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THE FIRST STUDY ON ESPARTO GRASS NEMATODES IN THE ALGERIAN STEPPES (M'SILA - ALGERIA)

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Abstract

A survey on nematodes of Esparto grass (Stipa tenacissima L.) was carried out in three stations located in the nature reserve of Mergueb (Ain el Hadjel - M'Sila).Our study aims to evaluate the diversity and trophic structure of nematodes associated with this grass plant distributed in the Algerian steppes, case of Mergueb natural reserve.In each station, we took a mixed sample composed of sub-samples of 200g to 300g of soil, at a depth of up to 30 cm from the ground, with one sample every 10m on a diagonal projection.

The results revealed the presence of 13 species divided according to their diets into four trophic groups: phytophagous, fungivorous, bacteriovorous and predatory-omnivorous, whose densities of the latter vary according to the study stations where the phytophagous nematodes are more abundant (960 N/dm^3) in the first station. The nematofauna is more abundant in station 1 (2640 N/dm^3) followed by stations 2 and 3 with densities of 1100 N/dm^3 and 400 N/dm^3, respectively.

This study illustrates the effect of plant cover on the abundance and trophic structure of nematodes. The first station, covered by Alfa and some grasses, has the highest nematode densities, mainly plant parasites.

Key words: Esparto grass, trophic groups, inventory, steppes, nematodes

INTRODUCTION

Throughout the world, researchers give great importance to the protection and balance of natural environments. They follow the relationships and interactions between species and between species and their environment.

Among the works that have been done on these protected natural areas are those of Sinclair and Arcese, 1995, in the Serengeti National Park in Tanzania and of Turner et al., 1997, Schwartz et al., 2006, in the Yellowstone National Park in the United States. The fauna of the Camargue National Park in France is studied by Lobo et al., 2001.

For the work done in the Doñana National Park in Spain, it is worth noting that of Mateo et al., 2000. Among the natural environments in Algeria "the natural reserve of Mergueb (Ain Elhdjel- M'sila)" presenting a landscape of the Steppe with Alfa, a typically Mediterranean grass, which is found as well in the flattened crests of the hills as in their slopes and in the summit part of the ravines.

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Other steppe landscapes composed of medicinal plants and forest species have been the subject of our previous nematological studies. Many works on the fauna of the Mergueb Nature Reserve have been carried out. For the Invertebrates, it is worth noting the work on insects in general by Doumandjiet al., 1993, Sekouret al., 2010 and Chebouti-Meziou, 2000, worked on Orthoptera. At the same time, for vertebrates and more precisely for the class of reptiles, the work of Kacimi, 1994, should be noted.

The studies concerning birds are carried out by Sellami and Belkacemi, 1989; Dahmani, 1990; Sellamiet al., 1992; Doumandji and Doumandji-Mitiche,1994; Yahiaoui, 1998; Biche et al., 2001; Sekouret al., 2002, 2003, 2005; Baziz, 2002; Marniche, 2011; Omri, 2012. As for Sellami et al., 1989 b; Dahmani, 1990; Doumandjiet al., 1993; Kacimi, 1994; Sellami, 1999, they were interested in mammals. For what the soil nematodes let us quote the only work in 2016 of Berrabah et al., 2016.

This study comes to complete, the works already made on the fauna of the natural reserve of Mergueb. It is a nematological analysis in three stations of esparto grass in the nature reserve of Mergueb. The main problem is to better understand the existing relationships between the different trophic groups of nematodes, as well as the diversity of nematodes associated with this grass plant distributed in this nature reserve.

MATERIAL AND METHOD

1. Description of the study site

The nature reserve of Mergueb covers an area of 16,481 ha 43 ares. It is located at a distance of 180 km south of Algiers, 55 km north of Boussaâda and 10 km south of Ain El-Hadjel (Fig. 1), (35°40'N and 03°55'W).

