

## Morphological Study of Different Developmental Stages of *Brachytrupes megacephalus* Lefebvre, 1827 (Orthoptera, Gryllidae) and Their Development in Oued Righ Region (Algerian Sahara)

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**Abstract:** In the Southeast of the Algerian Sahara (Touggourt), a morphological study of *Brachytrupes megacephalus* was conducted during 2014. According to the damages caused by this cricket through deviation and loss of irrigation water due to deep tunnels dug and damage crops, we found it useful to identify the insect and study the external appearance of this cricket. The results show that *B. megacephalus* has an annual life cycle with five nymph stages. The mating season is placed normally from mid-March to mid-April. The eggs are with an ovoid shape and a greenish color measured by 3.5 to 4 mm, First nymph stage is with a transparent colors which has a pronotum measured between 1.5 and 2.2 mm with a head between 3 and 4,6 mm and the femur has a length of 5 to 6 mm. Unlike the other nymph stages are yellow-orange with a darker head than the rest of the body. The adults of this cricket have a pronotum of 5 to 6 mm, the head is between 13 to 14 mm and the femur is from 17 to 22 mm. All these post-embryonic development mature throughout the summer until September, during which the cricket becomes imago.

**Key words:** Cricket • Morphology • Pronotum • Femur • Nymph stages • Touggourt

### INTRODUCTION

*Brachytrupes megacephalus* is a cricket of the desert. This Orthoptera mainly attacks the plant roots and leaflets which can be a source of plant contamination by pathogens, such as: *Fusarium sp.*, *Phytophthora sp.*, *Thialaviopsis paradoxa* abundant in the study area [1]. It is announced in several localities in southern Algeria and Tunisia. This insect is also found in the sandy grounds of the Mediterranean coastline and more particularly in the irrigated crops. This lifestyle gave it the name of the “cricket of sands” [2]. Due to its current rarefaction in Europe, this species has been included in the Annexes II and IV of EU Directive 92/43 as a species requiring strict protection [3].

Few works was studied on this cricket which has been reported since the forties in several localities in southern Algeria [4] with morphological studies which

are mentioned by Chopard (1943) and Belarbi (1979). The biology of *Brachytrupes megacephalus* was studied by Forel (1893) and Valdeyron-Fabre [2] in Tunisia, Scortecci (1971) in Libya and Caltabiano *et al.*, (1982) in Sicily [5] and the diet was studied by Lakhdari *et al.*, (2015) [6]. It is vegetarian, hygrophilous, subterranean, nocturnal and homochromous with the substrate which has a remarkable morphology [7]. It has a spectacular power in swimming [8]. The same author notes that *B. megacephalus* has an annual life cycle with a reproduction period normally placed between mid-March and mid-April [3, 6].

However, few data are available on *B. megacephalus* in Algeria and around the world. That is why we aimed in this study to determine how many nymphal stages is containing this species of crickets, recognize and specify the morphological characters of *B. megacephalus* stages.

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## MATERIALS AND METHODS

**Experimental Site:** The study was conducted in the region of Sidi Mehdi, which is a large part of the oasis of Oued Righ valley. The area of Oued Righ is a valley situated in the Northeast of the Algerian Sahara (Fig. 1). It is a saharian region with a temperate winter (Fig. 2) and a hot summer. It covers a South-North axis whose latitude is 32°54' to 39°9' North and longitude 05°50' to 05°75' East [9].

The experiment was conducted in the Tama site, situated at the experimental station of Sidi Mahdi (INRAA), which is approximately 07 km of Touggourt on the road leading to the airport. The choice of this site was made with an aim of identifying the cultures attacked by *B. megacephalus*.

