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BIOECOLOGY STUDY OF THE SPECIES *PARATETTIX MERIDIONALIS* (TETRIGIDAE, ORTHOPTERA) IN CONSTANTINE REGION, EASTERN ALGERIA

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ABSTRACT

The Constantine region is located in the semi-arid bioclimatic stage. The locust and grasshoppers fauna in this region totals the presence of five families and twelve sub-families. The family Tetrigidae is represented by only one species; *Paratettix meridionalis* (Rambur, 1838). It is a small species, black with white spots. The pronotum is elongated and often covers the abdomen to the apex. A large number of *P.meridionalis* was collected near to water source. We performed morphometric analyzes. Surveys and monitoring of this grasshopper during the study period indicate that it has two generations. As part of the diet study of this species, we identified 14 plants in our study station. Results of the analysis of faeces of males and females show that it consumes plants that belong to two essential families: Asteraceae and Poaceae. The Tetrigidae family still not well-known in Algeria.

Key words: Asteraceae, Chaab Erssas station, Diet, Grasshoppers, Morphometric analyses.

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1. INTRODUCTION

Some grasshoppers and locust are serious pests, causing damage to agriculture. The outbreaks and activity of these insects depend on climatic conditions. They dominate in the biotopes with dry and hot climate, and they become rare in cold winter.

In Constantine region, there are five (5) families of grasshoppers; Acrididae, Pamphagidae, Pyrgomorphidae, Dericorythidae and Tetrigidae [1].

The Tetrigidae family belongs to the super family Tetrigoidea. It is subdivided into 8 subfamilies including the subfamily Tetriginae which is subdivided into two tribes: Dinotettigini and Tetrigini. The tribe Tetrigini is subdivided into a large number of genera [2]. In Algeria the genus *Paratettix* Bolívar, 1887, is represented only by a single species, *Paratettix meridionalis* (Rambur, 1838). This family differs from Acridomorpha by its elongated pronotum that covers the abdomen to the apex.

In North Africa, there has not been much work on the grasshopper's diet. We can note the work of Benhalima et al [3, 4] on the use of trophic resources by *Dociostaurus maroccanus* in Morocco, Ould Elhadj [5] on the diet of five locust species in Algeria, and Benkenana et al [6] on the diet of Pamphagidae species.

The Tetrigidae family and the species *Paratettix meridionalis* are not well known in Algeria. Thus, our objective is to conduct a bioecological study related to this species. The diet of the Tetrigidae is poorly documented and this is the first study of the diet of the species belonging to this family of grasshoppers.

2. MATERIAL AND METHODS

2.1 Study area

Constantine region is located in the east of Algeria with geographical coordinates: 36° 21°N, 06°36°E and altitude 660m. It extends over an area of 2287 Km², limited to the North by the wilaya of Skikda at a distance of 89km. To the South by the wilaya of Oum El-Bouaghi, to the East by the wilaya of Guelma and to the West by the wilaya of Mila. (Fig.1)

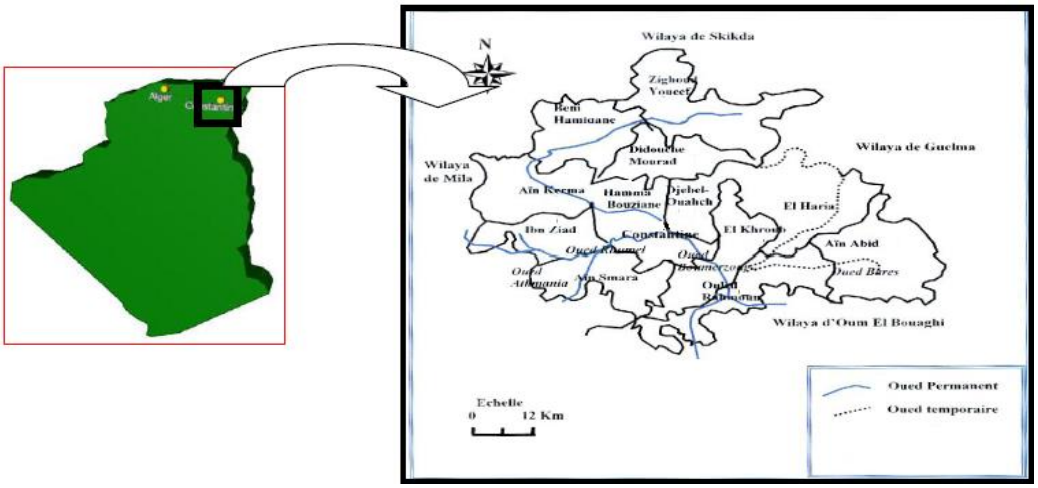

Fig.1. Geographical location of the study station [7]