It belongs to the set of high steppe plains, vast territory "aselvatic" which extends between the Tellian Atlas in the north and the Saharan Atlas in the south. Constituting the eastern end of the Algerian-Oranian steppes, the reserve is part of the Hodhna plain.

This site represents a unique steppe ecosystem of its kind, it contains biotopes that none exist in the Maghreb, which gives it an international dimension (Kaabeche, 2003).

This reserve is bounded to the north by the RN 40 along the OuedLaham, which flows into the depression of Chott El Hodhna. To the east by various depressions, including the dayas Nahéa and Rokbet-Senouk, and the area of spreading water Oued El-Guersa. To the south by the limit of the municipality of Benzouh, by the dayas El Guersa, Tahtania and Chouaf El Guersa and west by Koudiet El Beida of Ain El-Hadjel (Boudjadja, 1999; Moreau et al., 2005).

Rainfall is mainly in winter and spring, where the average annual rainfall is 155,4 mm.

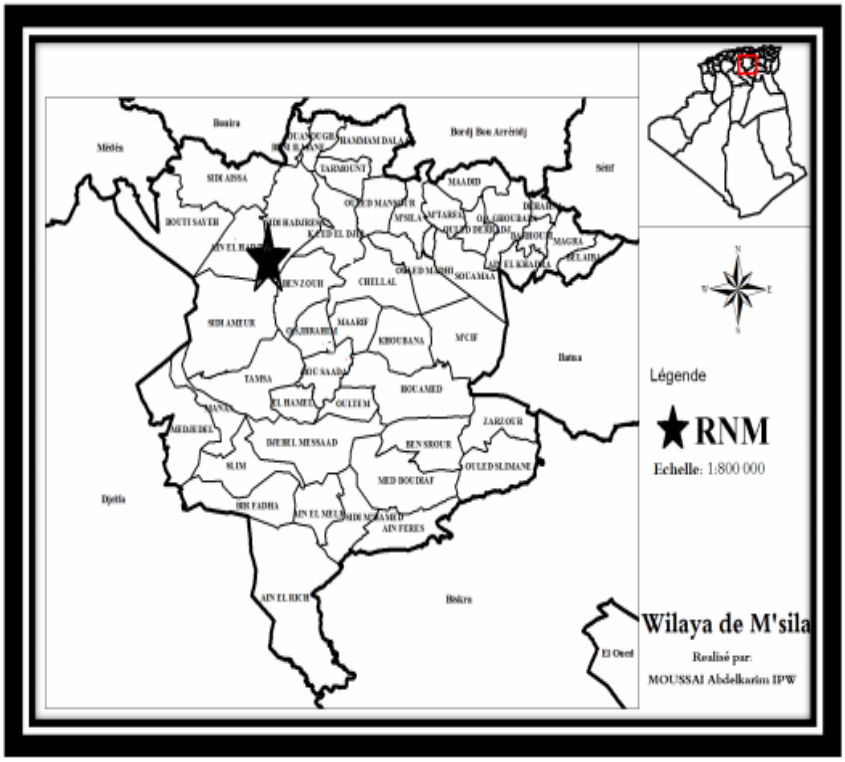

Fig. 1. Geographical location of the Mergueb nature reserve

2. Methodology

To carry out this faunistic study, we took a mixed sample composed of sub-samples of a weight of 200 g to 300 g of soil at a rate of one sample every 10 m on a diagonal projection of each plot (crop unit) (Fig. 2). The soil samples were taken from the rhizosphere of the plants at a depth of up to 30 cm from the soil. In each plot, these incremental samples are collected in a single reference bag (date, location and plant cover).

Nematodes are extracted from the soil by the bucket extraction method of Dalmasso, 1966, known as the flotation and sedimentation methods (Fig. 3), and then identified and counted under binocular loupe using the identification keys of Mai and Lyon, 1975, Yeates et al., 1993, Brzeski, 1998. Soil nematode populations are expressed as number of nematodes per dm^3 (N/dm^3) (Wang et al., 2002).

