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Evaluation of The Diversity of Durum Wheat Coleoptera (Triticum Durum Desf.) in the Region of Sigus Oum El Bouaghi (Eastern Algeria)

EVALUATION OF THE DIVERSITY OF DURUM WHEAT COLEOPTERA (*TRITICUM DURUM* DESF.) IN THE REGION OF SIGUS OUM EL BOUAGHI (EASTERN ALGERIA)

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ABSTRACT

The Oum El Bouaghi region in Eastern Algeria, long considered as a cereal-growing area is nowadays a durum wheat production region par excellence. Although the damage caused by Coleoptera is very significant, studies on the knowledge of their diversity are few and remain limited for some entomological groups. Our work is the first step to evaluate the diversity of Coleoptera and the long-term impact of taking biological management measures against harmful fauna in favour of more environment friendly agriculture. To assess the beetle community, different sampling methods were combined (Barber trap, coloured traps, mowing net and sight hunting). Evaluation of the results of a single campaign showed that Coleoptera infested with durum wheat vary in abundance and diversity. We identified more than 100 species of Coleoptera belonging to 22 different families for a total number of 5698 individuals belonging mainly to the Carabidae, Curculionidae, Chrysomelidae, Scarabidae and Staphylinidae families. Although the majority of Coleoptera collected are pests of durum wheat crops (47.57%) the case of *Tropinota hirta*, *Notaris sp* or *Oulema melanopus* in particular, there was an interesting presence of predators (28.15%) the case of Carabidae or Staphylinidae in particular even with low relative abundance. The temporal evolution of the Coleoptera showed that the species diversity indicated a peak of abundance at the full tillering stage following an accentuated vegetative development of the host plant, and the presence of weeds. The data collected in this way constitute a basis for a preliminary knowledge of the durum wheat Coleoptera and can thus be used to design pest control strategies.

Keywords: *Triticum durum*, Coleoptera, pests, predators, Oum El Bouaghi, Algeria.

INTRODUCTION

The eastern Algerian highland region is mostly dominated by cereal crops. The pedoclimatic conditions prevalent in this type of environment make it very important to have a diversified fauna, in particular the Coleoptera, which forms a category of arthropod animals recognized since ancient times and is a genus of insects. This constitutes 25 to 30 per cent of all animal populations (Powell, 2009; Moore, 2013).

This order, the richest in species on earth, forms the average element of biodiversity and can intervene at all levels of the food web. They can be primary consumers (phytophagous), secondary consumers or tertiary consumers (predators or parasites) (Odegaard, 2000; Marniche et al., 2014; Labruyere, 2017). According to Elizabeth (2015) Coleoptera constitutes more than 300,000 described species; they live in all environments and are characterized by the ease of harvesting and conservation (Perrier, 1977; Barney and Pass, 1986). The sources of food for Coleoptera are as varied as their lifestyles, ranging from a purely carnivorous diet to a phytophagous, mycetophagous or saprophagous diet (Zarazaga, 2015).

Cereals are by far the most important agricultural land use because they serve as staple food for a large proportion of the world's population. In Algeria, as in North Africa, these crops represent the main speculation and drain several processing activities, in semolina, bakery and food industry. In Algeria, during the last decade, wheat represented an average of 67.1% of all cereal production. They also constitute the basis of food and occupy a privileged place in the food habits of populations in both rural and urban areas (Derbal et al., 2015).

Although the damage caused by the beetle fauna in Algeria is very significant in cereal fields, studies on the knowledge of the bio-ecology of this procession remain insufficient and poorly known and are generally quite localized and focused on limited taxa. This is particularly the case for the family Aphididae, which is the most studied group (Boughida, 2010; Dif, 2010; Laabdaoui and Guenaoui, 2015; Aggoun et al., 2016; Lebbal, 2017). The bibliography dealing with the Coleoptera fauna in different regions of the globe is abundant, but in the Maghreb (North Africa), in-depth studies on this fauna are rather rare. Note that studies carried out recently in Algeria concern in particular the entomological fauna associated with forest species such as cork oak, holm oak or cedar (Benia, 2011; Bairi and Mennous, 2017). Adding some recent studies carried out on the Carabidae fauna (Ouchtati et al., 2012; Saouache and Doumandji, 2014; Saouache, 2017). On the other hand, the studies concern the stands of the entomofauna of cereals as a whole are few and fragmentary. However, we can cite in particular the study carried out by Kellil (2019) in the region of the high plains of Algeria.

In Morocco, numerous fragmentary studies on this order have been carried out by Chavanon et al., (1995); Chavanom and Mahboub (1998) in the mouth of the Moulouya River; Slim et al., (2016) in reserve of Sidi Boughaba Mehdia. In Tunisia (Touaylia et al., 2009) an inventory of Helophoridae and Hydraenidae was made. In Algeria, the study conducted by Boukli Hacene et al., (2012) of the salt marshes at the mouth of the Tafna (Tlemcen) was cited.

