Hydrophilidae, Carabidae and Dytiscidae Coleoptera, and Culicidae Diptera of The Rice Fields of Morocco

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Abstract

Rice is the staple food for half of the human population.It is necessary to determine the composition of its biosensors. In this work we determined, in Moroccan rice fields, the systematic structure of three families of Coleoptera (Dytiscidae, Hydrphilidae and Crarbidae) and one family (Culicidae) of the population constituting the population of the order Diptera. The qualitative sampling of the studied fauna was carried out by troubleau net every 15 days and during the 2018-2019 rice-growing campaigns. The results showed that the population concerned is systematically rich and diverse, and of palearctic, Mediterranean biogeographical origin or of wide distribution with wide geographical distribution. It is made up of 39 species divided into 15 Dytiscidae beetles, 11 Hydrophilid beetles, 7 Carabid beetles and 7 Culicid beetles. The Dyticidae family is systematically more diverse than those of hydrophilids and carabids. The genera Laccophilus, Cybister, Enochrus and Berosus are the genera most represented in species. The great abundance and the important specific diversity of coleopera and diptera could be the main factor of the entomological diversity of Moroccan rice fields.

Keywords: Coleoptera insects, Diptera insects, Specific structure, Rice fields, Morocco.

I. Introduction

Rice is the staple food of half the world's population [1], and its place as a nutritional element continues to grow and. Mainly, There are 2 forms of rice cultivation, rainfed cultivation and 55% irrigated cultivation. However, it should be noted that all rice cultivation systems have water requirements during the growing season[2].

In Morocco, as in the Camargue in France, the rice fields are considered as temporary summer aquatic environments. Rice cultivation is practiced there exclusively in the lowest part of the Gharb plain (Figure. 1) where the favorable climatic, pedological and hydrological conditions offered by this area are favorable [3]. Currently, the rice growing potential of this plain is around 4,500 hectares [4]. The yield achieved in 2014 is around 80 quintals per hectare, a yield that exceeds that recorded in countries specializing in this agricultural production. Thus, as indicated by Secket and Wopereis (2012) [4], and Schneider and Asch (2020) [5], to follow population growth, world rice production must increase by at least 25%) Moroccan rice production is part. However, this increase is based on the control of the cultivation of the plant and its relationship with its surrounding environment [6]. The physico-chemistry of the aquatic environment and the systematic structure of the biocenosis, the entomofauna are part of this environment. Indeed, as in the case of wetlands in general, the aquatic biodiversity of rice paddies plays an important role in the biological control of vectors and pests of the plant itself. The estimation of the specific composition of the biocenosis of rice paddies in Morocco is

therefore of great ecological interest for Morocco while contributing to the determination of the biodiversity of the rice paddies. However, few authors have been interested in estimating the structure of the biocenosis of Moroccan rice fields.

Thus, the initial objective of this study, carried out during the two successive rice growing cycles 2017 and 2018 in the rice fields of the Gharb plain, is to establish an inventory of insects belonging to three families of beetle insects (Carabidea, Hydrophilidea and Dytiscidea) and Diptera insects.

II. Material And Methods

1. Location of the rice fields of Morocco:

The plain of Gharb With a hydrogeographic area of 7,500 km2, the Ghab plain, a potentially rice-growing area in Morocco, covers the Atlantic coastal area between latitudes 34 ° and 34 ° 45 'N. It encompasses various diverse soils, rich in water resources (OuedSebou and its tributaries, Merjas, and water tables) and the climate is Mediterranean subhumid to semi-arid.

