

## **Contribution to the study of the beneficial fauna of olive orchards in Porto Martins, Terceira Island, Azores**

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**Abstract:** The olive tree culture in Terceira Island occupies a strip in Porto Martins area whose fruit is very sought, mainly by tourists and restaurants. The olive tree is very affected by pests, such as the olive fly, which causes high losses and a drastic loss of production. Therefore, large quantities of pesticides are applied whose applications have a great impact, in particular, on beneficial organisms. In this work, the beneficial fauna present in olive groves was identified through the technique of beatings. The impact of the application of pesticides on these beneficial insects present in olive trees with different levels of treatments was also evaluated. For this, orchards with intensive applications, with less intensive applications and one organic orchard were selected to studied and monitoring. It was verified that in the olive groves with intensive and semi-intensive pesticide applications the abundance of beneficial insects was unbalanced, with a low abundance of predatory insects and still high population densities of the olive cottonweed pest. The results obtained point to the fact that chemical treatments do not destroy the target pests and worst contribute to a reduction in auxiliary organisms. In the organic orchard was observed the highest abundance of predatory insects and the lowest abundance of herbivorous insects. These results showed that this type of orchard is in a natural balance and that this is the way to follow in preserving the presence of beneficial insects in the olive parcels because these are very important to keep low pest populations and permit its better control. The conclusions of this study point to the fact that producers can further increase their yield by taking the biological option in their daily practices that will have a lower impact on the beneficial fauna present in the olive groves. At the same time will also permit to preserve the environment and the health of the applicators, producers and of the consumer by obtaining a product without any pesticide residues.

**Key words:** beneficial fauna, predators, pests, olive tree, Azores

### **Introduction**

The Porto Martins olive production area is situated in the southeast area of Terceira island, is characterized by its rural landscape, where one can observe vineyards in the traditional way and known for being the place where traditionally exists the culture of the olive tree. In its great majority, the olive cultivation is seen as an extra activity made by a very aged farmer's group. There are also many abandoned orchards. The Porto Martins table olive is much sought by

tourists and restaurants. Some producers still recover small parcels abandoned and implant new olive trees to renew and increase the number of trees on the old orchards and also proceed to the creation of new ones.

The olive tree is a culture that presents some key-pests with economic importance and that cause great production losses, decreasing the quality of the olives and increasing the production costs, namely due to the phytosanitary treatments. Among the pests that attack this culture, the most important pests are olive fly *Bactrocera oleae* (Gmelin) and also the olive moth, *Prays oleae* (Bernard). Other pests, such as scales, *Saissetia oleae* (Olivier), olive thrips, *Liothrips oleae* (Costa) and olive cottonworm, *Euphyllura olivina* (Costa), can also be harmful to the crop, but can be controlled and kept at levels that do not affect this crop due to the presence of beneficial fauna and implementation of cultural practices (pruning and correct fertilizations). There are other problems that affect the olive tree with minor importance such as *Capnodium elaeophilum* Prill. (common named as fumagina), *Pseudomonas savastanoi* (Erw. Smith) Stevens (Tuberculosis), *Cercospora cladosporioides* Sacc. (*Cercospora*), *Margaronia unionalis* Hübn. (Jasmine butterfly) and *Phloeotribus scarabaeoides* Bern. (Olive tree beetle) (Figueiredo, 2003; Horta Lopes et al., 2009; Meneses, 2012).

Figueiredo (2003) carried out the first survey of the beneficial fauna present on the Porto Martins olive groves. A total of 550 individuals belonging to the families Entomobryidae, Formicidae, Aphelinidae, Encyrtidae, Araneae and also to the class Arachnida were referenced (Figueiredo, 2003). A similar study was made by Bacala (2007) in mainland Portugal, in plots with the Cobrançosa and Picual varieties with the survey of entomofauna in olive trees at Alentejo level, where were identified insects belonging to the families Coccinellidae, Staphylinidae, Carabidae, Cantharidae, Anthocoridae, Miridae, Nabidae, Chrysopidae, Hemerobiidae, Coniopterygidae, Syrphidae, Tachinidae, Chamaemyiidae, Cecidomyiidae and also to the class Arachnida. In his study Bacala (2007) found that the Coccinellidae family was that had more individuals captured and the Cantharidae family the one with less captured.

