Bio-Science Research Bulletin
http://www.bpasjournals.com

Original Research Article

Print version ISSN 0970 0889
Online version ISSN 2320 3161
DOI: 10.5958/2320-3161.2021.00015.8
Volume 37, Number 2
July-December 2021: P.39-48

Study and Classification of Invertebrates Present On fig Crop (*Opuntia ficus-indica*) in Ouadhias area (Tizi-Ouzou), Algeria

[1]Dyhia Guermah*
[2]Lynda Lakabi
[3]Ferroudja Medjdoub-bensaad

Author's Affiliation:
[1,2,3] Laboratoire de production, sauvegarde des espèces menacées et des récoltes. Influence des variations climatiques. Département de biologie. Faculté des sciences biologiques et des sciences agronomiques. Université Mouloud Mammeri de Tizi-Ouzou 15000. Algérie

***Corresponding Author:**
Dyhia Guermah
Laboratoire de production, sauvegarde des espèces menacées et des récoltes. Influence des variations climatiques. Département de biologie. Faculté des sciences biologiques et des sciences agronomiques. Université Mouloud Mammeri de Tizi-Ouzou 15000. Algérie
E-mail: guermah.dy@gmail.com

Received on18.07.2021
Accepted on 27.09.2021

ABSTRACT

The inventory of invertebrates on fig cultivation using 2 methods of sampling, Barber traps and colored traps in Ouadhias region (Tizi-Ouzou) Algeria, allowed us to collect 59 species divided into 46 families, belonging to 17 orders. The values of the centesimal frequencies applied to invertebrates orders identified in the studied plot vary from one type of trapping to another, each sampling method relates to a representative order group. The diets of insects are extremely diverse, due to the structures and function of the mouth parts, the structural and functional division of the digestive tract. We have established a distribution according to the different trophic categories according to our personal observations and the bibliography consulted. We were able to distinguish 9 groups among the 59 insect species selected. Shannon-Weaver diversity index values are quite high in the study plot, the fairness obtained for each type of trap varies from E = 0.91 to E = 0.93, these values tend towards 1, which reflects a balance between the species in the environment.

KEYWORDS: *Inventory, Invertebrates, Fig Tree, Ouadhias, Algeria.*

How to cite this article: Guermah, D., Lakabi, L. and Medjdoub-bensaad F. (2021). Study and Classification of Invertebrates Present On fig Crop (*Opuntia ficus-indica*) in Ouadhias area (Tizi-Ouzou), Algeria. *Bio-Science Research Bulletin,* 37(2), 39-48.

INTRODUCTION

Fruit arboriculture is an integral part of the economic and social life of Algeria. This large country, due to its geographical position and its various pedoclimatic conditions, indeed has the privilege of cultivating several fruit species and to produce fresh fruit all year round. Cultivated environments provide habitat and the various food resources necessary for predatory and parasitic arthropods, as well as microbial pathogens that act as natural enemies of agricultural pests and constitute means of biological control in agricultural ecosystems.

The preservation of biodiversity represents an indisputable ecological stake in the functioning of agroecosystems, but also economical for society (Tscharntke *et al*, 2005). Pollination is another important ecosystem service provided by biodiversity. Klein *et al.,* (2007) estimated that 75% of plant species of global importance for food production depend animal pollination, mainly by insects. In

addition, the soil microfauna providing the structure and soil fertility provides essential ecosystem services to agroecosystems. In this context, we carried out an inventory of the invertebrates fauna associated with fig tree cultivation in Tizi-Ouzou area (Kabylie), with the aim of improving our knowledge of biodiversity invertebrates and their classification according to the different trophic regimes.

MATERIALS AND METHODS

This study was conducted in an '*Opuntia ficus-indica*' orchard not subject to treatment by pesticides. The parcel is located in Ouadhias area (36°29'33'' Nord, 4°8'12'' East) (Tizi-Ouzou, Algeria) situated at an altitude of 700 meters, in a Mediterranean climate characterized by a sub-humid bioclimatic stage with temperate winter.

The study orchard represents an appropriate environment and an extraordinary ecosystem whose biological functions bring together ecological conditions conducive to installation and the multiplication of various invertebrates. So, various sampling methods have been addressed in Athouacif region from June 2020 until July 2021, covering vegetation, flowering and fruiting periods of *Opuntia ficus-indica* plants.

According to Ramade (2003), the different sampling methods depend on the environment in which the population studied is associated, the trap must account for the relative proportion of the various species, genera or families (Roth, 1963).

