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STUDIES ON CASTE POLYMORPHISM IN A HIGHER TERMITE *MICROCEROTERMES CHAMPIONI* SNYDER (TERMITIDAE: AMITERMITINAE)

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Abstract.- In *Microcerotermes championi* Snyder worker develops after five larval instars. The origin of soldier takes place from third instar worker larva which after three moults changes into soldier. Adult soldiers are without styli.

The alates develop from first instar worker larvae and undergo six moults to become adult. Sexual dimorphism is found in alates. The males are smaller than the females and in both the styli are absent.

In worker line, brain area, visible from dorsal side, decreased with development; whereas in the alate brain area increased from first to 5th instar nymph stage.

INTRODUCTION

The ability of an aniaml to exist in two or more morphological forms is referred to as polymorphism. Feytaud (1912), Goetsch (1946) and Pickens (1932) suggested that all individuals possessed equal potential and were alike at hatching, and that specific caste development for a given proportion of colony depended on extrinsic factors such as selective nutrition, influential exudates or environmental factors.

Lot of work is now available in different parts of the world on caste polymorphism (Noirot, 1969; Luscher, 1976l Okot-Kotber, 1981; Sewell and Watson, 1981). Unfortunately, little work has been done in Pakistan on polymorphism of termites. *Bifiditermes beesoni* is the only species whose developmental pathways have been described so far (Afzal, 1981). In addition to this, 49 species of termites occur in Pakistan (Akhtar, 1974), and nothing is known about their developmental pathways.

In the present paper developmental pathways of *Microcerotermes championi*, based on field colony, are described for the first time.

DESCRIPTIONS

Worker line

The developmental stages are characterized in Table I, and can be determined on the basis of measurements. Besides, the antennal segments help to some extent in early stages of development. Differentiation of the mandibular teeth is complete by the third larval instar (Fig. 1). Styli are present in all the stages, but are absent in workers.

In *Microcerotermes championi*, the worker passes through five larval instars. The frequency distribution of different characters of larval stages is shwon in (Figs. 2,3,4). Total body length provided an excellent basis for isolating different stages, which were further characterized by examining the mandibular differentiation and sclerotization of teeth.

TABLE I.- THE WORKER LINE DELIMITATION OF STAGES.

Stage	Qualitative characters
L1 (First Instar): Antennae 12 segmented;	Head and abdomen white; mandibles with apical and first marginal teeth very weakly indicated; brain area, visible through cuticle, very large, occypying whole of the head.
L2 (Second Instar): Antennae 12 segmented;	Head and abdomen white; brain area much reduced, half of first instar; left mandible with apical and first marginal teeth distinct; styli present.
L3 (Third Instar): Antennae 12 segmented;	Head and abdomen whitish; brain area much reduced; mandibles weakly pigmented, differentiation of different teeth almost complete; styli much reduced.
L4 (Fourth Instar): Antennae 12 segmented;	Head slightly darker than abdomen; head with lateral sides semi parallel; mandibles more strongly pigmented, differentiation of teeth more pronounced; styli slightly indicated.
L5 (Fifth Instar): Antennae 13 segmented	Head darker than abdomen; lateral side of postclypeus dark brown; mandibles strongly developed, teeth dark brown with blackish tinge.
Worker: Antennae 13 segmented;	Head yellowish brown; with lateral sides semi parallel, slightly narrowing posteriorly, mandibles dark brown, teeth with blackish tinge, styli absent.

Alate line

The developmental stages are characterized in Table II. The alate line orignated from the first instar worker larvae, and after six moults the alate develops (Fig. 5).

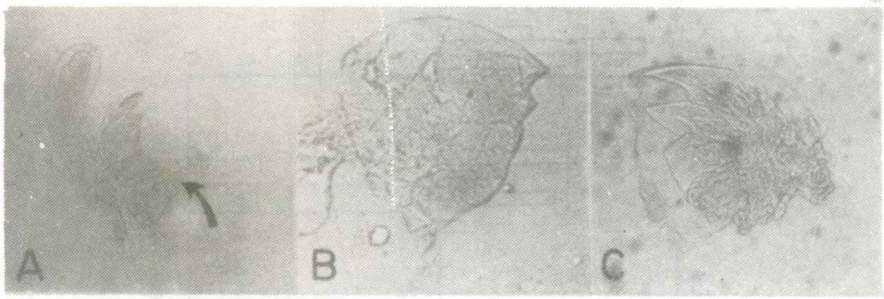

Fig. 1. Stages of mandibular development in larvae during worker differentiation: (A), First instar larva, (B), Second instar larva; (C). Third instar larva. X 100.

