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Original Research Article

Investigation of Invertebrates Presents on Oak Cork Crop (‘*Quercus suber*’) at Altitude (1300 m) in Bouzeguene Area (Tizi-Ouzou), Algeria

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ABSTRACT:
The inventory of invertebrates on oak cork cultivation using 2 methods of sampling, Barber traps and colored traps in Bouzeguene region (Tizi-Ouzou) Algeria, allowed us to collect 35 species divided into 18 families, belonging to 6 orders. The values of the centesimal frequencies applied to invertebrate 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 6 groups among the 35 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 = 0.85 to E = 0.91. These values tend towards 1, which reflects a balance between the species in the environment.

Keywords: *Inventory, Invertebrates, Oak Cork, Bouzeguene, Algeria.*

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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 on animal pollination, mainly by insects. In addition, the soil microfauna providing the structure and soil fertility provides essential ecosystem services to agroeco systems. In this context, we carried out an inventory of the invertebrate fauna associated with oak cork tree cultivation in Tizi-Ouzou area (Kabylie), with the aim of improving our knowledge of biodiversity of invertebrates and their classification according to the different trophic regimes.

MATERIALS AND METHODS

This study was conducted in *Quercus suber* orchard not subject to treatment by pesticides. The parcel is located in Bouzeguene (36°37'00'' Nord, 4°28'47'' East) (Tizi-Ouzou, Algeria) situated at an altitude of 1300 meters, in a Mediterranean climate characterized by a humid bioclimatic stage with cold 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 Bouzeguene region from June2020 until July2021, covering vegetation, flowering and fruiting periods of *Quercus suber* 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 preventing 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 level 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.

The maximum diversity is represented by H'max; 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).

$E = H'observed / H'max$

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 oak cork trees in an ecological orchard not subjected to pesticide treatments, 35 species were captured, distributed in 18 families belonging to 6 orders.

Total wealth and relative abundance

The collected arthropod in a oak cork tree cultivation using different trapping methods allowed us to identify 35 species. The total wealth of the species caught by the two trapping methods was 22 species for colored traps and 27 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= 22	S= 27

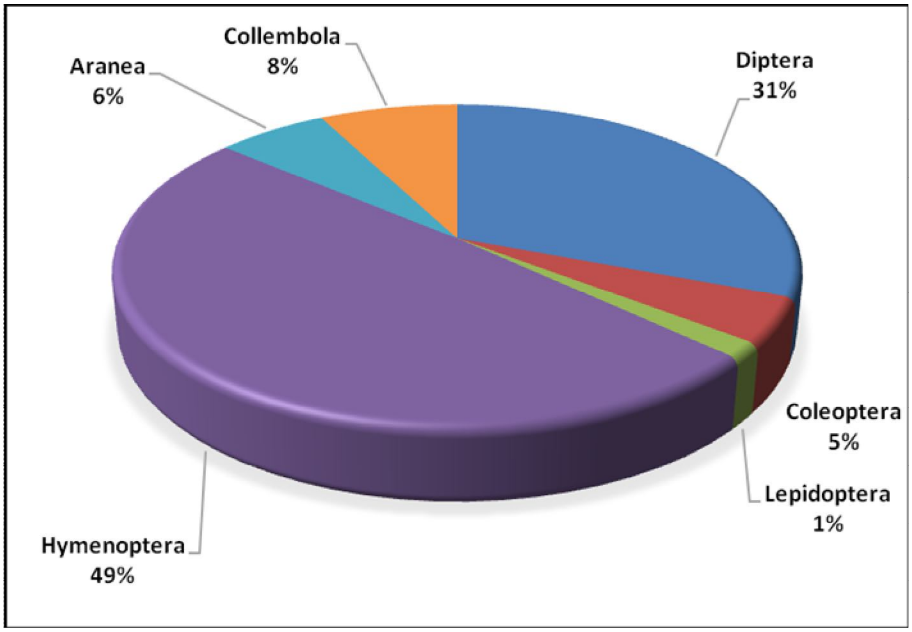

Figure 1: Centesimal frequency of invertebrate species captured using colored traps