### Methods Used in Land

**Description of the Method of Barber Pots:** A Barber pot is simply made up of a container of any kind (Fig. 3), either

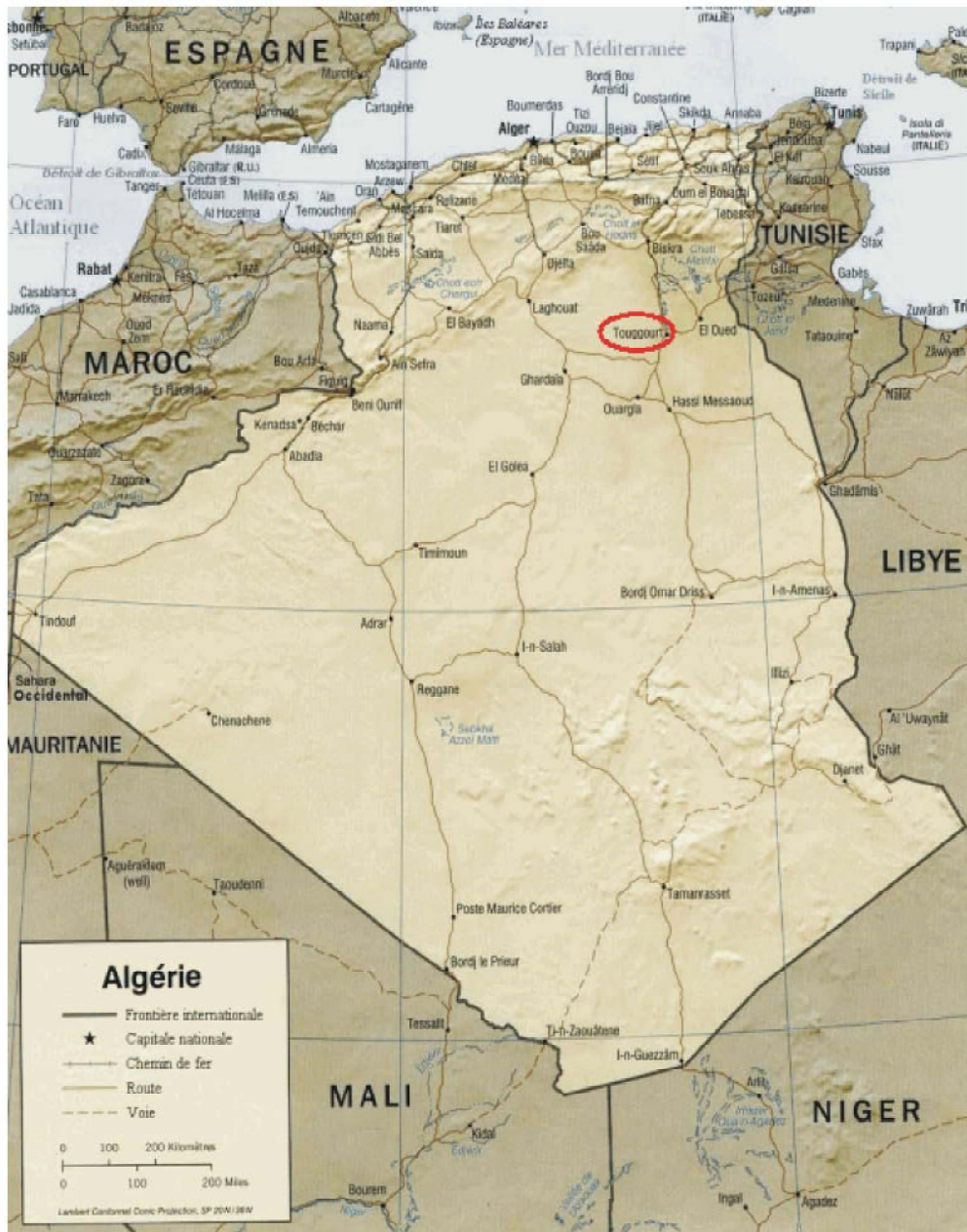


Fig. 1: Study site

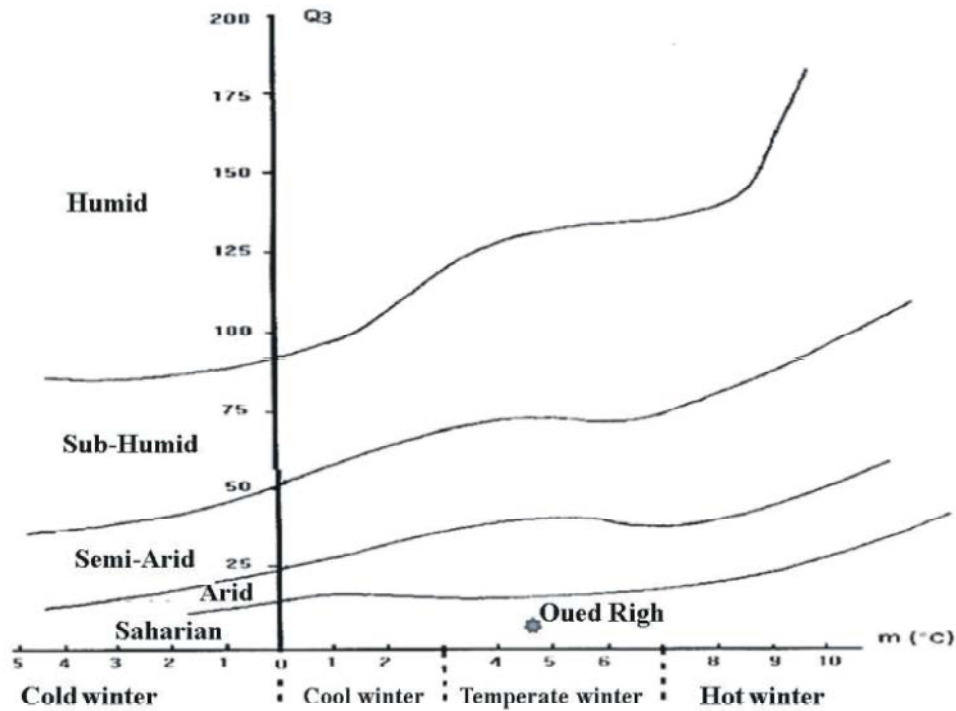


Fig. 2: Climatic gramme of EMBERGER (2005-2014)



Fig. 3: Barber Pot (Original)

a cup or even better metal canned cans having a volume equal to 01 dm<sup>3</sup>. These are inserted vertically, so that their top edges are at the ground level in order to facilitate the penetration of larvae of *B. megacephalus* circulating around. According to [10] filling pots up to 2/3 of their content with water mixed up with a liquid detergent (ISIS) would avoid putrefaction invertebrates fallen into the trap. The recovered insects are then brought to the laboratory for analysis.

**Methods Used in the Laboratory:** Upon capture, the individuals of *B. megacephalus* are brought to the laboratory for various morphometric measurements