tibia (Lti), tarsus (LTa), claw (Lcl) (μm) of soldiers of *O. obesus* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad).

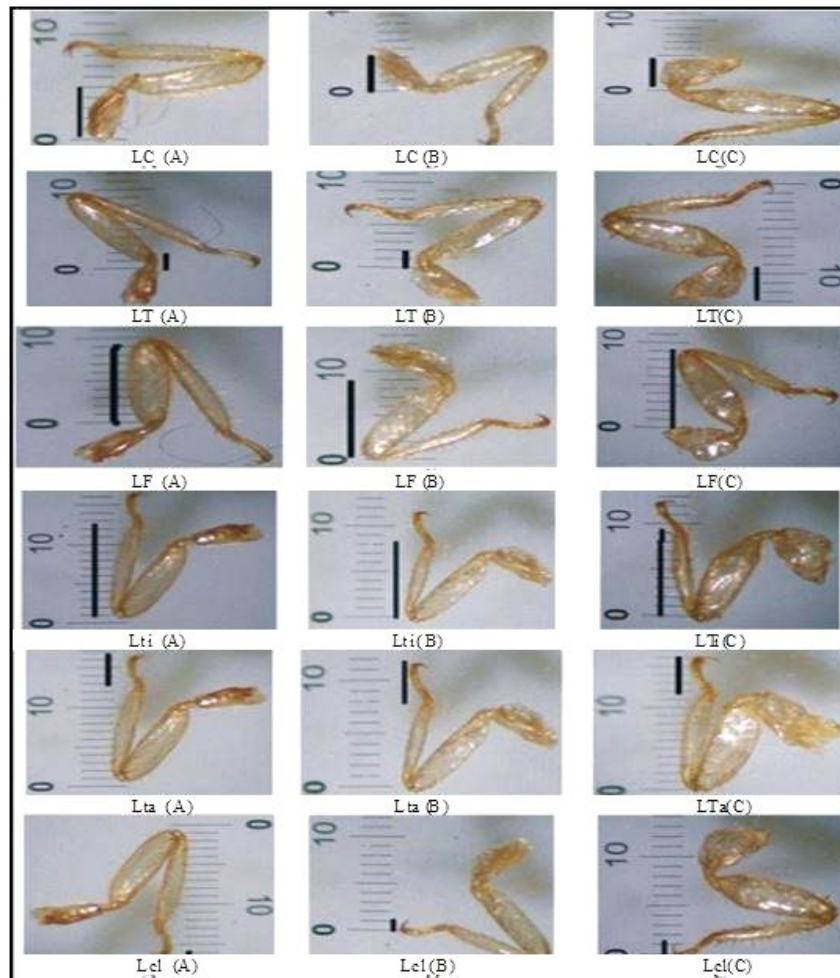


Figure 8. Variations in length of hind leg coxa (LC), trochanter (LT), femur (LF), tibia (Lti), tarsus (Lta), claw (Lcl) (μm) of soldiers of *O. obesus* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad).

