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Article

Coleoptera species associated with durum wheat in Ziban region (Northern Sahara of Algeria): Diversity, abundance and sharing of trophic resources

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Abstract : Our study highlights the ecology of coleopteran species associated with durum wheat in the Biskra region, based in three sites considered to be the most important cereal poles in the region, Using a fall trap, we were able to collect a total of 1671 individuals of Coleoptera, belonging to 42 species, 38 genus and 12 families. The most representative families were the Coccinellidae and the Carabidae (7 species for each), the Cetoniidae (5 species), the Curculionidae, the Staphilinidae, the Scarabeidae and the Cantharidae are represented by 4 species for each. The most represented species were *Coccinella septempunctata* (424 specimens), *Oulema melanopa* (342 specimens), *Hippodamia variegata* (243 specimens) and *Psilothrix viridicoerulea* (238 specimens). Shannon's diversity index (H') values are 1.31 bits in Sidi Okba, 1.45 bits in El Houche and 1.29 in El Outaya. The values of the Evenness index (E) are less than 0.50 which shows that populations are in imbalance. The trophic status of the collected species showed that predators are the most dominant species with a relative abundance of 50%, followed by phytophagous by a relative abundance equal to 36%.

Keywords : coleoptera; ecology; diversity; durum wheat; Biskra; Algeria

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1. Introduction

Coleoptera are currently considered among the insect orders with the richest number of identified species in the world (approximately 350,000 to 400,000) [1].The species of this order live in practically all biotopes, except polar and oceanic environments. The biology of the species in this taxonomic group is very diverse, with sometimes very strict ecological requirements which have made excellent bioindicators (case of saproxylic species or coprophagous beetles) [2].

Dajoz and Boukhemza [2,3], in a cereal field, report that Coleoptera are able to reach 70% as maximum abundance from December to May.

Cerealcultur occupies a very important place in the Biskra region with approximately 30,000 ha of agricultural land cultivated by cereals each year in different municipalities of the wilaya [4].

Due to the importance of cereal ecosystems in arid zones and the interest ecological of coleoptera, our study highlights the biodiversity of species related to cereal ecosystems as well as the study of the trophic status of each (phytophagus, predators , parasites etc…) in several localities in the region of Biskra. The aim of this study is to evaluate the diversity of coleopteran species in a cereal agrosystem and to assess the trophic state of each species in the region of Ziban area in Southern Algeria.

2. Materials and Methods

2.1 Presentation of the study region

The study area is located in the province of Biskra, in the Southern-Est of Algeria at 34° 52′ 00″ N, 5° 45′ 00″ E, this region is caracterized bya hot dry climate according to Koppen–Geiger classification, with very high air tempratures in summer that can reach a minimum temperature of 17 °C in December, and a maximum temperature 41.76 °C in july. And characterized in particular by low and irregular precipitation (maximum 20.33 mm in january), and Emberger's index (Q2) is at 11.3.

In our study, we selected three sites in three cereal zones (El Outaya: 35° 02′ 00″ N, 5° 36′ 00″ E, Sidi Okba: 34° 45′ N, 5° 54′ E, and El Haouche: 34° 33′ 43″ N, 6° 03′ 05″ E) (Figure 1),