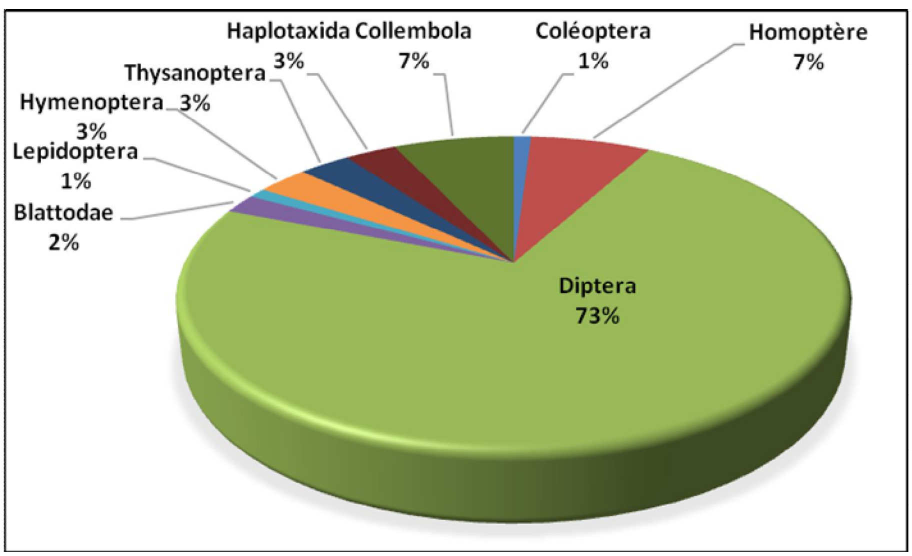

Figure 2: Centesimal frequency of arthropod species captured using Barber pots

Centesimal frequency (CF) of invertebrate orders captured in oak cork plot using two 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.

The most dominant order recorded for colored traps is Hymenoptera with relative abundance of 49%, followed by Diptera with centesimal frequency equal to 31%. For Barber pots, the most dominant order is Diptera with relative abundance equal to 73%, rest of orders are represented with low centesimal frequencies.

Table 2: invertebrate species captured using two sampling methods

Classes	Ordres	Familles	Espèces	Pots aériens	Pots Barber
Insecta	Diptera	Calliphoridae	*Calliphora vomitoria*	2	3
			Calliphora vicina	0	2
		Culicidae	*Culex pipiens*	5	11
			Anopheles plumbeus	0	4
			Anopheles sp	3	0
		Drosophilidae	*Drosophila funebris*	0	11
			Leucophenga maculata	2	1
		Psychodidea	*Phlebotomus sp*	1	0
		Lauxaniidae	*Sapromyzafaciata*	3	1
		Empididae	*Empis sp*	2	4
			Empis grisea	1	3
		Chironomidae	*Chironomus plumosus*	0	7
		Tephritidae	*Ceratitis capitata*	0	7
			Tephtitidae sp	1	2
			Milieriao missa	0	7
		Muscidea	*Graphomya maculata*	0	2
		Lauxaniidae	*Lauxaniidae sp*	0	1
		Scianidae	*Zygoneura sp*	1	7
	Blattodae	Blattidae	*Blatta sp*	0	2
	Coleoptera	Staphilinidae	*Philantusmaginatus*	2	1
		Nitidulidae	*Carpophilus hemeptetus*	1	0
	Homoptera	Cicadellidae	*Cicadella sp*	0	7
	Lépidoptera	Gracillaridae	*Gracillaridae sp*	1	1
	Hymenoptera	Formicidae	*Catoglyphis cursor*	19	1
			Compono tuslateralis	2	2
			Pheidole pallidula	7	0
			Compontus vagus	4	0
	Thysanoptera	Thripidae	*Thrips sp*	0	1
			Frankliniella occidentalis	0	2
Clitellata	Haplotaxida	Lumbricidae	*Lumbricus terrestris.*	0	3
Arachnida	Aranea	Thomisidae	*Synema globosum*	2	0
			Thomisus sp	1	0
	Opilione	Phalongidae	*Phlangium opilio*	1	0
Collembole	Entomobryomorpha	Entomobryiidae	*Entomobryanivalis*	2	4
	Symphypleona	Sminthuridae	*Sminyhurus viridis*	3	3

