Евразиатский энтомол. журнал 22(6): 309–316
doi 10.15298/euroasentj.22.06.06

Diversity and characterization of trophic behaviour of invertebrates on cherry tree *Prunus avium* (L.) L., 1755 at high altitudes in Thakhelijt area near Aпп El Hammam, Algeria

Разнообразие беспозвоночных и их трофическая специфика на черешне *Prunus avium* (L.) L., 1755 в условиях высокогорий Тахелиджта в окрестностях Айн-эль-Хаммама в Алжире

D. Guermah, F. Medjdoub-Bensaad
Д. Гуермах, Ф. Меджduб-Бенсаад

Laboratoire de production, amélioration et protect ion des végétaux et des denrées alimentaires, Faculté des Sciences Biologiques et des Sciences Agronomiques, Université Mouloud Mammeri, Tizi-Ouzou, BP 17 RP 15000 Algérie. E-mail: Algérie. E-mail: guermah.dyhia.d@gmail.com.

Лаборатория по производству, улучшению и защите овощей и пищевых продуктов, Факультет биологических и агрономических наук, Университет Мулу Мамри, Тизь-Узу, BP 17 RP 15000 Алжир.

Key words: inventory, invertebrates, Cherry, Thakhelijt, Algeria.

Ключевые слова: inventarizatsiya, насекомые, черешня, Тахелиджт, Алжир.

Abstract. An inventory of invertebrates on cherry cultivation using two methods of sampling, pitfall traps and coloured traps, in the Thakhelijt region (Ain El Hammam, Tizi-Ouzou) of Algeria, allowed us to collect 107 species divided into 61 families, belonging to 21 orders and 7 classes. The values of the centesimal frequencies applied to invertebrate orders identified in the studied plot vary from one type of trapping to another, with each sampling method relating to a representative order group. The diets of invertebrates are extremely diverse, due to the structures and function of the mouthparts, and the structural and functional division of the digestive tract. Distribution is defined according to the different trophic categories according to our personal observations and the bibliography consulted. It was possible to distinguish 10 large groups among the 107 insect species selected. Shannon-Weaver diversity index values are quite high in the study plots, with H' = 5.78 bits for pitfall traps and H' = 4 bits for coloured traps. The fairness obtained for each type of trap varies from E = 0.88 to E = 0.90; these values tend towards 1, which reflects a balance between the host and parasite species in the environment.

Резюме. Учёт беспозвоночных на посадках черешни в высокогорном районе Тахелиджт близ города Айн-эль-Хаммам в Алжире, проведённый с помощью почвенных и цветных ловушек и ручного сбора, позволил выявить 107 видов из 61 семейства, 21 отряда и 7 классов животных. Процентное соотношение видов на уровне отрядов беспозвоночных, выявленных на исследуемом участке, варьирует в зависимости от метода сбора, образуя специфичные группы для каждого метода. Рацион беспозвоночных оказался очень разнообразным в силу строения ротового аппарата и структурного и функционального разделения пищеварительного тракта. Распределение 107 видов по 10 трофическим группам установлено на основе оригинальных и литературных данных. Значения индекса разнообразия Шеннона-Уивера на исследуемом участке достаточно высокие и составляют H' = 5,78 единиц для почвенных ловушек и H' = 4 единицы для цветных ловушек. Достоверность для каждого типа ловушек варьирует от E = 0,88 до E = 0,90, эти значения стремятся к 1, что отражает баланс между видами в среде обитания.

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 cherry 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 diets.

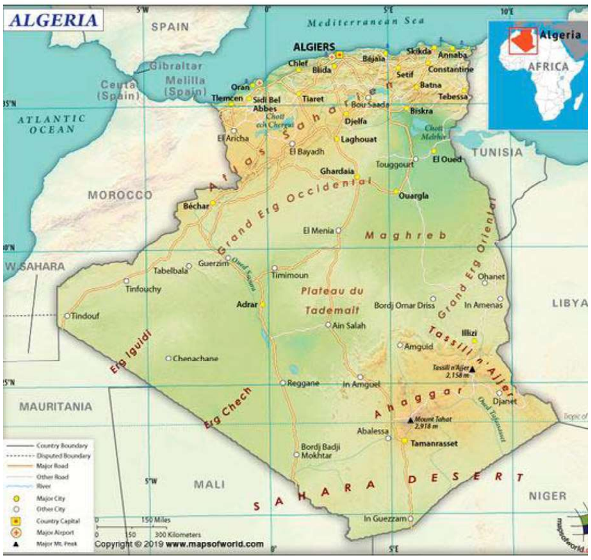

Fig. 1. Location of the study area in Algeria (Google maps, 2022).
Рис. 1. Карта места исследования в Алжире (Google карты, 2022).

