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Some Elements of the Bio-ecology of *Brachytrupes megacephalus* Lefebvre, 1827 (Orthoptera, Gryllidae) in the Region of Oued Righ (Algerian Sahara)

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Abstract: In the region of Oued Righ (South-eastern Algeria), a study on the bio-ecology of *B. megacephalus* was performed in the experimental station of Sidi Mahdi, INRAA during 2014. The results show that *B. megacephalus* is a burrowing insect that lives in tunnels (more superficial and articulated in spring and summer (30 cm), more deep and linear in winter (about 2 m). This insect has an annual life cycle with breeding season placed normally between mid-March and mid-April. The female lays eggs singly (after 48 hours of coupling) and larvae appear from late-May to mid-August. The morphometric study showed that there was not a significant difference between the length of body and femur of male and female unlike the width of the head capsule and pronotum which are bigger in males.

Key words: *Brachytrupes megacephalus* · Bio-ecology · Oued Righ · Morphometric study

INTRODUCTION

The Southeast Algerian side knows these past two decades an important development especially in social, industrial, cultural, educational, but also agricultural. The latter speculation was encouraged by the development of large areas for the production of dates, grain and the vegetable crops under cover, field, season and late season. Nevertheless, agriculture in this region is facing several constraints including plant health. Indeed, diseases, mites and insects cause great losses in yields as well as storage period of culture. Among the group of pests is the cricket *Brachytrupes megacephalus* Lefebvre, 1827. This orthopter has been reported since the forties in several localities in southern Algeria [1]. The biology of *Brachytrupes megacephalus* was studied by Forel (1893) and Valdeyron-fabre (1955) in Tunisia, Scortecci (1971) in Libya and Caltabiano *et al.* (1982) in Sicily [2] and the diet was studied by Lakhdari *et al.*, 2015. It is an insect herbivore, hygrophile, homochrome with the substrate, evening and night which has a remarkable morphology [3]. It is a spectacular power in swimming [4]. The same author notes that *B. megacephalus* has an annual life cycle with a reproduction period normally placed between mid-March and mid-April.

However, few data are available on *Brachytrupes megacephalus* in Algeria. That's why we found it useful to make a research project to study the bio-ecology in the three selected sites.

MATERIALS AND METHODS

Presentation of the 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. It covers a South-North axis whose latitude is 32°54' to 39°9' North and longitude 05°50' to 05°75' East [5].

The experiment was conducted out at three locations: two sites at the experimental station of Sidi Mahdi (INRAA), which is approximately 07 km of Touggourt on the road leading to the airport and the third one at the station of Saoud, which is a small private palm plantation,

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Fig. 1: Burrows of *Brachytrupes megacephalus* (Original)

contains cultures subjacent with the date palm. The choice of this site was made with an aim of identifying the field attacked by *B. megacephalus*.

Methods Used on Land

Population Dynamics of *B. megacephalus*: The pest population dynamics is the best way to detect the presence of insects, monitor their behaviour and know the extent of damage. In this context, a study was conducted on *B. megacephalus* in order to study the population dynamics and establish a damage threshold to intervene against this pest, based on the appearance of the burrows orthopter. Indeed, little work has been done on the insect in this region. This may be due to nocturnal and subterranean lifestyle of it. Three sites 500 m^2 each were chosen and three times a week were conducted to count the number of burrows (Fig. 1). After each count, they are deleted.

This method was inspired by the work of Valdeyron-Faber [6] in Tunisia and Petralia *et al*. [7] in Sicily. They have wanted to know the distribution of this orthopter in several Sicilian areas, the comments made during the breeding season (late March to late April), over several years (1997-2003). To assess the presence of this species, two indicators were used: observation of sand burrows and listening to chirping produced by males to attract females.

Burrows Measures: The height, width and depth of the burrows were measured using a caliper and a ruler (Fig. 2).

Methods of Individuals Capture: The following methods were used to capture individuals of *B. megacephalus*.

The Method of Plots Submergence Method: Flooded method is to let the water flow until the total flooding of plots to submerge the burrows and take out the insects (Fig. 3).

The Method of Flooding Burrows with Water: This method is to use a tube and fill the water into the hole to force the insect out of its gallery; it is then recovered by hand. This technique has been used throughout the year (Fig. 4).