The richness and particular characteristics of the Beetles as auxiliary fauna is far from negligible and concerns several families (Carabidae, Silphidae, Cleridae, Anthribidae, Lampyridae...) and several hundred species (Kulkarni et al., 2015) . They are mainly generalist predators but some groups or families are more or less specialised, such as the Coccinellidae which, depending on the genus and species, are consumers of aphids, mealybugs or mites. Some species are parasites of diptera Anthomyiidae (cabbage maggot), this is the case of certain staphylins of the genus Aleochara. Beetles represent an important biomass especially in the tropics. They are a part of food chains and their impact as decomposers and consumers (Gullan and Cranston, 2010). The distinctive characteristics of this fauna have aroused the interest of many researchers all over the world and also our interest, given that little work has been done on this fauna in Algeria, particularly on this group of insects and on durum wheat crops (Ouchtati et al ., 2019).The aim of this work was to analyse the taxonomic composition of the beetle population harvested at the family and species level (Talmaciu, 2018). This study also aims to determine the bio-ecological status of the different species inventoried (abundance, constancy and trophic status) determined through their diets and their temporal distribution in relation to the phenology of the host plant.

MATERIAL AND METHODS

Study Area

The durum wheat field where our experiment took place is located in the Ghoul Moussa pilot farm located in the commune of Sigus. Among the activities carried out by this farm we can mention among others poultry fattening and industrial hatching with egg production; industrial fattening of cattle and sheep (in converted stables) and other slaughter animals for slaughter. The farm has an area of 1398 Ha intended mainly for the cultivation of durum wheat, soft wheat, barley, oats and certain vegetable crops such as chickpeas and lentils, adding 10 Ha intended for olive growing (A.S.D, 2018). The commune of Sigus located in the extreme northeast of the wilaya of Oum El Bouaghi (Figure 1),

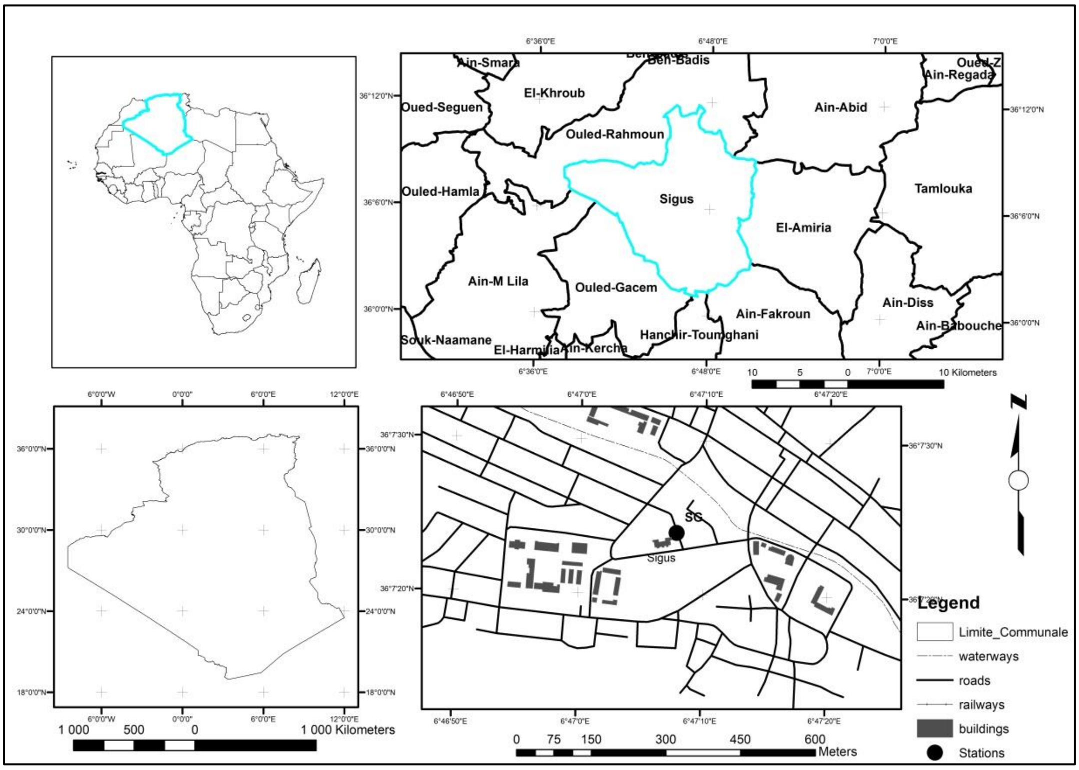

Figure 1: Map of the geographical location of the study site in the Sigus region.

Figure 2: Barber pot at the start of tillering

Figure 3: Barber pot at full tillering

Figure 4: Colored Trap (Original)

Figure 5:Moving Net (Original)

covers an area of 210.24 km². This region is under the dominance of a continental climate with strong thermal amplitudes, both annual and daily, which is characterized by cold winters, irregular rainfall, very frequent spring frosts and hot and drying winds at the end of the cereal cycle (Baldy et al., 1993).