Materials and methods

This study was conducted in a *Prunus avium* orchard not subject to treatment by pesticides. The parcel is located in Thakhelijt in Ain El Hammam area (36°29'51" N, 4°22'25" E) (Tizi-Ouzou, Algeria) situated at an altitude of 1080 meters, on the heights of the Djurdjura massif (Fig. 1).

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 Michelet region from October 2019 until September 2020, covering vegetation, flowering and fruiting periods of *Prunus avium*' 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].

Figs 2–3. Different sampling methods used in the work. 2 — Yellow plastic bins serving as an aerial trap; 2 — Pitfall pots buried in the ground.

Рис. 2–3. Различные методы сбора, применённые в ходе сбора материала. 2 — жёлтые пластиковые контейнеры для отбора аэрофауны; 3 — почвенные ловушки для сбора герпетобия.

In the field

We opted to use two trapping methods (Figs 2, 3) namely Pitfall pots or terrestrial traps as well as yellow aerial traps, at the rate of one outing per month.

Pitfall 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, they are visited once a week.

Coloured traps. 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, they are visited once a week.

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. The identification of individuals of listed invertebrates is carried out using the different determination keys [Seguy, 1951; Perrier, 1964; Piham, 1986; Chinery, 1988; Delvare, Aberlenic, 1989].

Trophic behavior

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 Sampling quality and total wealth for each sampling method. The relative abundance 'centesimal frequency' Fc (%) was also evaluated; it gives the percentage of individuals of a species Ni relative to the total number of individuals N [Dajoz, 1971].

$FC = N_i \cdot 100 / N$

According to Barbault [1981], species diversity is measured by various indexes; the most se des the Shannon-Weaver. It is calculated by the following formula:

$H' = -\sum q_i \log_2 q_i$

H': The diversity index expressed in bit units.

q_i: The probability of encountering species i.

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 is the ratio of observed diversity (H') to maximum theoretical diversity (H' max) [Barbault, 1981].

$E = H' / H'max$

Results

During this study which focused on the inventory of invertebrates fauna associated to cherry trees in an ecological orchard not subjected to pesticide treatments, 107 species were captured, distributed in 61 families belonging to 21 orders and 7 classes.

The values of sampling quality of the species caught using two sampling methods are presented in following table 1.

Sampling quality. Values of species captured once and in a single copy are Q = 0.06 for coloured traps and Q = 0.38 for Pitfall traps, the sampling quality is considered very good because the values approach 0.

Total wealth and relative abundance. The collected arthropod in a «*Prunus avium*» cherry plot using different trapping methods allowed us to identify 107 species. The total wealth of the species caught by the two trapping methods was 21 species for coloured traps and 90 species for Pitfall pots (Table 2).

Centesimal frequency (CF) of invertebrates orders captured in cherry plot using two sampling methods is shown in Figure 4 for coloured traps and figure 5 for Pitfall pots. Centesimal frequency of species identified according to the order, and family are presented in Table 3.

The most dominant order recorded for coloured traps is Diptera with relative abundance of 35.71% followed by Hymenoptera with centesimal frequency equal to 33.93 %. For Pitfall pots, the most dominant order is Coleoptera with relative abundance equal to 32.91% followed by Hymenoptera with centesimal frequency equal to 23.74 %.

The coloured traps allowed us to collect 21 species, represented mainly by *Myzus cerasi* with centesimal frequency of 18.75 %, followed by *Apis mellifera* with 16.96 %, who is important pollinator specie.

Barber pot allowed us to collect 90 species, represented mainly by *Ocypus olens* with relative abundance of 6.15 %, followed by *Lasius niger* and *Brachinus crepitans* with respectively 5.96 % and 5.33% which are natural predators of various pests.