The frequency distribution of body length in nymphal instars of alate caste is illustrated in Fig. 6.

TABEL II.- THE ALATE LINE DELIMITATION OF STAGES.

Stage	Qualitative characters
N1: Antennae 12 segmented	Head and abdomen whitish, brain area much reduced; mandibles with apical and first marginal teeth slightly indicated; meso and metathorax with minute wing pads (Fig. 5).
N2: Not found	
N3: Antennae 13 segmented	Head and abdomen whitish; brain area broader than first instar; teeth of mandibles pigmented; meso and meta thorax with distinct wing pads.
N4: Antennae 13 segmented	Brain area much larger than third instar nymphs; differentiation of teeth more pronounced, more darkly pigmented; wing pads longer than third instar nymphs.
N5: Antennae 13 segmented	Brain large, occupying the whole area between antennae; wing pads whitish, extending upto 1/4 of abdomen; eyes weakly indicated.
N6: Antennae 13 segmented	Head round, light brown brain not visible through cuticle of head; eyes well developed; teeth of mandible dark brown; wing pads extending upto 2/3 of abdomen.

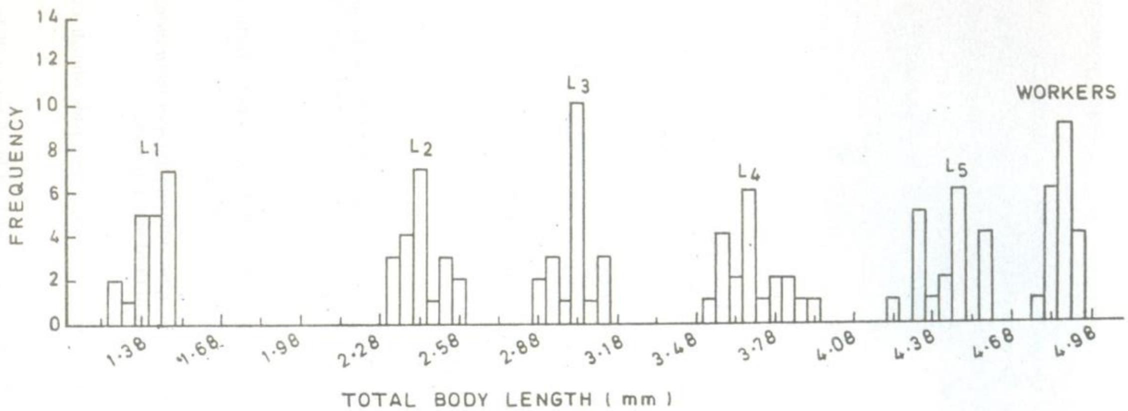

Fig. 2. Frequency distributions of total body length in larval and worker stages of *Microcerotermes championi*.