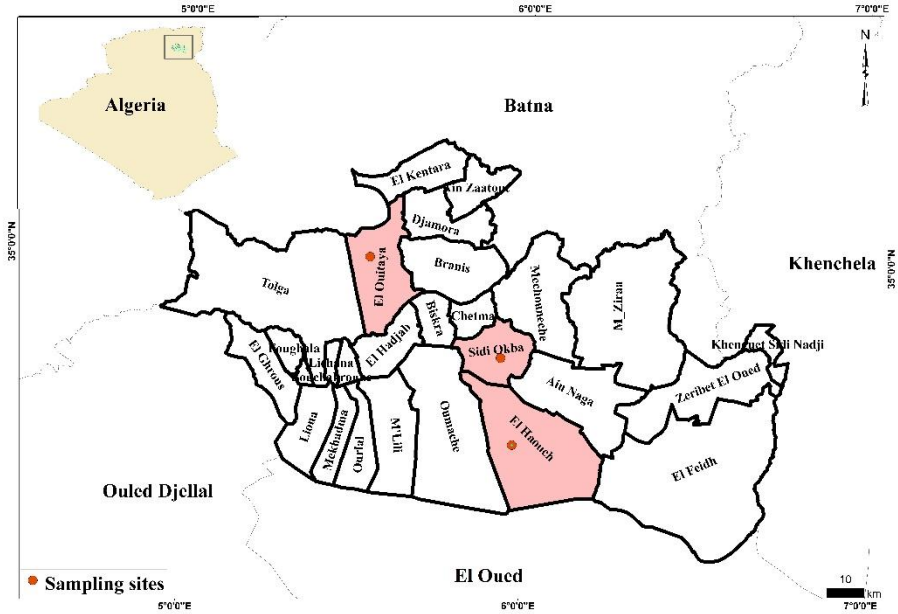

Figure 1. geographic Location of study sites.

2.2 Sampling methods

Samples were taken every week over a period of 06 months, from December to May (during the cereal campaign). On one (01) ha of durum wheat, cylindrical half plastic bottles were used at a depth of about 20cm and a diameter of 25cm. Fall traps are buried vertically so that the opening is at the ground level (Figure 2), the traps are filled to 2/3 of their capacity with soapy water. We have placed five fall traps in each plot.

In the field, the collected specimens were kept separately in plastic bottles. After, in the laboratory, they were stored in ethanol at 70 °. The species were identified using a reference collection and conformed by a specialist from the National School of Agronomy (ENSA), El Harrach in Algiers.

Figure 2. Type of trap (fall trap).

In order to analyse our results, we have used five ecological indexes; Total wealth (S), relative abundance, Shannon index (H'=log2-Σpi), the evenness (E=H'/H'max =H'/log2S), and Simpson index (S= 2C (A+B)).

3. Results

1.1. Diversity of coleopteran species on durum wheat in the Biskra region

From the 24 samples taken on each site during the study period, the analysis of the overall Coleoptera faunal composition led to the collection of 1260 individuals belonging to 42 species, 38 genus and 12 families (Table 1)

Table 1. Collected Coleoptera species on durum wheat in the Biskra region.

Families	Genera	Species	Trophic statut
Chrysomelidae	Oulema	*Oulema melanopa* Linné 1758	Phy
	Clytia	*Clytiasp*	Phy
Silphidae	Silpha	*Silpha obscura* Linné 1758	Phy
Curculionidae	Otiorhynchus	*Otiorhynchus sp*	Phy
	Brachycerus	*Brachycerus algirus* Olivier, 1790	Phy
	Lixus	*Lixus algirus*, L., 1767	Phy
	Curculionidae	*Curculionidae sp*	Phy
Staphilinidae	Xantholinus	*Xantholinus sp*	Pol
	Ocypus	*Ocypus olens* Muller, 1764	Pre
		Ocypus nitens Schrank, 1781)	Pre
	Staphyla	*Staphyla sp*	Pre
Carabidae	Cicindela	*Cicindela campestris* Linné 1758	Pre

