

Entomofaunal diversity of Diptera in a semi arid region in the west of Algeria (Tiaret)

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ABSTRACT

The contribution to the study of the biodiversity of Diptera associated with the cultivated olive tree took place over a year from December 2018 to November 2019, in two stations located in the west of Algeria. The aim of this present work is to learn about the biodiversity of Diptera associated with the olive tree cultivated in the Tiaret region. Sampling frequency was on the order of one outing per month using the yellow plates and barber jars to collect the specimens. We identified 1124 individuals or 46 species belonging to 29 families. The Sciaridae family is the most representative in Ain Guesma station with a relative abundance AR% of 23%. While in the station of Oued lili the Chironomidae family is the most captured, at 18.52%. The two stations present a great diversity of species ($H' = 3.58$ Ain Guesma, $H' = 3.65$ in Oued Lili). The equity of the species identified in this study is greater than or equal to 0.76.

KEY WORDS

Algeria; Biodiversity, Chironomidae; Diptera; Sciaridae; Chironomidae.

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INTRODUCTION

Diptera have an important and recognized ecological role. They participate in the pollination of small flowers, not appreciated by large insects. They protect small plants, which didn't find a taker and they therefore have an essential role for the ecosystem. They are also at the top of the food chain for terrestrial insects and as insect predators. Their characteristics sensitive to changes in habitat and environment can be used as a valuable biological indicator of environmental change or habitat disturbance (Samways, 1995).

The Diptera Linnaeus, 1758 is the largest order in the biosphere (Ashley et al., 2017). In the world there are 160,000 species (Pape et al., 2011) and approximately there are 160 families (Savage et al., 2019). This order is called real flies or wing

flies. It is a group of insects that contains flies, mosquitoes, horse fly, black flies, fruit flies, and house flies (Courtney et al., 2017). The order of the Diptera had been the subject of several studies both in the world and in Algeria. Among these, it is to quote those of Siti Khairiyah et al. (2013) in Malaysia, of Brown et al. (2018) in Costa Rica, and of Savage et al. (2019) in Canada. In Algeria, work on Diptera is undertaken by Dedet et al. (1984) in Constantine, Zerguine et al (2018) in the east of Algeria, Djelleb et al. (2013) in the North-West of Algeria, Bounouira (2016) and Belkharchouche et al. (2020) in Tiaret, and Baba Aissa et al. (2017) in the Sahara (Mestfaoui et al., 2020).

This study aims to determine the different species of Diptera in two cultivated orchards located in the west of Algeria, Tiaret and to compare their diversity and abundance in different regions.

MATERIAL AND METHODS

Study area

This present work was carried out in two stations located in the west of Algeria, Tiaret. The first orchard is located in Oued Lili (35°22'15" N - 1°19'01" E ; Fig. 1) which is located to the north-east of Tiaret. It has an area of 3 ha of cultivated *Olea europaea*, Sigoise variety. It is a very well maintained orchard.

The second orchard is located in Ain Guesma (35°15'1" N - 1°19'55" E; Fig. 1) south of the center of Tiaret. This plot is occupied by 5 ha of *Olea europaea* cultivated variety of Sigoise. It is almost abandoned and unmaintained orchard.

Sampling method

In order to count the Diptera, two methods were chosen, the method of Barber pots and the method of yellow plates. The principle of both methods is to fill 1/3 of each container (Barber jar and yellow plate) with water, adding a detergent to prevent trapped invertebrates from escaping. This 10 traps are placed in line for the Barber pots and for the yellow plates, separated by intervals of 5 meters. These samplings are carried out over a year from December 2018 to November 2019 at the rate of a monthly release, on the 15th of each month.

The traps remain in site the field for 24 hours. The trapped species are collected in eppendorfs filled with 70% alcohol, mentioning the trap number

and the date of trapping. Only the contents of 8 traps are taken into account.

The identification of the species was done at the zoological laboratory at the national school of veterinarian with Professor Marniche Faiza using available keys and original descriptions (Séguy, 1923, 1934; Hutson et al., 1980; Bechev & Koç, 2006; Babytskiy et al., 2019; Seunggwon et al., 2019).

Exploitation of results

The results obtained are used by the following diversity indices:

- The total richness (S) which is the total number of species found in each station (Blondel, 1975);
- The relative abundance (AR%) which is the percentage of individuals of a species *i* taken into consideration in relation to the total of individuals, all species combined (Dajoz, 1971; Bigot & Bodot, 1973);
- The Shannon-Weaver diversity index (H'), considered to be one of the best means of expressing the diversity of an assemblage (Blondel et al., 1973), it makes it possible to obtain information on the diversity different environments (Abarken, 2014) and which is obtained by the formula: $H' = -\sum q_i \log_2 q_i$ where H' is the diversity index expressed in bits and q_i the relative frequency of the species *i* considered. According to Prakash and Amita, 2012, if the range of H' is 1 to 2.4, it indicates that the site has low diversity, if the range is 2.5 to 3.5, it has diversity of moderate species, and if the range is 4.0 above indicate a high species diversity.