Species centesimal frequency according to their trophic relationships. The relative abundance obtained for species according to their trophic relationships is il-

Table 1. Sampling quality of the species caught by different sampling methods

Таблица 1. Индекс качества метода отлова насекомых разными ловушками

Traps	Coloured trap
Sampling Quality (Q)	Q =0.06

Table 2. Total wealth of species caught by different sampling methods

Таблица 2. Общее число видов, отловленных разыми методами сбора

Traps	Coloured trap	Pitfall trap
Total Wealth	21 species	90 species
Total of species	107 species	

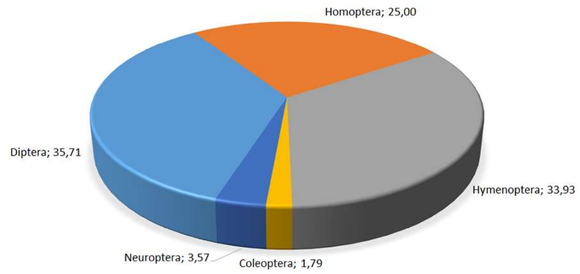

Fig. 4. Centesimal frequency of invertebrate orders captured using coloured traps

Рис. 4. Относительная численность видов разных отрядов насекомых, отловленных с помощью цветных ловушек.

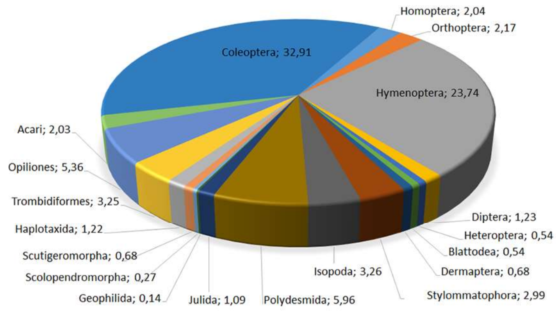

Fig. 5. Centesimal frequency of arthropod orders captured using Pitfall pots

Рис. 5. Относительная численность видов разных отрядов насекомых, отловленных с помощью почвенных ловушек.

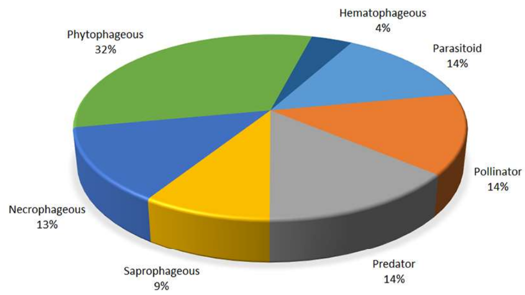

Fig. 6. Relative frequency of species caught using coloured traps following their trophic behavior.

Рис. 6. Относительная частота попадаемости видов, отловленных в цветные ловушки, с учётом их трофических связей.

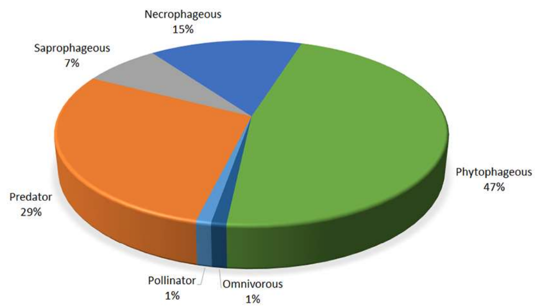

Fig. 7. Relative frequency of species caught using pitfall pots following their trophic behavior.

Рис. 7. Относительная частота попадаемости видов, отловленных в почвенные ловушки, с учётом их трофических связей.

lustrated for coloured traps (Fig. 6) and for pitfall pots (Fig. 7).

The best represented group using coloured traps is pests with 32 %, followed by predator, parasitoid and pollinator with 14%.

When using pitfall pots, the best-represented group is pests with relative abundance of 44 %, followed by predator with 27 %. This shows that the species of the environment not subjected to pesticide treatment are in equilibrium.

Shannon-Weaver diversity index (H '), maximum diversity (H'max.) and equitability (E) applied to species trapped by the different sampling techniques are presented in Figure 8.

Shannon Weaver diversity index and evenness index (E). Shannon-Weaver diversity values for the various species caught by trapping methods are equal to H' = 4.01 bits; H max = 4,41 bits for coloured traps and H' = 5.78 bits; H max = 6.52 bits for Pitfall pots. The species evenness values are E = 0.90 for coloured traps; and E = 0.88 for Pitfall pots. A fairly high evenness is recorded for two sampling methods (coloured traps and pitfall pots) this value approaches a value of 1 which reflects a balance between the middle of species.