The olive tree culture has a huge insecticide application and therefore a high cost of associated plant protection products, to the point that every fortnight the olive groves are subjected to treatments so that in the end the producers can obtain some production with healthy olives. These pesticides applied have a negative impact on the environment and beneficial fauna. The beneficial fauna reveals itself very important in the control of major pests, because some beyond the plagues there are natural predators of the olive fly, the olive moth and the mealybugs among others. When there is the application of non-selective insecticides, the ladybirds die causing the mealybugs to increase their populations and attack the olive trees, followed also by an increase in the incidence of fungi (*Capnodium elaeophilum* Prill.) presence.

In relation to the final destination of the olive production, in Terceira island all of it is preserved in salt water, to be consumed later as table olives. There is no olive oil production on the island.

The adaptation of this crop in Porto Martins is related to the particular edapho-climatic characteristics of that area, as it has a specific soil and microclimate, with mild temperatures throughout the year, with considerable rainfall and humidity and because it is not subject to fogs. The soils are essentially made up of materials of volcanic origin. The dominant exposure is to the East. The groves have a small number of olive trees per hectare and pruning and harvesting are manual, meaning that the type of agriculture is predominantly family-based.

## Materials and methods

The olive orchards were chosen according to the number of phytosanitary treatments during a crop cycle:

- 1 organic olive orchard – without treatments application;
- 3 semi-intensive regime olive orchards – less than 10 treatments;
- 3 intensive regime olive orchards – more than 10 treatments.

In each plot, 15 trees were selected in the month of April and May and in each were made 5 treatments.

The foliage and insects from each beat were collected in a bag. The arthropods were collected in jars in which 70 % alcohol was added. All samples were collected and in laboratory screening and identification was performed to separate each family and species of arthropods present in each olive orchard sampled.

Regarding species diversity the Hill series indices were used to measure it (Magurran, 2004; Lopes and Gelisch, 2020)

- Hill n° 1 – species richness (S);
- Hill n° 2 –  $\exp(H')$ , being  $H'$  the Shannon-Wiener index;
- and Ratio  $H'/S$

## Results and discussion

The field work lasted for 3 months and 525 samples were collected. In the studied olive orchards were collected and identified 1470 arthropods belonging to the orders Araneae, Coleoptera, Hemiptera, Hymenoptera, Psocoptera and Thysanoptera (Table 1).

In olive orchards with intensive regime the order that dominated was Hemiptera with 57 % (Figure 1) and in olive orchards with semi-intensive regime the distribution of insects was more balanced (Figure 2). The obtained data show that in orchards with intensive and semi-intensive regime a greater diversity of predators was lost.

In relation to the organic olive orchard, the order Psocoptera with 53 % was the one with the highest percentage followed by Hemiptera (25 %) (Figure 3). This organic orchard was where the highest abundance of predatory insects and the lowest abundance of herbivorous insects were observed, showing that this type of orchard is in natural balance.

Table 1. Distribution among order and families of the sampled arthropods in Porto Martins olive groves.