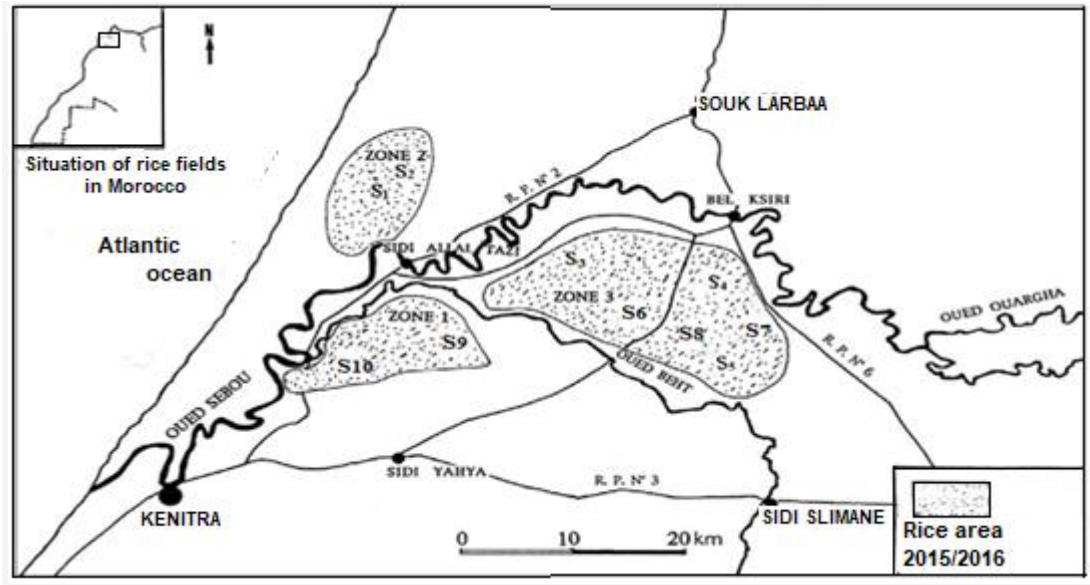

Figure1: Map of the location of the Gharb plain and location of the study stations

2. Collection of the studied fauna:

All located in the Gharb plain, the rice fields of Morocco, installed on a hydromorphic clay soil, under the same climate, and irrigated by water from the Sebouwadi, the rice fields of Morocco are very homogeneous. Thus, as in figure 1, to try to cover small heterogeneities of the medium, 10 sampling stations covering the three rice-growing areas of Morocco were taken to estimate the systematic composition of the four systematic entomological taxa to be studied: ColeopteraHydrophilidea, Carabidea and Dytiscidus, and Diptera. The fauna sampling, carried out by troubleau net every 15 days, converges the 2018 agricultural campaign. Note that the fauna sampling technique that we carried out in the rice fields is therefore similar to those recommended for collecting helioplankton in shallow environments (ponds)[4,6]. In addition, the

systematic determination of the species harvested was carried out from the original descriptions, European keys and the collections of the Scientific Institute of Rabat. For aerial beetles, the sampling of the ontological population studied is carried out by mower net or by sight hunting.

III. Results

Inventory and systematics of harvested species

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. Order of Coleoptera

- Family Dytiscidae

Coelambusparallelogrammus.
Copelatusatriceps.
Cybesterlateralimarginalis.
Cybestertripunctatus.
Copelatusatriceps.
Dytiscuspisanus.
Ertessticticus.
Guignotuspusillus.
Hydrovatusclypealis.
Hygrotusinaequalis.
Hyphydrusaubei.
Laccophilusminitus.
Laccophilushyalinus.
Rhantuspulverosus.
Yola bicartina.

- Family Hydrophilidae

Anacaenaglobulus.
Berosusaffinis.
Berosushispanicus.
Berosussuturalis.
Coelostomahispanicum.
Enochrusaffinis.
Enochruscoarctatus.
Enochrusfuscipennis.
Helochareslividus.
Hydrous pistaceus.
Paracymusaeneus.

- Family Carabidae

Anchomenus dorsalis.
Calatusambiguus.
Carabusauratus.
Harpalus affinis.
Poeciluscupreus.
Pseudoophonusrufipes.
Pterostichusmelanarius.

. OrderDiptera

- Family des Culicidae

Anophelesmaculippennis.
Culex theileri.
Culex impidicus.
Culex univittatus.
Culex pipiens .
Culex modestus.