The background knowledge of invertebrates restricted to the cherry crop in the region of Tizi Ouzou is a first step towards developing effective approaches for pest control and for auxiliary species conservation.

Discussions and conclusion

The background knowledge of invertebrate restricted to cherry trees in an ecological orchard not subjected to pesticide treatments, revealed 107 species were captured, distributed in 61 families belonging to 21 orders and 7 classes.

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. Aberkane-Ounas [2013], in his study of the entomofauna in the vineyard of the Tizi-Ouzou region identified 99 species of insects divided into 46 families and 11 orders. Guermah et al. [2019] finded 113 species distributed in 64 families belonging to 10 orders in their evaluation of arthropods diversity on apple crop in Tizi-Ouzou. Guermah et al. [2019] collected 42 species divided into 29 families, belonging to 7 orders in the inventory of entomofauna in Tadmait on apple crop.

The sampling quality values reported by Guermah [2019] in an arthropodological study on apple trees are between 0.03 and 0.25. Menacer [2012] estimated the sampling quality at Q = 0.04 in the Biskra palm grove. Merabet [2014] estimated the quality of sampling by using Pitfall pots at Q = 0.36 at Agni N Smen. Otherwise, Berchiche [2004] mentions that the sampling quality of the Entomofauna at the station (Oued Smar, Algiers) is equal to 0.7.

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 63 species for coloured traps and 56 species for Pitfall pots. Fritas [2012] estimated total wealth at S = 64 on cereal crops in the Batna region. Frah et al. [2015] during his study on arthropodological fauna in Sefiane (Batna) estimated the total wealth at S = 71 using Pitfall pots and S = 63 using coloured traps. Djetti et al. [2015] in a study on the arthropodofauna 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 coloured traps who is Hymenoptera with relative abundance of 37.13 %, for Pitfall pots, 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%.

During our study, we identified pests that can cause significant damage to our crop, but we also harvested auxiliary arthropods. These auxiliaries form an ecological balance on the ground and their presence slows down the spread of pests and limits their damage.

Spiders. As predators, spiders play a major role in regulating insect populations, and they are themselves regulated by often specific predators (reptiles, birds or insects of the Pompilidae family) [Chinery, 1988].

Coccinellidae. Ladybugs are well known for their biological control because they are predatory in the larval and adult stages. Their preys are small insects: aphids, mealybugs, whiteflies, diptera and lepidopteran larvae (caterpillars) [Dajoz, 2003].

Carabidae. They are the large ground beetles, hunter the caterpillaries, worms, snails, which frequent damp places (with the exception of course of some steppe species) and are found under stones, dead leaves, felled trunks; the larvae are typically campodeiform and hunt-

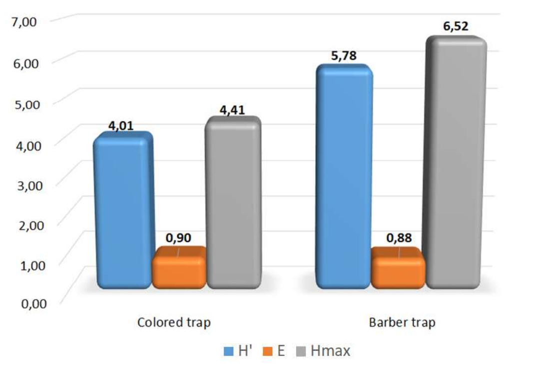

Fig. 8. Shannon-Weaver diversity values H' and evenness of species trapped by the various traps.

Рис. 8. Индекс Шеннона-Вивера H' и выравненность разнообразия видов, отловленных различными ловушками.