3. Data analysis

The data collected on the Alfa nematode populations in the Mergueb nature reserve (Ain Elhadjel - M'Sila) are subject to statistical analysis:

First, the results are presented in the form of histograms, most often joining average values with standard deviations, the latter were carried out by the Excel software.

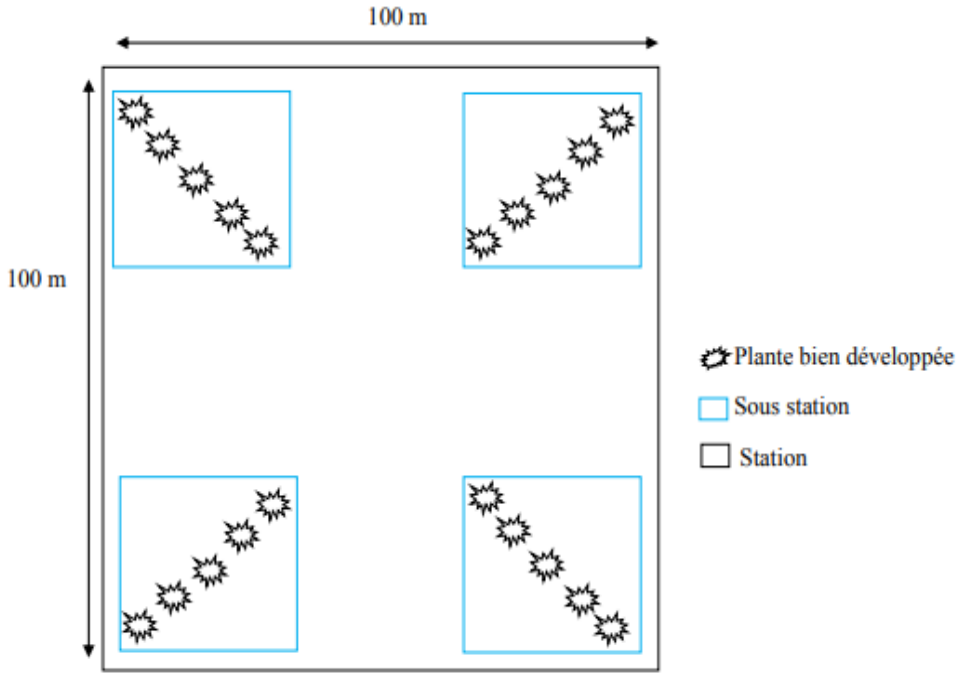

Fig. 2. Schematic of the selected soil nematode sampling device

Fig. 3. The main steps of the method used to extract nematodes from soil:
(a) suspension of nematodes; (b) passing the suspension through the 0.05 mm sieve;
(c) recovery of the sieve contents in the crystallizer.

When the problem is to know if the average of a quantitative variable varies significantly over time or according to the conditions (regions, pests, grape variety, etc....), it is recommended to carry out an analysis of variance by the software "SYSTAT vers. 12, SPSS 2009 and Excel TM". In cases where several factors are involved, it may happen that not all interactions between factors are relevant to be tested. We then used the global linear model (G.L.M).

RESULTS AND DISCUSSION

1. Inventory of soil nematodes found in the Mergueb reserve

The nematological analysis revealed a total richness of 13 species of nematodes whose densities vary according to the study stations. They are divided according to their diet into four trophic groups (Yeates et al., 1993):

- Fungivorous nematodes (FF): *Aphelenchus sp.*, *Tylenchus sp*. and *Ditylenchus sp.*
- Bacteriovorous nematodes *(*BF*)*: *Rhabditis sp.*, *Cephalobus sp.* and *Chiloplachus*
- Plant- Parasite nematodes (PP): *Paratylenchus sp.*, *Tylenchorhynchus sp.*, *Xiphinema sp.*, *Pratylenchus sp.* and *Nothotylenchus sp.*
- Omnivorous predatory nematodes (OP): *Dorylaimus sp.* And *Discolaimus sp.*