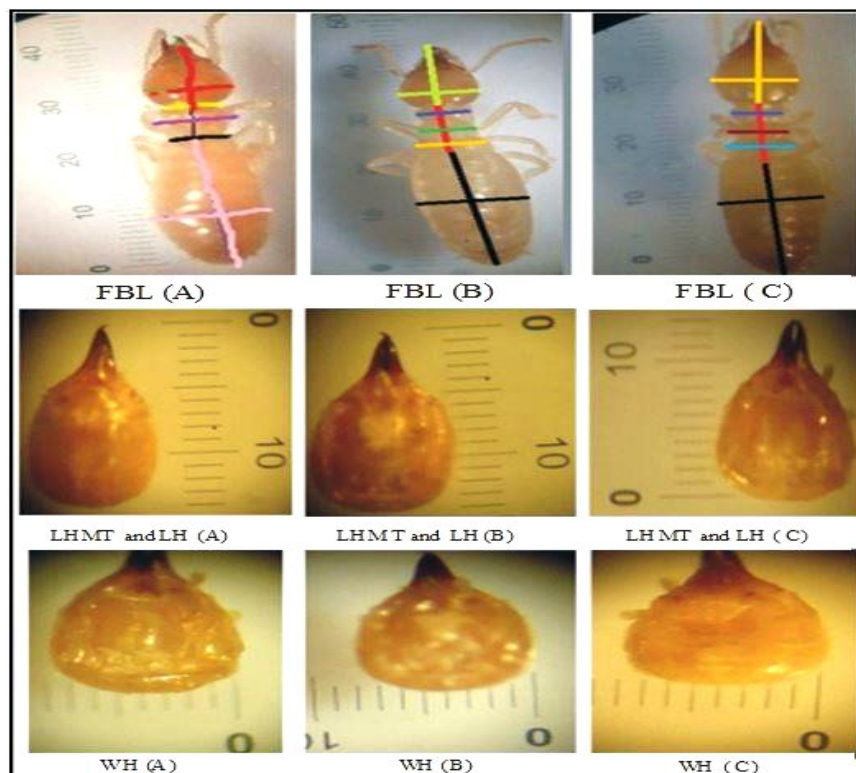


Figure 9. Variations in full body length (FBL), length of thorax (LT) (Prothorax, mesothorax, metathorax) (μm), length of abdomen (LA) (μm) and length from head to mandible tip(LHMT) (μm), length of head (LH) (μm) and width of head (WH) (μm) of soldiers of *M. obesi* from site A (Gujar khan), site B (Rawalpindi) and site C (Islamabad).