The study of the species *Paratettix meridionalis* was conducted in Chaab Erssas area at the university's campus (Frères Mentouri Constantine University 1). It is located in the Southeast of the commune of Constantine, in the coordinates: 36° 20'19''N; 6°37'27''E and at an altitude of 580 m. (Fig.2)

Fig. 2. a: Satellite photos representing the study station (Google Earth, February 2019)**, b:** Chaab Erssas Station (photo)

2.2 Sampling

Two sampling methods were chosen: the capture of the pterygotic individuals was made using a filleting net and for the unwinged (larval form) a sieve has been used. Harvested individuals were put in a plastic box while indicating the date and place of their capture. Observations of each trip were noted. In order to know the cycle life, the field trips were made in one year between March 2018 and March 2019, one trip each week, from 10h to 14h.

2.3 Identification

In the laboratory, specimens were spread out and fixed by pins. They were identified up to the taxonomic rank of the species using the keys of: Chopard [8], Jago [9], Launois [10], Massa et *al* [11], and the OSF2 website: http: //orthoptera.species File.org [2]. Plants were identified using the keys of Quézel and Santa [12].

2.4 Study of the species *Paratettix meridionalis*

2.4.1 Morphometric analysis

Morphometric analysis of males and females of *P .meridionalis* were made using millimetre paper. The individuals are fixed by an insect pin on a device consisting of a cardboard circle covered with graph paper in the base of the binocular loupe. The following parameters have been measured; the general size of males and females, the length and width of the posterior femur and wings.

2.4.2 The diet study

For the diet study, the method of the examination of faeces was used conforming to Launois-Luong [13]. This technique consists of three steps:

Preparation of reference collection of the epidermis; the reference slides are prepared from the aerial parts of the plants (stems, leaves, flowers) according to a conventional technique, which consists of putting the plant in water if it is in the dry state for 24 hours. Then using a blade, the epidermis is scraped off and detached from the underlying tissues. Then they are soaked in 12% bleach, after rinsing in distilled water, they are subjected to progressive concentration in alcohol baths (70, 80 and 96%). Finally, they are preserved between a slide and a coverslip in Canada balsam. The slides are placed on a hot plate until boiling to prevent the formation of air bubbles.

Analysis of faeces; the faeces are recovered after 24 hours of capture. The technique of analysis of faeces consists of softening the samples for 24 hours in the water. Then, the epidermal fragments are homogenized for a few seconds to a minute, in a sodium hypochlorite, thus undergoing a

discolouration without apparent destruction of the epidermis. The remaining of the operations is identical to the one used for the vegetable epidermis.

Comparison; the comparison was made by determining the reference plant fragments found in the feces.

2.4.3 Geographical distribution

A review of all grasshoppers' fauna collection boxes, from the year 1998 to 2019, has been done at the laboratory of Biosystematics and Ecology of Arthropods in the University of Mentouri Constantine 1, for the purpose of studying the geographical distribution of the species *Paratettix meridionalis* in the East of Algeria.

3. RESULTS

The Tetrigidae grasshopper's family is represented by only one species; *Paratettix meridionalis* (Rambur, 1838) in Constantine region.

3.1 Description and morphometric analyses

It is a small grasshopper, black or grey in colour. The abdomen is compressed, long wings and antennae short and filiform with 11 articles. An elongated pronotum that covers the abdomen to the apex (fig.3).

