Morphometric Analysis of Population Samples of Soldier Caste of *Odontotermes takensis* Ahmad (Isoptera: Termitidae: Macrotermitinae)

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Abstract.- In order to study morphometric variations in *Odontotermes takensis* Ahmad, soldiers from the samples collected by Dr. Muzaffar Ahmad, Professor Emeritus, Department of Zoology, University of the Punjab, Lahore, were used. For each individual soldier, the following ten parameters were measured: i) length of head to side base of mandibles ii) width of head to side base of mandibles iii) width of head at the posterolateral ends of antennal carinae iv) maximum width of head v) length of left mandible vi) tooth of left mandible from tip vii) length of Pronotum viii) width of pronotum ix) length of postmentum. x) width of postmentum. The mean values of different parameters of different population samples were compared with the help of Student's `t' test. In addition to this population samples for the species collected from geographic range of the species have been compared according to Manhattan Distance (Mayer and Ashlock, 1991) to highlight similarities and differences of the population samples. Specimens from locality 'A' (Sarawak, Bako) and 'E' (Malaya, Terenganu) are distantly related to specimens from other localities.

Key words: Termite, soldier caste, morphometric variability, *Odontotermes takensis*.

INTRODUCTION

*O*dontotermes *takensis* Ahmad was described by Ahmad (1965) from Thailand. Later on, it was collected from Indonesia and Malaysia. This species is not found in Pakistan. Morphological features of termites are very important in their taxonomy and classification. Only a few studies on morphometric variation in termites have been made (Ahmad, 1949; Roonwal, 1970; Chhotani and Das, 1979; Chhotani, 1981; Akhtar and Anwar, 1991; Akhtar and Ahmad, 1991; Coronel and Porcel, 2002). As the species exists in various forms, relationship amongst the population samples are described in this report for the first time using Manhattan distance (Mayr and Ashlock, 1991).

The morphometric analysis of *O. takensis* Ahmad presented in this paper will provide a standard of comparison for specimens from different localities of the range of that species and other species of the genus. The photographs of the specimens have also been prepared to present exact morphological appearance of various taxonomic characters. The objective of this work is to contribute to a better taxonomic knowledge of this species by means of the study of the intracolonial and intercolonial variations in the soldier caste.

MATERIALS AND METHODS

The present study is based on the following preserved material available in the collection of Dr. Muzaffar Ahmad, Professor Emeritus, Department of Zoology, University of the Punjab, Lahore.

Material examined
The material examined was collected from the following localities:

Indonesia
Sumatra: Lankat Reserve, near Bukit Lawang (latitude 10°30'S, longitude 100°00'E), soldiers and workers, collected by D.H., A.C. and K.M.C. Kistner, H.R. and J.A. Jacobson, N. Dondo from nest T-887, 9-7-1977, determined by Ahmad and Akhtar.

Malaysia
Sarawak: Bako (latitude 1°40'N, longitude 110°22'E), soldiers and workers, collected by M.

Ahmad, from a log, 28-6-62, determined by M.B. Sheikh, checked by M. Ahmad.

Sarawak: Sabal Tapang (latitude 1°10'N, longitude 111°00'E), soldiers and workers, collected by M. Ahmad, from a log, 26.6.62, determined by M.B. Sheikh, checked by M. Ahmad.

Malaya: Sungei Lalang (latitude 3°00'N, longitude 103°19'E), soldiers and workers, collected by M. Ahmad, from a log, 2.5.62; determined by M.B. Sheikh, checked by M. Ahmad.

Malaya: Terenganu, 21 km W. Dungun, Bukit Bank, soldiers and workers, collected by D.H. and K.M.C. Kistner, H.R. Jacobson, N. Dondro, 27.7.1977, from forest reserve, nest, T-928, determined by Ahmad and Akhtar.

Malaya: Negrisembilan, 1 mi. S. Telok Kemang, 8 mi. S. Porr Dickon, soldiers and workers, collected by D.H. Kistner from ex-Nest in mound of T-649, 14.6.1973, determined by Ahmad and Akhtar.

Thailand

Tak (latitude 16°47'N, longitude 99°9'E), collected and determined by M. Ahmad, in a log, 16.4.1962.