The Method of the Light Trapping: According to the farmers of the region Sidi Mahdi, this cricket is attracted to light houses (Fig. 5). That is why the lamps were placed in the experimental sites at the dusk. Individuals of *B. megacephalus* regrouped under light traps. Sampling was done by hand as well. This method has been used particularly in the spring.

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 90° 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 (H) (Fig. 6).
- Interocular space (IS) (Fig. 6).
- Length of the middle hull of the pronotum (P) (Fig. 7).
- Femur length (F) (Fig. 8).
- Body length (L) (Fig. 9).

These body parts were chosen because they are strongly sclerotized and suffer no increase during inter-molts [1].

Statistical Analyzes for Morphometric: The variances (σ2), average (x) and standard deviations (σ) of the five morphological characters of this cricket (Pronotum, head capsule, femur, wings and weight) were calculated and analyzed by statistical software (STAT BOX 6.0.4., GRIMMERSOFT). The device is held in total uni-factorial randomization (one factor studied: morphology) by Newman and Keuls test at 5% and 1% (P0.05 and P0.01). The experimental unit is the measurement of 5 characters, the factor is studied the morphology, the variables are the 5 characters (Pronotum, head capsule, femur, wings and weight).

Fig. 2: Burrows measures (A: burrow width; B: height; C: depth) (Original)

Fig. 3: Capture of *B. megacephalus* by flooding plot (Original)

Fig. 4: Capture of *B. megacephalus* by flooding burrows with water (Original)

Fig. 5: Light Trapping of *B. megacephalus* (Original)

Fig. 6: Grouping of *B. megacephalus* individuals (Original)

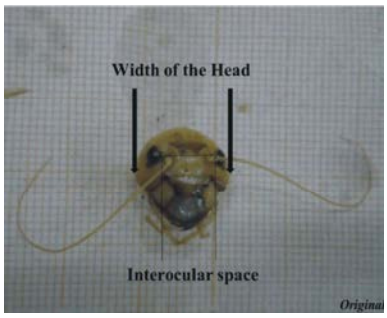

Fig. 7: Width of the head and Interocular space of *B. megacephalus* (Original)

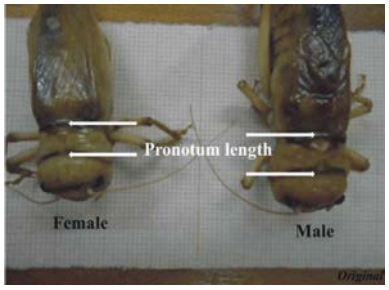

Fig. 8: Pronotum Length of *B. megacephalus* (Original)

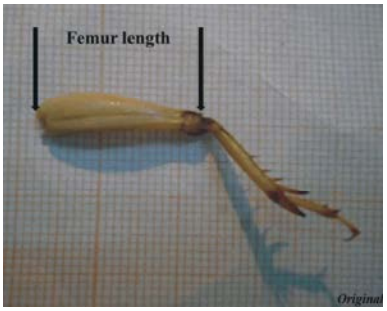

Fig. 9: Femur length of *B. megacephalus* (Original)

RESULTS AND DISCUSSION

Population Dynamics of *Brachytrupes megacephalus*: The study of population dynamics of *B. megacephalus* allowed us to know the lifestyle of the insect. Indeed, this orthopter is characterized by performing a sort of burrows (mound sandbox-like molehills) on the arrival of spring to early summer. These clusters conical sand, hiding the entrance to the gallery, deceives the presence of *B. megacephalus* (Fig. 10).

When the hole is not covered, the gallery is often empty. These results are identical to those found by Belarbi[1].The insect burrows using the land freed from it to form mounds of varying sizes. These mounds have a height of 1.9 cm and 9 cm in diameter for the smallest and a height of 5.58 cm and a diameter of 20.5 cm for the

Table 1: Size burrows of *B. megacephalus* in the summer (June - July)

	Number of burrows	Middle height (cm)	Middle diameter (cm)
Small burrows	53	1,9	9
Big burrows	10	5,87	20,5

Table 2: Size burrows of *B. megacephalus* in autumn (September)

	Number of burrows	Middle height (cm)	Middle diameter (cm)
Small burrows	3	1,5	2
Big burrows	27	6	8,5

Fig. 10: Body length of *B. megacephalus* (Original)