Table 3. Centesimal frequency of invertebrate's species captured
Таблица 3. Относительная численность отловенных видов из разных отрядов насекомых

Classes	Orders	Families	Species	Pitfall traps	Coloured traps
Gastropoda	Stylommatophora	Agriolimacidae	*Agrolimacidae* sp. (Müller, 1774)	0.41	–
			Deroceras sp. (Müller, 1774)	0.54	–
		Milacidae	*Milax nigricans* (Philippi, 1836)	0.41	–
		Helicidae	*Cornu aspersum* (O.F Müller, 1774)	0.14	–
		Helicidae	*Cantharus subapertus* (Born, 1778)	0.27	–
		Hygromiidae	*Ganula flava* (Linnée, 1758)	0.41	–
		Limacidae	*Lehmania marginata* (O.F Müller, 1774)	0.54	–
			Lehmania sp. (O.F Müller, 1774)	0.27	–
Malacostraca	Isopoda	Glomeridae Glomeridae	*Glomeris convexa.* (Blackwall, 1870)	0.68	–
			Glomeris sp. (Blackwall, 1870)	0.54	–
		Armadilidiidae	*Armadillidium vulgare* (Latreille, 1804)	1.63	–
		Philosciidae	*Philoscia muscorum* (Scopoli, 1763)	0.41	–
Diplopoda	Polydesmida	Paradoxosomatidae	*Oxydus gracillis* (C.L. Koch, 1847)	4.88	–
		Polydesmidae	*Polydesmus angustus* (Latzel, 1884)	1.08	–
	Julida Julida	Blaniulidae	*Blaniulus guttulatus* (Fabricius, 1798)	0.41	–
		Julidae	*Tachypodoiulus albipes* (Leach, 1814)	0.68	–
Chilopoda	Geophiles	Geophilidae	*Necrophloeophagus longicornis* (Leach, 1814)	0.14	–
	Scolopendromorpha	Scolpendridae	*Haplophilus subterraneus* (Shaw, 1789)	0.27	–
	Scutigeromorpha	Scutigeridae	*Scutigera coleoptrata* (Linnée, 1758)	0.68	–
Clitellata	Haplotaxida	Lumbricidae	*Eisenia fetida* (Savigny, 1826)	0.41	–
			Lumbricus terrestris (Linnée, 1758)	0.81	–
Arachnida	Aranea	Dysderidae	*Dysdera crocata* (CL Koch, 1838)	2.31	–
			Dysdera erythrina (Walcknaer, 1802)	0.27	–
		Lycosidae Lycosidae	*Lycosa narbonensis* (Linnée, 1758)	3.25	–
			Lycosidae sp. (Latreille, 1804)	2.03	–
		Salticidae	*Plexippus paykulli* (Audouin, 1826)	0.95	–
		Segestriidae	*Segestrina* sp. (Latreille, 1804)	0.14	–
		Thomisidae	*Thomisus* sp. (Walcknaer, 1805)	0.27	–
			Synema globosum (Fabricius, 1775)	0.41	–
		Gnaphosidae	*Gnaphosa sericata* (L Koch, 1866)	0.27	–
	Trombidiformes	Trombidiidae Trombidiidae	*Trombidium holosericeum* (Linnée, 1758)	2.17	–
			Trombidium sp (Fabricius, 1775)	1.08	–
		Tetranychidae	*Panonychus ulmi* (Koch, 1836)	2.03	–
	Opiliones	Phalangidae	*Phalangium opilio* (Linnée, 1758)	2.71	–
			Phalangium sp. (Linnée, 1758)	1.63	–
			Leiobunum rotundum (Latreille, 1804)	0.88	–
			Megabunus diadema (Fabricius, 1779)	0.14	–
Insecta	Coleoptera	Scarabaeidae	*Rhizotrogus maculicollis* (Villa, 1833)	1.99	–
			Rhizotroyus aestivus (Olivier, 1789)	0.54	–
			Onthophagus nigriventris (Dorbigny, 1902)	0.14	–
			Scarabaeus sacer (Linnée, 1758)	0.41	–
			Tropinota squalida (Scopoli, 1763)	2.5	–
			Oxythyrea funesta (Poda, 1761)	1.08	–
		Staphylinidae	*Ocypus olens* (O.F Müller, 1764)	6.15	–
			Bledius furcatus (Olivier, 1811)	0.54	–
		Carabidae	*Harpalus affinis* (Schrank, 1781)	0.95	–
			Harpalus paratus (Casey, 1924)	3.3	–
			Brachinus crepitans (Linnée, 1758)	5.33	–
			Bembidion obtusum (Audinet-Serville, 1821)	0.41	–
			Macrothorax morbillosus (Fabricius, 1792)	3.59	–
		Tenebrionidae	*Lagria villosa* (Fabricius, 1781)	1.76	–

Table 3. (Continuations)
Таблица 3. (Продолжение)