Order	Family	Species
Araneae	Araneidae	<i>Mangora acalypha</i> (Walckenaer, 1802)
	Linyphiidae	<i>Erigone autumnalis</i> Emerton, 1882
	Linyphiidae	<i>Erigone dentipalpis</i> (Wider, 1834)
	Clubionidae	<i>Porrhoclubiona decora</i> (Blackwall, 1859)
	Dictynidae	<i>Emblyna acoreensis</i> Wunderlich, 1992
	Dictynidae	<i>Nigma puella</i> (Simon, 1870)
	Salticidae	<i>Pseudeuophrys vafra</i> (Blackwall, 1867)
	Clubionidae	<i>Porrhoclubiona genevensis</i> (L. Koch, 1866)
	Linyphiidae	<i>Entelecara schmitzi</i> (Kulczynski, 1905)
	Salticidae	<i>Macaroeris diligens</i> (Blackwall, 1867)
Coleoptera	Staphylinidae	<i>Atheta fungi</i> (Gravenhorst, 1806)
	Staphylinidae	<i>Tachyporus chrysomelinus</i> (Linnaeus, 1758)
	Phalacridae	<i>Stilbus testaceus</i> (Panzer, 1797)
	Scraptiidae	<i>Anaspis proteus</i> (Wollaston, 1854)
	Nitidulidae	<i>Brassicogethes aeneus</i> (Fabricius, 1775)
	Curculionidae	<i>Mecinus pascuorum</i> (Gyllenhal, 1813)
	Curculionidae	<i>Otiorhynchus cribricollis</i> (Gyllenhal, 1834)
	Brentidae	<i>Kalcapion semivittatum semivittatum</i> (Gyllenhal, 1833)
	Cetoniidae	<i>Oxythyrea funesta</i> (Poda, 1761)
	Cryptophagidae	Gen. sp. Proj. Teresa
Hemiptera	Cixiidae	<i>Cixius azoterceirae</i> (Remane & Asche, 1979)
	Lygaeidae	<i>Kleidocerys ericae</i> (Horváth, 1908)
	Psyllidae	<i>Euphyllura olivina</i> (Costa, 1839)
	Cicadellidae	Gen. sp. 4
	Cicadellidae	Gen. sp.
	Anthocoridae	Gen. sp. 2.
Hymenoptera	Formicidae	<i>Lasius grandis</i> (Forel, 1909)
Psocoptera	Ectopsocidae	<i>Ectopsocus briggsi</i> (McLachlan, 1899)
	Trogiidae	<i>Cerobasis</i> cf sp. 1
	Caeciliusidae	<i>Valenzuela flavidus</i> (Stephens, 1836)
	Psocidae	<i>Atlantopsocus adustus</i> (Hagen, 1865)
	Trichopsocidae	<i>Trichopsocus clarus</i> (Banks, 1908)
Thysanoptera	Aeolothripidae	<i>Aeolothrips gloriosus</i> (Bagnall, 1914).