The soils at the experimental site are characterized by flat topography, belong to the clay loam group, and are 120 cm deep. The previous crop is an unworked fallow. The study focused on the durum wheat variety Waha.

For the second harvesting technique, we used 30 coloured traps (yellow plates) made of plastic (Figure 4) in which we placed water with an added wetting agent, which not only reduces the surface tension of the water but also acts on the integuments of the insects and causes drowning of those who come into contact with the liquid (Benkhellil, 1991). This type of trap is one of the models most frequently used in wildlife entomology in agricultural environments because they are effective and lend themselves to large-scale sampling (Mignon et al., 2003)

For the third capture technique, we used the mowing net (Figure 5), a method for harvesting Coleoptera that is not very mobile and is confined in the grass (Lamotte and Bourliere, 1969).The contents are examined regularly after a few shots of the net, and the species are removed with fingers, soft pliers or with the aid of a vacuum cleaner (Benkhellil, 1991).

The number of shots with the mowing net is 10 times. These three trapping techniques are complemented by the sight-hunting method, in which Coleoptera is captured on stems, leaves and ears and sometimes even moving over the ground. The Coleoptera captured by the different sampling methods are placed in small plastic bottles containing 70% ethanol and labelled with the dates of the different surveys.

The determination and identification of the collected Coleoptera were carried out at the ecology laboratory of Larbi Ben M'hidi University in Oum El Bouaghi using a binocular magnifying glass and through the consultation of several guides and keys: (Delvare and Aberlenc, 1989; Perrier, 1961; Perrier, 1963; Perrier, 1964; Chopard, 1943; Silva et al., 2012) as well as the consultation of several entomological web sites.

Data Analysis

The results are analysed by ecological structure indices such as relative abundance and occurrence and composition indices such as the Shannon Diversity Index and Equitability to get an idea of the structure and composition of the harvested beetle to stand at the agro-system level studied The Shannon-Weaver Diversity Index, which quantifies the heterogeneity of biodiversity in the environment (Benyacoub, 1993) was calculated according to the following formula:

$$H' = -\sum (P_i * Log_2 P_i)$$

$P_i = n_i / N$

N: Number of species in the sample

P_i: Frequency of species i

n_i: number of individuals of a species of rank i

This index is a bit unit; its value depends on the number of species present, their relative proportions and the logarithmic base. To be able to compare the diversity of samples containing different numbers of species,

Equitability (E') is calculated.

$$E' = H'/H_{max}$$

$$H_{max} = Log_2 S$$

S: total richness

Equitability (E') tends towards 0 when one species largely dominates the stand and is equal to 1 when all species have the same abundance (Dajoz, 2002). A study of the trophic composition of the identified species was carried out by classifying them according to diet to determine the role played by each species. We also studied the temporal variation in species richness at certain stages of the life cycle of the host plant.

RESULTS

The sampling system applied during the study year enabled us to draw up a taxonomic list of 103 species divided into 22 families for a total number of 5698 individuals belonging essentially to the following families: Carabidae, Curculionidae, Chrysomelidae, Scarabidae and Staphylinidae (Table.1).

The distribution of Coleoptera inventoried indicates that the family Staphylinidaeas the most diverse and representative in the number of species with 16 taxa and a rate of 15.53% followed by Curculionidae and Chrysomelidae which also show species-rich with rates of the order of 12.62% and 11. 65% respectively. The least represented families were the Histeridae, Cerambycidae, Pubrestidae, Elateridae, Cléridae and Meloidae each represented by a single species with similar rates of the order of 0.97% (Table.1, Figure. 6) .

The settlement of the Coleoptera recorded in the study area is characterized by an apparent dominance of certain species, in particular, the species *Tropinota hirta* belonging to the Cetonidae, which marks an extremely high number of 1296 individuals, followed by the species *Psilothrix viridicoerulae* and the species *Psilothrix aureola* belonging to the Melyridae, also the species *Oulema melanopus* belonging to the Chrysomelidae, followed by *Notaris sp* belonging to the Curculionidae. For the Carabidae, the dominance returns to species *Syntomus fuscomacalatus* and *Syntomus sp*.

For the Scarabidae the species *Aphodius consparctus* dominates. For Coccinelidae the species *Coccinella spetempunctata* is the most representative. Finally, the Staphylinidae which constitutes the most diversified family the dominance is due to the species *Tachyporus Chrysomelidae* and *Tachyporus sp*. To better understand the role of the species in the wheat crop biocenoses and to understand their place in the food chains and food webs, a distribution of their trophic status has been carried out. This distribution takes into consideration the type of diet of adult states, although in nature there is no absolute trophic specialization (Beaumont and Cassier, 1983).

