

## **FOOD DIET OF *DOCIOSTAURUS MAROCCANUS* THUMBERG, 1815 (ORTHOPTERA, ACRIDIDAE) IN ITS GREGARIOUS STATE: A STUDY IN SIDI BELABBES REGION, ALGERIA (2010)**

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### **ABSTRACT**

This study of diet and food preferences in the gregarious phase of *Dociostaurus maroccanus* (THUMBERG, 1815), was carried out in the wild during the months of June and July 2010 in the region of Marhoum (State of Sidi Bel Abbes).

The determination of the diet and food choice was made by the method of faeces content analysis, which is based on the recognition of epidermises fragments of the consumed plants, using alight microscope.

The results of this study show that *D.maroccanus* is a polyphagous species whose adult have a tendency to over-consume of Poaceae (Gramineae). Poaceae account for a large part in the diet of adult males and females of the gregarious populations with over 60% of the total food spectrum, compared with the other consumed plant families which are very diverse but whose consumption frequencies are very low. Regardless of the plant species, males and females show no specific food choices, especially in the consumption of Dicotyledons. Among Poaceae species, and compared to other species, *Lolium multiflorum* is highly consumed both by males and females, with the exception of *Stipa parviflora* whose frequency of consumption is different.

**KEYWORDS:** Diet, *Dociostaurus maroccanus*, Polyphagous, Poaceae, Acrididae-Plant Relation

### **INTRODUCTION**

The Moroccan locust *Dociostaurus maroccanus* is a specific pest in Algerian highland regions and in some countries of the Mediterranean region and Asia Minor. It is among the most feared locusts because of his polyphagia, his gregarious field and his group traveling that can affect large areas. It can attack cereals, vegetables and growing fruits, in the regions of western Algeria particularly. The monitoring and control device deployed by the National Institute of Plant Protection, has allowed treating areas of tens of thousands of hectares, with more than 23,000 ha in 2010, particularly in wilayas of Sidi Bel Abbes, Tlemcen, Saida and Tiaret.

Considering the economic importance of this locust we have undertaken, in a natural environment, a study of its diet and food preferences in its gregarious phase.

This work was carried out in June and July 2010 in Marhoum region (Wilaya of Sidi Bel Abbes) containing several of Moroccan locust foci grégari-gène, which were defined by PASQUIER (1934. 1937), DOUMANDJI-MITICHE

and *al* (1992), and listed by the National Institute of Plant Protection of El Harrach (Algiers). These habitats have recorded a very important activity, particularly since 1999.

## MATERIALS AND METHODS

Study of the diet was performed by the method of faeces content analysis, which is based on the recognition of epidermal fragments of the consumed plants contained in the faeces, using a light microscope. The determination is made by comparing to the reference epidermises, prepared from fresh plants with drawn from the study site. Analysis of the epidermal fragments contained in the faeces has been used by several authors on various locusts : on *Locusta migratoria* in Madagascar by LAUNOIS (1976), on the Orthoptera of coastal dunes (HAMDI, 1992), on *Calliptamus genus* (CHARA 1987 and TOUATI, 1992) and in Morocco by BENHALIMA (1983). To understand food preferences, estimates of recovery and abundance - dominance of each plant species were made (Table 1). Faeces collect have been undertaken on the ground during the months of June-July 2010.

Each captured individual is put in a pill box for 24 hours, until it empties the contents of its digestive tract. The Egesta are then dried and stored until they are prepared between a slide and a cover slip. Depending on the size of Egesta products during captivity, one to several slides were prepared for the same individual.

### Preparation of the Reference Epidermises

The epidermises are processed using the method recommended by BENHALIMA (1983). The plants fragments are softened in a test tube containing 10ml of hot distilled water for ten minutes (Figure 1). Once the epidermis isolated, it is soaked for five minutes, depending on its consistency, diluted bleach solution to destroy the cell contents. It is then rinsed with water and then soaked in alcohol baths of 50°, 75°, and 100° respectively. The different epidermises are then placed between slide and cover slip in a drop of Faure's liquid (Figure 2).