- The equity index (E) which is the ratio of observed diversity (H') to maximum diversity (H'_{max}) (Barbault, 1981; Ramade, 1984; Dajoz, 2000). The maximum diversity is given by the formula: $H'_{max} = \log_2 S$ where *S* is the total richness (Ramade, 1984). Equity varies between 0 and 1.

RESULTS AND DISCUSSION

The contribution to knowledge of the biodiversity of Diptera in the Tiaret region has enabled us to identify 1124 individuals, or 46 species belonging to 29 families. In the present work we collected 26 families in the Ain Guesma station and 23 families in the Oued Lili station (Table 1).

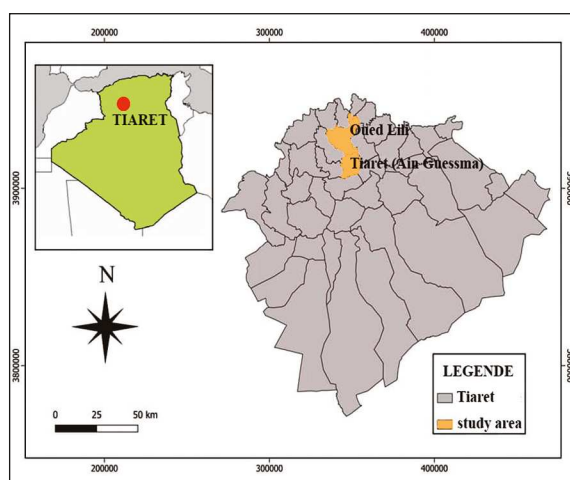


Figure 1. Geographical location and administrative division of Tiaret region in Algeria. Situation of the two sampling localities.

| Families | Station Ain Guesma | | Station Oued Lili | |
|-----------------|--------------------|------------|-------------------|------------|
| | Ni | AR(%) | Ni | AR(%) |
| Agromyzidae | 3 | 0.40 | 3 | 0.79 |
| Anthomyiidae | 14 | 1.87 | 10 | 2.65 |
| Biblionidae | 0 | - | 1 | 0.26 |
| Calliphoridae | 14 | 1.87 | 5 | 1.32 |
| Cecidomyiidae | 73 | 9.78 | 38 | 10.05 |
| Chironomidae | 25 | 3.35 | 70 | 18.52 |
| Ceratopogonidae | 10 | 1.34 | 7 | 1.85 |
| Dolichopodidae | 13 | 1.74 | 6 | 1.59 |
| Drosophilidae | 54 | 7.23 | 22 | 5.82 |
| Ephydriidae | 6 | 0.80 | 6 | 1.59 |
| Faniidae | 1 | 0.13 | 0 | 0 |
| Heleomyzidae | 3 | 0.40 | 0 | 0 |
| Hybotidae | 75 | 10.05 | 13 | 3.44 |
| Mycetophilidae | 39 | 5.22 | 26 | 6.88 |
| Muscidae | 0 | 0 | 1 | 0.26 |
| Opomyzidae | 2 | 0.26 | 3 | 0.79 |
| Phoridae | 33 | 4.42 | 49 | 12.96 |
| Piophilidae | 97 | 13.00 | 11 | 2.91 |
| Pipunculidae | 1 | 0.13 | 0 | 0 |
| Psychodidae | 2 | 0.26 | 14 | 3.70 |
| Psilidae | 1 | 0.13 | 0 | 0 |
| Scatopsidae | 25 | 3.35 | 32 | 8.47 |
| Sciaridae | 168 | 22.52 | 56 | 14.81 |
| Simuliidae | 0 | 0 | 1 | 0.26 |
| Sphaeroceridae | 3 | 0.40 | 1 | 0.26 |
| Syrphidae | 2 | 0.26 | 2 | 0.53 |
| Tabanidae | 1 | 0.13 | 0 | 0 |
| Tephritidae | 80 | 10.72 | 0 | 0 |
| Trichoceridae | 1 | 0.13 | 1 | 0.26 |
| Total | 746 | 100 | 378 | 100 |

Table 1. The relative abundance of Diptera families in the two stations. AR%: Relative abundance. Ni: Number of individuals.

The Sciaridae Billberg, 1820 is the most captured family at the Ain Guesma station (AR% = 22.52%). It is represented by the genera *Bradysia* Winnertz, 1867 and *Lycoriella* Frey, 1942. Sciaridae are known as black midges because of their dark color (Carvalho-Fernandes, 2016). The larvae of this family live in the soil, under the bark of trees, on the mycelium or in the bodies of fungi (Frank et al., 2003). They play a role in the decomposition of organic matter. Nevertheless, Sciaridae species are considered harmful to crops (Babytskiy et al., 2019). This family is less representative in Oued Lili, i.e. 14.81%.