Table 1: Taxonomic Composition, Relative Abundance and Frequency Occurrence of Harvested Coleoptera on Durum Wheat Crop

Family	Species	Diet	Number of individuels	Relative abundance (%)	Occurrence (%)	Range of occurrence
Carabidae	*Carabus nemoralis* (C.F Muller, 1764)	Predator	10	0.175	50	RE
	Syntomus fuscomacalatus (Hope, 1838)	Predator	250	4.387	100	OM
	Syntomus sp (Hope, 1838)	Predator	121	2.123	80	C
	Microlestes (Schmidt-Godell, 1846)	Predator	75	1.316	80	C
	Harpalus tenebrosus (Dejean, 1829)	Predator	2	0.035	20	A
	Harpalus sp (Dejean, 1829)	Predator	1	0.017	10	A
	Amara aenea (Degeer, 1774)	Polyphagous	5	0.087	30	AC
	Calathus fuscipes (Goeze, 1777)	Predator	1	0.017	10	A
	Zabrus tenebrioides (Goeze, 1777)	Phytophagous	75	1.316	70	RE
	Pterostichus melanarius (Illiger,	Predator	1	0.017	20	A

	1998)					
	Trechus quadristriatus (Ericheon, 1837)	Predator	2	0.035	20	A
Scarabidae	*Trypocopris vernalis* (Linneaus, 1758)	Coprophagous	4	0.07	20	A
	Onthophagus ovatus (Latreille, 1802)	Coprophagous	3	0.052	30	AC
	Rhizotrogus aestivus (Olivier, 1789)	Phytophagous	7	0.122	70	RE
	Aphodius consparctus (Linneaus, 1758)	Coprophagous	25	0.438	40	AC
	Aphodius obliteratus (Linneaus, 1758)	Coprophagous	5	0.035	40	AC
	Aphodius sp (Linneaus, 1758)	Coprophagous	6	0.105	10	A
	Rhizotrogus sp (Sabatinelli, 1975)	Phytophagous	2	0.035	10	A
	Cyphonistes vallatus (Paulan ,1954)	Phytophagous	1	0.017	10	A
	Onthophagus sp (Latreille, 1802)	Coprophagous	1	0.017	30	AC
	Geotrogus deserticola (Guerin, Meneville,1842)	Phytophagous	5	0.0351	30	AC
Cetonidae	*Tropinota hirta* (Poda,1761)	Phytophagous	1296	22.744	100	OM

	Oxytheria squalida (Scopoli, 1763)	Phytophagous	65	1.14	70	RE
	Cetonia sp (Fabricus, 1798)	Phytophagous	2	0.035	20	A
Coccinellidae	*Coccinella tredecimpunctata* (Linneaus 1977)	Predator	3	0.052	20	A
	Coccinella undecimpunctata (Linneaus 1977)	Predator	1	0.017	10	A
	Coccinella variegata (Linneaus 1977)	Predator	4	0.07	30	AC
	Coccinella septempunctata (Linneaus 1977)	Predator	22	0.386	80	C
	Coccinella algerica (Linneaus 1977)	Predator	7	0.122	20	A
Tenebrionidae	*Pachychila sp* (Herbst , 1799)	Saprophagous	85	1.49	80	C
	Tentyria bipunctata (Solier, 1835)	Saprophagous	68	1.193	70	RE
	Opatrum sabulosum (Linneaus, 1761)	Saprophagous	13	0.228	70	RE
	Pimelia costata (Walts, 1835)	Saprophagous	2	0.035	20	A
	Blaps sp (Fabricus, 1777)	Saprophagous	1	0.017	10	A
	Gonocephalum sp (Solier, 1834)	Saprophagous	3	0.052	20	A

Latridiidae	*Enicmus sp* (C.G.Thomson, 1859)	Phytophagous	7	0.122	40	AC
	Corticaria sp (Marsham ,1802)	Phytophagous	3	0.052	20	A
	Lathridius sp (Herbst, 1793)	Phytophagous	4	0.07	20	A
Nitidulidae	*Meligethes sp* (Stephen,1830)	Phytophagous	13	0.228	50	RE
	Meligethe aeneus (Linneaus, 1775)	Phytophagous	45	0.789	80	C
Curculionidae	*Aulacobaris coerulescens* (Scopolis, 1763)	Phytophagous	1	0.017	10	A
	Baris sp1	Phytophagous	29	0.508	50	RE
	Sitona lineatus (Linneaus, 1761)	Phytophagous	2	0.035	10	A
	Sitonia sp (Germar, 1817)	Phytophagous	1	0.017	10	A
	Baris sp2	Phytophagous	1	0.017	10	A
	Pachytychius hordei grandicollis (Walt, 1835)	Phytophagous	6	0.105	30	AC
	Brachycerus lutulentus (Fabricus, 1798)	Phytophagous	19	0.333	40	AC
	Brachycerus muricatus (Oivier, 1790)	Phytophagous	10	0.175	40	AC
	Notaris sp (Germar, 1817)	Phytophagous	450	7.897	100	OM