under binocular microscope, using a graph paper and a caliper. One hundred imagoes were used in this manipulation. Finally, the insects are killed by placing them in 70°

alcohol (denatured alcohol, said alcohol burn) and stored individually in bottles of alcohol numbered on which are specified by the date and place of sampling.

**Morphometric Study:** Different measures were performed on the imagoes of *B. megacephalus* in the laboratory.

- Width of the head (T) (Fig. 4A).
- Interocular space (EIO) (Fig. 4A).
- Length of the middle hull of the pronotum (P) (Fig. 4B).
- Femur length (F) (Fig. 4C).
- Body length (L) (Fig. 4D).

These body parts were chosen because they are strongly sclerotized and suffer no increase during inter-molts [3].

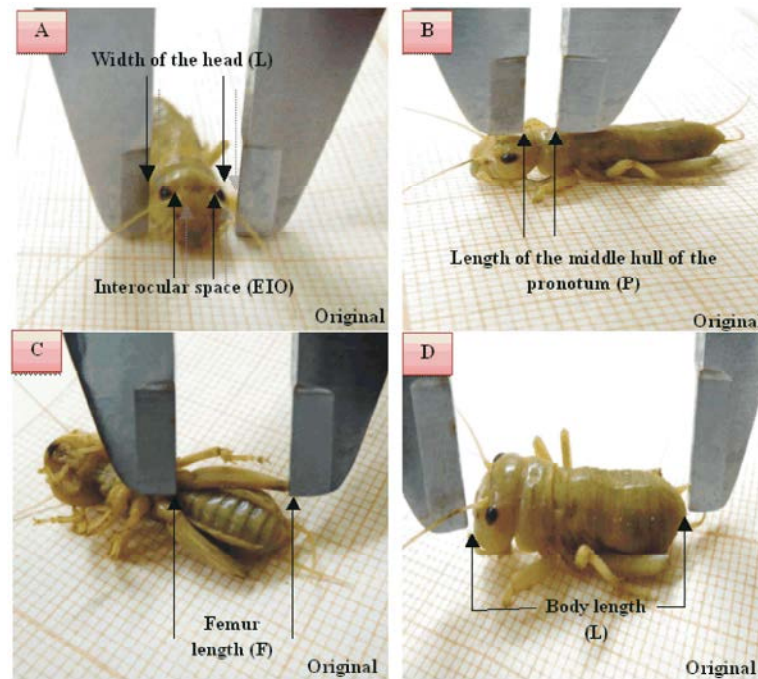


Fig. 4: Morphometric study of *B. megacephalus* larvae (A: Width of the head and Interocular space; B: Length of the middle hull of pronotum; C: Femur length; D: Body length) (Original)