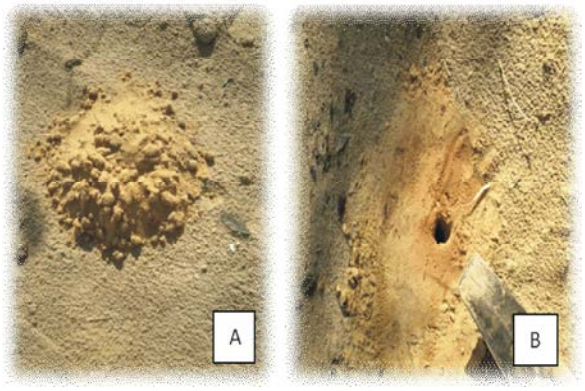

Fig. 11: Burrow and entrance hole of *B. megacephalus* galleries hidden by the sand (A: Burrow; B: entrance hole hidden by the sand) (Original)

biggest (Table 1). The sand which is fillingthe hole is in a slightly different color than the surface revealing a humidity difference. The galleries are deep enough so that each one can hold about 10 liters of water.

The variability of the mound's size is explained by the volume of loose sand that is related to the length of the gallery, the size and stage of development of *B. megacephalus*.

The introduction of a probe inside the lodge did not have an idea of its form so we had the idea of digging. What is sure, the burrow is never vertical; it sinks into the ground more or less obliquely with a curvy look. In winter burrows are deeper, they can reach up to 2 m against the spring and summer, they are superficial.

In September, the number of big burrows has not changed while the small has decreased; it has almost disappeared compared to July (Table 2).

The counting of the insect burrows during the period 2014-2015, allowed us to have knowledge about the period of its manifestation. Also, the post-embryonic development of this pest has been well known through the study of the difference between the size and the time of appearance of mounds. The high number of big burrows registered in September was due to the fact that the larvae of *B. megacephalus* became older. These observations have been noted by Belarbi [1] in the same site (Sidi Mehdi station).

Burrows have probably increased depth because of the comparatively high amount of sand discharged to the outside when the cricket manufactures them. The figure below helps reveal the presence of adult burrows of *B. megacephalus* in the end of March to mid-April (Fig. 11), after each appearance, a sample is taken into consideration. A peak of 378 burrows were recorded (at the three sites) in the first week of April with an average of 42 ± 17.64 burrows / week / 500 m^2 (per site).

The results also show the presence of small burrows (larvae stage) with a peak of 462 burrows (at the three sites) from 17 to 22 July, registering a maximum average of 51.33 ± 15.58 burrows / week / 500 m^2. It was also noted the total absence of burrows during the period from 19 October to 6 January 2015. This can be explained by the entry of the insect into an overwintering phase.

Conti *et al.* [2] reported that there is a peak around mid-April, while highly variable climaticconditions can cause slowdowns or suspensions of the activity. As for the total lack of sand mounds (burrows) in the period from early October to early March, it could be explained by the imaginal diapause of the insect during the cold period, because it sinks deep in the soil and winters until mid-March. These results suggested that *B. megacephalus* is an insect univoltine. Indeed, in winter,

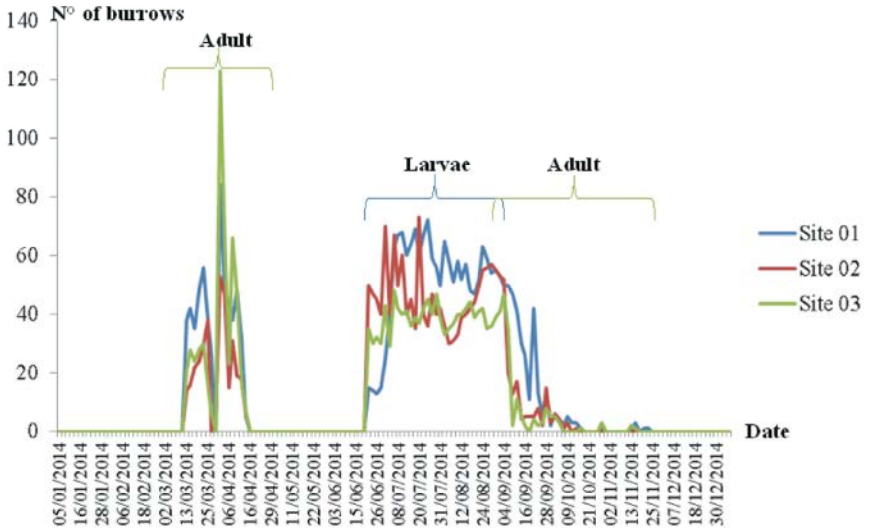

Fig. 12: Populations Dynamics of *B. megacephalus* with burrows counting in the three sites (Original)