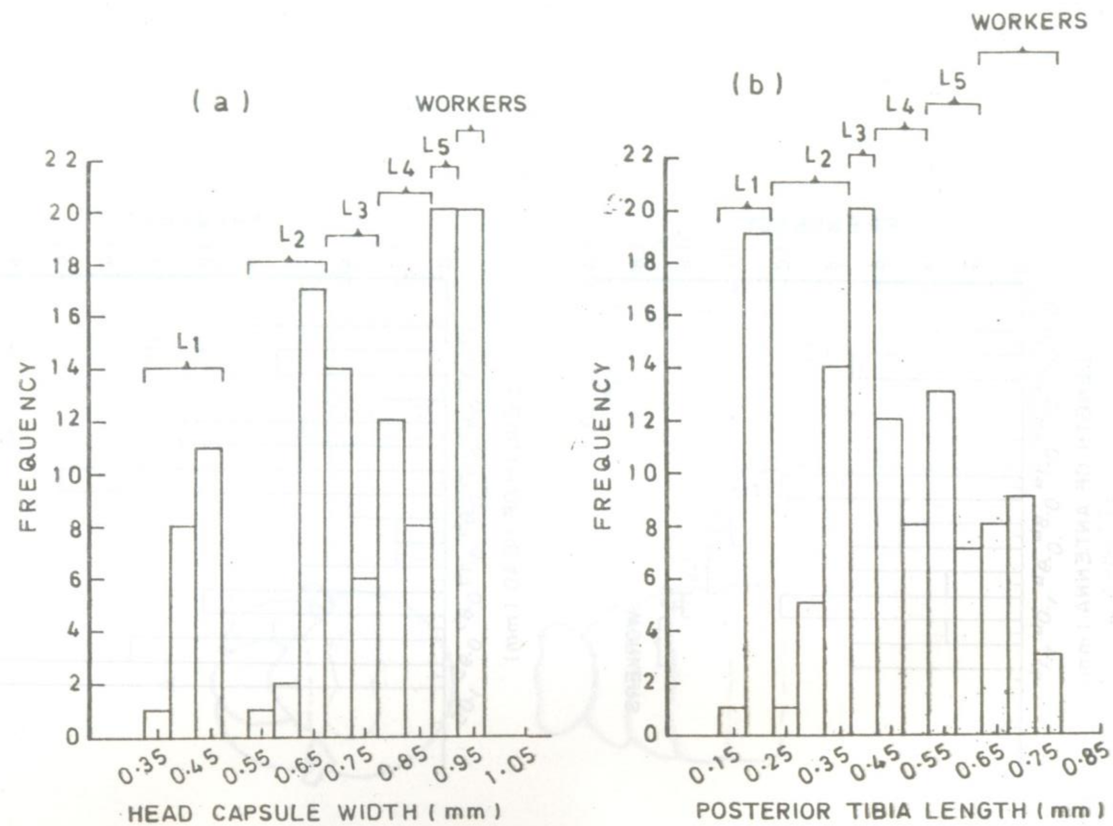

Fig. 3. Frequency distribution in larval and worker stages of *Microcerotermes championi*; (a). Head capsul width; (b). Posterior tibia length. Group interval = 0.04 mm.