	Procas armillatus (Fabricus, 1798)	Phytophagous	85	1.491	80	C
	Otiorhynchus striatus (Germar, 1822)	Phytophagous	3	0.052	30	ACE
	Omphalapion laevigatum (G. Paykull, 1792)	Phytophagous	1	0.017	10	ACI
	Stenocarus sp (C.G Thomson, 1858)	Phytophagous	21	0.368	70	RE
Chrysomelidae	*Psylliodes chrysocephalus* (Linneaus, 1783)	Phytophagous	25	0.438	60	RE
	Longitarsus parvulus (Latreille, 1802)	Saprophagous	21	0.368	50	RE
	Longitarsus ochroleucus (Latreille, 1802)	Saprophagous	17	0.298	50	RE
	Longitarsus sp	Phytophagous	2	0.035	10	ACI
	Antipus sp (Degeer, 1778)	Phytophagous	1	0.017	10	ACI
	Smaragdina concolor (Fabricus, 1792)	Phytophagous	35	0.614	50	RE
	Gastrophysa viridula (Degeer, 1778)	Phytophagous	31	0.544	70	RE
	Clytra taxicornis (Fabricus, 1792)	Phytophagous	1	0.017	10	ACI

	Galeruca interrupta (Illiger, 1802)	Phytophagous	15	2.83	30	ACE
	Oulema melanopus (Linneaus, 1758)	Phytophagous	530	9.301	100	OM
	Entomoscelis rumicis (Fabricus, 1787)	Phytophagous	21	0.368	40	ACE
	Chrysomelidae sp	Phytophagous	1	0.017	10	ACI
Alleculidae	*Heliotaurus ruficollis* (Breitter, 1906)	Phytophagous	6	0.105	20	ACI
	Heliotaurus sp (Mulsant, 1856)	Phytophagous	108	1.895	40	ACE
	Allecula sp (Fabricus, 1787)	Phytophagous	25	0.438	20	ACI
Cassidae	*Cassida vittata* (Villers, 1789)	Phytophagous	4	0.07	20	ACI
	*Cassida sp (*Linneaus, 1758)	Phytophagous	2	0.035	10	ACI
Silphidae	*Silpha obscura* (Illiger, 1798)	Predator	7	0.122	40	ACE
	Silpha sp (Linneaus, 1758)	Predator	2	0.035	40	ACE
Merylidae	*Aplocnemus andalusicus* ((Rosenhauer, 1856))	Phytophagous	5	0.087	30	ACE
	Aplocnemus sp (Paykull, 1799)	Phytophagous	9	0.157	40	ACE
	Psilothrix viridicoerulea (Geoffroy, 1785)	Phytophagous	975	17.111	100	OM

	Psilothrix aureola (-Kiesenwetter, 1859)	Phytophagous	830	14.566	100	OM
Elateridae	*Conoderus sp* (Candeze,1865)	Phytophagous	1	0.017	10	ACI
Meloidae	*Lytta vesicatoria* (Linneaus, 1758)	Coprophagous	2	0.035	20	ACI
Dermestidae	*Anthrenus pimpinellae* (Fabricus, 1775)	Coprophagous	1	0.017	10	ACI
	Attagenus unicolor (Latreille, 1802)	Coprophagous	9	0.157	20	ACI
	Dermestes murinus (Linneaus, 1758)	Coprophagous	12	0.21	20	ACI
Staphylinidae	*Xantholinus linearis* (Oivier, 1795)	Predator	3	0.052	20	ACI
	Philonthus quisquiliarius (Gyllenhal, 1810)	Predator	3	0.052	30	ACE
	Anthophagus sp (Gravenhorst, 1802)	Predator	1	0.017	10	ACI
	Lestiva sp (Latreille, 1802)	Predator	1	0.017	10	ACI
	Lithocharis nigriceps (Latreille, 1829)	Predator	2	0.035	20	ACI
	*Habrocerus Tachinus (*Krantz, 1859)	Polyphagous	2	0.035	20	ACI

	Tachyporus chrysomelidae (Linneaus, 1758)	Polyphagous	21	0.368	60	RE
	Tachyporus sp (Gravenhorst,1802)	Polyphagous	15	0.263	50	RE
	Cryptobium fracticornis (Paykull, 1800)	Predator	1	0.017	10	ACI
	Stenus guttula (Muller,1821)	Predator	1	0.017	10	ACI
	Tychobythinus lavagnei (Levitt, 1913)	Polyphagous	1	0.017	10	ACI
	Philonthus nigrita (Sharp, 1874)	Predator	2	0.035	20	ACI
	Omalium sp (Gravenhorst, 1802)	Predator	1	0.017	10	ACI
	Oxytelinae sp1	Predator	2	0.035	20	ACI
	Oxytelinae sp2	Predator	8	0.14	40	ACE
	Ocypus olens (O.F.Muller, 1764)	Predator	1	0.017	10	ACI
Histeridae	*Saprinus acuminatus* (Fabricus, 1798)	Predator	4	0.07	10	ACI
Cleridae	*Trichodes alvearius* (Fabricus, 1792)	Phytophagous	4	0.07	20	ACI
Cerambycidae	*Stenostola sp* (Laichartin, 1784)	Phytophagous	1	0.017	10	ACI
Pubrestidae	*Anthaxia sp* (Linneaus, 1758)	Phytophagous	1	0.017	10	ACI