The most representative family in the Oued Lili station is Chironomidae with a relative abundance of 18.52% (ni = 70 individuals) (Table 1). The presence of running water near this station justifies its high dominance. Unlike the Ain Guesma station where it is less representative (AR = 3.35%).

The genus collected from the two stations is *Chironomus* Meigen, 1800. Chironomidae are a very diverse group of aquatic insects, found in high density in different types of ecosystems. They are of great importance in the structure and function of lotic systems due to their great abundance, diversity and occurrence (Cranston, 1995). *Chironomus* larvae are found in polluted areas or flowing waters (Carlos et al., 2019).

Chironomids have attracted the attention of many scientists, interested in studying giant chromosomes in larval salivary glands, hemoglobin, morphological aberrations, usually related to specific stressors (e.g. thermal and chemical) (Armitage et al., 1995).

In Ain Guesma the Piophilidae Macquart, 1835 family comes second after the Sciaridae family with a rate of 13% (ni = 97) (Table 1) and weakly represented in Oued Lili. It includes the species *Piophilidae casei* (Linnaeus, 1758) which is important in forensic entomology because it is informative for the estimation of the postmortem interval (Smith, 1986). In Italy, *P. casei* larvae are often introduced into pecorino cheese to promote fermentation. They create a unique flavor in cheese (Nanzi et al., 2008).

The Tephritidae Newman, 1834 family is classified in third position in Ain Guesma, i.e. 10.72% (ni = 80). It is represented by two genera, the first is *Bactrocera* Macquart, 1835 and the second is *Ceratitis* Macleay, 1829. Tephritidae are known by the name of fruit fly (Marcoandre et al., 2016). Females of this family are characterized by a long

and expandable ovipositor that is used to lay eggs under the skin of fruits and vegetables where the larvae develop and feed (Delrio & Cocco, 2012). Most species of this family cause qualitative and quantitative damage to plants of economic interest (Foote, 1967). This family is not present in Oued Lili because the orchard is maintained unlike the orchard of Ain Guesma.

The family Cecidomyiidae is registered in the two stations with an approximate relative abundance of 10% each. It is represented by three subfamilies including Micromyiinae, Lestremiinae and Cecidomyiinae. According to Maia (2016), Micromyiinae and Lestremiinae are fungivores. Flies and other Diptera are plant pests; they cause direct damage and also economic losses (Gagné, 1994).

The family of Phoridae Latreille, 1796 is counted with a relative abundance of 12.96% in Oued Lili and 4.42% in Ain Guesma. In this family we have counted three genera including *Megasellia* Rondani, 1856, *Conicera* Meigen, 1830 and *Phora* Latreille, 1796. The Phoridae, also called scuttle flies, are one of the most biologically diverse families on Earth. In this family, the most representative genus is *Megasellia*. They are found in almost all terrestrial habitats except cold and dry places (Disney, 1994). This family includes decomposers, fungivores, phytophages, inquilines, predators and parasitoids (Savage et al., 2019).

The Hybotidae family is counted with a rate of 10.05% in Ain Guesma and 3.44% in Oued Lili. The representative genus of this family is *Platypalpus*. Species in this family are predators and others feed on nectar and pollen (Chvála, 1976).

From Table 2, we notice that the highest diversity index is recorded in Oued Lili with 3.65 Bits. For Ain Guesma station the diversity is 3.58 bits. According to Prakash & Amita (2012), if the range of H' is 4.0 above indicates a great diversity of species. The equity index of the species identified in this study is greater than or equal to 0.76. These values all tend towards 1. As a result, the two stations are diversified throughout our sampling ($0.76 \leq E < 0.81$).

CONCLUSIONS

The contribution of the study of the entomofauna of Diptera associated with the olive tree cultivated

| Stations of study | H' | Hmax | E |
|-------------------|------|------|------|
| Ain Guesma | 3.58 | 4.70 | 0.76 |
| Oued Lili | 3.65 | 4.52 | 0.81 |

Table 2. Shannon-Weaver diversity index and equity index to the two stations. H' : Shannon-Weaver diversity index. Hmax: Maximum diversity. E: equity index.

in a semi- arid region Tiaret (Algeria), took place for a year between December 2018 and November 2019 in two stations: Oued Lili and Ain Guesma. 1124 individuals were collected or 46 species belonging to 29 families. The Sciaridae family is the most representative in Ain Guesma station with a relative abundance AR% of 23%. While in the station of Oued lili the Chironomidae family is the most captured, at 18.52%. The two stations present a great diversity of species ($H' = 3.58$ Ain Guesma, $H' = 3.65$ in Oued Lili). The equity of the species identified in this study is greater than or equal to 0.76.

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