In the field

We opted to use two trapping methods namely Barber pots or terrestrial traps as well as yellow aerial traps, at the rate of one outing per month.

Barber traps

Nine pots are placed in the study plot, these pots consist of simple plastic containers, about 10cm deep, and these are buried at the foot of the trees, vertically so that the opening is flush with the ground, the earth being packed around, in order to avoid the barrier effect for small species. The traps are filled to 2/3 of their capacity with water added with preservation liquid.

The use of Barber pots allows the capture of diurnal and nocturnal species that frequent the soil. The detergent serves as a wetting agent, it dissolves the lipid layer of the epicuticle causing the death of arthropods by drowning, and thus it prevents captured individuals from emerging from the trap.

Weekly visit replaces water in Barber jars lost by evaporation due to too high heat in summer. Also, avoid the loss of content spilling outward (invertebrates previously caught) by excess water in case of heavy rain which can flood the basins (Baziz, 2002).

Colored traps

Colored traps are plastic containers, yellow, filled to 3/4 of their content with water added with conservation product. We used 9 yellow traps, 15 cm in diameter and 15 cm deep, placed at a height of 1.5 meters and fixed with wire to the branches of the trees.

These colored traps have a double attractiveness on the one hand, due to their complexion and on the other hand to the presence of water (Roth, 1963). This method makes it possible to capture purely hygrophilic insects for which yellow radiation is particularly attractive, it is easy to use and it is of lower financial cost.

Laboratory working methods

After each trip and according to the different capture methods used, the samples obtained are placed in Petri dishes, bearing labels on which are indicated the date of the exit and the trap concerned.

Sorting

Samples collected in the field are sorted in the laboratory by separating the arthropods from the other branches (gasteropods, annelids, myriapods), then we proceeded to sort the individuals according to their orders, families to arrive at the species when possible.

Counting
After counting individuals, small insects are kept in bottles containing 70% diluted alcohol with the following information: the date, the order, the family, the type of trap and the number of individuals according to the plot studied.

The same indications are mentioned on Petri dishes in which medium to large individuals are dried, fixed and spread out to prepare them afterwards for identification.

Identification
The identification of individuals of listed invertebrates is carried out using the different determination keys (Perrier, 1964); (Piham, 1986); (Delvare and Aberlenic, 1989); (Chinery, 1988); (Seguy, 1924).

Trophic diet
After identification of the invertebrates species captured by the different sampling methods, their trophic regimes are determined after bibliographic research.

Exploitation of the results obtained by the sampling of invertebrates
In order to exploit the results relating to the inventoried species, we used ecological indices of composition and structure.

Exploitation of results by ecological indices
For our study, ecological indices in particular, ecological indices of composition and ecological indices of structure were used for the exploitation of the results of the global inventory obtained during the study period.

Ecological composition indices applied to invertebrates sampled in the environment studied
The results obtained from the arthropod census are analyzed by the ecological composition indices which are as follows: Total Wealth (S) and relative abundances (centesimal frequency) (AR %).

Total specific wealth
According to Ramade (2003), the total wealth represents one fundamental parameters characteristic of a stand; the total wealth is the total number of species included in the stand considered in a given ecosystem.

Abundance relative (centesimal frequency)
According to Dajoz (1971) the relative abundance is the number of individuals of the species (ni) in relation to the total of individuals N (all species combined). Relative abundance (AR) is expressed as follows:
AR = ni (100) / N
ni = Number of individuals of a species.
N = Total number of individuals (all species combined).

Ecological structural indices applied to the fauna captured in the study environment

These indices include the Shannon-Weaver Diversity Index, and the Fairness Index.

Shannon diversity index
Shannon's diversity index corresponds to the calculation of the entropy applied to a community (Ramade, 2003). The basic idea of this index is to bring from the capture of an individual within a sample for more information when its probability of occurrence is low. It is given by the following formula:

$H' = \sum qi \, Log_2 \, qi$
H': The diversity index expressed in bit units.
qi: The probability of encountering species i.

The latter is calculated by the following formula: qi= ni/N
ni: Number of individuals of the species i.
N: Total number of all species combined.

H'max represents the maximum diversity; it corresponds to the highest possible value of the stand. It is given by the following formula:
$H'max = Log_2 S$
S: Is the total number of species found during N surveys.