Procedure adopted

Specimens from the samples were picked up at random and measured under stereoscopic binocular microscope with built in magnification changer. Measurements were taken with the aid of calibrated ocular micrometer. Diagrams of the mandibles and postmentum were prepared by Olympus binocular with attached camera lucida.

Taxonomic terms and measurements used in the present study are as explained by Emerson (1945, 1952), Ahmad (1965) and Akhtar (1975). Population samples of the species collected from the geographic range of the species have been compared according to Manhattan Distance (Mayr and Ashlock, 1991) to highlight similarities and differences of the population samples. For Manhattan distance data matrix, the character states of each character were coded on the basis of frequency distribution of specimens of the pooled data.

For estimating the Manhattan distance, ranges were coded as three characters; Character range of

the maximum number of individuals was coded as 1, less than this range as 0 and more than that range as 2. Later on, some of the absolute differences between the characters states of each character for each possible pair of population samples collected from different localities were worked out.

Statistical analysis

The data were statistically analyzed for mean, standard deviation, standard error, coefficient of variability and confidence interval (95%) and analysis of variance (Model II ANOVA), The mean values of the different population samples were compared with the help of Student 't' test according to Minitab version.

RESULTS AND DISCUSSION

Soldier

The soldier of *O. takensis* Ahmad is characterized by uniformly colored antennae; head sub rectangular, slightly longer than broad, lateral margin weakly convex. Mandibles short, stout; left mandible with a small, laterally directed tooth situated a little anterior to middle; Postmentum moderately arched, about one and a half times as long as broad, broadest in middle; lateral margins convex.

Internest comparisons revealed that there were significant differences for the parameters; length of head to side base of mandibles ('t'-value, 3.97; d.f., 18; P<0.001); width of head to side base of mandibles ('t'-value, 7.97; d.f., 18; P<0.001); width of head at the posterolateral ends of antennal carinae ('t'-value, 4.54; d.f., 18; P<0.001); maximum width of head ('t'-value, 10.36; d.f., 18; P<0.001); length of left mandible ('t'-value, 5.42; d.f., 17; P<0.001); length of pronotum ('t'-value, 6.59; d.f., 17; P<0.001); width of pronotum ('t'-value, 12.81; d.f., 18; P<0.001); length of postmentum ('t'-value, 3.20; d.f., 18; P<0.001) and width of postmentum ('t'-value, 8.42; d.f., 18; P<0.001).

Length of left mandible, varied from 0.77-0.85 mm, tooth of left mandible also varied from 0.30-0.35 mm and most of the samples showed overlapping. Highest tooth distance was recorded for sample from locality A (Indonesia: Sumatra) and

E (Malaya: Terrenganu). It was also revealed that samples are more variable for width of head to side base of mandibles (C.V. = 8.97). Cluster analysis reveals that specimens from locality B (Malaya: Sarawak) and D (Malaya: Sungei Lalang) are more closely related than specimens from other localities (Fig. 1).
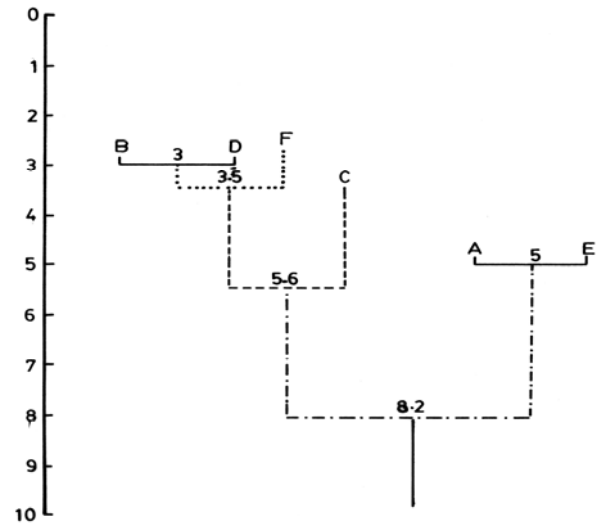

Fig. 1. Phenogram : Manhatten distance of the soldier samples of *O. takensis* Ahmad. Primary clusters are indicated by solid lines, secondary clusters by dotted lines and tertiary clusters by dashed lines. Quartnary clusters are indicated by dashed-dotted line

Some variation exists in specimens collected from different localities. Head in specimens collected from Sumatra (A) and Bako, Sarawak (B) is slightly elongately oval. In specimens collected from Sumatra (A) and Terenganu (E) head to side base of mandible is narrower than those of Thailand (0.65-0.75 mm vs. 0.80-0.85 mm).