the burrows are deeper and can reach up to 2 m, for against the spring and summer; they are more superficial, cannotexceed 30 cm. Our results point in the same direction as those obtained by Conti *et al.* [2], they made a study on the galleries of *B. megacephalus* in Sicily, they said that the burrows are more superficial and articulated in spring, more deep and linear in winter. According, Valdeyron-Faber [6], the disappearance of *B. megacephalus* in winter can only be due to death or a life slowed in land (hibernation). Belarbi [1] noted that most insects which outgoing in late winter and spring are over wintered imagoes.

According Chopard [8], this cricket is not uncommon in the sand, especially in the north of Africa, where it burrows the depth up to 2 m. According Belarbi [1], the burrow entrance is blocked during the day and is recognizable by the presence of a small mound. Belarbi [1], noted that the variable size of the burrows is explained by the volume of sand generated in connection with the length of the gallery and the size of the insect.

B. megacephalus also causes considerable indirect damage by digging burrows that cause irrigation water losses deviation. In fact, the galleries are deep enough so that each can hold about 10 liters of water. Thus, the traditional irrigation method, flood, would not be appropriate and it would be interesting to replace it with other systems such as drip-drop where drip irrigation.

Some Elements of the Bio-Ecology of *B. megacephalus*: From mid-March to mid-April, the males began stridor (continuous stridor without interruption); this behavior shows that imagoes are sexually mature. It is the breeding season. In fact, all the females captured and dissected in this period have ovarioles full of oocytes with an average of 85 oocytes / ovariole (Fig. 12). Eggs are laid singly (after 48 hours of coupling) with an average of 10 eggs / day. During this period, most collected individuals are males (eg: 6 females / 39 males).

This result suggests that females, during that time, stay inside burrows to lay eggs. According Petralia *et al.*, Conti *et al.* [7, 2], after mating the females are segregated in lateral branches of the male burrow. In fact, during the same period each male, generally around sunset, attracts females in his lair by intense sounds produced by rubbing. Similar observations were noted in most of the region where we studied this cricket [6, 7, 2].

The stridor of adult males is no longer heard in mid-April. All the individuals males captured during this period discharge their spermatophores and die (Fig. 13, 14).

The hatching eggs are held at the end of April early May because several individuals of the L1 stage were captured by Barber pots. The post-embryonic development continuous throughout the summer until September, the cricket becomes imago. All the larval stages were observed during the period which lasts from late May to late August. At the end of September, there was a total absence of burrows except those that appear after irrigation.

Conti *et al.*[2] noted that *B. megacephalus* has an annual cycle with a breeding season from mid-March to late April. Valdeyron-Faber[6], had studied the insect of *B. megacephalus* in Tunisia, said that this orthopterous insect has an annual cycle. It couples in April and all the

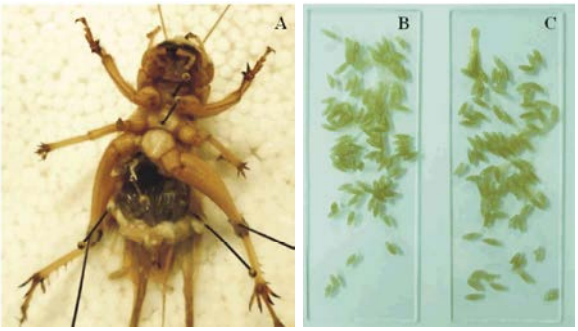

Fig. 13: A: Dissection of mature female, B: Oocytes of ovariole1; C: Oocyte of ovariole 2. (Original)

Fig. 14: Male of *B. megacephalus* rejecting his spermatophore (Original)