**Figure 1: Analysis Procedure for the Epidermises of Collected Plants from the Field**

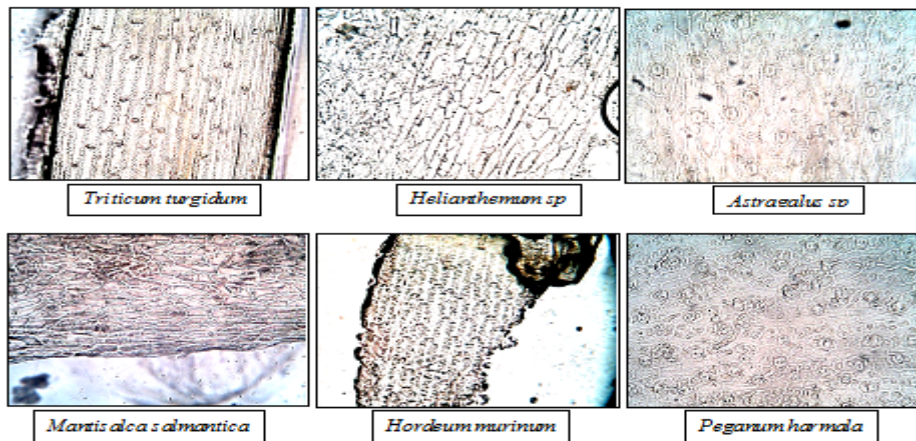


Figure 2: Reference Epidermis for Some Plant Species of the Study Site

## PREPARATION OF THE FAECES CONTAINED EPIDERMISES

The first treatment is the rehydration of the Egesta in water, for 24 hours. The faeces are then soaked for five to ten minutes in a bleach solution to enlighten the epidermis. The epidermal Fragments are then rinsed roughly with distilled water and then dehydrated progressively, as for the plant epidermises of the field, in alcohol baths (50°, 75° and 100°).

The different epidermis is separated using pliers under the magnifying glass, and then placed between slide and cover slip, using Faure's liquid for conserving the preparation. The plant species consumed by the Moroccan locust are determined under the light microscope by comparing the epidermal fragments contained in the Egesta to the reference plant epidermises collected from studied station. Frequently, a, Egesta contains plant debris that belong to several species where as the identification keys are the same, the relative proportion of each plant is estimated on the whole preparation.

For each determined species, we calculated the relative frequency according to the formula  $Fr \% = (n_i/N) \times 100$  where  $n_i$  : is the number of plant fragments found in the faeces, and  $N$  : is the total number of examined samples. The determination of the plant fragments is based on several criteria; size and shape of the cells, type of the cell wall (smooth or sinuous), shape and density of the stomata, presence or absence of pile and spines, and the number of cells constituting the pile (unicellular, bicellular or multicellular).

## RESULTS AND DISCUSSIONS

### Feeding of Gregarious Populations of *D. maroccanus*, Marhoum Station (Sidi Bel Abbas) in June-July 2010

The frequencies of consumption of the plants found in the faeces of 30 individuals, analyzed by sex, were compared for their relative abundance on the ground.

### Covering of the Collected Plant Species in the Study Station

The vegetation cover of Marhoum station adds up to a richness of 58 plants species belonging to the respective families of Asteraceae, Poaceae, Fabaceae, Resedaceae, Aizoaceae, Renonculaceae, Papaveraceae, Plantaginaceae, Caryophyllaceae, Geraniaceae, Malvaceae, Lamiaceae, Boraginaceae and Liliaceae (Table 1, Figure 3).

We find that the most represented plant families are the Poaceae (39.65%) and the Asteraceae (25.15%), followed far behind by the rest of the families, where Papaveraceae and Lamiaceae have a covering rate of 2.55% and 2.95% respectively (table 1). The Asteraceae family alone has 25 species with a very low rate of land occupation, with *Artemisia*

*herba alba* (4.2%) and *Carlinalanata* (2.1%) being the most represented.