Anthicidae	*Omonadus floralis* (Linneaus, 1758)	Polyphagous	35	0.614	60	RE
	Cyclodinus sp (Germar, 1824)	Polyphagous	15	0.263	40	RE
Total			5698			

ACI: Accidental; ACE:Accessor; C:Constant;UB: Ubiquitous; RE:Regular

The trophic status of collected Coleoptera indicates that the majority of species belonging to the category of phytophagous with 49 species and a rate of 47.57% found in particular in the Curculionidae_with 13 species and the *Chrysomelidae* with 12 species; followed by the category of predators with 29 species and a rate of 28.15% found in particular in the Staphylinidae with 12 species and the Carabidae with 9 species. The lowest categories are Polyphagous and Saprophagous with quite similar rates (Figure. 7, Table.1).

The phenology of the host plant, was divided into distinct periods (emergence, early tillering, full tillering, run-in, heading and maturity), as well as the monthly variations in abundance and species richness, show that the periods when durum wheat crop zoocenosis was richest and most abundant in species coincide with the period of full tillering, which was less reduced at run-in, heading and maturity. The emergence stage was characterized by a low species richness rate of about 1.35% (all species combined). A number which tends to increase in an apparent way from the early tillering stage reaching a peak of abundance at the full tillering stage presenting a rate of about 49.21%.The heading stage was characterized by a reduction in species richness but is still of interest following the appearance of new species in the adult state, such as the species *Heliotaurus sp* belonging to the Alleculidae family. The same observation concerns the period of maturity of the grain. It should be noted that each period of the life cycle of the host plant is marked either by the appearance or disappearance of a given species.

DISCUSSION

The taxonomic composition of the diversity of the harvested Coleoptera included 103 species divided into 22 families for a total population of 5698 individuals. To give an idea of the representativeness of the species within the beetle population, we have calculated ecological indices. The Shannon-Weaver diversity index (total diversity index) H' indicated a value of 2.70. This interesting value reflected the richness and complexity of the stand at the level of the agro-system under study. The value of the equitability index in our study was 0.58. It reflected a disturbed distribution of species. This anomaly in the stand composition of the Beetles harvested from the agro-ecosystem studied could be explained by the dominance of certain expansionist species, mainly *Tropinota hirta*, *Psilothrix viridicoerulea*, *Psilothrix auréola* and *Oulema melanopus* (Table. 2).

Table 2: Structural parameters of the stands of Harvested beetles

Structural parameters	Corresponding values
Diversity index	**H'= 2.70**
H maximal	**4.63**
Equitability index	**E'= 0.58**

As for the scale of occurrence, accidental or rare species played an important part in our results with extremely low relative abundances, this allowed us to say that species observed once considered rare were not specified to be neglected since they can play an important role in the functioning and

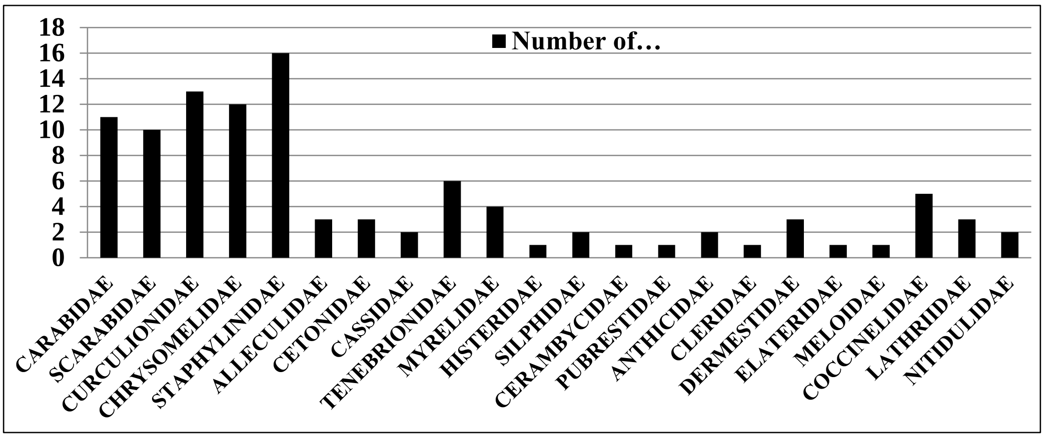

Figure 6: The abundance of Coleoptera caught by the number of families and the number of species