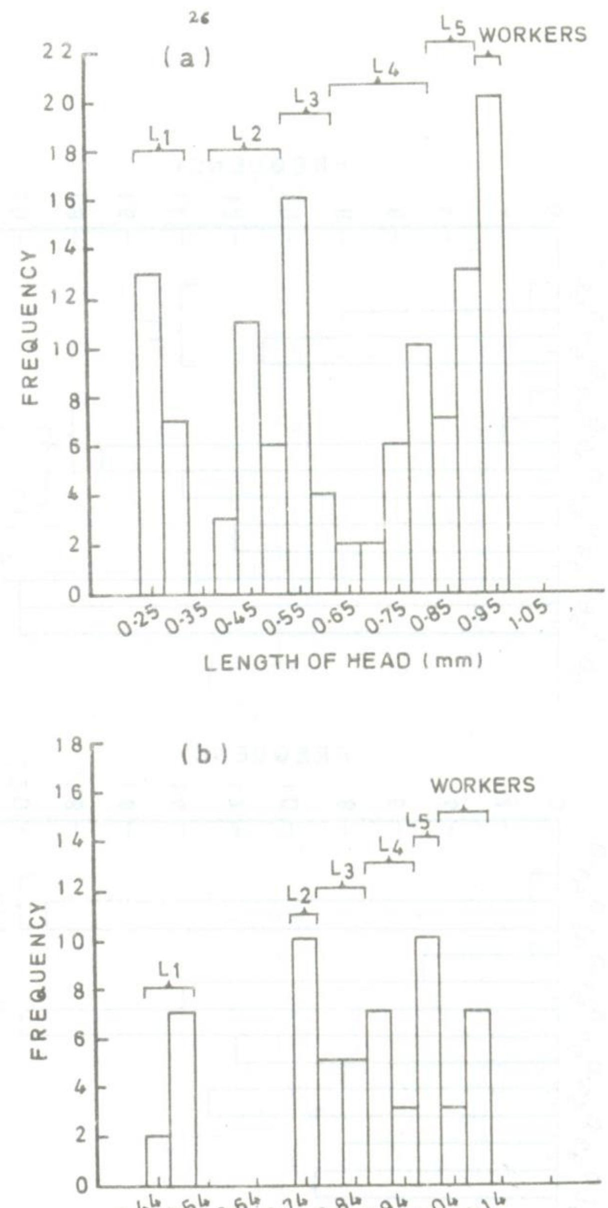

Fig. 4. Frequency distributions of larval and worker stages of *Microcerotermes championi*; (a), Length of head; (b), Length of antennae. Group interval = 0.04 mm.

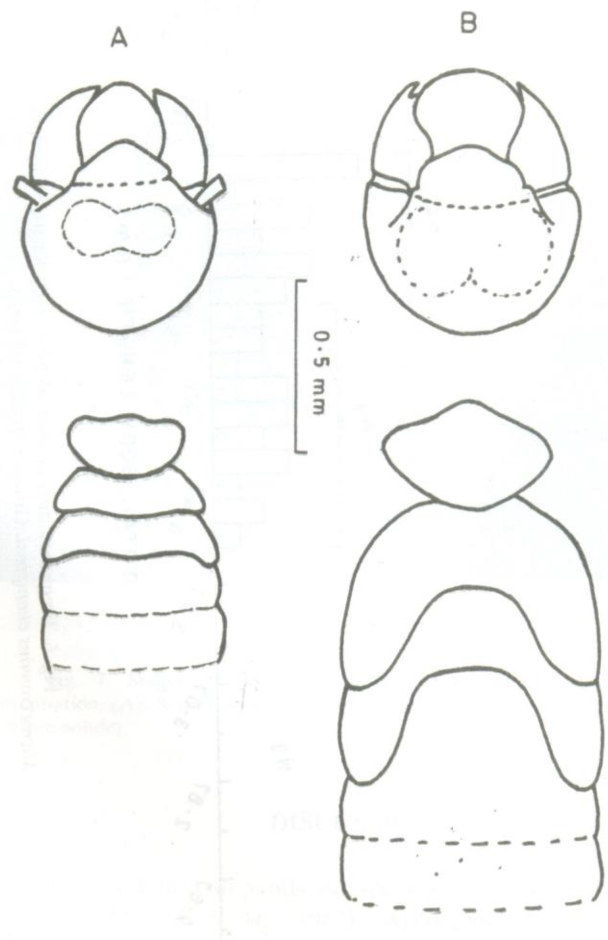

Fig. 5. Nymphal stages of *Microcerotermes championi*; (A), First instar nymph; (B), Third instar nymph.