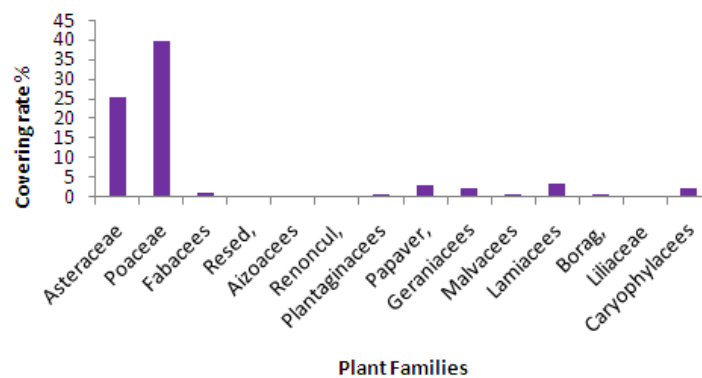
Poaceae are represented by only a total of 14 species but at rates of land occupation higher than Asteraceae's although these latter are more present. We can notice the presence of the Gramineae *Poabulbosa*, characteristic of the permanent habitat of the Moroccan locust. However, another Gramineae *Hordeum murinum* more abundant with an covering of 15% (Table1).

**Table 1: Covering Rates of the Main Families and Plant Species Found in Marhoum Station. (2010)**

Plant Families	Species	Covering Rate %
Asteraceae (25,15 %)	<i>Xeranthemum inapertum</i>	1,75
	<i>Carlina lanata</i>	2,1
	<i>Anacyclus latealatus</i>	1,05
	<i>Scorzonia laciniata</i>	0,5
	<i>Carthamus lanatus</i>	1,2
	<i>Hedypnois cretica</i>	0,35
	<i>Mantisalca salmantica</i>	1,2
	<i>Filago spathulata</i>	0,5
	<i>Centaurea maroccana</i>	0,3
	<i>Anacyclus depressus</i>	1,1
	<i>Stemomacantha acaulis</i>	0,2
	<i>Anacyclus clavitus</i>	1,3
	<i>Carduncellus pinnatus</i>	1,17
	<i>Hedypnois cretica</i>	0,35
	<i>Centaurea grincana</i>	0,4
	<i>Centaurea involucrata</i>	0,02
	<i>Launaea nudicaulis</i>	1,95
	<i>Lasiopogon muscoides</i>	1,8
	<i>Sonchus oleraceus</i>	0,14
	<i>Carthamus lanatus</i>	0,17
<i>Scorzonera laciniata</i>	0,1	
<i>Artemisia herba-alba</i>	4,2	
<i>Helianthemum sp</i>	1,85	
<i>Anacyclus valentinus</i>	1,05	
<i>Atractylis capitosa</i>	0,4	
Poaceae (39,65 %)	<i>Hordeum murinum L.</i>	15
	<i>Stipa parviflora</i>	2,6
	<i>Triticum turgidum</i>	1,05
	<i>Poa bulbosa L.</i>	3,7
	<i>Lolium temulentum</i>	3,45
	<i>Avena longissimus</i>	0,9
	<i>Bromus rubens</i>	2,45
	<i>Lolium perenne</i>	0,9
	<i>Dactylis glomerata</i>	0,5
	<i>Lolium multiflorum</i>	0,2
	<i>Stipa sp</i>	0,25
	<i>Phalaris arundinacea</i>	2,25
	<i>Anisantha fasciculata</i>	0,2
	<i>Avena longiglumis</i>	6,2
Fabaceae (0,9 %)	<i>Astragalus sp</i>	0,45
	<i>Vicia sativa</i>	0,45
Resedaceae (0,1%)	<i>Reseda decursiva</i>	0,1
Aizoaceae (0,01 %)	<i>Aizoon hispanicum</i>	0,01
Renonculaceae (0,01 %)	<i>Delphinium peregrinum</i>	0,01
Plantaginaceae (0,3 %)	<i>Plantago valtorcanus</i>	0,3

**Table 1 : Contd,**

Caryophyllaceae (1,8%)	<i>Minuartia cismontana</i>	0,15
	<i>Minuartia meditenarea</i>	0,1
	<i>Herniaria hirsuta</i>	0,2
	<i>Vaccaria pyramidata</i>	0,05
	<i>Dianthus gaditanus</i>	1,3
Papaveraceae (2,55%)	<i>Glaucium corniculatum</i>	0,45
	<i>Hypecoum pendulum</i>	2,1
Geraniaceae (1,95 %)	<i>Erodium guttatum</i>	1,95
Malvaceae (0,45 %)	<i>Malva parviflora</i>	0,45
Lamiaceae (2,95 %)	<i>Salvia sp</i>	2,25
	<i>Marrubium sp</i>	0,7
Boraginaceae (0,5 %)	<i>Echium sp</i>	0,5
Liliaceae (0,01%)	<i>Muscari neglectum</i>	0,01