Fairness index
Fairness is the ratio of observed diversity (H ') to maximum theoretical diversity (H' max) (Barbault, 1981).
E= H'observé / H'max
H'observed: diversity observed.

H'max: maximum diversity expressed as a function of specific richness.

RESULTS

During this study, which focused on the inventory of invertebrates fauna associated to fig trees in an ecological orchard not subjected to pesticide treatments, 59 species were captured, distributed in 46 families belonging to 17 orders.

Total wealth and relative abundance

The collected arthropod in an '*Opuntia ficus-indica*' fig plot using different trapping methods allowed us to identify 59 species. The total wealth of the species caught by the two trapping methods was 17 species for colored traps and 41 species for Barber pots (Table 1).

Table 1: Total wealth of species caught by different sampling methods

Traps	Colored traps	Barber pot
Total Wealth	S= 17	S= 41

Centesimal frequency (CF) of invertebrate orders captured in a fig plot using different sampling methods is shown in figure 1 for colored traps and figure 2 for Barber pots. Invertebrate species identified according to the order, and families are presented in Table 2.

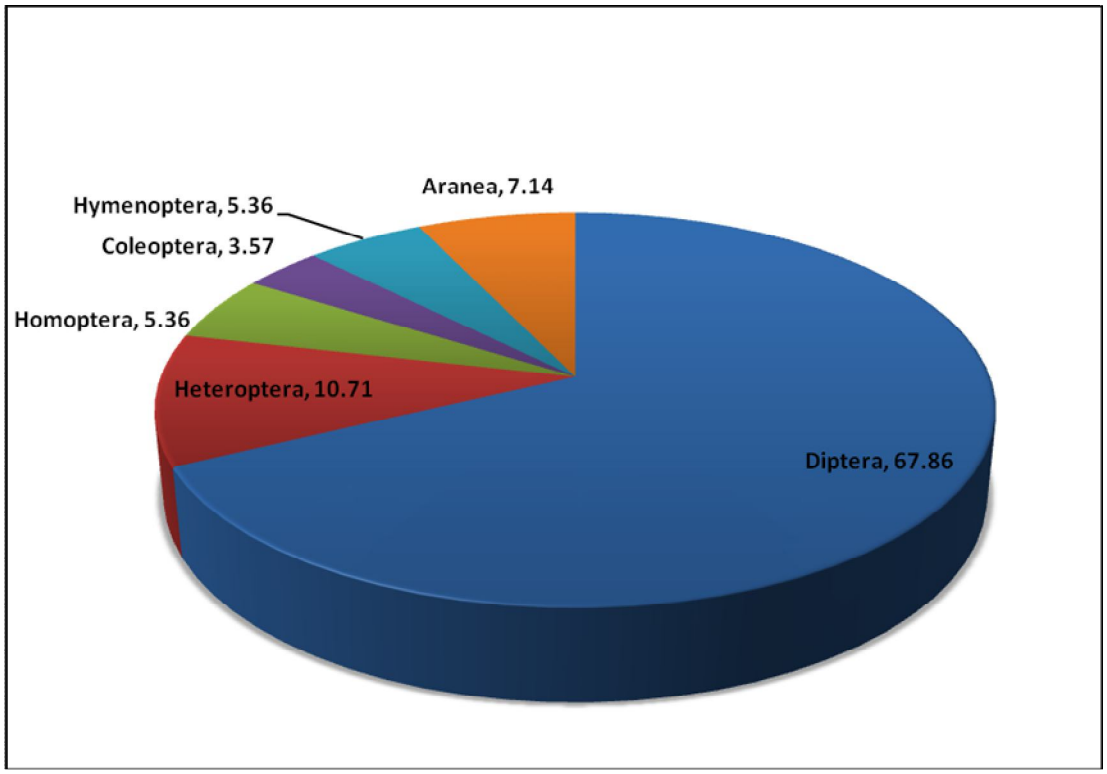

Figure 1: Centesimal frequency of invertebrate species captured using colored traps