Classes	Orders	Families	Species	Pitfall traps	Coloured traps
Insecta	Coleoptera	Dascillidae	*Dascillus cervinus* (Linnée, 1758)	0.27	–
		Curculionidae	*Curculio* sp. (Linnée, 1758)	0.14	–
			Liparus glabrirostris (Küster, 1849)	0.27	–
			Otiorhynchus sp. (Germar, 1822)	0.41	–
			Polydrusus impressifrons (Gyllenhal, 1834)	0.14	–
			Polydrusus tereticollis (De Geer, 1775)	0.14	–
			Phyllobius sp. (Germar, 1824)	0.14	–
		Chrysomelidae Chrysomelidae Chrysomelidae	*Longitarsus dorsalis* (Fabricius, 1781)	0.81	–
			Altica sp. (Geoffroy, 1762)	0.14	–
			Longitarsus pratensis (Panzer, 1794)	0.81	–
		Lucanidae	*Dorcus* sp. (Mac Leay, 1819)	0.14	–
		Staphylinidae Staphylinidae	*Staphylinus caerareus* (Cederhjelm, 1798)	0.27	–
			Xantholinus linearis (Olivier, 1795)	0.54	–
		Coccinellidae	*Adalia bipunctata* (Linnée, 1758)	–	1.79
	Homoptera	Cicadellidae Cicadellidae	*Amblysellus curtisii* (Fitch, 1851)	1.36	6.25
			Helochara communis (Fitch, 1851)	0.68	–
		Aphididae	*Myzus cerasi* (Fabricius, 1775)	–	18.75
	Orthoptera	Tettigoniidae	*Tettignia viridissima* (Linnée, 1758)	0.95	–
		Acrididae	*Pezotettix giornae* (Rossi, 1794)	0.27	–
		Gryllidae	*Gryllus campestris* (Linnée, 1758)	0.27	–
		Tetrigidae	*Tetrix undulata* (Sowerby, 1806)	0.68	–
	Hymenoptera	Formicicidae	*Messor structor* (Latreille, 1798)	2.44	–
			Messor barbara (Linnée, 1767)	3.12	–
			Camponotus lateralis (Olivier, 1792)	2.71	–
			Camponotus ligniperdus (Latreille, 1792)	0.27	–
			Cataglyphis cursor (Fonscolombe, 1846)	1.95	–
			Pheidol pallidula (Nylander, 1849)	1.22	–
			Lasius niger (Linnée, 1758)	5.96	0.89
			Solenopsis invicta (Buren, 1972)	3.55	–
			Camponotus vagus (Scopoli, 1763)	0.27	–
			Lasius flavus (Fabricius, 1782)	0.41	–
		Apidae	*Apis mellifera* (Linnée, 1758)	1.84	16.96
			Eucera longicornis (Linnée, 1758)	–	3.57
		Andrenidae	*Panurgus calcaratus* (Scopoli, 1763)	–	2.68
		Pteromalidae	*Pteromalus pupaum* (Linnée, 1758)	–	5.36
		Ichneumonidae	Ichneumonidae sp. (Latreille, 1802)	–	2.68
			Netelia testacea (Gravenhorst, 1829)	–	1.79
	Diptera	Sarcophagidae	*Sarcophaga carnaria* (Linnée, 1758)	0.27	–
		Lonchaeidae	*Lonchaea chorea* (Fabricius, 1781)	0.41	–
		Drosophilidae	*Drosophila funebris* (Fabricius, 1787)	0.14	–
		Calliphoridae	*Calliphora vomitoria* (Linnée, 1758)	–	2.68
			Lucilia caesar (Linnée, 1758)	–	1.79
		Muscidae	*Musca domestica* (Linnée, 1758)	0.41	0.88
			Graphomya maculata (Scopoli, 1763)	–	3.57
		Tephritidae	*Ragoletis cerasi* (Linnée, 1758)	–	2.68
			Myopites stylatus (Fabricius, 1794)	–	6.25
			Ceratitis capitata (Wiedemann, 1824)	–	7.14
			Xyphosia miliaria (Schrank, 1781)	–	1.79
		Sepsidae	*Sepsis fulgens* (Meigen, 1826)	–	1.79
		Culcidae	*Culex pipiens* (Linnée, 1758)	–	3.57
		Syrphidae	*Syrphus ribesii* (Linnée, 1758)	–	3.57
	Heteroptera	Cydnidae	*Cydnus aterrinus* (Forster, 1771)	0.27	–
		Lygaeidae	*Graptostethus servus* (Fabricius, 1787)	0.27	–
	Blattodae	Blattellidae	*Ectobius* sp. (Stephens, 1835)	0.54	–
	Dermaptera	Forficulidae	*Forficula auricularia* (Linnée, 1758)	0.68	–
	Neuroptera	Chrysopidae	*Chrysoperla carnea* (Stephens, 1836)	–	3.57
Total	21	61	107	100	100