**Figure 3 : Covering Rates of the Principal Represented Plant Families in Marhoum Station. (2010)**

#### Frequencies of Plant Consumption by the Moroccan Adult Locust in Marhoum Station (Sidi Bel Abbes)

The food spectrum of the gregarious adults of Marhoum population is very diverse as it includes a cocktail of plants dominated by Poaceae and Asteraceae and by other varied Dicotyledon families with no specific importance (Table 2).

The highest consumption frequencies are those of Poaceae plants (between 60.6% and 63.5%), followed by those of Asteraceae which are clearly less important (between 8.1% and 9.2%).

Of all the recorded plant species, some plants are not consumed at all; and which are *Anisantha fasciculata* (Poaceae), *Carlina lanata*, *Anacyclus clavatus*, *Carduncellus pinnatus* and *Lasiopogon muscoïdes*, *Scorzonera laciniata*, *Atractylis capitosa*, *Mantisalca salmantica*, *Filago spathulata* and *Centaurea grincana* (Asteraceae), as well as *Minuartia cismontana* (Caryophyllaceae) which were not palatable neither by males, nor by females (Table 2).

**Table 2 : Relative Frequencies of Plant Consumption (%) by Gregarious Males and Females of the Moroccan Locust In Marhoum Station**

Families	Species	Male	Female
Poaceae	<i>Hordeum murinum L. (15%)</i>	4,9	2,13
	<i>Stipa parviflora (2.6%)</i>	0,91	8,18
	<i>Triticum turgidum (1.05%)</i>	3,86	1,5
	<i>Poa bulbosa L (3.07%)</i>	0	1,91
	<i>Lolium temulentum (3.45 %)</i>	8,24	4,5
	<i>Avena longissimus (0.9 %)</i>	0	0,98
	<i>Bromus rubens (2.45 %)</i>	5,91	3,43
	<i>Lolium perenne (0.9 %)</i>	5	2,89
	<i>Lolium multiflorum (0.2 %)</i>	21,7	24,1
	<i>Stipa sp (0.25 %)</i>	7,1	5,5
	<i>Dactylis glomerata (0.5 %)</i>	3,75	1,1
	<i>Phalaris arundinacea (2.25 %)</i>	0	0,18
	<i>Anisantha fasciculata (0.2 %)</i>	0	0
	<i>Avena longiglumis (6.2 %)</i>	2,13	0
	Caryophyllacees	<i>Minuartia meditenarea</i>	1,17
<i>Herniaria hirsuta</i>		0	2,51
<i>Vaccaria pyramidata</i>		0	2,76
<i>Dianthus gaditanus</i>		2,13	0
Fabacees	<i>Astragalus sp</i>	0,9	2,5
	<i>Vicia sativa</i>	2,1	2,73
Papaveracees	<i>Glaucium corniculatum</i>	1,7	2,15
	<i>Hypecoum pendulum</i>	0,7	0
Plantaginacees	<i>Plantago valtorcanus</i>	1,13	0
Resedacees	<i>Reseda decursiva</i>	0	1,81
Aizoacees	<i>Aizoon hispanicum</i>	3,43	2,75
Renarculacees	<i>Delphinium peregrinum</i>	3	4,91
Asteraceae	<i>Xeranthemum inapertum</i>	0	0,27
	<i>Carlina lanata</i>	0	0
	<i>Anacyclus latealatus</i>	0,86	1,12
	<i>Scorzzonea laciniata</i>	0	0,11
	<i>Carthamus lanatus</i>	0	0,31
	<i>Hedypnois cretica (0.35 %)</i>	2,1	2,2
	<i>Mantisalca salmantica</i>	0	0
	<i>Filago spathulata</i>	0	0
	<i>Centaurea maroccana</i>	0	0,91
	<i>Anacyclus depressus</i>	0,89	0,75
	<i>Stemomacantha acaulis</i>	0	0,31
	<i>Anacyclus clavatus</i>	0	0
	<i>Carduncellus pinnatus</i>	0	0
	<i>Hedypnois cretica</i>	0,91	0
	<i>Centaurea grincana</i>	0	0
	<i>Centurea involucrata</i>	0	0,3
	<i>Launaea nudicaulis</i>	0,11	0
	<i>Lasiopogon muscoides</i>	0	0
	<i>Sonchus oleraceus</i>	0	0,16
	<i>Carthamus lanatus</i>	1,71	0
	<i>Scorzonera laciniata</i>	0	0
<i>Artemisia herba-alba</i>	1,12	0	
<i>Filago spathulata</i>	0,44	1,56	
<i>Anacyclus valentinus</i>	1,13	0,13	
<i>Atractylis capitosa</i>	0	0	
Zygophyllacees	<i>Peganum harmala</i>	1,83	2
Caryophyllacees	<i>Minuartia cismontana</i>	0	0
Cistacees	<i>Helianthemum sp</i>	2,25	3,52