Table 1: Designation reference table of nymphal stages (BELARBI 1979)

Nymphal stages	C+P+F
N1	15,8 mm
N2	18,26 mm
N3	22,6 mm
N4	27 mm
N5	33,7 mm

C: Cephalic capsule; P: Pronotum; F; Femur

The measurement of the total body length of *B. megacephalus*, often indicated by the authors, was neglected because the abdomen of the insect can expand or be compressed substantially during the nymph stage.

Furthermore, in order to determine the nymph stages, it was necessary to calculate the sum  $C + P + F$  and compare it to values in Table 1.

## RESULTS AND DISCUSSIONS

**Morphological Description of the Adults of *B. megacephalus*:** *B. megacephalus* in the southeast region of Algeria (Sidi Mehdi) is an insect of a yellowish color with some brown spots on the joints of the legs and pronotum (Fig. 5). In the imaginal state, it has a length between 34 mm and 40 mm, with pronotum approximately 4.17 mm and 17.23 mm femur. The wings and elytra are well developed with a length

of 27.8 mm. The weight of adults varies according to season; in spring, it is 2.63 g, unlike the summer, it is about 3.54 g.

Our observations are the same with those of [11, 12, 13 and 3].

**Head:** The head of adults of *B. megacephalus* is curved and highly compressed back and forth in both sexes. This shape has a matching character to landfill. The average  $C / P = 2.80$  (C: largest width of the head and P: median length of pronotum). It is usually larger in males than in females (Fig. 5).

**Thorax:** The thorax and legs wearing specialized wings for walking and flight consists of three distinct segments: prothorax, mesothorax and metathorax. The most obvious and the widest part is the pronotum (Fig. 5). A median skull more or less pronounced emphasizes the height.

The legs are inserted on the chest (Thorax). They are six in number, divided into three pairs. The wings are the dorsal-lateral expansions; pairs of the second and third thoracic segments. Adults, forewings called elytra; are carried by the mesothoracic segment. They are narrow, rigid and have a protective role and incidentally flight-balancing. The hind wings, which provide the flight, fit the metathorax and are wide and membranous.

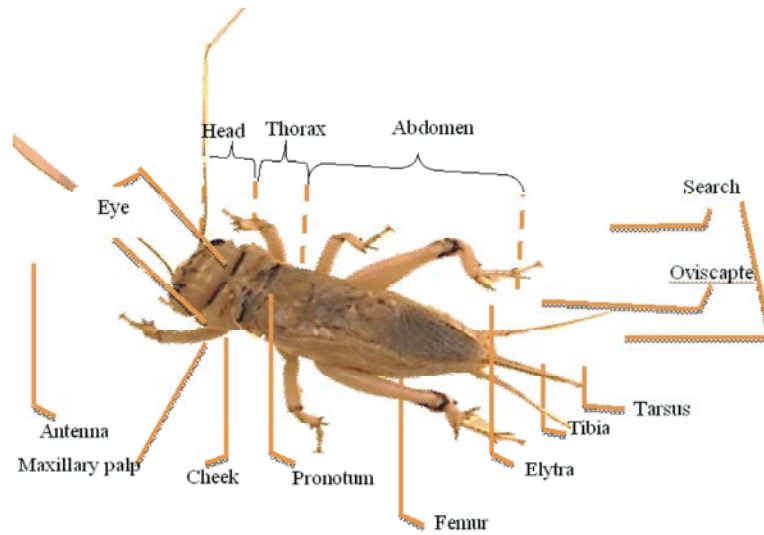


Fig. 5: External morphology of *Brachytrupes megacephalus* (Original)