ing [Roth, 1980]. According to Dajoz [2003], Carabidae have an opportunistic eating behavior and are generally omnivorous (seeds, fruits or other insects) or sometimes exclusively predators.

Staphylinidae. Staphylinidae are saprophagous or predators depending on the species [Perrier, 1964]. They have the same diet and their actions do not differ much from that of the Carabidae.

Formicidae. Ants are omnivorous generalists. However, some species maintain colonies of aphids and protect them from predators in exchange for the honeydew, which provided them [Perrier, 1964].

Aphids. Aphids are the main pest in agriculture causing very unsightly deformations in plants, losses in force, preventing the full yield of the plant and its good fruiting [Chinery, 1988].

Scolopendra. They are carnivorous and voracious invertebrates, which prove to be useful against pests; they are predators of the soil macrofauna [Chinery, 1988].

Hymenoptera. They are often parasitoids thus actively participating in maintaining the natural balance of an ecosystem [Berland, 1999]. Bees and wasps play a key role in pollinating crops.

Isopods. Woodlice are detritivores; they thus contribute to the recycling of organic matter and allow a rapid return of nutrients in the soil [Chinery, 1988].

Lepidoptera. Lepidopteran larvae are voracious phytophagous, adults feed on nectar and flower pollen [Chinery, 1988].

Diptera. The diet of dipterans is very varied, they can be pollinators (Bombyles, Syrphs, Muscids), they are also predators of insect pests (Syrphs, Cecidomyidae) but can also be phytophagous causing significant damage like the Mediterranean fruit fly *Ceratitis capitata* [Seguy, 1951].

According to the trophic behavior, 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 coloured traps is pests with 30 %, whereas the least abundant group are saprophagous and bioindicators with only 1 %. When using pitfall 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 %. 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. Guettala-Frah [2009], in its study on the economic impact and the bioecology of the main apple pests in the Aurés region, recorded 69.72 % of phytophages, followed by predators and parasitoids with a percentage equal to 15.98 %, and 4, 76 % respectively. Finally, saprophages, necrophages and coprophages represent small percentages below 3 %.

Guermah et al. [2019] reported a diversity of Shannon-Weaver values for the various species caught by trapping methods, they are equal to H' = 5.58 bits; H max = 6 bits for coloured traps and H' = 5.33 bits; H max = 5.95 bits for Pitfall pots. Using Barber pot technique for the study of arthropod biodiversity at 3 steppes in the region of Djelfa 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 et al. [2015] during his study on arthropodofauna in an olive plot in Sefiane (Batna) report a diversity value equal to H = 4.7 bits, Hmax = 6.1 using the pitfall pots; H = 4.6 bits, Hmax = 6 using the colour 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 coloured traps; and E = 0.89 for Pitfall pots. A high evenness is recorded for three sampling methods (sweep net, coloured traps and pitfall 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. 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.

The proliferation of arthropods and their diversity is favored by the absence of phytosanitary treatment in the study plot. Therefore, we notice the presence of a very varied auxiliary fauna composed of predators and parasitoids with significant values to maintain the pest populations at an economically acceptable level.

The identification of these arthropods and their trophic relationship constitutes an important scientific base, likely to contribute to the establishment of an appropriate integrated control strategy within these agro-ecosystems, from the perspective of an alternative approach to the use of pesticides and the preservation of biodiversity and the environment.

References

Aberkane-Ounas N, 2013. Inventaire des insectes inféodés à la vigne *Vitis vinifera* L dans la région de Tizi-Rached (Tizi-Ouzou). Thèse magister, université Mouloud MAMMERI de Tizi-Ouzou. 82 p.

Barbault.R, 1981. Ecologie des populations et des peuplements. Paris : Masson et C. 200 p.