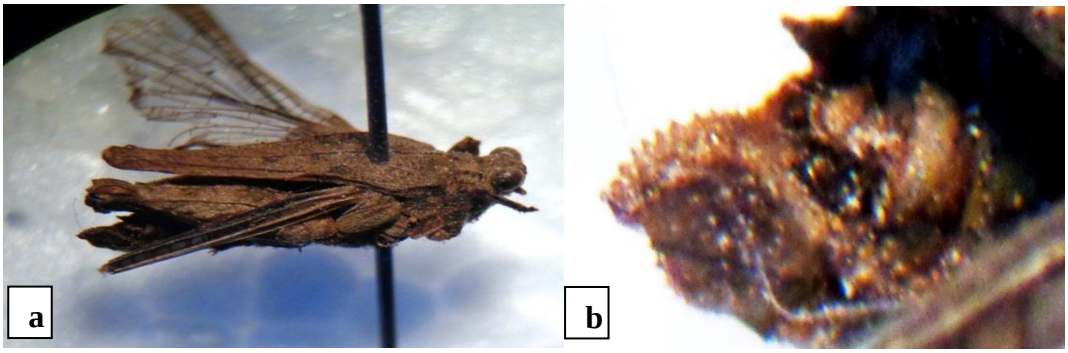

Fig.3. a: *Paratettix meridionalis* (Rambur, 1838), **b:** male genitalia of *Paratettix meridionalis (*x *40)*

The results of the morphometric analyses of the species *Paratettix meridionalis* are shown in the table (1).

Table 1. Morphometric analyses of the species *Paratettix meridionalis*

Species / **Settings**	**Overall size (mm)**	**Posterior femur (mm)**	**Wings (mm)**
N: 12 (♂)	11,75 ± 1 ,25	**L** : 5,25 ± 0,5 **l** : 1,25 ± 0,5	**L** : 7,75 ± 0,5 **l** : 3,75 ± 0,5
N : 12 (♀)	13 ,25 ± 1 ,25	**L** : 5,5 ± 0,5 **l** : 1,5 ± 0,5	**L** : 8,5 ± 0,5 **l** : 4,25 ± 0,5

L: length, **l**: width, **N**: number of individuals examined

3.2 Bioecology of the species

3.2.1 Cycle life

According to the field trips, a big number of *P.meridionalis* adults was collected during the months of March and April, many individuals were observed coupling. During the months of July and August, the adults of this species were captured for the second time. Between the two periods, individuals at different larval forms (from the first larval stage to the imago form) were collected. It was noticed that *Paratettix meridionalis* species has two generations per year in the climatic conditions of the region of Constantine (Fig.4).

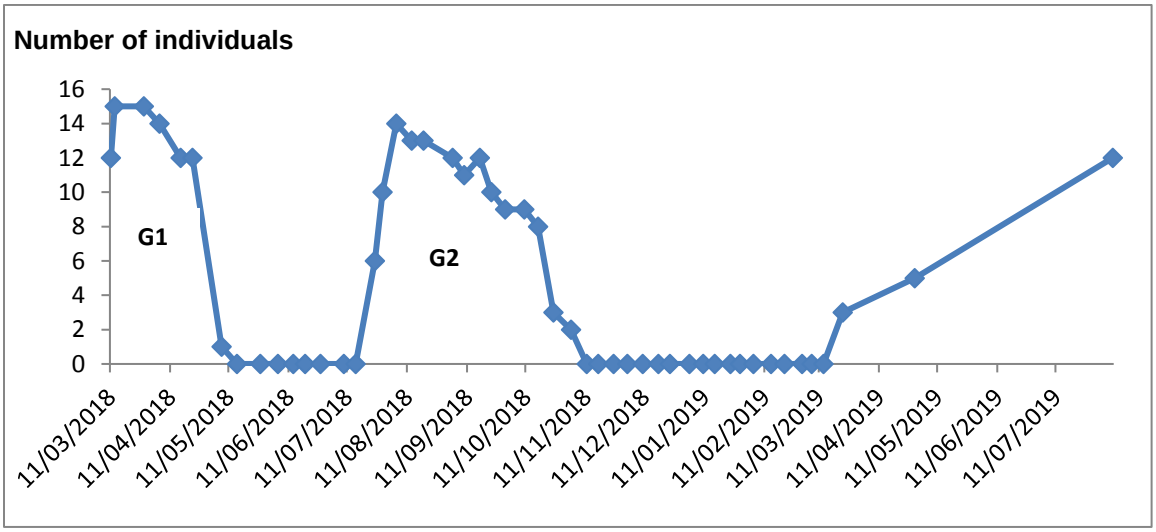

Fig.4. The development cycle of *Paratettix meridionalis* during the study period (March 2018 to March 2019)