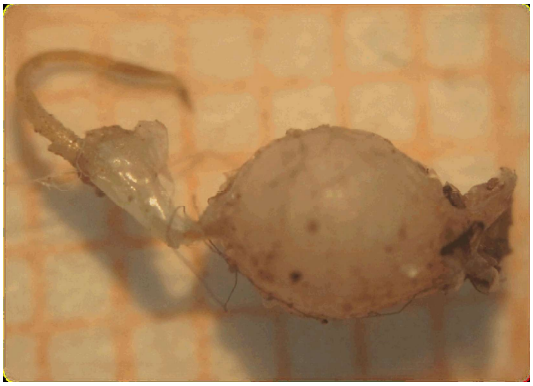

Fig. 15: Spermatophore of a mature male of *B. megacephalus* (Original)

Fig. 16: Larva of B. megacephalus in full molt (Original)

Fig. 17: Exuviate the third larval molting *B. megacephalus* (Original)

males die, towards the end of this month, with an abdomen completely emptied after pressing out and performance of their functions. The eggs hatch and the young larvae appear to have occurred in June. According to Vicidomini *et al.* [9], during the months from June to September of the new generation of *B. megacephalus,* insects grow by spending most of the time in searching food, which is brought into the burrow to be consumed.

Brachytrupes megacephalus molt and lose its exuviate to increase (Fig. 15). (Fig. 16), it leaves his molt cuticle is then soft and clear; it hardens and becomes darker and thicker within days. Wings appear at the second molt. The observing of larval stages in the laboratory based on the examination of larvae exuviate off during moulting was very difficult because they are quick to devour them. In fact, we have observed that molting of the third stage.

B. megacephalus is a nocturnal, subterranean, homocromous with the substrate and crepuscular. This is consistent with the observations of Belarbi, Conti *et al.* [1, 2]. Wherever *B. megacephalus* was observed, the sand was damp suggesting that the insect is hygrophile. Our observations are the same with those of Conti *et al.* [2].

Morphometric Study: *B. megacephalus*of 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. In the imaginal state, it has a length between 34 mm and 40 mm, with pronotum approximately 4.17 mm and a femur with17.23 mm. The wings and wing covers are well developed with a length of 27.8 mm. The weight of adults differs according to season; in spring, it is 2.63 g, unlike the summer, it is about 3.54 g.

Our results are identical to those of Chopard [8] who suggested that *B. megacephalus* is an insect of a yellowish color. It has a length of 32 mm to 40 mm, with the imaginal state; pronotum is 5 mm to 6 mm; his femur has a length of 18-24 mm, wings and wing covers are well developed with a length of 25 mm to 30 mm.

Table 3: Average Analysis

Average	Femur	Head capsule	Pronotum	Weight	Length	Wing
Male	19,7	12,4	4,9	3,813	39,567	38,333
Female	19,167	11,5	4,533	3,332	38,733	37,9

Table 4: Analysis of Variance Model

Variance	Femur	Head capsule	Pronotum	Weight	Length	Wing
Male	1,685	1,329	0,548	0,55	3,245	2,09
Female	2,394	0,861	0,629	0,426	2,599	2,845

According Lefebver [10], *B. megacephalus* has a length of 41 mm, the volume of highly compressed head back and forth and which greatly exceeds the width of the abdomen it joins the thorax, distinguishes at first sight of those of its kind.

The first two pairs of legs are slightly pubescent, the very large hind and furnished with strong short spines. Finot [11] noted that the head of the cricket is very wide, flat previously curved, often mottled with brown. Its eyespots are large, placed in a straight line. The antennas are setaceous. Also Finot [11] reported that, the cricket has a length of 37 mm to 40 mm for males and from 40 mm to 42 mm for the female. The pronotum is pointed posteriorly. The wing covers are well developed reaching the apex of the abdomen and wings beyond the elytra. According Belarbi [1], *B. megacephalus* is a curious and great cricket with a length over 40 mm. According Djocgoue [12], the head of this insect is very wide, short, flattened forward; the pronotum is very short, wide forward. Our results seem to be very close to those obtained by Belarbi [1] who studied abdominal end individuals (male and female) of *B. megacephalus*.

The Difference Between Male and Female: According to the tables of statistical analyzes (Tables 3 and 4), there is no difference between a body length of males (39.6 mm) and females (38.73 mm) (F test = 1.205 NS; CV = 7.51%). Unlike, there was a highly significant difference between the weight of male individuals (3.813 g) and female (3.332 g) (F test = 14.321; ** CV = 13.78%).