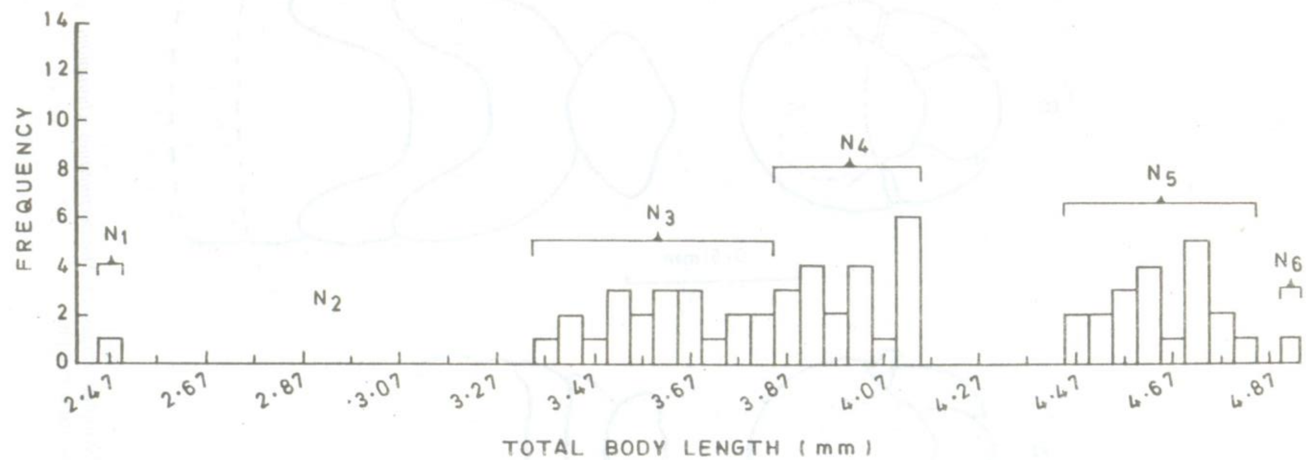

Fig. 6. Frequency distributions of total body length in nymphal stages of *Microcerotermes championi*. Group interval = 0.01 mm.

Soldier line

First instar soldier was not found in the collection. The second instar presoldier was quite advanced in mandibular pattern and possessed 13 article antennae (Fig. 7). It is possible that first presoldier originates from the third instar worker larvae and then after four moults changes into soldier. Head length helped in the delimitation of various stages, but width of head was not reliable (Fig. 8).

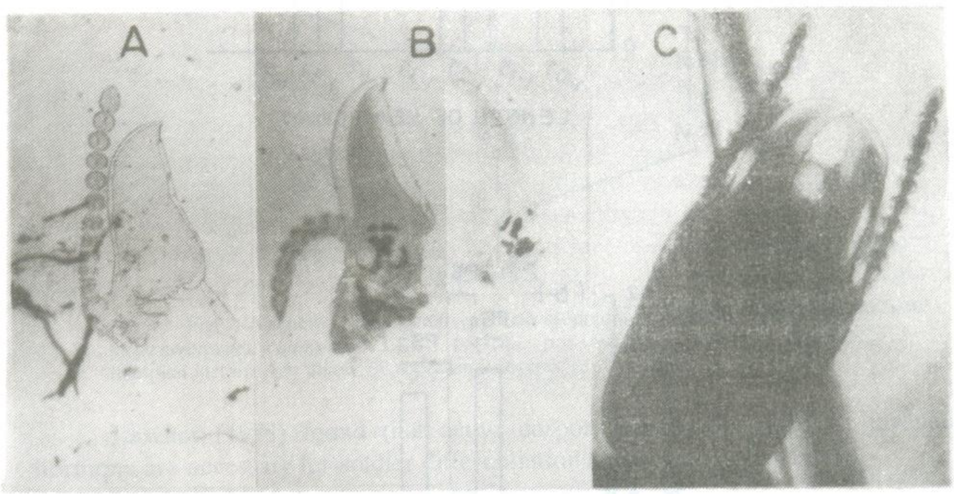

Fig. 7. Stages of mandibular development in larvae during soldier differentiation: (A); Second instar; (B). Early third instar pre-soldier; (C). the third instar pre-solider.

DISCUSSION

Caste differentiation depends on specific "trigger", stimuli acting during sensitive period (Dewild *et al.*, 1982). According to Hadron (1967), caste differentiation is the programming of developmental poteintial by activation of specific genes. Juvenile hormone (JH) is at the base of this control in caste polymorphism. Extrinsic control of caste determination is mediated through the environmental impact of juvenile hormone.