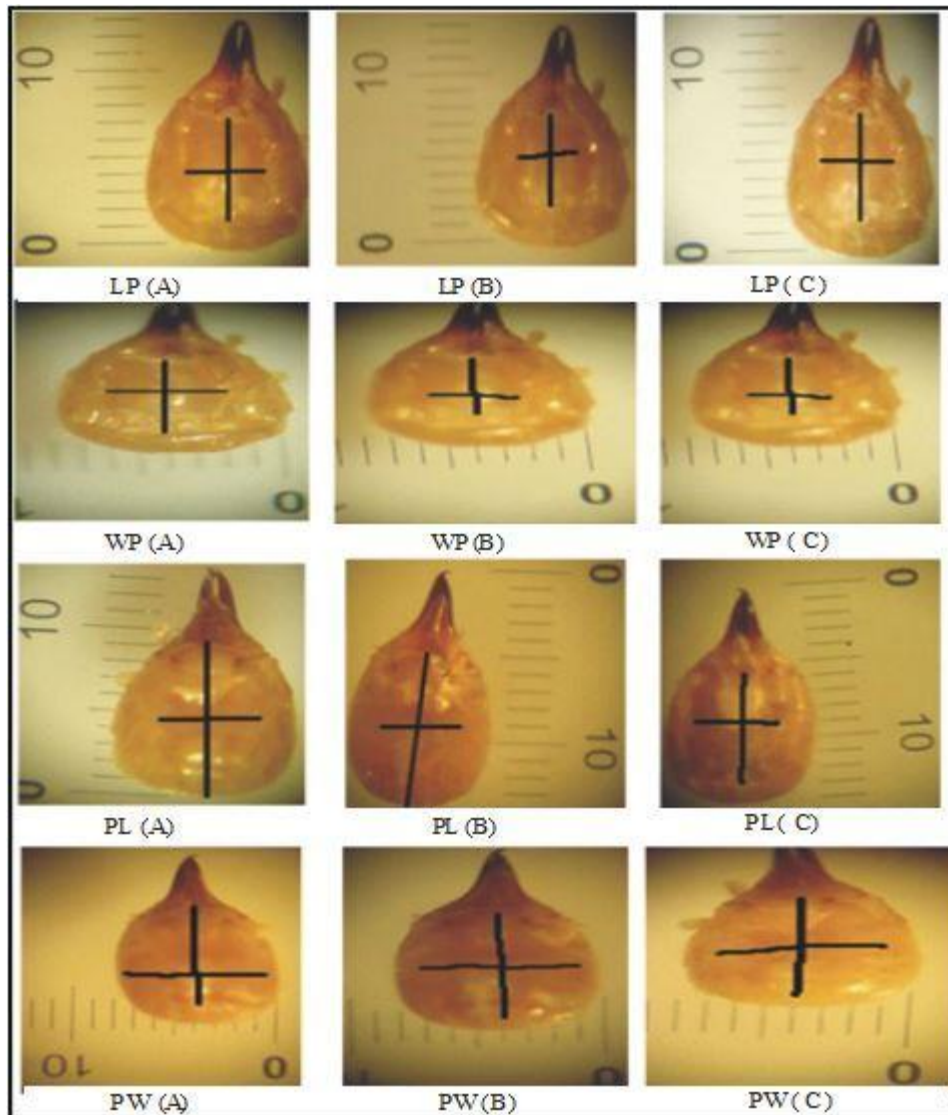


Figure 10. Variations in length of pronotum (LP) (μm), width of pronotum (WP) (μm), postmentum length (PL) (μm) and postmentum width (PW) (μm) of soldiers of *M. obesi* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad).

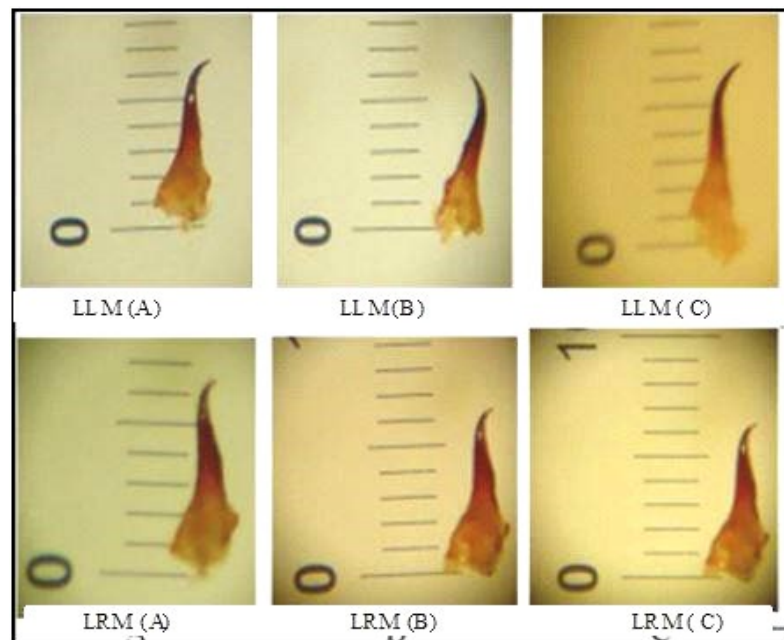


Figure 11. Variations in length of left mandible (LLM) (μm), length of right mandible (LRM) (μm) and length of tooth on left mandible (LTM) (μm) of soldiers of *M. obesi* from site A (Gujar khan), site B (Rawalpindi) and site C (Islamabad).

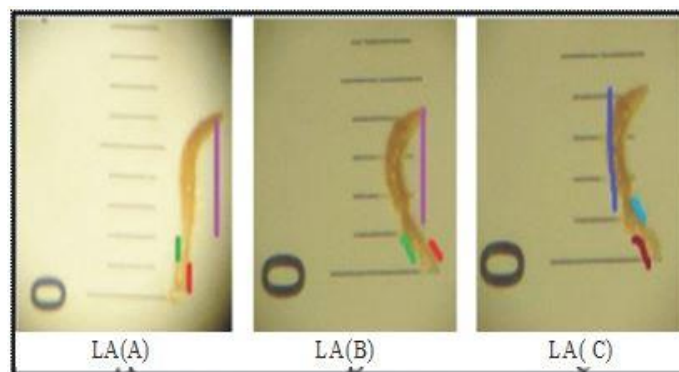


Figure 12. Variations in length of antenna (LA) (scape, pedicel, flagellum) (μm) of soldiers of *M. obesi* from site A (Gujar khan), site B (Rawalpindi) and site C (Islamabad).