Our results on the inventory of nematodes identified in this reserve are in line with the work done by several authors on grasses in different countries of the world, in particular those of Tikyani and Khera, 1969, in India, who demonstrated the presence of *Nothotylenchus sp*. in the rhizosphere of *Sorghum vulgare* (Sorghum bicolor), as well as, the work of Kimpinski and al.,1992, for *Pratylenchus penetrans* and *Tylenchorhynchus sp*. in Prince Edward Island (Canada).

2. Spatial distribution of nematode trophic groups at the study stations

The spatial distribution of the different nematode trophic groups at the three stations is shown in Figure 4.

The distribution of average abundances (N/dm^3) of the trophic groups in the reserve varies with the existing vegetation as follows:

- Three stations covered by esparto grass and some grasses *(Stipa tenacissima L., Avena fatua L. , Hordeum murinum L., Bromus madritensis L., Lygeum spartum, Arastida pungens L.)*, we observe high densities of plant-feeding nematodes with 960 (N/dm^3), followed by the group of bacteriovores with 700 (N/dm^3) and fungivores with 540 (N/dm^3) while the group of omnivores is the least represented with 440 (N/dm^3).

- Three stations covered by dense esparto grass vegetation *(Stipa tenacissima* L.*)*, the group density of bacteriovores and omnivores are almost similar with 380 (N/dm^3) and 360 (N/dm^3) respectively followed by the group of fungivores with 200 (N/dm^3) and phytophages with 160 (N/dm^3).

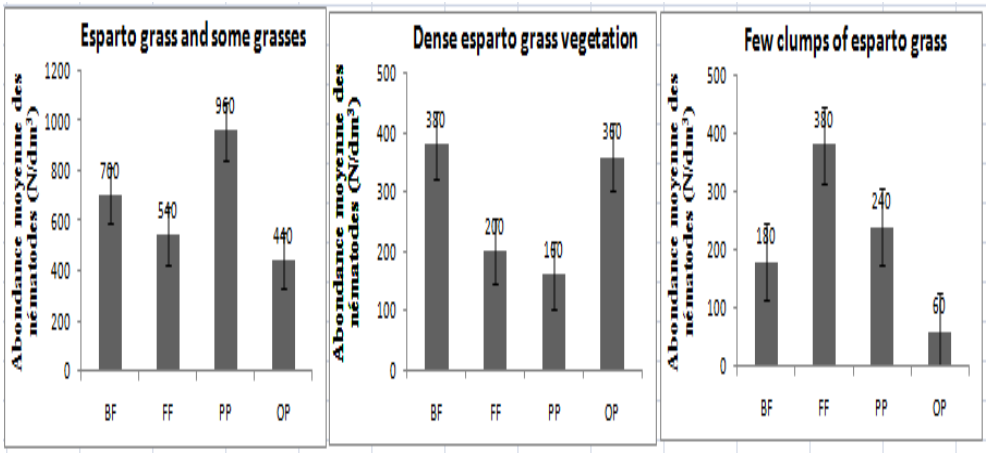

Fig. 4. Spatial variation in mean abundances (N/dm^3) of different trophic groups in the Mergueb Nature Reserve

- Three station covered by a few clumps of esparto grass *(Stipa tenacissima* L.*)*, the highest densities were observed respectively for the group of fungivores with 380 (N/dm^3) and phytophagous with 240 (N/dm^3) followed by the group of bacteriovores with 180 (N/dm^3) while the group of omnivores had the lowest density with 60 (N/dm^3).

According to Norton and Niblack, 1991, the variability of nematode abundances is related to differences in their life cycles, the quality and availability of food resources, biotic relationships with soil microorganisms, and physico-chemical factors of the environment. Similarly, Hânel, 1995, states that changes in the trophic structure of nematode populations are related to changes in their food resources.