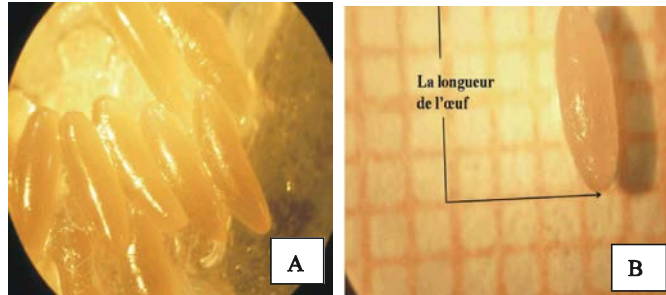


Fig. 6: Eggs of *B. megacephalus* (A: Egg clusters; B: a single egg) (Original)

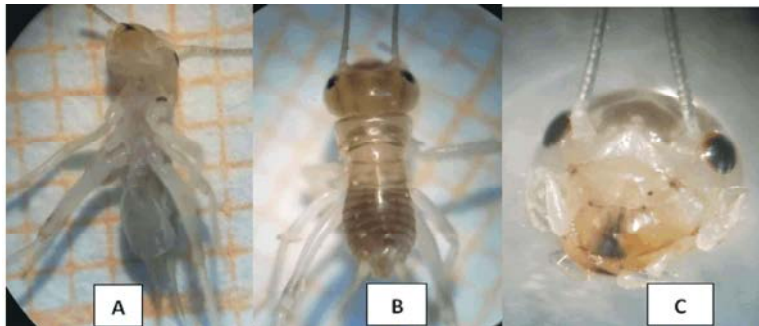


Fig. 7: First nymphal stage N1 of *B. megacephalus* (A: Ventral view; B: dorsal view, C: Head) (Original)

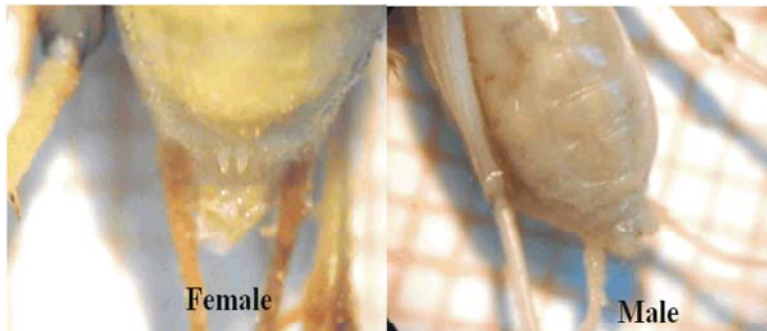


Fig. 8: Abdominal end of future female N1 and future male N1 of *B. megacephalus* (Underside) (Original)



Fig. 9: Dorsal surface of the nymphal stage N2 of *B. megacephalus* (Original)

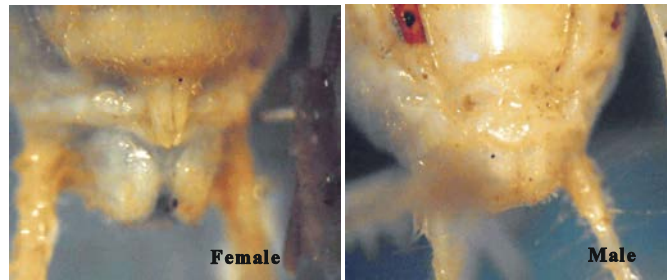


Fig. 10: Abdominal end of future female N2 and future male N2 of *B. megacephalus* (Underside) (Original)



Fig. 11: N3 of *B. megacephalus* (Original)

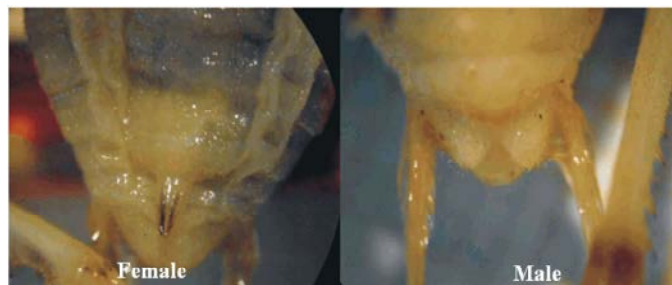


Fig. 12: Abdominal end of future female N3 and future male N3 of *B. megacephalus* (Underside) (Original)



Fig. 13: Nymphal stage N4 of *B. megacephalus* (Original)