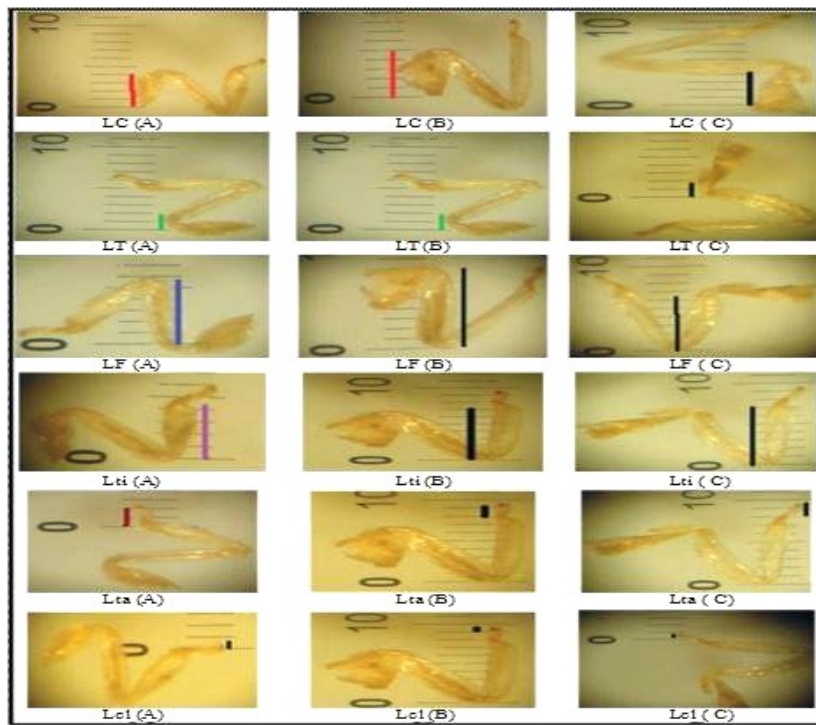


Figure 13. Variations in length of front leg (coxa (LC), trochanter (LT), femur (LF), tibia (LTi), tarsus (LTa), claw (Lcl) (μm) of soldiers of *M. obesi* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad).