	Calosoma	*Calosoma sycophanta* Linné 1758	Pre
	Pterostechus	*Pterostechus sp*	Pre
	Brachinus	*Brachinussp*	Pre
	Carabus	*Carabus inquisitor,* L., 1758	Pre
	Broscus	*Broscus cephalotes,* L., 1758	Pre
	Zabrus	*Zabrus sp.*	Phy
Elateridae	Agriotes	*Agriotes lineatus* Linnaeus, 1767	Phy
Aphodiidae	Aphodius	*Aphodius obliterates* Panzer, 1823	Cop
Scarabeidae	Copris	*Coprishis panus* Linnaeus, 1764	Cop
	Geotrogus	*Geotrogus deserticola* Blanchard, 1851	Sap
	Rhizotrogus	*Rhizotrogus aestivus Olivier, 1789*	Phy
	Scarabaeidae	*Scarabaeidae sp*	Pre
Tenebrionidae	Tribolium	*Tribolium castanium* Herbst, 1797	Sap
	Pimelia	*Pimeliacostata,* Waltal, 1835	Sap
Coccinellidae	Coccinella	*Coccinella septempunctata* L., 1758	Pre
		Coccinella undecimpunctata	Pre
	Hippodamia	*Hippodamia variegata*Goeze, 1777	Pre
	Exochumus	*Exochumus nigripennis* Erichson, 1843	Pre
	Scymnus	*Scymnus subvillosus* Goeze, 1777	Pre
	Stethorus	*Stethorus punctillum* Weise, *1891*	Pre
	Pharoscymnus	*Pharoscymnus ovoideus* Sicard, 1929	Pre
Cantharidae	Psilothrix	*Psilothrix viridicoerulea* Geoffroy, 1785	Pre
	Rhagonycha	*Rhagonycha lignose* Muller, 1764	Pre
	Canthathris	*Canthathris pellucida* Fabricius, 1792	Pre
	Cantharis	*Cantharis rustica* Fallén, 1807	Pre
Cetoniidae	Oxythyrea	*Oxythyrea pantherina* Gor. & Per., 1833	Phy
		Oxythyrea funesta Poda 1761	Phy
	Tropinota	*Tropinota hirta* Podavon Neuhaus, 1761	Phy
		*Tropinota turanica*AuktorReitter, 1889	Phy
	Citonia	*Citoniasp*	Phy
12	38	42	

Phy: Phytophagous; Pol: Polyphagous; Pre: predators; Cop: Copophagous; Sap:Saprophagous.

The most representative families were Coccinellidae and Carabidae (7 species for each), the Cetoniidae (5 species), Curculionidae, Staphilinidae, Scarabeidae and Cantharidae are represented by 4 species for each. The most represented species were *Coccinella septempunctata* (424 specimens), *Oulema melanopa* (342 specimens), *Hippodamia variegata* (243 specimens) and *Psilothrix viridicoerulea* (238 specimens).

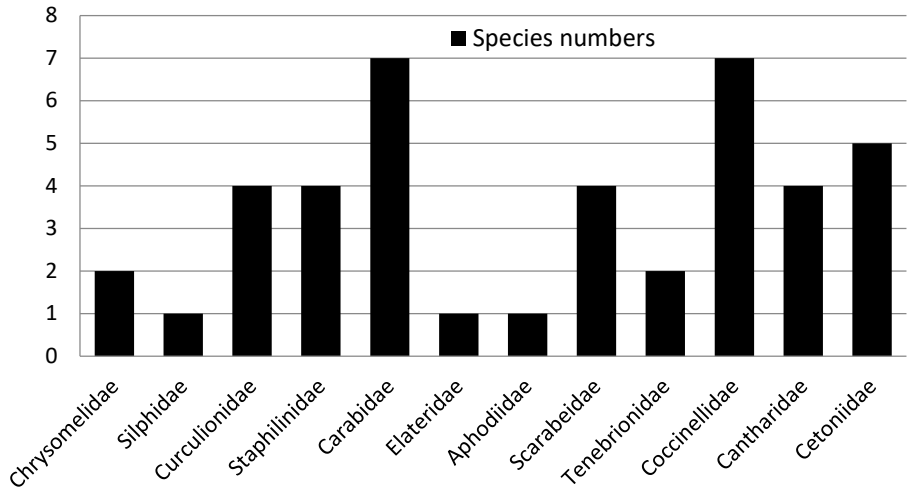

Figure 3. The importance of different families.

1.2. Abundance of coleopteran species

The fall traps yielded 1260 individuals of coleoptera (Figure 4). The average of specimens sampled per site was higher in Sidi Okba (521 specimens), followed by El Outaya (418specimens), and finely El Houche (321 specimens).