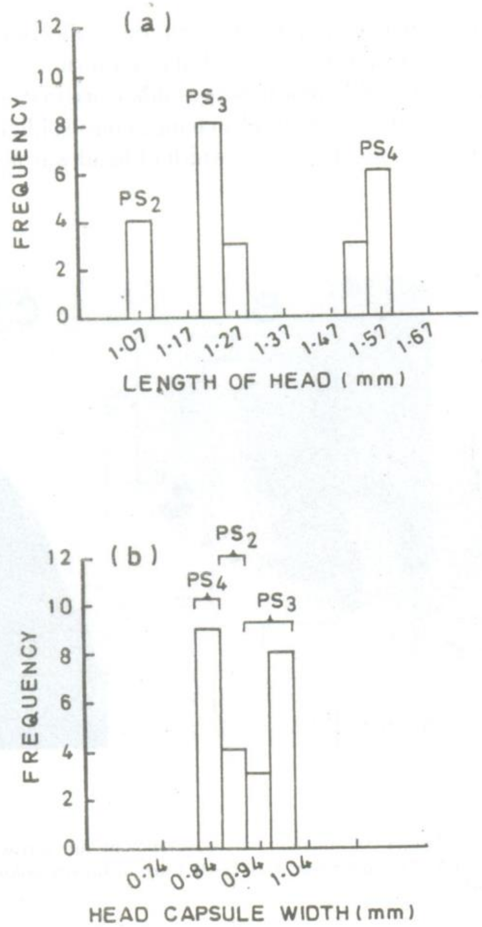

Fig. 8. Frequency distributions of (a). Length of head; (b). Head capsule width, in different stages of soldier caste of *Microcerotermes championi*. Group interval = 0.04 mm.

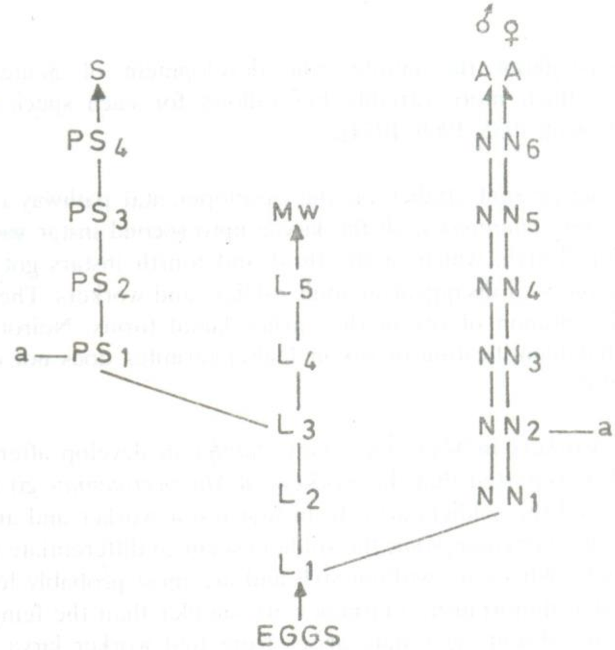

Fig. 9. A scheme of post-embryonic development in a mature field colony of *Microcerotermes championi*. L_1-L_5. PS_1-PS_4. pre-soldier; S. soldiers; NN_1-NN_6, nymphal instars, AA, alates. 'a' represents absence of that instar.

Luscher (1958) found that active corpora allata which secrete juvenile hormone are necessary for soldier differentiation in *Kalotermes flavicollis*.

Lebrun (1957, 1967a) confirmed that if corpora allata are transplanted even in nymphs, soldier differentiation may be induced in the recipients.

Luscher (1965) carried out further studies on corpora allata and reported that enlargement of corpora allata is known to occur in Kalotermes flavicollis during.

a) Development of imago
b) Formation of presoliders
c) Formation of neotenics

In case of higher termites the most characteristic pattern observed in all the species so far studied, is the visible separation, at the firt moult, of the sexual and neuter lines (Noirot, 1969). The development of the imaginal alates, through five nymphal instars after the undifferentiated first instar larva (Noirot, 1969), seems uniform throughout the family. The development of neuters (soldiers and workers) is much more variable but follows for each species a very definite pathway (Noirot, 1955, 1969, 1974).

During present studies on the developmental pathway of worker line of *Microcerotermes championi*, all the larvae upto second instar were provided with well developed styli, which in the thrid and fourth instars got greatly reduced. Ultimately, the styli disappear in adult soldiers and workers. The styli do not help in the differentiaion of sex in the earlier larval forms. Noirot (1955) has also reported that identification of sex in higher termites does not depend upon the presence of styli.

The workers in *Microcerotermes championi* develop after 5 larval moults. Noirot (1969) reported that the workers of *Microcerotermes* go through three or four stages and the soldiers arise from first instar worker and are always female. In *Microcerotermes championi*, the soldiers seem to differentiate from third instar larvae. Adult soldiers are without styli and are most probably females. In alates, there is sexual dimorphism and males are smaller than the females. In both the sexes styli are absent. The alate arises from first worker larva and the nymphs undergo six moults to develop into alates.

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