Plant Family	Species	Value 1	Value 2
Chenopodiaceae	<i>Beta macrocarpa</i>	0	0
Geraniaceae	<i>Erodium guttatum</i>	0	1,31
Malvaceae	<i>Malva parviflora</i>	1,9	0
Lamiaceae	<i>Salvia sp</i>	2,5	0
	<i>Marrubium sp</i>	0,97	0,91
Boraginaceae	<i>Echium sp</i>	2,1	3,12
Liliaceae	<i>Muscari neglectum</i>	1,22	0

### Food Preferences of the Gregarious Populations of Marhoum Station

This study allowed us to conduct a study on the diet of *D. maroccanus*, depending on the local trophic availabilities. We analyze here the resources exploitation on the gregarious population scale. We compared subsequently the Poaceae supply in some gregarious locusts, of Marhoum’s population in 2010, with that of the solitary population studied by BENHALIMA in Morocco (1983) and BENFEKIH in Medea (1993).

We note that the Poaceae are the most palatable plants by both males and females with consumption frequencies superior to 60%, showing that this plant family occupies almost the entire food spectrum of these gregarious locusts (Figure 4). Asteraceae with other dicotyledons are obviously less desired with very low consumption frequencies of less than 5% overall (Figure 4).

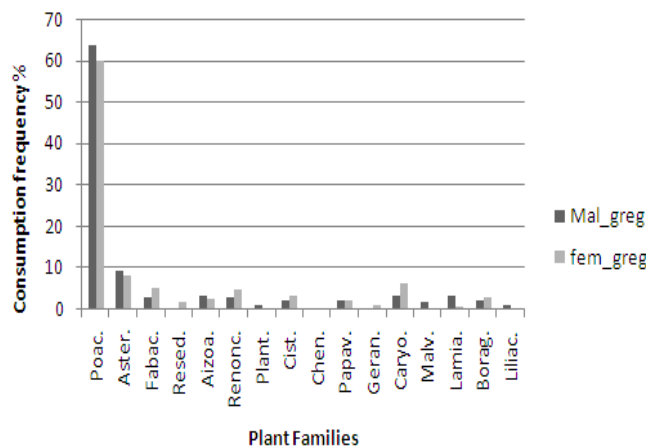
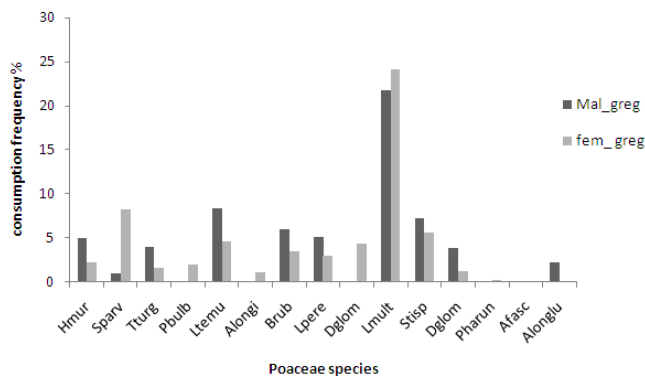


Figure 4: Diversity of the Consumed Plant Families during the Gregarious Phase of *D. maroccanus* in Marhoum Station

The Poaceae species preferred by males are *Lolium multiflorum* (21.7%), *L. tementulum* (8.24%), *Stipa sp.* (7.1%), *Bromus rubens* (5.91%), *Hordeum murinum* with *Lolium perenne* (4.9%) and *Triticum turgidum* with *Dactylis glomerata* (3.86% and 3.75%) respectively. Contrary to what is reported of the solitaires, *Poa bulbosa* was not desired by gregarious males during the months of June and July 2010 (Table 2 and Figure 5). Moreover, *Avena longissimus* and *Phalaris arundinacea* were not also consumed.