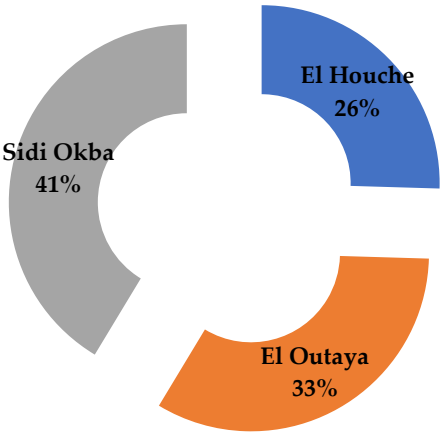

Figure 4. Number of coleoptera species collected at each site.

1.3. Analysis of results by ecological indexes

In order to deepen the study, we evaluated the richness by calculating ecological structural indices such as the Shannon index (H '), and the stand equitability index (E). Rocklin, (2010), these indices are always more precise, and provide more information and are developed in order to allow a better understanding of communities structure for a better environment and habitat management. The results obtained from ecological indices calculation are reported in Table 2.

Table 2. Total wealth (S), Diversity index (H') and Evenness index (E).

Sites	Total wealth (S)	Diversity index (H')	Evenness index (E)
Sidi Okba	21	1.31	0.21
El Haouche	25	1.45	0.19
El Outaya	23	1.29	1.43

For total wealth, the site of El Houche was dominant by 25 species, followed by El Outaya (23 species), than Sidi Okba by 21 species. Diversity index of Shannon (H') values are 1.31 bits in Sidi Okba, 1.45 bits in El Houche and 1.29 in El Outaya. The values of the Evenness index (E) are less than 0.50 in Sidi Okba and El Houch which shows that populations are in imbalance. While at El Outaya site, a value of 1.43 was recorded, which indicates that the population is in equilibrium.

1.4. Similarity between coleoptera communities in study sites

In order to understand the similarity or the existing difference in the composition of the coleoptera population in the three study stations, we calculated the Sorenson coefficient of similarity (Qs) (Magurran, 1988), the results obtained are illustrated in Table 3.

Table 3. Similarity between coleoptera communities in study sites (Simpson's coefficient).

Sites	El Outaya	Sidi Okba	El Houch
El Houche	53.33%	59.09%	100
Sidi Okba	53.65%	100	
El Outaya	100		

A non-significant similarity was noted between the populations of coleoptera in the three study sites, the values of the Simpson index far to 100% in all cases (53.33%, 53.65% and 59.09%), which indicates a non-similarity between populations.

1.5. Trophic status of coleoptera species

Trophic status of each species is presented in Figure 5. In order to illustrate population variation.

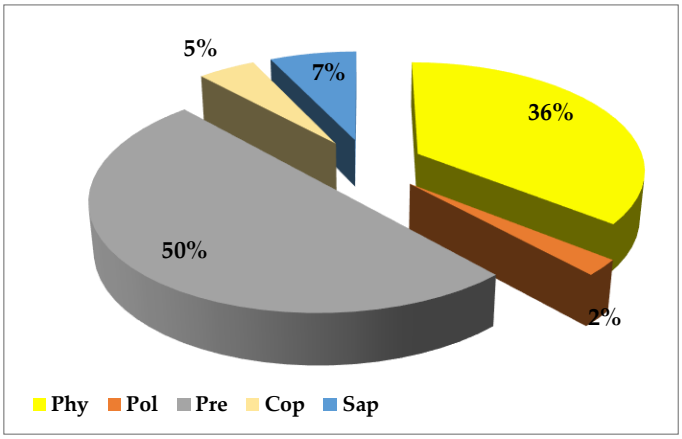

Figure 5. Relative abundance of collected insects according to trophic statut.

The predator class is the most represented by 21 species, mainly by *Coccinella septempunctata*, *Hippodamia variegata* and *Psilothrix viridicoerulea*. Followed by phytophagous (15 species), with a relative abundance value of 36%. Where the grain beetle *Oulema melanopa* is dominated with 342 individuals.