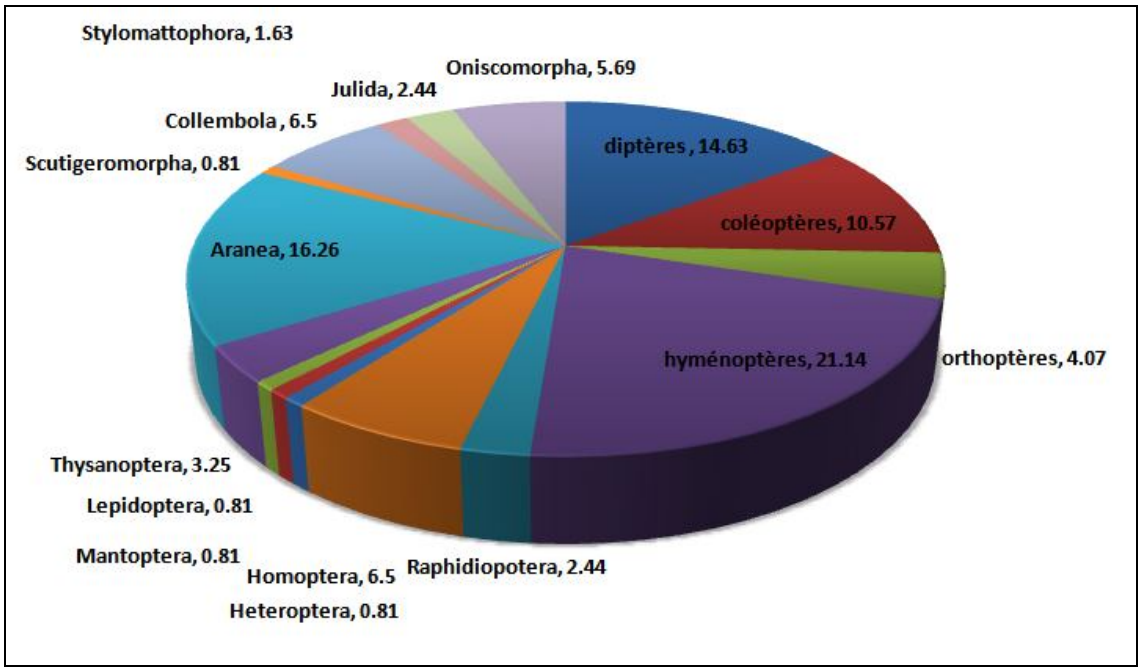

Figure 2: Centesimal frequency of arthropod species captured using Barber pots

The most dominant order recorded for colored traps is diptera with relative abundance of 67.86%, heteroptera are represented with centesimal frequency equal to 10.71 %. For Barber pots, the most dominant order is hymenoptera with relative abundance equal to 21.14 % followed by *Araneae anddiptera* with relative abundance equal to 16.26 % and 14.63 % respectively.

Table 2: invertebrate species captured using two sampling methods

Classes	Ordres	Familles	Espèces	Pots Barber	Pots aériens
Insecta	Diptera	Calliphoridae	*Calliphora vicina*	2	0
		Coratopogonidae	*Culicoides albicans*	2	0
			Culicoides absoletus	1	0
		Psychodidae	*Pericoma sp*	6	0
			Phlebotomus sp	1	0
		Culicidae	*Culex pipiens*	2	0
			Anopheles stephensi	0	2
			Anopheles plumbus	0	5
		Chloropidae	*Thaumatomyia notata*	4	0
		Chironomidae	*Chironomus plumosus*	0	3
		Tabanidae	*Tabanus sudeticus*	0	6
		Drosophilidae	*Drosophila fenebris*	0	1
		Lauxaniidae	*Lauxaniidae sp*	0	3
		Tephritidae	*Xyphosia miliaria*	0	1
		Syrphidae	*Syrphus ribesii*	0	1
		Tipulidae	*Tipula maxima*	0	2
		Sepsidae	*Sepsis fulgens*	0	2
		Sciaridae	*Zygoneura sp*	0	12