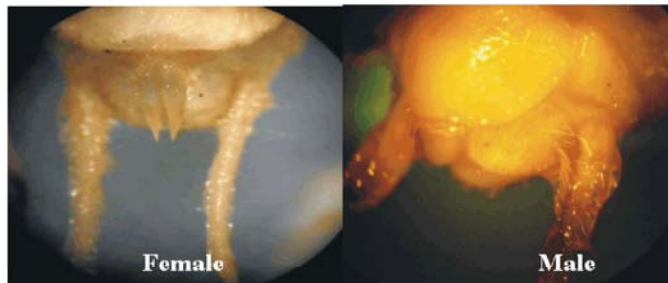


Fig. 14: Abdominal end of future female N4 and future male N4 of *B. megacephalus* (Underside) (Original)

The dorsal thorax is composed of three parts: pronotum and mesonotum metanotum. The first segment thereof widens transversely and has lateral lobes hiding pleural parts prothoracic is thereon that fits the first pair of legs. The second carries the wing covers and the second pair of legs while the third supports membranous wing and the hind legs.

**Abdomen:** The ventral side in female's sternites has 10, of which only 8 are visible, five have normal development. It differs from the male by the number and shape of the segments. In fact, in males, 7 of 9 apparent sternites are simple.

The female reproductive tract is located at the end of the abdomen. It consists of two pairs of valves whose body called typical laying ovipositor.

#### **Morphological Description of the Nymphal Stages of *B. megacephalus***

**The Eggs:** Eggs are an ovoid shape and a greenish color with a length of 3.5 to 4 mm (Fig. 6).

*The first nymph (N1)* These are the smaller samples of the harvested nymph. N1 nymph stage is an almost transparent colors aside the head that is darker than the

rest. The body of this measure an average of 13,8 mm long, head 3 mm to 4.6 mm, 1.5 mm to 2,2 mm pronotum and femur from 5 mm to 8 mm (Fig. 7).

N1 female future are characterized by the rudimentary state of the valves of the ovipositor that are almost transparent and translucent (Fig. 8).

*The second nymph (N2)* The second nymphs (N2) are yellow-orange with a darker head than the rest of the body. They have an average of 21,8 mm, the head is 6 mm to 7 mm, 2 mm to 3 mm pronotum and femur 9 mm to 11 mm. The legs having spines whose tip end is darker than the first stage (Fig. 9).

Pteridophytes of this stage are longer and the end of the future membranous wing slightly exceeding that of the elytra. The length of the ovipositor in the future female N2 is substantially greater than that of the previous stage. Ventral valves are smaller than the dorsal side (Fig. 10).

*The third nymph (N3)* The N3 nymph has a generally darker color than the previous stages. The body of this nymph measures an average of 22, 75 mm head between 7 mm and 9 mm, 2 mm and 3 mm pronotum and femur between 11 mm and 13 mm. The spines of the legs are almost black. The valves of L3 future females are colored (Fig. 11).



Fig. 15: Nymphal stage N5 of *B. megacephalus* (Original)

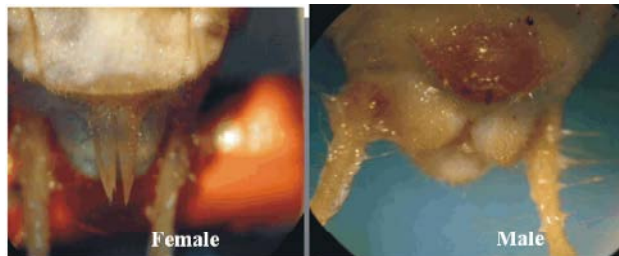


Fig. 16: Abdominal end of future female N5 and future male N5 of *B. megacephalus* (Underside) (Original)

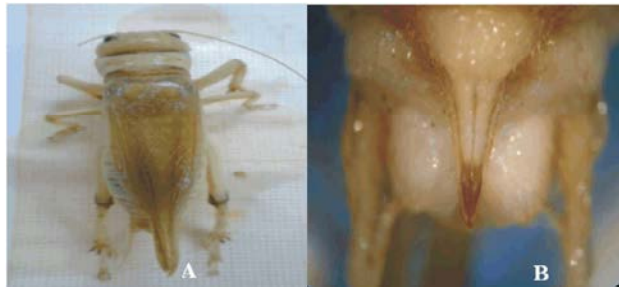


Fig. 17: Female imago of *B. megacephalus* (A: Dorsal surface; B: ventral abdominal end (G: X10) (Original)



Fig. 18: Male imago of *B. megacephalus* (A: Dorsal surface; B: ventral abdominal end (G: X10) (Original)

Pteridophytes this stage and become longer even the end of the wing reaches the extension of the lower edge of the pronotum. Elytra which is a little

shorter reaches only three-quarters of that edge. The ventral valves females approach the dorsal valves (Fig. 12).