Saprophagous, Coprophagous and Polyphagousare represented by a relative abundance value of 7%, 5% and 2% respectively.

4. Discussion

In Algeria, several studies have been carried out in different areas in cereal agroecosystems. For example,[5] in the Mitidja region had cited 68 species; [6] in Oued Smar had listed 36 taxa. [7], in Biskra region on durum wheat collected 15 species of Coleoptera. In the Saharan bioclimatic stage, in the Bechar region, [8], inventoried 10 families grouping together 32 species as part of a faunistic study of coleoptera population in two biotopes (Beni Abbès & Tabelbala). During the present study, we identified 42 species belonging to 12 families.

The inventoried Coleoptera contain in their rank seven *Coccinellidae* predators, two of which are aphidiphagous; They are *Coccinella septempunctata* and *Hippodamia variegata*. According to [9-12], these species are aphidiphagous predators. The analysis of ladybirds' distribution in different locations shows that the species: *Coccinella septempunctata*, *Hippodamia (Adonia*) *variegata* and *Stethorus punctillum* have a wide ecological plasticity, they are present in all regions of Algeria and adapt to all climates [13]. The predator *Psilothrix viridicoerulea* species of the *Contharidae* family was also reported by [14] in the study region. According to [15], the larvae of this predator are carnivorous while the adults are floricultural. The *Carabidae* family includes six predatory species; *Cicindela campestris*, *Calosoma sycophanta*, *Pterostechus* sp, *Brachinus* sp, *Carabus inquisitor* and *Broscus cephalotes*. [16] indicated that the majority of *carabidae* species are considered as crop auxiliaries.

The cereal leaf beetle *Oulema melanopa* ranks first among phytophagous species. These results are consistent with those obtained by [17], in his study about population dynamics of *O. melanopa* on cereals in Setif. Moreover, [18] concluded that the phenology and the adaptability of beetles differs from one region to another. According to [19, 20], many physical and biological factors are directly or indirectly involved in fluctuations in the population of coleoptera species, such as habitat, microclimate, food, quality of the host plant and the abundance of natural enemies or competing species.

The absence of similarity between the inventoried insect populations is due to many factors that affect biodiversity, ecosystem functioning and insect distribution such as landscape structure, surface parameters, isolation and heterogeneity [21, 22]. While richness and abundance of insects are more important in diversified landscapes than in simple landscapes, in case of the study region of El Outaya, which is a plain that does not contain a landscape diversity; Compared to Sidi Okba, which is characterized by the presence of an important number of oases that offer a specific favorable microclimate to entomological diversity and specific richness.

5. Conclusions

The aim of this study was to assess and evaluate coleoptera population diversity in a cereal agrosystem in the region of Biskra in three different sites (Sidi Okba, El Outaya, El Haouche) during a period of six months. During our survey, we collected 1260 individuals belonging to 42 species, 38 genus and 12 families, the most representative families were Coccinellidae and Carabidae, the Cetoniidae, Curculionidae, Staphilinidae, Scarabeidae

and Cantharidae. While the most represented species were *Coccinella septempunctata*, *Oulema melanopa*, *Hippodamia variegata* and *Psilothrix viridicoerulea*. By comparing sampeling results in each site the average of specimens sampled per site was higher in Sidi Okba, followed by El Outaya, and finely El Houche. Ecological indices were calculated in order to analyses biodiversity status at the study area, total wealth was higher in El Haouche site while Shannon index was higher in Sidi Okba, although the population in El outaya station was more in equilibrium. For trophic status analysis, the predator class is the most represented by mainly by *Coccinella septempunctata*, *Hippodamia variegata* and *Psilothrix viridicoerulea*. Followed by phytophagous, with a relative abundance value of 36%. At the end of our study it is worth noting that, the inventory of Coleoptera species in cereal ecosystems is far from being completed, it is necessary to continue this work to broaden research in order to establish an updated list and safeguard the biodiversity of species to be protected in arid zones.

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