Species centesimal frequency according to their trophic relationships

The relative abundance obtained for species according to their trophic relationships is illustrated in figure 3.

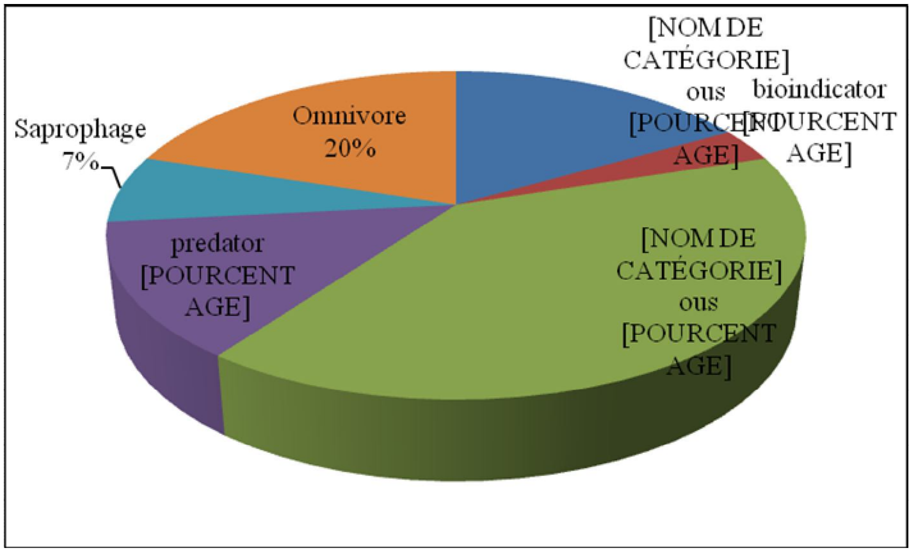

Figure 3: **Relative frequency of species caught following their behavior diet.**

The best-represented group is pests with 40%, predator are represented with low relative abundance equal to 13%.

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'	3.81 Bits	4.36 Bits
H' max	4.47 Bits	4.77 Bits
E	0.85	0.91

Shannon-Weaver diversity values for the various species caught by trapping methods are equal to H' = 3.81 bits; H max = 4.47 bits for colored traps and H' = 4.36 bits; H max = 4.77 bits for Barber pots.

The species evenness values are E = 0.85 for colored traps; and E = 0.91 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

Yahiaoui *et al.* inventory 13 arthropod species on olive cultivation in Lake of Reghaia in Algiers regionin 2017. Vayssières *et al*. (2001) report a diversity of 123 species divided into 40 families belonging to 8 orders during a preliminary inventory of arthropod pests and auxiliaries of vegetable crops on the island of Reunion. The preliminary inventory carried out by Tendeng *et al*. (2017) obtained 35 species of arthropod pests belonging to 18 families and 11 species of auxiliary arthropods belonging to 9 families. Vasquez *et al*. (2002) in the Peruvian Amazon have counted 36 insect species associated with guava cultivation. Guermah *et al*. (2019) collected 42 species divided into 29 families, belonging to 7 orders in the inventory of entomo fauna in Tadmait on apple crop.