IV. Discussion

The systematic structure of the entomological taxa studied shows that the population concerned is made up of 39 species divided into 15 Dytiscidae beetles, 11 Hydrophilid beetles, 7 Carabid beetles and 7 Culicid beetles. Thus, these results show that, in Moroccan rice fields, this group of beetles studied is systematically rich and diverse. Indeed, just for the total number of species of the three Coleoptera families studied (32 species), this taxonomic group shows great systematic diversity. It should also be noted that, for the three families of beetles studied, the Dyticidae family is systematically more diverse than those of the hydrophilids. Indeed

this one gathers 13 genera against septe genus for the hydrophilids and seven genus for the carabids. At the genera levels for the three beetle families the species diversity is low. In Dytiscidae only the genera Laccophilus and Cybister carry 3 species each, the other ten genera have only one species each. Also, for the Hydrophilidae family only the genera Enochrus and Berosus have 3 species each, the other genera of the family carry only one species each. The specific diversity is even lower in genera of the carabidae family; there are as many genera as there are species. For the other entomological family studied, the CulicidaeDiptera, the population consists of only seven species divided into two genera, of which six species belong to the Culex genus.

On the other hand, regarding the great diversity of beetles in the rice fields, this great diversity could come, first of all, from the great abundance and great diversity of insect groups in nature. Indeed, this group of insects belongs to the order Coleoptera which is said to be the most abundant [6], and the most diverse [7]–[9], of the insect class. Then, this frequency of beetles in Moroccan rice fields could be a consequence of the ability of their species to occupy all natural environments and all major habitats, with the exception of the polar and marine regions. Among these aptitudes which favor the species belonging to the order Coleoptera to be taxonomically more diverse and very frequent in many Hydrosystems the diversity of the position of the species in the food web; the species could be destroyers, phytophagous, parasites, etc. In addition, from the point of view of ecological interest of beetles, many beetles are used in biological control against harmful species. Coccinellidae are one species. Dytiques, aquatic beetles Dytiscidae constitute a very rich group of beetles comprising 4000 species, the majority of which are freshwater predators. The second Beetle family studied, Hydrophilidae, also includes a large number of species (approximately 3,400 species spread over 200 genera), of which 400 species are aquatic or live in habitats bordering on wetlands [10]. They are polyphagous [11].

Concerning the carabidae family, the third group of beetles studied, it is the most numerous group of beetles, more than 1,800 genera comprising about 40,000 species, terrestrial, with a varied diet but often carnivorous (predators) [12], [13]. In addition, as invertebrate predators, most ground beetles are considered beneficial organisms [14], particularly as species that can be exploited organically[14], and many beetle species are pollinators [15, 16]. Concerning the Culicidae family, it constitutes a family of insects belonging to the order Diptera. The latter family, like Coleoptera, is a numerically dominant group in the class of insects, 150,000 species described [17, 18]. In hydrosystems many species of this group, through the coprophagous or scavenging diet of their larvae, they produce humus in their aquatic environment [18]. However, this group of insects is known to be harmful to animal and human health [19]. Regarding the biogeographical origin and the ecology of the species collected, the majority of these species are of Mediterranean origin or even collected

in Moroccan water accumulations. Indeed, according to the chronological categories established by GRECA, about half of this population is essentially Mediterranean elements and the other half is made up followed by elements whose distribution extends to the Palaearctic domain or to a wide geographical distribution.

V. Conclusion

The studied population of Coleopera and Diptera in Moroccan rice fields is rich and diverse. It is made up of 39 species divided into 15 Dytiscidae beetles, 11 Hydrophilid beetles, 7 Carabid beetles and 7 Culicid beetles. However, the Dyticidae family is systematically more diverse than those of the Hydrophilidae and the Carabidae. In the DytiscidaeColeoptera the genera Laccophilus and Cybister and in the Hydrophilids only the genera Enochrus and Berosus have 3 species each, while the majority of the other genera of the Coleoptera have only one species each. In CulicidaeDiptera the genus Culex is the most represented in species. In addition, this diversity in coleopètere of the Macocan rice fields could come from the dominance and the importance of this entomological group in almost all natural aquatic environments and from the ability of its species to cover, in nature, a large number of areas, habitats and trophic roles. It should also be noted that numerous beetles and numerous larvae of Diptera, through their diets, constitute beneficial organisms for the cultivation of rice.