Beddiaf R., Kherbouche Y., Sekour M., Souttou K., Ababsa L., Djillali K., Ebouz A., Guerzou L., Hamid Oudjana A., Hadj Sayed A., Doumandji S, 2014. Aperçu sur la faune arthropodologique de Djanet (Tassili N'Ajjer, Algérie) // Revue El Wahat pour les recherches et les études. Vol.7. No.2. P.70–78.

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. Vol.4. No.3. P.1–8.

Berchiche S. 2004. Entomofaune de *Triticum aestivum* et de *Vicia fabae* Etude des fluctuations d'*Aphis fabae* Scopoli, 1763 (Homoptera : Aphididae) dans la station expérimentale (I.T.G.C.) de Oued Smar. Thèse Magister. E.N.S.A. El-Harrach. 274 p.

Berland L. 1999. Atlas des Hyménoptères de France Belgique et Suisse. T.I. Paris : Boubée. 157 p.

Chinery M. 1988. Insectes d'Europe occidentale. Paris : Arthraud 307 p.

Dajoz R. 1971. Précis d'écologie. Paris Bordas. 434 p.

Dajoz R. 2003. Les coléoptères Carabidés et Ténébrionidés: Ecologie et Biologie. Ed. Paris : Lavoisier, Tec et Doc. 522 p.

Delvare G., Aberlenc H.P. 1989. Les insectes d'Afrique et d'Amérique tropicale // Clé pour la reconnaissance des familles. France : Cirad. 298 p.

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. 1 p. https://doi.org/10.13140/RG.2.1.1109.1924.

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. Vol.16. No.2. P.37–45.

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. 115 p.

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. 188 p.

Guermah D., Medjdoub-Bensaad F., Aouer-Sadli M. 2019. Evaluation of arthropods diversity on apple crop ('Red Delicious') in Sidi Naâmane area (Tizi-Ouzou), Algeria // Acta Agriculturae Sclovenica. Vol.113. No.1. P.137–146. https://doi.org/10.14720/aas.2019.113.1.12.

Guermah D., Medjdoub-Bensaad F., Marnich F. 2019. Bioecology of Codling Moth *Cydia pomonella* (Lepidoptera: Tortricidae) and Study of the Associated Entomofauna on Anna Variety in Tadmaitregion (Tizi-Ouzou, Algeria) // Bulletin of pure and applied science: zoology. Vol.38. No.2. P.150–160. https://doi.org/10.48165.

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. Vol.4. P.41–50.

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. 166 p.

Gull S., Ahmad T., Rasool A. 2019. Studies on diversity indices and insect pest damage of walnuts Kashmir, India // Acta agricultutae Slovenca. Vol.113. No.1. P.121–135. https://doi.org/10.14720/aas.2019.113.1.11.

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 world crops // Proceeding of the royal society B. Vol.274. P.303–313. https://doi.org/10.1098/rspb.2006.372.

Menacer S. 2012. Influences des facteurs microclimatiques de la palmeraie sur la biodiversité des peuplements aphidien dans la région de Biskra. Thèse magister, Ecole National Supérieur Agronomique. 81 p.

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. 83 p.

Perrier R. 1964. La faune de la France. Tome VI: Les Coléoptères 1ère Partie. Paris: Delagrave. 192 p.

Piham J.C. 1986. Les Insectes. Paris. 160 p.

Ramade F. 2003. Eléments d'écologie fondamentale. 3ème édition France: Dunod. 690 p.

Roth M. 1963. Comparaison des méthodes de capture en écologie entomologique // Revue de pathologie végétale et d'entomologie agricole de France. Vol.42. No.3. P.177–179.

Roth M., 1980. Initiation à la morphologie, la systématique, et la biologie des insectes // Office de la recherche scientifique et technique outre-mer. Paris. 259 p.

Seguy E. 1951. Les diptères de France, Belgique et Suisse // Nouvel Atlas d'Entomologie. No.8. 244 p.

Tscharntke T., Milder J.C., Schroth G., Clough Y., DeClerck F., Waldron A., Rice R., Ghazoul J. 2015. Landscape perspectives on agricultural intensification and biodiversity — ecosystem service management // Ecology Letters. Vol.8. No.8. P.857–874. https://doi.org/10.1111/conl.12110.

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. Vol.20. No.3. P.1–22.

Поступила в редакцию 20.7. 2023