Cluster analysis
Manhattan distance reveals that population sample from locality B (Malaysia: Sarawak) and D (Malaysia: Sungei Lalang) form first primary cluster at value of 3, A (Indonesia: Sumatra) and E (Malaysia: Terenganu) form second primary cluster at value of 5. Sample F (Malaysia: Negerisembilan) joins BD at value of 3.5 to form secondary cluster. Sample C (Malaya: Sarawak) joins BDF at value of 5.6 to form another cluster. Pair AE joins BDFC at

an average value of 8.2, the level at which last separate clusters are joined (Fig. 1).

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Table I.- **Internest morphometric variations in the taxonomic parameters, Length of head to side base of mandibles (I), Width of head at side base of mandibles (II), Width of head at the posterolateral ends of antennal carinae (III), Maximum width of head (IV), Length of left mandible (V), Tooth of left mandible from tip (VI), Length of pronotum (VII), Width of pronotum (VIII), Length of postmentum (IX), Width of postmentum (X).**

Nest Sample	N	I	II	III	IV	V	VI	VII	VIII	IX	X
A	10	1.508± 0.0231 ^{a}	0.6870± 0.0146 ^{a}	1.05± 0.0169 ^{a}	1.3560± 0.0179 ^{a}	0.7910± 0.0124	0.3480± 0.0013 ^{a}	0.5690± 0.0098 ^{a}	0.9410 ±0.0164	0.8280± 0.0098 ^{a}	0.6340± 0.0060 ^{a}
B	10	1.450± 0.0186 ^{ab}	0.8070± 0.0122 ^{b}	1.045± 0.0164 ^{ab}	1.2030± 0.0092 ^{b}	0.8260± 0.0102 ^{ab}	0.3040± 0.0027 ^{b}	0.5180± 0.0096 ^{b}	0.9070 ^{a} ±0.0181 ^{ab}	0.8720± 0.00100 ^{b}	0.6060± 0.0030 ^{ab}
C	10	1.404± 0.0148 ^{cf}	0.7950± 0.0121 ^{c}	1.041± 0.0124 ^{abc}	1.13200± 0.0086	0.7990± 0.0139 ^{abc}	0.30± 0.00 ^{abc}	0.5100± 0.0067 ^{bc}	0.8640± 0.0031 ^{c}	0.8590± 0.0096 ^{abc}	0.6150± 0.0050 ^{abc}
D	5	1.434± 0.0225 ^{abcdf}	0.8060± 0.0098 ^{bcd}	1.070± 0.0122 ^{abcd}	1.2020± 0.0120 ^{bd}	0.8280± 0.00970 ^{acd}	0.0219± 0.0098 ^{bcd}	0.5340± 0.010 ^{bcd}	0.8660± 0.0040 ^{bc}	0.8760± 0.0060 ^{bcd}	0.5480± 0.0080 ^{c}
E	10	1.388± 0.0195 ^{cde}	0.6810± 0.0100 ^{a}	1.111± 0.0091 ^{a}	1.3310± 0.0162 ^{a}	0.7800± 0.0105 ^{ac}	0.3490± 0.0010 ^{ac}	0.5480± 0.010 ^{bcd}	0.9720± 0.0079 ^{ae}	0.8660± 0.0027 ^{bcde}	0.6130± 0.0052 ^{ab}
F	9	1.414± 0.0355 ^{bcdf}	0.7956± 0.0144 ^{bcd}	1.066± 0.0105 ^{abcd}	1.1789± 0.0177 ^{bf}	0.8555± 0.0073 ^{bd}	0.3178± 0.0068 ^{bdc}	0.4878± 0.0070 ^{bcd}	0.9478± 0.0120 ^{abe}	0.87566± 0.0065 ^{bcde}	0.58560.0 ± 0.0065
G	1	1.51	0.82	1.09	1.22	0.77	0.33	0.51	0.90	0.84	0.51

Values given are Mean ± S.E.M, and those sharing similar letters within a respective column indicate non significant differences. Single factor ANOVA; P>0.05 (at 95% confidence limit).