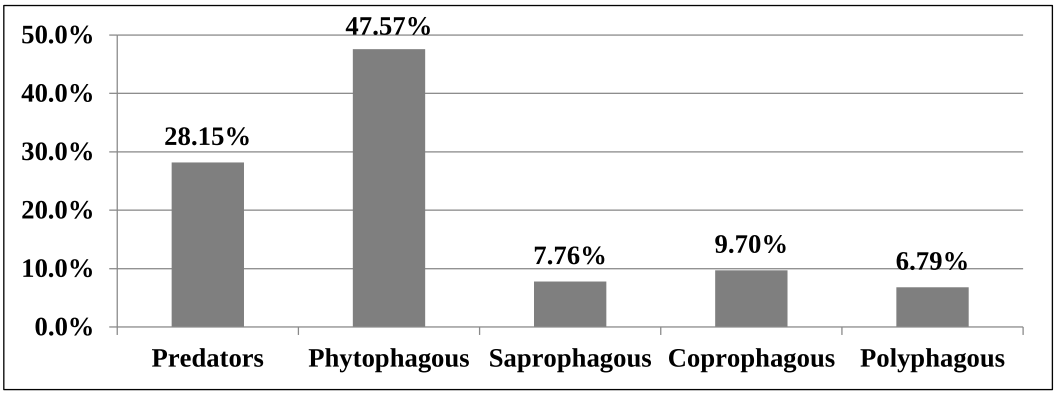

Figure 7: Distribution Percentage of Coleoptera trophic diet censused

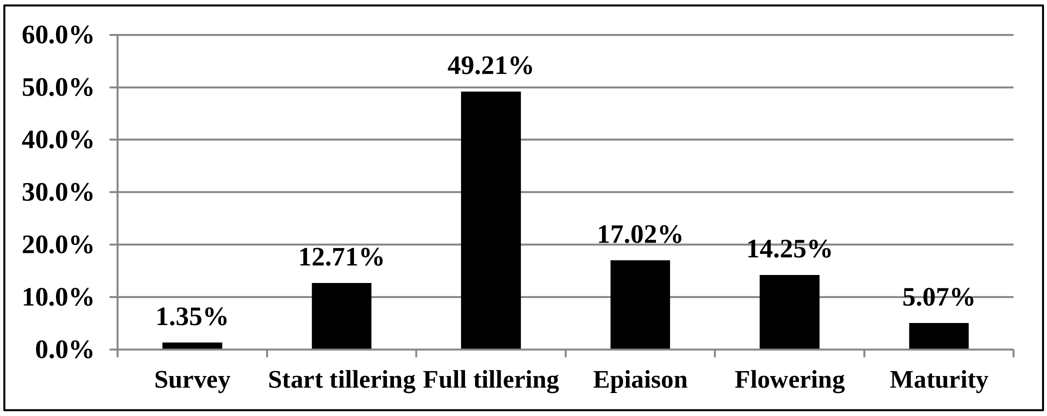

Figure 8: Frequency of abundance of captured Beetles according to Durum Wheat phenology

Studies concerning the systematics of Staphylinidae or their identification in Algeria were absent or rare and dozens or even hundreds of species await a description or discovery as this group of insects occuped or colonised almost all terrestrial biotopes with certainly a large specific diversity. Concerning the Carabidae currently used in biogeographic studies and conservation biology, research on Carabidae populations in Algeria remains generally limited (Ouchtati et al., 2012; Saouache and doumandji, 2014; Saouache, 2017). The species that best represented this group in our results with an interesting relative abundance was *Syntomus fuscomacalatus*, which had a very wide distribution in the Palaearctic region Oleg A and Artsiom O (2017), followed by *Syntomus sp* and Microlestes. The study carried out by Boukli (2010) in the mouth of Tafna in Tlemcen showed that Microlest and Syntomus are plastic species which belong to a family characterised by a very wide adaptive success to multiple ecological conditions with which explained their high abundance and occurrences. The majority of the ubiquitous species were considered among the groups of insects potentially most harmful and specific to cereals in the highland's region the case of the species *Tropinota hirta* and the species *Oulema melanopus* in particular, one of the most formidable primary pests of cereal crops in the Algerian highlands with yield losses of up to 25%. If the flag leaf is 90% damaged, the yield loss ~~is~~ was about 23%. Most of the damage was caused by larvae feeding on the leaf tissue, leaving long stripes on the upper leaf surface while the lower surface remained intact (Rouag, 2012). Concerning the ubiquitous *Tropinota hirta* species with the highest relative abundance, no previous studies had been done on this polyphagous ketoid causing severe crop damage in Algeria(Good and Giller, 2020). Insect families considered useful and have shown uninteresting relative abundances are part of the predatory fauna, are groups to be preserved and used in particular during biological control programmes, for example, by establishing uncultivated herbaceous 'crop border' area where useful fauna species can overwinter (Bohan et al., 2011, Eyre et al., 2013; Robin, 2014). These biotopes could constitute a refuge, allowing Coleoptera such as carabid Coleoptera, for example, to shelter, reproduce, feed and could serve as a corridor for their dispersal. Thus, the preservation of these grassy strips is very important to maintain their presence in crops (Rouabah, 2015; Saouache and Doumanji, 2014; Rouabah et al., 2015).