3.2.2 Diet

The plant census in the study station indicated the presence of 11 plant species belonging to six (6) families; Asteraceae, Fabaceae, Brassicaceae, Lamiaceae, Apiaceae and Poaceae. Asteraceae is the dominant family with four species. The data are summarized in (Fig.5).

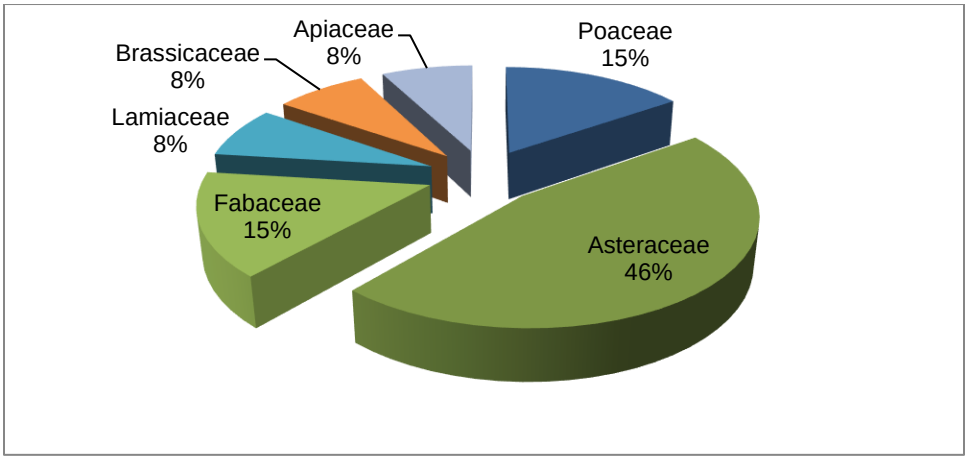

Fig.5. Recovery rate of each family in the study station

Comparing the plant fragments in faeces and plant epidermis, the epidermal cells of plants of the family Asteraceae are represented with 50%, followed by the Poaceae family with 25%. The Brassicaceae, Apiaceae and Lamiaceae families are represented with 8.3%. The results are shown in Table (2).

Table 2. Plant species in faeces of individuals of the species *Paratettix meridionalis* in Chaab Ersass station. **RR**: Recovery rate of plant families**, CR**: Consumption rate, **(+)**: Presence of plant plants in faeces, **(-)**: Absence of plant plants in faeces

Species	Feces	Families	RR (%)	CR (%)
Avena fatua L	+	Poaceae	15.38	25
Hordeum murinum L	+			
Bellis sylvestris L	-	Asteraceae	46.15	50
Calendula arvensis L	-			
Leucanthemum vulgare	+			
Hieracium caespitosum	+			
Medicago truncatula	+	Fabaceae	15.38	8.3
Lathyrus setifolius L	-			
Thymus ciliatus	+	Lamiaceae	7.69	8.3
Sinapis alba	+	Brassicaceae	7.69	8.3
Daucus carota	-	Apiaceae	7.69	0
Total : 11	**7**	**6**	**100**	**100**

3.2.3 Geographical distribution

The geographical distribution of the species *Paratettix meridionalis* inventoried in the area of eastern Algeria is mentioned in Table (3) and (Fig.6).