	Coleoptera	Staphylinidae	*Ocypus olens*	4	0
			Philonthus marginatus	2	0
		Tenebrionidae	*Pemelia grandis*	3	0
			Lagria villosa	1	0
		Curculionidae	*Polydrusus impressiprons*	2	0
		Carabidae	*Macrothorax morbillosus*	1	0
		Elateridae	*Agriates lineatus*	0	2
	Orthoptera	Gryllidae	*Gryllus campestris*	2	0
		Tettigoniidae	*Ephippigera ephippigera*	2	0
		Acrididae	*Anacridium aegyptium*	1	0
	Hymenoptera	Formicidae	*Messor structor*	10	0
			Cataglyphis cursor	9	0
			Camponotus lateralis	1	0
			Camponotus vagus	6	0
		Apidae	*Apis mellifera*	0	3
	Raphidioptera	Raphidiidae	*Raphidia notata*	3	0
	Homoptera	Cicadellidae	*Cicadella viridis*	7	0
			Amblysellus curtisii	1	0
		Aphididae	*Aphis citricola*	0	3
	Heteroptera	Cydnidae	*Cydnus aterrimus*	1	0
		lygaedae	*Lygaeus saxatilis*	0	5
		Pyrrhocaridae	*Pyrrhocoris ribesii*	0	1
	Montodea	Empusidae	*Empusa pennata*	1	0
	Lepidoptera	Choreutidae	*Choreustisne morana*	1	0
	Thysanoptera	Thripidae	*Franckliniella occidentalis*	4	0
Arachnida	Araneae	Lycosidae	*Lycosa narbonensis*	6	0
		Salticidae	*Salticidae*	2	0
			Salticussp	0	4
		Gnaphosidae	*Gnaphsadolosa*	3	0
		Thomisidae	*Thomisus sp*	4	0
			Synema globosum	2	0
		Dysderidae	*Dysdera crotata*	1	0
	Opiliones	Phalangiidae	*Phalangium opilio*	2	0
Chilopoda	Scutigeromorpha	Scutigeridae	*Scutigera coleoptrata*	1	0
Entognatha	Collembola	Entomobryidae	*Entomobrya nivalis*	8	0
Gasteropodes	Stylommatophra	Milacidae	*Milax nigricans*	2	0
		Geomitridae	*Xerotricha conspurcata*	2	0
Diplopoda	Glomerida	Gloméridae	*Glomeris sp*	3	0
			Glomeris convexa	4	0
	Julida	Julidae	*Tachypodoiulus albipes*	3	0
6	17	46	59	123	56

Species centesimal frequency according to their trophic relationships

The relative abundance obtained for species according to their trophic relationships is illustrated in figure 3 for colored traps and figure 4 for Barber pots.

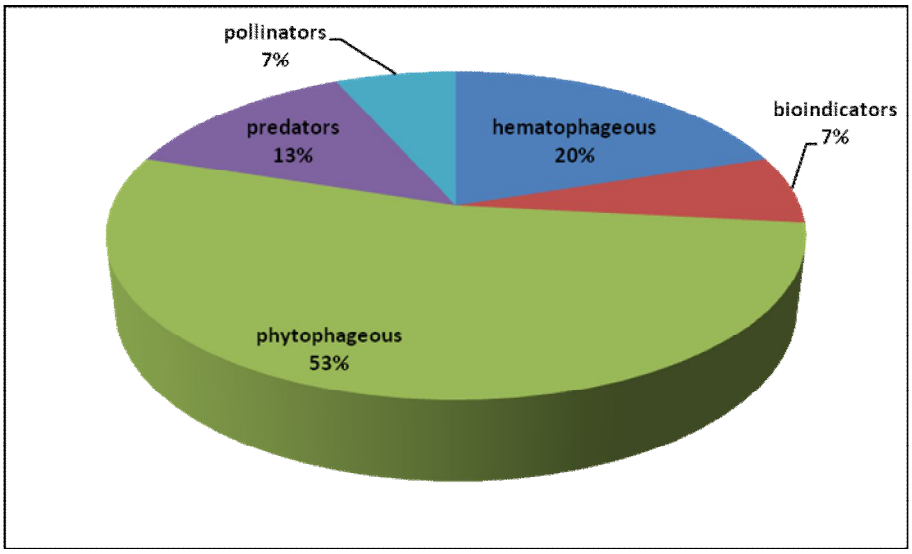

Figure 3: Relative frequency of species caught using colored traps following their diet.