The trophic specialization of the Coleoptera was an important criterion in the functioning of the settlement. According to Beaumont and Cassier (1983) the insects' diet was extremely diverse, and there was no absolute trophic specialization in nature. It was also important to note that in some groups, also, it was possible to observe the transition from one diet to another so that some predators can become phytophagous. Indeed, our results revealed the dominance of phytophagous species that are part of the crop pest fauna, which was very selective as to which plant species they prefer rather than which part of the plant they will eat. They feed on the expense of the chlorophyll plants they gnawed or grazed on. Any part of the plant (root, stem, leaf) can be attacked (Kellil, 2018). The dominance of phytophagous Coleoptera as a pest had always been reported in cereal crops Since durum wheat is a foliaceous crop for almost all its above-ground biomass, it was a favourite food source for phytophagous Coleoptera. The latter occupied the first place in the number of species concentrated much more in the Curculionidae, Chrysomelidae and Merylidae. Predators which were part of the auxiliary fauna, and were also well represented in the number of species but with a low relative abundance, especially in Staphylinidae, Carabidae and

Coccinellidae. Concerning the Coccinelidae the study carried out by Saharaoui et al., (2014) in Algeria revealed the presence of 46 species of ladybirds belonging to 12 tribes and 22 genera have been inventoried. The latter played a very important role in limiting the populations of insect pests.They feed on the larvae of different insects. Therefore, a good knowledge of the systematics, biology and ecology of predators was essential for the management of their populations in crops and their practical used in biological pest control (Ghezal,2019). Coprophagous represented in particular by Scarabidae were favoured by the presence of cattle breeding which ensured their maintenance at the studied agroecosystem level. This particularly useful fauna was inferred from dung,. The latter facilitated the burial and recycling of faecal matter by improving the soil structure and its nitrogen content. Coprophagous animals made an important contribution to soil improvement in grazing areas (Labidi et al., 2012). Saprophagous as useful fauna were poorly represented, consuming decomposing plant and animal organic matter through the action of microorganisms, fungi and insects that will constitute humus (Meyer, 2016). Concerning the polyphagous which forms the category the least represented have a more eclectic diet, feed on animal and vegetable organic matter in different forms. They can play a double role, both beneficial and destructive (Dajoz, 2002).

Concerning the distribution of Coleoptera according to the development cycle of durum wheat, the low species richness at emergence could be explained by the fact that the plant cover ~~is~~ was less dense. The climate itself acts as a factor dependent on density during the winter by eliminating individuals that have not been able to find favourable wintering sites. In winter, as the temperature drops, the entomofauna decreases. From spring onwards, the climatic conditions become milder as the temperature rises, and we have seen a gradual increase in the total species richness. The most dominant families were the Cetonidae, the Melyridae, and the Chrysomelidae. The specific diversity showed a peak of abundance at the full tillering stage as a result of an accentuated vegetative development of the host plant, as well as the climatic conditions, especially the temperature, which had a very beneficial role in the activity, survival and hatching of insect eggs (Régnière., 2012; Pernet., 2015; Sebastião et al., 2015) adding species selectivity to the plant organs which coincided reciprocally with the different stages of development of the host plant. The seasonal climate was important factor acting on insect density by favouring the nutritional needs of the species and consequently their movements, proliferation and distribution. It was in the spring, when the plants were in bloom, that the different groups of insects recorded experience the highest frequencies of abundance (Bensaada et al., 2014).Noting the significant proliferation of weed flora in the experimental field tends to favour the importance of insects. Among the dominant weed species in the cereal, the field was *Papever-rooms* (Poppy), *Malva marviflora* (Mallow), *Avena sativa* (Wild oats), *Bromus rigidus* (rigid bromine), *Hordeum murinum* (Rat barley) and many other species. According to Dajoz (2002), monocultures were frequently invaded by insect pests, weeds that may be abundant or by parasitic diseases and the variability in the abundance of arthropod populations was higher in agro-systems than in natural ecosystems; certain botanical families were more or less sought after by insects and within a species, varietal, morphological or chemical characteristics increased their attractiveness or repellent power (Bennett and Cahill (2013), Eyre et al., 2013, Duflot et al., 2017) the seasonal climate was an important factor influencing insect density. By favouring the nutritional quality of the pests and consequently their movements, proliferation and distribution. It was in the spring, when the plants were in bloom, that the different groups of insects recorded experience the highest frequencies of abundance.

CONCLUSION

Our study indicates a diversity of 103 species of Coleoptera divided into 22 families for a total number of 5698 individuals, with interesting specific diversity in favour of Staphylinidae, followed by Cucrculionidae, Chrysomelidae and Carabidae. Phenology as well as monthly variations in abundance and species richness showed that the Beetle fauna presents a peak of abundance, at the full tillering stage. The dominant diet ~~is~~ was that of the Phytophagous category which characterizes in particular the Curculionidae and the Chrysomelidae with very strong effects on durum wheat cultivation, followed by the Predatory category represented in particular by the Carabidae, the Staphylinidae and the Coccinellidae which are important biological agents for the control of crop pests. The results obtained constitute a first database for the knowledge of the biodiversity of this fauna in the study region and for the cultivation of Durum Wheat in order to acquire even preliminary knowledge of the trends in the biodiversity of Beetles in cereal agro-ecosystems, which was an urgent concern for agronomists in the region who were seeking to determine the actual and potential impact of insect pests and their natural enemies in regions with a cereal vocation.

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