3. Spatial distribution of overall mean abundances (N/dm^3) of trophic groups through analysis of variance

The global linear model (GLM) applied to the spatial distribution of mean trophic group abundances shows significant differences between stations; the probability is ($p=0.029$; $p<0.05$).

Station 1 hosts the highest nematode densities (2640 N/dm^3) followed by station 2 (1100 N/dm^3) and station 3 (400 N/dm^3).

However, differences are non-significant between trophic group and nematode densities ($p=0.791$ and $p=0.075$ respectively; $P> 0.05$) (Fig. 5).

These results confirms the work of Villenave et al., 2001, who showed that the simple act of clearing the soil of weeds reduces the number of roots on which plant-parasitic nematodes can feed.

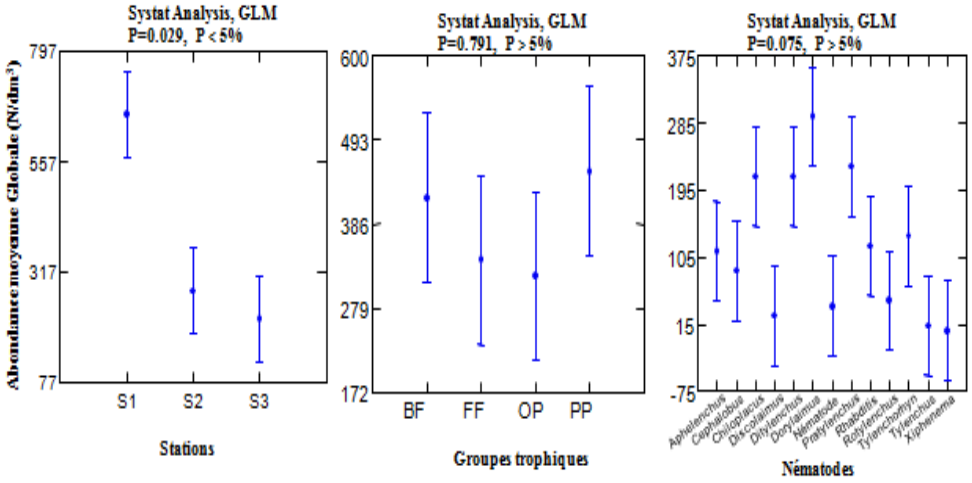

Fig. 5. Spatial variation in overall mean abundances of trophic groups at surveyed stations. S1: Station 1; S2: Station 2; S3: Station 3

CONCLUSIONS

The study on nematodes present in the Mergueb reserve revealed thirteen genera of nematode whose densities vary according to the vegetation cover (*Stipa tenacissima L.* and other grasses). They are represented by *Rhabditis sp., Cephalobus sp., Chiloplacus sp., Aphelenchus sp., Ditylenchus sp., Tylenchus sp., Tylenchorhynchus sp., Pratylenchus sp., Paratylenchus sp., Nothotylenchus sp., Xiphinema sp, Discolaimus sp.* and *Dorylaimus sp.*

The identified taxa are divided according to their diet into four trophic groups (fungivore, bacteriovore, phytophagous and omnivorous predator).

The distribution of abundances of trophic groups varies within the reserve depending on the stations surveyed. The analysis of the results by the General Linear Model (G.L.M.) reveals a significant difference between the study stations, the first of which has the highest density of nematodes compared to the other two stations that have almost similar nematode densities. The vegetation in the first station is more varied in esparto grass and other grasses than the other two stations.

These results allowed us to observe that the stand of soil nematodes affects much more the growth of esparto in the stations where the nematological stand little diversified, of which some plant-parasitic genera

are strongly colonizing in the absence of competition, very aggressive and cause the disruption of rhizogenesis and mineral and water absorption.

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