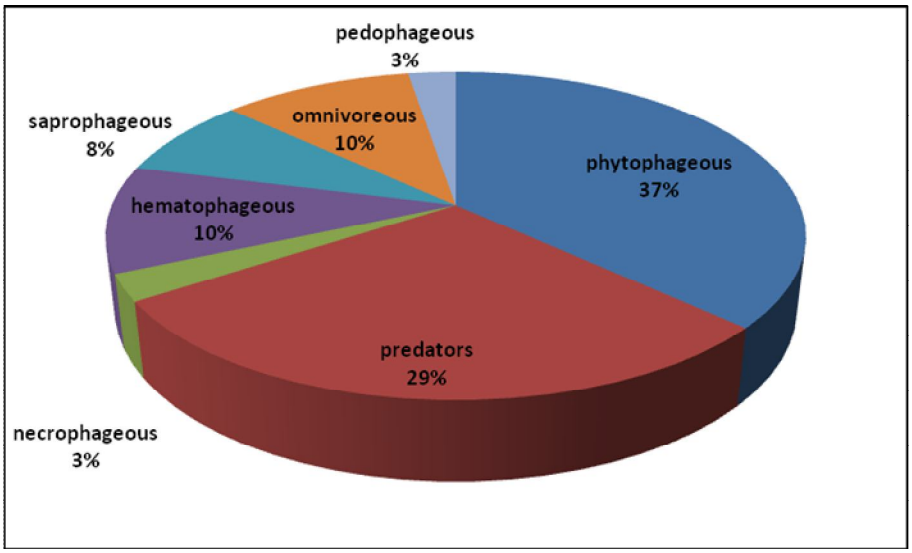

Figure 4: Relative frequency of species caught using Barbr traps following their diet.

The best-represented group is pests with 53% and 37% for colored traps and Barber pots respectively, followed by predator with relative abundance of 13% for colored traps and 29% for Barber pots.

Shannon Weaver diversity index and evenness index (E)

Shannon-Weaver diversity index (H'), maximum diversity (H'max.) and equitability (E) applied to species trapped by the different sampling techniques are presented in Table 3.

Table 3: Shannon-Weaver diversity values H' and evenness of species trapped by the various traps.

Traps	Colored traps	Barber pot
H'	3.73 Bits	5.01 Bits
H' max	4.1 Bits	5.38 Bits
E	0.91	0.93

Shannon-Weaver diversity values for the various species caught by trapping methods are equal to H' = 3.73 bits; H max = 4.1 bits for colored traps and H' = 5.01 bits; H max = 5.38 bits for Barber pots. The species evenness values are E = 0.91 for colored traps; and E = 0.93 for

barber pots. A fairly high evenness is recorded for two sampling methods (colored traps and barber pots) this value approaches a value of 1 which reflects a balance between the middle of species.

DISCUSSIONS

Chafaa *et al*. (2019) finded in their study on apricot orchards 125 species belonging to 54 families and 9 orders in Batna region of North-East Algeria. Naceri (2011) obtained similar results in an olive grovein Batna with a total of 156 species belonging to 16 orders and 80 families. Chafaa (2013) recorded in three olive groves in the region of Batna 206 species of insects belonging to 11 orders and 74families.

Using the Barber jar technique in a palm grove in Oued Sidi Zarzour (Biskra), Souttou *et al*. (2006) have captured 70 species of arthropods, belonging to 3 classes, including that of insects, represented by 69 species, divided into 36 families of 8 orders.

Guermah *et al*. (2019) registered a total wealth of the species apple crop in Tadmait region; it was 17 species for the sweep net; 21 species for colored traps and 14 species for Barber pots. Chouiet *et al*. (2012) during a study on the biodiversity of the arthropodo fauna of the cultivated areas of the ghardaia region noted a total richness of 188 species, which is 133 species captured using Barber pots and 124 species using yellow traps. Djetti *et al*. (2015) in a study on the arthropodo fauna of the cultivation of corn in two different bioclimatic stages reported the existence of 40 species in the region with a subhumid bioclimatic tier (El Harrach) and 38 species in the semi-arid bioclimatic tier region (Tisselmsilt).

Guermah *et al*. (2019) registered the most dominant order recorded for sweep net and colored traps who is Hymenoptera with relative abundance of 36.38% and 37.13% respectively, for Barber potgs, the most dominant order is Coleoptera with relative abundance equal to 50.35 %. Gull *et al*. (2019) note that the order of beetles largely dominates with a percentage equal to 89%, followed by hemiptera with 7% and lepidoptera with only 3%.

Beddiaf *et al*. (2014) during a study carried out on arthropodological fauna in the Djanet region, report that the Hymenoptera order is best represented with a relative abundance equal to 78.6%.

Djetti *et al*. (2015) in a study on the arthropodo fauna of corn cultivation noted that Hymenoptera dominate in the region with a subhumid bioclimatic tier (El Harrach) with a relative abundance equal to 55%, on the other hand in the region with semi-arid bioclimatic tier, the coleopteran are best represented with a centesimal frequency equal to 50%.