Guermah (2019) reported that the total richness of the species caught is very variable, it depends on the type of trap used and the plot studied. Guermah *et al*. (2019) reported a total wealth of the species caught by the three trapping methods on apple crop in Tizi-Ouzou region; it was 80 species for the sweep net; 63 species for colored traps and 56 species for Barber pots. Merabet (2014) estimated total wealth at S = 74 by using Barber pots at Agni N Smen. 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) registred 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 and *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%.Ounis *et al*. (2014) during an estimate of soil biodiversity in an apricot plot, reported that the order of Coleoptera dominates with a centesimal frequency of 46.67%. Achoura and Belhamra (2010), reported that the order of Orthoptera dominates with a centesimal frequency of 18.75%, followed by Coleoptera with 16.67%, and finally Lepidoptera and Hymenoptera with a centesimal frequency of 14.58% in the palm grove (Biskra). 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%.

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. Mahdjane (2013) obtained a frequency of 57.4% for phytophages, followed by predators worth 20.63% and polyphages with 18.87%, in its inventory on plum insects in the Tadmait area, Tizi- Ouzou. Our results confirm those of previous work which demonstrated the dominance of the trophic category of phytophages (Collignon *et al*., 2000; Hautier *et al*., 2003 and Debras, 2007). According to Beamont and Cassier (1983), in a given area, 40 to 50% of insect species are phytophagous.

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. N'zala *et al.,* (1997) who reported that if the living conditions in a given environment are favorable, there are many species, each of which is represented by a small number of individuals, explain variations in the values of the Shannon index. If the conditions are unfavorable there are only a small number of species each of which is represented by a large number of individuals. Barbault in (1981) adds that the quantity of plant species available affects the richness of the animal procession. So the insect community is linked to architecture, the quantity of plants and the diversity of ecological niches.

Using Barber pot technique for the study of arthropod biodiversity at 3 steppes in the region of Djelfa, Guerzou *et al*. (2014) report variations in the diversity values of Shannon between 1.9 and 3.7 bits in Taicha, 3.02 and 3.5 bits in El Khayzar, 3.6 and 4.0 bits in Guayaza. Frah *et al*. (2015) during his study on arthropodo fauna in an olive plot in Sefiane (Batna) report a diversity value equal to H = 4.7 bits, Hmax = 6.1 using the barber pots; H = 4.6 bits, Hmax = 6 using the color traps and H = 5.2 bits, Hmax = 5.8 using the sweep net.

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 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 arthropodo 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. N'dépo *et al*. (2013) estimated Pielou's fairness between 0.64 to 0.82. The Pielou's evenness index showed by Gull and al. (2019) varies from 0.62 to 0.87.