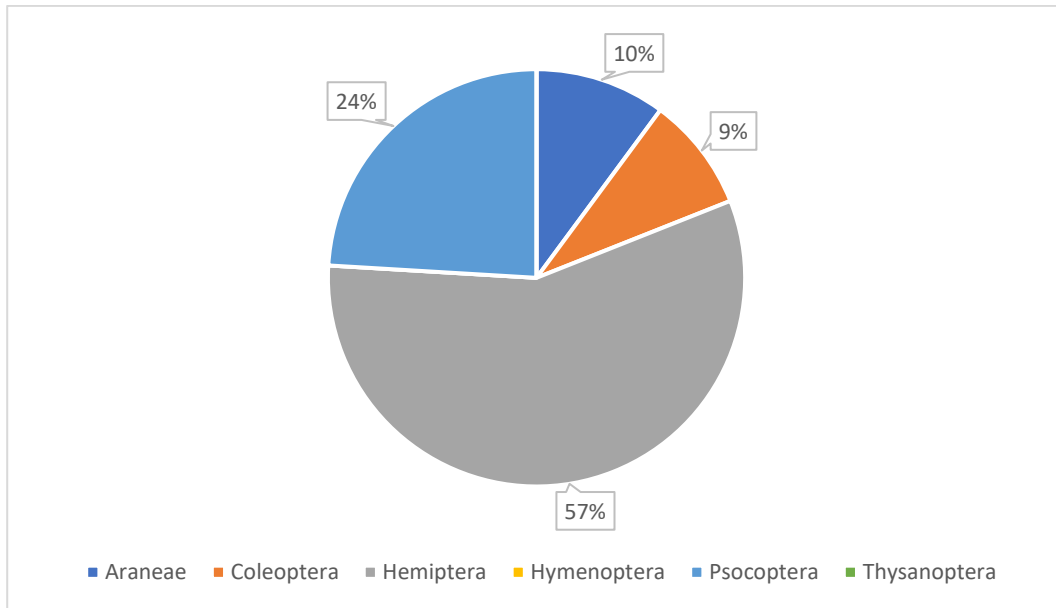


Figure 1. Distribution of insect orders captured in the orchards with intensive phytosanitary treatments.

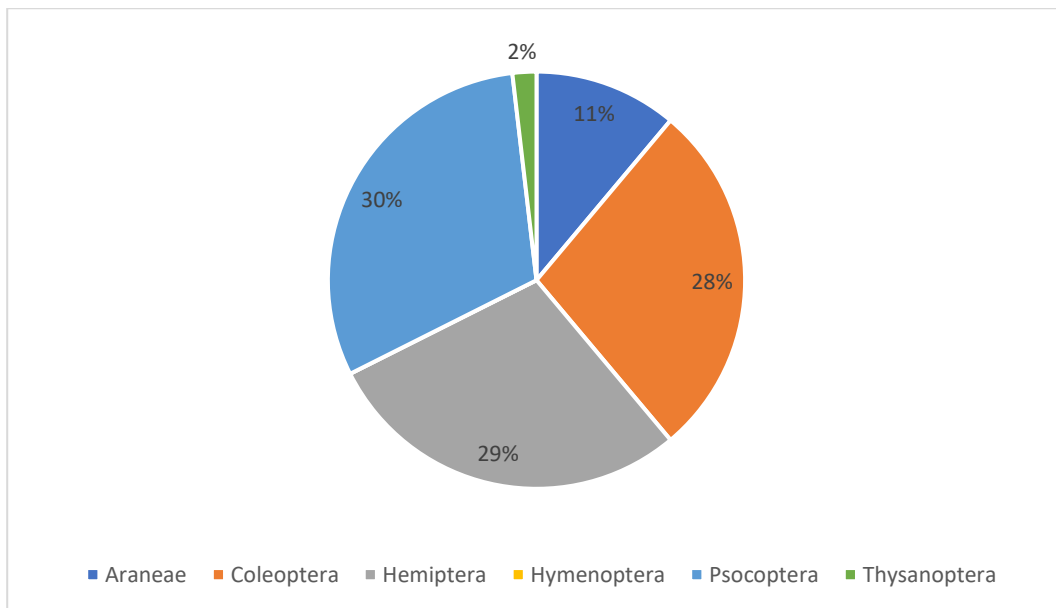


Figure 2. Distribution of insect orders captured in the orchards with less intensive phytosanitary treatments.