Guermah *et al*. (2019) notes that the best-represented group using sweep net is predators with relative abundance of 33 %, whereas the least abundant group is saprophagous with only 1 %. The best-represented group using colored traps is pests with 30 %, whereas the least abundant group are saprophagous and bioindicators with only 1 %. When using barber pots, the best-represented group is pests with relative abundance of 42.88 %, while the group of saprophagous is the least represented recording only 2.43 %.

According to the trophic diet of arthropods, Achoura and Belhamra (2010) noted five groups whose phytophages are best represented with 56.25%. They are followed by predators with 20.83%, saprophages with 18.78% and finally parasites and polyphages with 2.08%. Diab and Deghiche (2014) indicate a dominance of phytophages with 53%, followed by predators with 35%, then polyphages with 12% in an olive crop in the Sahara region.

Guermah *et al*. (2019) reported a diversity of Shannon-Weaver values for the various species caught by trapping methods, they are equal to H' = 5.90 bits; H max = 6.40 bits for sweep net; H' = 5.58 bits; H max = 6 bits for colored traps and H' = 5.33 bits; H max = 5.95 bits for Barber pots. Chalane and Djouder (1999) note Shannon diversity worth 2.29 bits. Benkhelil and Doumandji (1992) mention for Shannon Diversity Index values 4.82 bits for the degraded scrubland, 3.96 bits at the level of the cedar and 5.64 bits for the mixed forest, in the region of Bordj Bou Arriridj. According to Blondel (1979),

a community is even more diverse as the index of diversity is higher.

The Pielou's evenness values reported by Guermah *et al*. (2019) are equal to E = 0.92 for the sweep net and colored traps; and E = 0.89 for Barber pots. A high evenness is recorded for three sampling methods (sweep net, colored traps and barber pots) this value approaches a value of 1 which reflects a balance between the middle of species. Very low fairness is reported by Guettala-Frah (2009) during a wildlife inventory on apple trees carried out in the Aurès with a value equal to E = 0.44 for the auxiliaries of the Ichemoul station, and also by Belmadani *et al*. (2014) in a study on the distribution of arthropods in the pear orchard in Tadmait with an equal value E = 0.3.In a study on the arthropod and fauna of corn cultivation, Djetti *et al*., (2015) estimated the fairness at E = 0.77 in the region with a subhumid bioclimatic tier (El Harrach) and E = 0.88 in the region with a semi-arid bioclimatic tier.

REFERENCES

[1]. Achoura, A. & Belhamra, M. (2010). Aperçu sur la faune arthropodologique des palmeraies d'El Kantara. *Courrier du savoir. Université de Biskra,* 10, 93-101.

[2]. Barbault. R, (1981). Ecologie des populations et des peuplements. Ed., Masson.et C, Paris, 200p.

[3]. Baziz B., (2002). Bioecologie et régime alimentaire de quelques rapaces dans différentes localités en algerie- cas du faucon crécerelle Falco tinnunculus Linné, 1758, de la Chouette effaire Tyto alba (Scopoli, 1769), du hibo moyen duc Asiootus (Linné, 1758) et du Hibou grand- duc ascalaph Bobo ascalaphus Savigny, 1809. Thèse de Doctorat d'etat, Inst. nati. agro., El Harrach, 499p.

[4]. Beddiaf R, Kherbouche Y, Sekour M, Souttou K, Ababsa L, Djillali K, Ebouz A, Guerzou L, Hamid Oudjana A, Hadj Sayed A and Doumandji S. (2014). Aperçu sur la faune arthropodologique de Djanet (Tassili N'Ajjer, Algérie). *Revue El Wahat pour les recherches et les études*, 7(2), 70-78.

[5]. Belmadani K, Hadjsaid H, Boubekka A, Metna B, et Doumandji S, (2014). Arthropods distribution to vegetal strata in pears tree orchards near Tadmaït (Grande Kabylie). *International Journal of Zoology and Research*, 4(3), 1-8.

[6]. Benkhelil M.L. et Doumandji S., (1992) – Notes écologiques sur la composition etla structure du peuplement des coléoptères dans le parc national de Babor (Algérie). *Med. Fac. Landbouww. Univ., Gent*, (57/3a), 617 – 626.

[7]. Blondel J., (1979). Biogéographie et écologie-, Edit., Masson, France, 4701, 173 p.

[8]. Chafaa S., (2013). Contribution à l'étude de l'entomofaune de l'olivier. *Olea europaea*et de la dynamique des populations de la cochenille violette *Parlatoriaoleae* Colvée, 1880 (Homoptera:Diaspididae) dans la région de Batna. Thèse Doctorat: Ecole National Supérieure Agronomique. El-Harrach. Alger, Algérie, 168 pp.