REFERENCES

1. Achoura A, Belhamra M, (2010). Aperçu sur la faune arthropodologique des palmeraies d'El Kantara. Courrier du savoir. Université de Biskra, N 10 pp 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. Beaumont A. & Cassier P., (1983). Biologie animale des protozoaires aux Métazoaires épithélioneuriens. Tom II. Ed. Dumon, Paris, 954 pp.
5. Belmadani K, Hadjsaid H, Boubekka A, Metna B, & 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. Chinery M., (1986). Insectes d'Europe occidentale. Ed. Arthraud. Paris, 307p.
7. Colignon, P., Hastir, P., Gaspar, C. & Francis, F, (2000). Effets de l'environnement proche sur la biodiversité entomologique en cultures maraîchères de plein champ. *Parasitica* 56 (2-3), 59- 70.
8. Dajoz R., (1971). Précis d'écologie. Ed. Bordas, Paris, 434 p.
9. Debras, J. F. (2007). Rôles fonctionnels des haies dans la régulation des ravageurs: Le cas de Psylle *Cacopsyllapyri* L. dans les vergers du Sud- est de la France. Thèse de Doctorat en sciences de la vie. Université D'Avignon, pays de Vaucluse. 240 p.
10. 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.
11. 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.
12. 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.
13. Frah N, Baala H, & Loucif A, (2015). Etude d'arthropodofaune dans un verger d'olivier à Séfiane (wilaya de Batna Est Algérien). *Lebanese Science Journal*, 16(2), 37-45.
14. Fritas S, (2012). Etude bioécologique du complexe des insectes liés aux cultures céréalières dans la région de Batna, Algérie. Thèse de magister, université de Tlemcen, 115p.
15. Guermah D., (2019). Bioécologie du carpocapse du pommier *Cydia pomonella* L. lepidoptera : tortricidae et inventaire de la faune arthropodologique dans des vergers de pommier traités et écologique dans la région de tizi-ouzou (Sidi Nâamane et Draa Ben Khadda).doctorat 3éme cycle LMD.UMMTO, 188pp.
16. Guermah D., Medjdoub-Bensaad F., Aouar-Sadli M., (2019). Evaluation of arthropods diversity on apple crop ('Red Delicious') in Sidi Naâmane area (Tizi-Ouzou), Algeria. *Acta Agriculturae Sloverica*. 113(1), 10.
17. Guerzou A, Derdouk W, Guerzou M & Doumandji S, (2014). Arthropod diversity in 3 step region of Djelfa area (Algeria). *International journal of zoology and research*, 4, 41-50.
18. 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.
19. Hautier L., Patiny S., Thomas-Odjo A. & Gaspar M. Ch., (2003). Evaluation de la biodiversité de l'entomofaune circulante au sein d'associations culturales au Nord Bénin. *Notes faunistiques de Gembloux*, 52, 39 – 51.
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, vol 274 issue 1608.

21. Mahdjane H, 2013. Inventaire qualitatif et quantitatif des insectes inféodés au prunier dans la région de tadmait dans la région de Tizi-Ouzou. Mémoire magister. Sci. agro. univ. Mouloud Mammeri. T.O, 78p.

22. Merabet S, (2014). Inventaire des arthropodes dans trois stations au niveau de la forêt de Darna (Djurdjura). Mémoire magister. sciences biologiques Université Mouloud Mammeri de Tizi-Ouzou, 83p.

23. N'zala D, Noungamani A, Moutsambote J M & Mapangui A, (1997). Diversité floristique dans les monocultures d'eucalyptus et de pins au Congo. *Cahier d'Agriculture,* 6, 169-174.

24. N'Dépo O. R., Hala N., N'Da A. A., Coulibaly F., Kouassi K. P., Vayssieres J. F. & De Meyer M. (2013). Fruit flies (Diptera: Tephritidae) populations Dynamic in mangoes production zone of Côte d'Ivoire. *Agricultural Science Research Journal,* 3 (11), 352- 363.

25. Ounis F., Frah N., Medjdoub-Bensaad F., (2014). Diversité de la faune du sol dans une parcelle d'abricotier à Takout (Batna, Est de l'Algérie). International journal of *Agriculture Innovation and Research,* 2, 4.

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

27. Piham J C, (1986). Les Insectes. Paris, 160P.

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

29. 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.

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

31. Tendeng E, Labou B, Djiba S, Diarra K. (2017). Actualisation de l'entomofaune des cultures maraîchères en Basse Casamance (Sénégal). *International Journal of Biological and Chemical Sciences*, 11(3), 1021-1028.

32. 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.

33. Vasquez J., Belmont AS., & Sedat JW. (2002). The dynamics of homologous chromosomus pairing during male Drosophila meiosis. *Current Biology,* 12(17), 1473-1483.

34. Vayssières JF., Delvare G., Maldes JM., & Aberlenc HP. (2001). Auxiliaires des cultures maraîchères sur l'Ile de la Réunion. *International journal of tropical insect science*, 20 (3), 1-22.

35. Yahiaoui K, Bouchenak O, Fertas M, & Arab K, (2017). Inventaire et répartition spatiale des ravageurs de l'olivier au lac de Réghaia. *Algerian journal of environmental science and technology,* 3 (3A), 190-195.

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