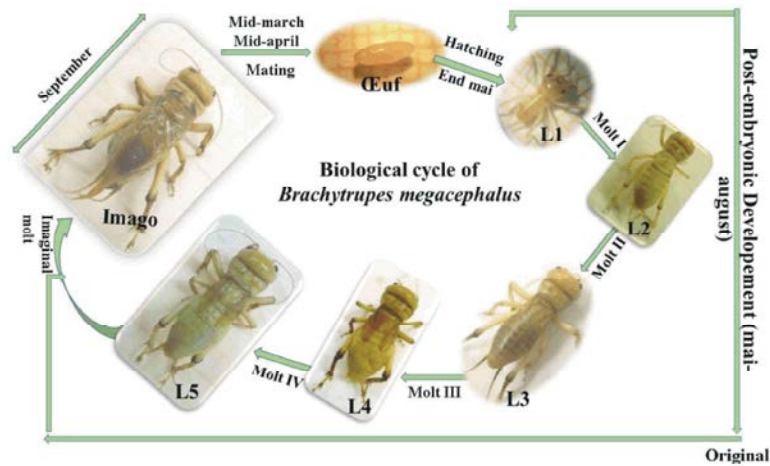


Fig. 19: Biological cycle of *B. megacephalus* (Original)

*The fourth nymph (N4)* The N4 has the same general color but is darker. The measuring body average 29,45 mm long, head between 9 mm and 11 mm, pronotum between 3 mm and 4 mm and the femur is between 13 mm and 16 mm. The spines of the legs are almost black. The valves become very dark (Fig. 13).

At this stage occurs flipping pterophyses, which are applied on the dorsal side of the thorax. The distance between the apex membranous wings is approximately 4 mm (Fig. 14).

*The fifth nymph (N5)* The N5 has the same general color but is darker. The measuring body average of 37,4 mm long, head between 8 mm and 12 mm, pronotum between 4 mm and 5 mm and femur between 16 mm and 20 mm. The spines of the legs are almost black. The valves become very dark (Fig. 15, 16)

**The Imago:** The average length of the body of the imaginal point is 37.5 mm, the measuring head of 13 mm to 14 mm, pronotum 5 mm to 6 mm and the femur 17 mm to 22 mm (Fig. 17, 18).

**Biological Cycle of *Brachytrupes megacephalus*:** Depending to our investigation during all the four years ago (2011-2014), we confirmed that the mating season is placed normally from mid-March to mid-April. The hatching eggs are held at the end of April early May because several individuals of the N1 stage were captured by Barber pots. The post-embryonic development continues throughout the summer until September, during which the cricket becomes imago (Fig. 19). All nymphal stages were observed during the period which runs from May to the end of August (Fig. 19). At the end of September, there was a total absence of burrows except those that appear after irrigation.

## CONCLUSION

The results show that *B. megacephalus* has an annual life cycle with five nymph stages. The mating season is placed normally from mid-March to mid-April. The eggs are measured by 3.5 to 4 mm, First nymphal stage has a pronotum measured between 1.5 and 2.2 mm with a head between 3 and 4,6 mm and the femur has a length of 5 to 6 mm. Unlike the second nymphal stage has a pronotum length of 2 to 3 mm, the head is from 6 to 7 mm and the femur is 9 to 11 mm. The third nymphal stage has a pronotum measured from 2 to 3 mm, head of 7 to 9 mm and femur of 11 to 13 mm. The fourth nymphal stage of this insect was measured by a pronotum from 3 to 4 mm, head between 9 to 11 mm and femur from 13 to 16 and the last nymphal stage (N5) has a pronotum length between 4 to 5 mm, head from 8 to 12 mm and femur between 16 to 20 mm. The adults have a pronotum of 5 to 6 mm, the head is between 13 to 14 mm and the femur is from 17 to 22 mm. All these post-embryonic development mature throughout the summer until September, during which the cricket becomes imago.

The results show that the cricket of *B. megacephalus* has an annual life cycle with five nymphs stage during the summer season (June-August).

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