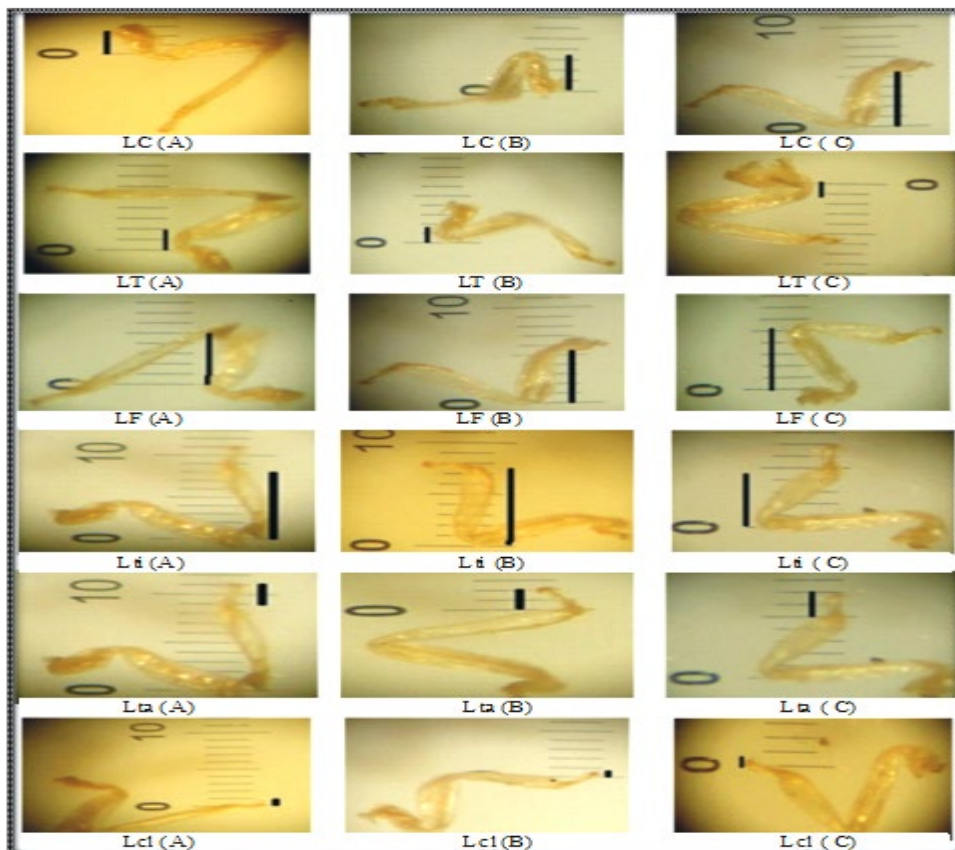


Figure 14. Variations in length of middle legs coxa (LC), trochanter (LT), femur (LF), tibia (LTi), tarsus (LTa), claw (Lcl) (μm) of soldiers of *M. obesi* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad).

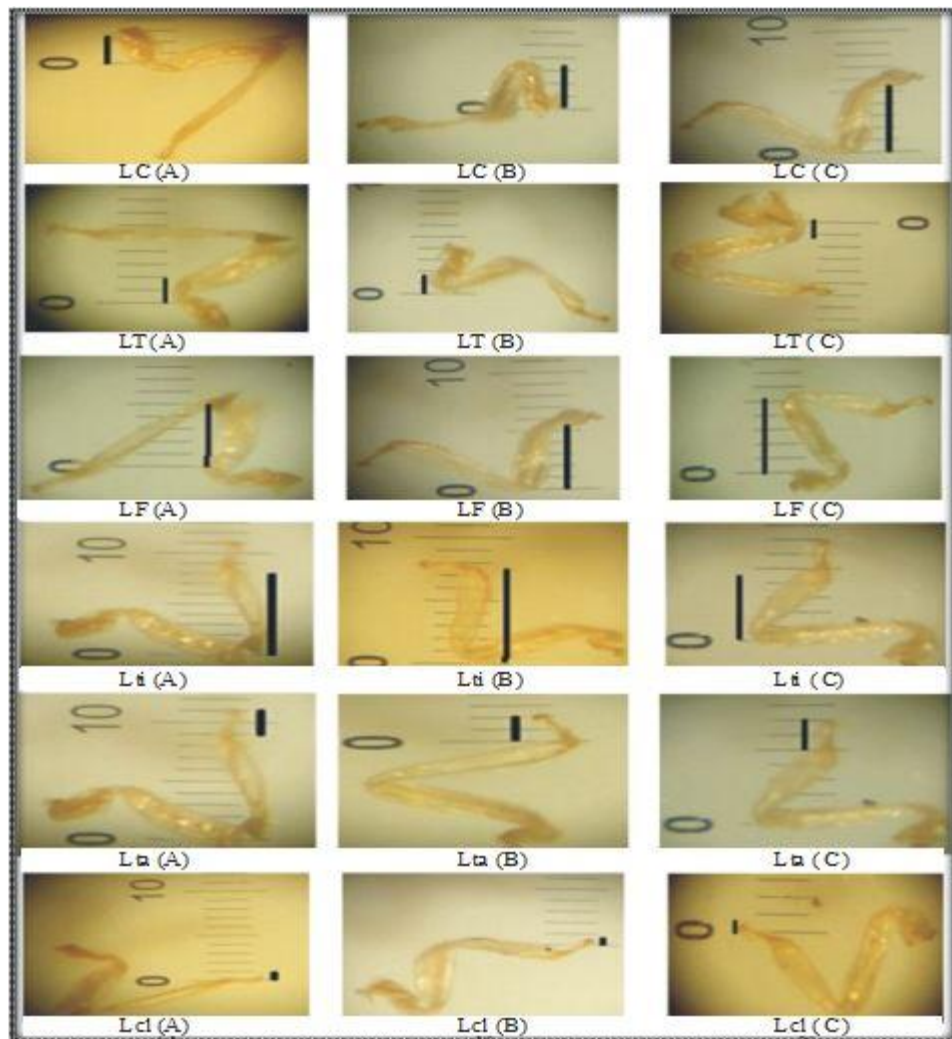


Figure 15. Variations in length of hind leg coxa (LC), trochanter (LT), femur (LF), tibia (Lti), tarsus (Lta), claw (Lcl) (μm) of soldiers of *M. obesi* from site A (Gujar Khan), site B (Rawalpindi) and site C (Islamabad).