**Figure 5: Frequencies of Consumption of the Main Poaceae Species by the Gregarious *D. maroccanus* Males and Females in Marhoum Station**

Gregarious females consumed 12 Poaceae species of the 14 representative species of the station (Table 2). However, the favorite Poaceae species are *Lolium multiflorum* (24.1%), *Stipa parviflora* (8.18%), *Lolium temulentum* (4.5%) and *Bromus rubens* (3.43%) (Table 2 and Figure 4). *Poa bulbosa* was palatable with a frequency of only 1.91%.

The different Poaceae were all over-consumed according to their abundance in the field (the respective covering rate of each plant between parentheses) (Table 2). With the exception of the species *Hordeum murinum* which is under-consumed as compared with its covering in the station.

BENHALIMA (1983) and BENFEKIH (1993) have shown that solitary adults consume about 40% of Poaceae, while the solitary first stage larvae show a real tendency to over consume Poaceae especially *Poa bulbosa* which is very appreciated by the solitary larvae particularly L1 and L2 (about 60%). The same authors have reported that as the solitary adults of the Moroccan locust evolve in their imaginal life, the season is becoming drier. They consume less than 40% of Poaceae. The consumption of Dicotylédones and monocotylédones, is proportional to their abundance.

In its solitary phase, the Moroccan locust is very sedentary. The insect becomes less demanding in its food choice: its outcome is to find water and moisture in the consumed plants.

Its movements are very limited (BENHALIMA, 1983). According LATCHININSKY and *al.* (1992) this species is in the position of some Oedipodinae, capable of micro-migrations but without being committed to migrate which may suggest that *Dociostaurus maroccanus* capable of making major moves, but this species cannot be migratory as *Locusta migratoria*. It is therefore important to expand these ideas to the gregarious phase. Since the work of SVIRIDENKO (1924) in UVAROV (1977), it was recognized that the gregarious adult is polyphagous. The fourth and especially the fifth stage and the imagos feed on many dicotyledons.

The Gomphocerinae are almost exclusively graminivorous (JOERN, 1979; CHAPMAN, 1990). UVAROV (1977) even cites *D. maroccanus* as graminivorous. Though, according to the observations of BENHALIMA (1983), the Moroccan locust is an ambivorous species as reported (LATCHININSKY and *al.*, 1992) in late larvae stages and in gregarious phase adults. On the scale of an individual, a gradual opening of the trophic range could be related to an increased movement.

In fact, the differentiation factors involved in the perception of the vegetation cover like its floristic composition, its structure or its phenological state, play a role in the distribution of locusts (DURANTON and *al.*, 1982). The locust,



therefore, expresses its choice in its own biotope to meet its relational, nutritional and reproductional needs.

## CONCLUSIONS

Poaceae account for a large part of the diet of adult males and females of the gregarious populations with over 60% of the total food spectrum, compared with the other consumed plant families which are very diverse but whose consumption frequencies are very low. Regardless of the plant species, males and females show no specific food choices, especially in the consumption of Dicotyledons. Among Poaceae species, and compared to other species, *Lolium multiflorum* is highly consumed both by males and females, with the exception of *Stipa parviflora* whose frequency of consumption is different.

The results of this study show that *D. maroccanus* is a polyphagous species whose adults express a tendency to over-consume Poaceae (Gramineae) and present therefore a real risk to cereal crops including periods of heavy p

The *Dociostaurus maroccanus* species has both practical and theoretical interests. Practical, because it is useful to know the existence and proliferation conditions of a pest ; theoretical, since the use of the environment by a polyphagous species has rarely been undertaken because of the difficulties to overcome and the variety of resources to take into consideration.

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