References

[1] N. Ahmadi and B. Bouman, "Riz et rizicultures, enjeux économiques, écologiques et scientifiques," vol. 22, no. 5, *Cah. Agric*, 2013, pp. 333–335.

[2] Q. Ye, X. Yang, S. Dai, G. Chen, Y. Li, and C. Zhang, "Effects of climate change on suitable rice cropping areas, cropping systems and crop water requirements in southern China," , vol. 159, *Agric. Water Manag*,2015, pp. 35–44.

[3] N. Ahmadi and B. Bouman, "Riz et rizicultures, enjeux économiques, écologiques et scientifiques," vol. 22, no. 5, *Cah. Agric*,2013, pp. 333–335.

[4] P. A. Seck, A. Diagne, S. Mohanty, and M. C. S. Wopereis, "Crops that feed the world 7: Rice. vol.4 , no.1, Food security, 2012,pp.7–24.

[5] P. Schneider and F. Asch, "Rice production and food security in Asian Mega deltas—A review on characteristics, vulnerabilities and agricultural adaptation options to cope with climate change," vol. 206, no. 4, *J. Agron. Crop Sci*,2020, pp. 491–503.

[6] E. Cowles, "The Book of Beetles: A Life-size Guide to Six Hundred of Nature's Gems, edited by Patrice Bouchard." University of California Press USA, 2015.

[7] V. H. Resh and R. T. Cardé, *Encyclopedia of insects*. Academic press, 2009.

[8] M. L. Rosenzweig, *Species diversity in space and time*. Cambridge University Press, 1995.

[9] D. Poinsot, M. Hervé, B. Le Garff, and M. Ceillier, *Diversité animale: Histoire,*

évolution et biologie des Métazoaires. De Boeck Superieur, 2018.

[10] A. E. Short and M. Fikáček, "World catalogue of the Hydrophiloidea (Coleoptera): additions and corrections II (2006–2010)," vol. 51, no. 1, *Acta Entomol. Musei Natl. Pragae*, 2011, pp. 83–122.

[11] E. K. Lhadi, M. Mountadar, A. Younsi, G. Martin, and J. Morvan, "Nitrate pollution of groundwater in the coastal area of El Jadida province (Morocco)[principal component analysis]," *Hydrogeol. Fr.*, 1996.

[12] P. A. Chiverton, "Searching behaviour and cereal aphid consumption by Bembidion lampros and Pterostichus cupreus, in relation to temperature and prey density," *Entomol. Exp. Appl.*, vol. 47, no. 2, pp. 173–182, 1988.

[13] L. Suty, *La lutte biologique: Vers de nouveaux équilibres écologiques*. Editions Quae, 2010.

[14] H. I. Hanson, E. Palmu, K. Birkhofer, H. G. Smith, and K. Hedlund, "Agricultural land use determines the trait composition of ground beetle communities," *PLoS One*, vol. 11, no. 1, p. e0146329, 2016.

[15] J. Ollerton and S. Liede, "Pollination systems in the Asclepiadaceae: a survey and preliminary analysis," vol. 62, no. 4, *Biol. J. Linn. Soc*,1997, pp. 593–610.

[16] P. J. G. Cranston, *The Insects: an outline of entomology/Penny J. Gullan, Peter S. Cranston*. 2010.

[17] D. K. Yeates and B. M. Wiegmann, "Phylogeny and evolution of Diptera: recent insights and new perspectives," *Evol. Biol. Flies*, 2005, pp. 14–44.

[18] J. L. V. Montesinos, "Evolución de la fitofagia en los insectos," no. 95,*Bol. Real Soc. Esp. Hist. Nat. Actas*, 1998, pp. 23–30.

[19] M. A. De Souza *et al.*, "Adulticide and repellent activity of essential oils against Aedes aegypti (Diptera: Culicidae)–A review," vol. 124, *South Afr. J. Bot*, 2019, pp. 160–165.

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