Table 3. Characteristics of distribution stations

Stations / Characteristics	Constantine			Jijel Al Akbia	Oum El Bouaghi Sigous	Mila Boumalek	Biskra
	Djebel Ouahch	Beni Hamidane	Chaab Ersass				
Bioclimatic floor	Sub-humid	Semi-arid	Semi-arid	Humid	Semi-arid	Semi-arid	Arid
Geographic coordinates	36°27’ 59’’ N 6°44’ 13’’ E	36°30’ 20’’ N 6°32’ 59’’ E	36°20’ 19’’ N 6°37’ 27’’	36°49’ 13’’ N 5°46’ 00’’ E	35°52’ 31’’ N 7°06’ 48’’ E	36°16’ 46’’ N 6°13’ 56’’ E	34° 51' 1’ ’ N 5° 43' 40’ ’
Altitude	994m	450m	580m	9m	925m	815m	87m

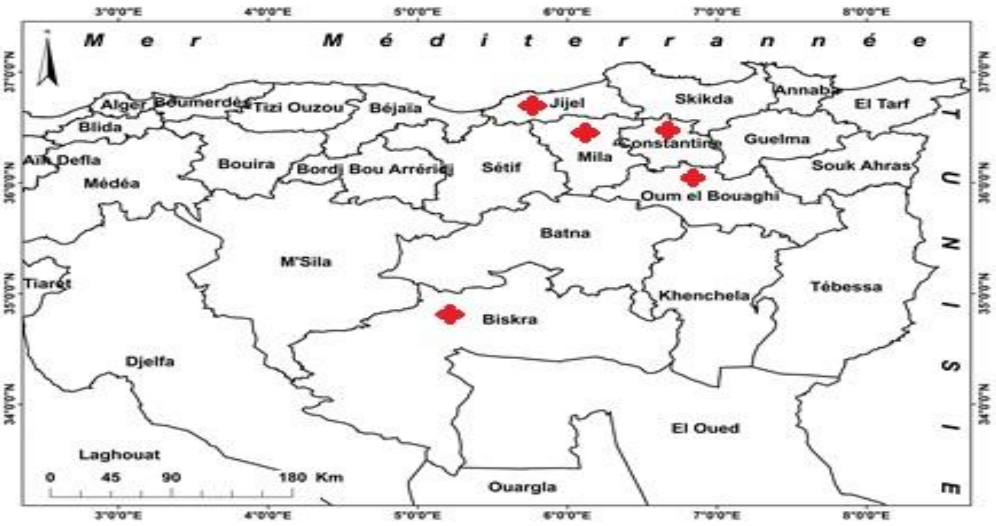

Fig.6. Geographical distributions of *Paratettix meridionalis* in eastern Algeria

4. DISCUSSION AND CONCLUSION

In Algeria, this species has been reported in the Constantine region by Moussi [14], in Bordj El Kiffan by Belhadj and Nouasri [15], in Mitidja *P. meridionalis* is present in its larval and adult form during all months of the year [16].

Based on the results of faeces analyses, it is to be noted that the plant families: Asteraceae, Brassicaceae, Lamiaceae and Poaceae are present in the faeces of *P. meridionalis*. Asteraceae is the most consumed with a frequency of 50%; this could be related to the dominance of this family of plants, on the medium followed by Poaceae with 25%, Brassicaceae, Lamiaceae and Fabaceae with 8.3%. Apiaceae are not eaten. There are several types of diet of grasshoppers (i) forbivores (= herbivores), which feed predominantly on dicotyledonous plants, (i i) graminivores, which feed mainly on plants belonging to the family Poaceae, and (i i i) ambivores which deed on plants belonging both groups. *P.meridionalis* consumes many species of plants, so it's polyphagous [17]. The geographical distribution shows that the species *P. meridionalis* is present in five regions: Constantine, Mila and Oum El Bouaghi which belong to semi-arid bioclimatic area, Biskra in the dry bioclimatic area and Jijel in the humid bioclimatic area. It is present in an altitude from 9m up to 994m. The distribution of this species in our study remains limited because most of the study areas belong to the semi-arid bioclimatic area. *P.meridionalis* is still collected in humid areas. In Bordj El Kiffan (Alger), this grasshopper was captured during most of the year which shows that the humid area has the most suitable conditions for this species and Tetrigidae family [15]. The semi-arid stage with fresh winter and sub-humid stage with cold winter are the most suitable conditions for Pamphagidae family [6]. The climatic conditions affect directly the progress and the geographical distribution of the locust and grasshopper species.

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