[9]. Chafaa S., Belkhedria S., & Mimeche F., (2019). Entomology fauna investigation in the apricot orchard, Prunusarmeniaca L. (Rosales: Rosaceae) in OuledSidiSlimane, Batna, North Est Algeria. *Biodiversity journal,* 10 (2), 95-100

[10]. Chalane S., Djouder N., (1999). Etude de l'entomofaune de trois stations selon différents types de formations végétales dans la région de Bejaia. Mémoire de magister. univ. de Béjaia, 128p.

[11]. Chinery M., (1986). Insectes d'Europe occidentale. Ed. Arthraud. Paris, 307p.

[12]. Chouiet N & Doumandji-Mitiche B, (2012). Biodiversité de l'arthropodofaune des milieux cultivés de la région de Ghardaïa (sud Algérien). 3ème congrès de zoologie et d'Ichtyologie, Marrakech, 13p.

[13]. Dajoz R., 1971. Précis d'écologie. Ed. Bordas, Paris, 434 p.

[14]. Delvare G & Aberlenc H.P, (1989). Les insectes d'Afrique et d'Amérique tropicale. Clé pour la

reconnaissance des familles. Ed. Cirad, France, 298 p.

[15]. Diab N, & Deghiche L, (2014). Arthropodes présents dans une culture d'olivier dans les régions Sahariennes, cas de la plaine d'El Outaya. Dixième conférence international sur les ravageurs en Agriculture, Montpellier, 11p.

[16]. Djetti T, Hammache M, Boulaouad B.A, & Doumandji S, (2015). L'arthropodofaune de la culture du maïs dans deux étages bioclimatiques différents en Algérie. Association pour la conservation de la biodiversité dans le Golf Gabes, 1p.

[17]. Guermah D., Medjdoub-Bensaad F., & Aouar-Sadli M., (2019). Evaluation of arthropods diversity on apple crop ('Red Delicious') in SidiNaâmane area (Tizi-Ouzou), Algeria. *Acta Agriculturae Sloverica*, 113(1), 10.

[18]. Guettala, Frah. N., 2009.Entomofaune, Impact Economique et Bio- Ecologie des Principaux Ravageurs du Pommier dans la région des Aurès. Diplôme de Doctorat D'état Université de Batna. 166P.

[19]. Gull S., Ahmad T., & Rasool A., (2019). Studies on diversity indices and insect pest damage of walnuts Kashmir, India. *Acta agricultutae Slovenca,* 113 (1), 121-135.

[20]. Klein A.M, Vaissière B.E, Cane J.H, Steffan-Dewenter I, Cunningham S.A, Kremen C, & Tscharntke T, (2007). Importance of pollinators in changing landscapes for worldcrops. Proceeding of the royal society B, 274(1608).

[21]. Naceri T., (2011). Contribution a l'étude de l'arthropodofaune de l'Olivier dans une oliveraie à Boumia (W. de Batna). Mémoire Ingénieur. Université de Batna, Batna, 78 pp.

[22]. Perrier R., (1964). La faune de la France, Tome VI : Les Coléoptères 1ère Partie. Ed. Lib. Delagrave, Paris, 192 pp.

[23]. Piham J C, (1986). Les Insectes. Paris, 160P.

[24]. Ramade F. (2003). Eléments d'écologie. Ecologie fondamentale. 3èm Ed. Dunod, Paris, 690 p.

[25]. Roth M. (1963). Comparaison des méthodes de capture en écologie entomologique. *Revue de pathologie végétale et d'entomologie agricole de France*, 42 (3), 177-179.

[26]. Seguy E., (1924). Les moustiques de l'Afrique mineure, de l'Egypte et de Syrie. Encyclopédie entomologique. Ed., Paul Le chevalier, Paris, 257p.

[27]. Souttou K, Farhi Y, Baziz B, Sekkour M, Guezoul O & Doumandji S, (2006). Biodiversité des arthropodes dans la région de Filiach (Biskra, Algérie). *Ornithologica Algerica* 4 (2), 25-28.

[28]. Tscharntke, T., Milder, J.C., Schroth, G., Clough, Y., De Clerck, F., Waldron, A., Rice, R. & Ghazoul, J. (2015). Landscape perspectives on agricultural intensification and biodiversity – ecosystem service management. *Ecology Letters*, (8)8, 857-874.

****