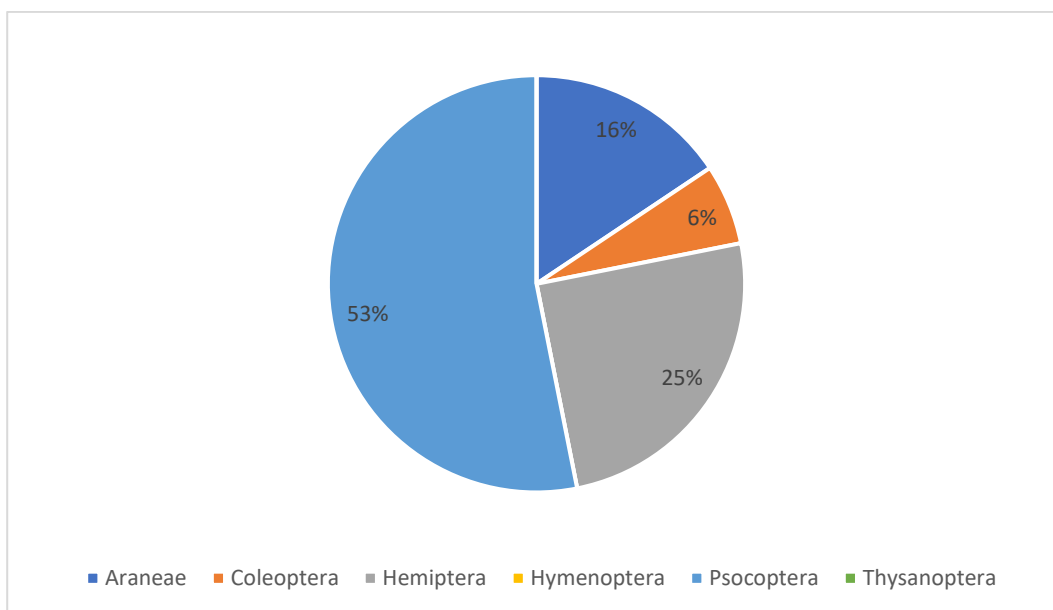


Figure 3. Distribution of insect orders captured in the organic orchard.

Regarding the Hill indices obtained for the predators and herbivores present in the sampled olive groves in the case of predatory insects, as shown in Tables 2 and 3. The plots with lower intensity of phytosanitary treatments and the organic orchard had a higher average abundance of species compared to the orchard with much intensity and frequency of chemical treatments.

Through the H'/S ratio results shown in Table 2 for predatory insects it was found that in the intensive and less intensive orchards where greater diversity of predator species was lost, 73 % and 82 % and in the organic orchard where there is greater diversity of predators (49 %).

Table 2. Hill index calculated for predatory insects present in Porto Martins olive groves.

<b>Predatory insects</b>			
	Intensive	Less intensive	Organic
Hill 1 (S)	8	10	6
S Mean	4.3	5.7	6
Hill 2 (exp H')	2.14	1.81	2.96
Ratio (H'/S)	0.27	0.18	0.49

Regarding the herbivorous insects present in the olive groves (Table 3), the organic orchard is where there is less abundance, with only three species, which would be expected as there are fewer insects harming the trees. It is also in this orchard where the least diversity of species is lost, 57 %, while in the intensive and less intensive orchards some diversity is lost, 79 % and 77 %, respectively.

Table 3. Hill index calculated for herbivorous insects present in Porto Martins olive groves.

<b>Herbivorous insects</b>			
	Intensive	Less intensive	Organic
Hill 1 (S)	5	7	3
S Mean	2.7	4.7	3
Hill 2 (exp H')	1.07	1.62	1.3
Ratio (H'/S)	0.21	0.23	0.43

## Conclusions

Plant protection products are of great importance in this olive groves ecosystems and can therefore be very harmful to auxiliary organisms. Chemical treatments did not destroy the target pests but contributed to a reduction in beneficial organisms.

From the results obtained we can affirm that there is always a great loss of diversity in the orchards that are treated in relation to that which does not have chemical applications. In the orchards where there are applications of phytopharmaceutical products, whether in an intensive or semi-intensive regime, there is an imbalance of the species present and there is a great presence of olive cotton (*E. olivina*).

In the organic orchard there is olive cotton, but it is controlled, probably by the presence of insects which naturally combat this pest. It was also noted that in the organic orchard there is a greater diversity of predators and a lower abundance of herbivorous insects, which is to be expected, because naturally the orchard controls the pests without the use of chemicals that make the environment unbalanced in terms of fauna.

In fact, producers are trying to combat pests with plant protection products and yet they are still present in large numbers in these same orchards. So producers will be able to increase the yield extracted from the crop mainly by taking the biological option in exploring their olive groves.

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