The head is usually larger in males than in females. Indeed, statistical analysis shows that there is a highly significant difference between the width of the head of the male sex (12.4 mm) and female (11.5 mm) (F test = 9.693; ** CV = 9.37%). Unlike the length of pronotum, there is a difference between males (0.548 mm) and females (0.629 mm) (F test = 5.8 *; CV = 12.5%). However, there are none for the length of the femur (male: 19.7 mm, female: 19.16 mm) and wings (males: 38.33 mm, females: 37.9 mm) (F test = NS 0.996; CV = 10.65% and F test NS = 0.452; CV = 6.55% for males and females respectively).

CONCLUSION

Brachytrupes megacephalus manufactures very deep burrows in winter that can reach up to 2 m. Unlike, they are superficial and cannot exceed 30 cm in spring and summer. The mounds formed by the earth excavated during the implementation of galleries appear from March to September, they have a height of 5.87 cm and a diameter of 20.50 cm. This mode of underground life can cause significant losses in irrigation water because it is deflected far into the ground, out of reach of crop roots. These challenges may give us an idea to change the traditional irrigation systems (flood) and consider using others such as drip irrigation.

Comparison of morphometric elements of males and females of *B. megacephalus*, namely the length of the body, femur and wings revealed no significant difference between the two sexes. As against the pronotum, this reveals a difference between male and female. However, weight and head capsule give a highly significant difference between the two sexes.

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REFERENCES

1. Belarbi, B., 1979. Contribution à la connaissance de Brachytrupes megacephalus Lef. En Algérie (Orthoptera; Gryllidae). Mém. Ing. Institut National Agronomique Agronomiques. Algerie, pp: 76.
2. Conti, E., G. Costa, A. Petralia and E. Petralia, 2012. Eco-ethology of *Brachytrupes megacephalus* (Orthoptera, Gryllidae), protected species in UE. Atti e Memorie Dell'Ente. Fauna Siciliana, XI: 51-56.

3. Chopard, L., 1938. *La biologie des Orthoptères*. Ed. Lechevalier, Paris, 1: 402.
4. Caltabiano, AM., G. Costa and A. Petralia, 1980. Ricerche sulla locomozione negli Insetti. V. I! nuoto in alcune specie di Coleotteri Carabidi. *Animalia*, 8: 105-114.
5. Lakhdari, W., B. Doumandji-Mitiche, A. Dahliz, S. Doumandji, L. Bendifellah, Y. Bouchikh, H. Hammi, A. Soud and R. Mlik, 2015. Host Plant Determination of *Brachytrupes megacephalus* Lefebvre, 1827 (Orthoptera, Gryllinae) Using Faeces Analysis in the Region of Oued Righ (Algerian Sahara). American-Eurasian J. Agric. & Environ. Sci., 15(2): 271-277.
6. Valdeyron-fabre, L., 1955. Observation sur la biologie *Brachytrupes megacephalus* Lef. en Tunisie. Rev. Path. Vég. Et Entom. Agri. De France., Tom. XXXIV, 3: 136-158.
7. Petralia, A., C. Russo and S. Cartarrasa, 2003. Topology of *Brachytrupes megacephalus* (Lefebvre, 1827) (Orthoptera, Gryllidae) in some Sicilian Natural reserves. Atti "Fifth International Symposium on GIS and Computer Cartography for Coastal Zone Management", Genova.
8. Chopard, L., 1943. Orthopteroïdes de l'Afrique du Nord. Ed. Larose, Paris, ''Coll. Faune de l'empire français'', I, pp: 450.
9. Vicidomini, S. and C. Pignataro, 2006. Interessante acquisizione di reperti entomologici da parte del Museo Naturalistico degli Alburni (Corleto Monforte: SA): *Brachytrupes megacephalus* (Lefevre, 1827) (Orthoptera: Gryllidae). *Il Naturalista Campano*, 22: 1-3.
10. Lefebvre, M.A., 1827. Description de divers insectes inédit recueillis en Sicile. *VI volume des Annales de la Société Linnéenne de Paris*, pp: 10-13.
11. Finot, A., 1896. Faune de l'Algérie et de la Tunisie. Ann. Soc. Entom. de France, 65: 513-629.
12. Djocgoue, P.F., 2014. Projet d'urgence d'assistance aux retournes de la république centrafricaine. Public Disclosure Authorized, 2: 37: 106.