Journal of Agricultural Research Advances
ISSN: 2582-7227

Research Article
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Contribution to the study of the sugar beet cyst nematode in the Moulouya Perimeter

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Received on: 13/07/2021 Accepted on: 30/09/2021 Published on: 02/10/2021

ABSTRACT

Aim: The study was aimed to evaluate the infestation status of sugar beet by cyst nematode in the Moulouya**.**
Materials and Methods: Thirty-one samples were collected from the study area by adopting a random sampling pattern. The collected samples were labeled and brought back to the laboratory for extraction, the latter being performed by the technique of Fenwick (1940), modified by Oostenbrink (1960).
Results: Analyses of 31 soil samples revealed the presence of the cyst nematode *Heterodera schachtii* in 71% of the plots surveyed, with densities ranging from 3 to 300 cysts/300g of soil. The analysis of the different samples collected as well as the survey carried out among the beet growers in the perimeter allowed us to observe that the type of crop succession remains the main factor that acts most on the distribution of this species and on the level of infestation, followed by the type of soil that plays a significant role. The highest levels of infestation were observed in plots where sugar beet returned to the same plot 3 or 2 years in a row with 251 cysts/300g and 113 cysts/300g of soil respectively.
Conclusion: Nematological analyses showed that 66% of infested plots are characterized by a silty-clay texture. The highest infestation levels were observed in plots where sugar beet returns 3 years out of 3 years (251cysts/ 300g soil) and 2 years out of 3 years (113 cysts/ 300g of soil) and the region of Garet in Nador is the most infested by the beet cyst nematode.

Keywords: Sugar beet, cyst nematode, *Heterodera schachtii*, Moulouya perimeter.

How to cite this article: Otouya S, Khadija C, Ibtissam M, Maria R and Zoheir C (2021). Contribution to the study of the sugar beet cyst nematode in the Moulouya Perimeter. J. Agri. Res. Adv., 03(03): 36-40.

Introduction

Sugar beet occupies a very important place in the Moroccan economy. The area sown to crop is about 64,500 ha with a production of 3.2 million tons (SAM, 2015). The eastern region represents 11% of the area (5,899 ha) cultivated and 9% of the production (68,871 T) (ORMVAM, 2015). The Oriental region and specifically the Moulouya perimeter has great potential for sugar production due to climatic and edaphic conditions, however the conditions can become conducive to spread of diseases and the outbreak of many pests such as nematodes (De Guiran, 1983). These pests cause considerable damage and yield reductions of up to 45% (Sasser, 1978).

The damage depends on the density of outbreaks in the soil, which varies according to climatic and edaphic conditions and cultural practices (Scotto, 1986). *Heterodera schachtii* is the main nematode of sugar beet. Its presence is manifested by a fatigue of the land where the yields drop every year. The symptoms caused by this species are manifested by stunted plants with a root hair where the tiny white spheres of the females can be seen. In Morocco, the nematode *Heterodera schachtii* was first detected in the irrigated area of Moulouya in 1978 (El Bekkay, 1994). Recently, other perimeters have been found to be infested by this nematode, notably Tadla (Hakim, 1989) and Doukkala (Bouderham, 1988), this species causes quantitative and qualitative losses. According to ITB (2008), the yield loss can reach 30% of the regional average. IRBAB (2005), estimates that the presence of each larva in 100 g of soil can cause the loss of 3 kg of sugar per hectare.

Given their agro-economic importance, the present study was focused on the degree of infestation of this parasite in the Moulouya perimeter.

Materials and Methods

Study area

The study was carried out in the Moulouya area in northeastern Morocco. In order to cover the whole area, the zonal division of the ORMVAM was adopted. The study consists of nematological surveys on plots occupied by sugar beet.

Sampling method

The sampling adopted in this study followed the zonal division established by the ORMVAM in order to cover the whole area and to have a better representativeness. The number of samples was chosen according to the area and the number of farms in each locality. To do this, the farms and plots were chosen at random, and the samples were taken randomly in all directions of the plot. Soil samples were taken around the rhizosphere of the plants at a depth of between 10 and 30 cm from the soil using a trowel. Each sample, about 3kg of soil, was composed of a series of soil samples according to the area of the plot (Fig 1).

Extraction of cysts

To extract the cysts, it was used technique of Fenwick (1940), modified by Oos-tenbrink (1960). This technique was essentially based on the principle of cyst flotation (based on the density of the cysts relative to that of the water). Dry cysts, whatever their content, have a density lower than 1. Thus, full and wet cysts sediment very quickly while dry cysts float on the surface of the water, which allows easy recovery. Sample analysis was equipment based on the principle of the Fenwick apparatus. In the apparatus, a 300g sample of air-dried soil was placed on 1 mm mesh sieve, dried soil was drawn into the body of the apparatus by a jet of water, the cysts and other floating materials were drawn into the collection gutter, under which was placed a 250 µm sieve, the water supply was maintained until the sample was exhausted. The rejects from the sieve were collected on filter paper, dried and the cysts were observed and counted under a binocular magnifying glass using a very fine brush.

Data processing

Data were analyzed using SPSS statistical software to determine the degree of infestation of the cyst nematode *Heterodera schachtii* in region.

Fig 1. Steps for the extraction of cysts from the soil

Results and Discussion

Heterodera schachtii was first detected (Fig 2) in the Moulouya perimeter in 1978 (El Bekkay, 1994), and then spread to other perimeters, notably Tadla (Hakim, 1989), Gharb (Cherquaoui and Mahtaj, 1992) and Doukkala (Bouderham, 1989).

Importance of the cyst nematode

The results of the nematological analyses showed that 71% of the plots surveyed were infested by the cyst nematode *Heterodera schachtii*, with densities ranging from 3 to 300 cysts/ 300g of soil. Assuming that the threshold of harmfulness was fixed at 10 L2/g of soil (Mugniery, 1975), this threshold was exceeded by the degrees of infestation obtained in the majority of the infested plots. The damage was presented in patches with less developed vegetation and stunted roots with very abundant root hairs (Fig 3).

Fig 2. cyst and juvenile 2 of nematode *Heterodera schachtii*

Fig 3. Damage caused by sugar beet cyst nematode

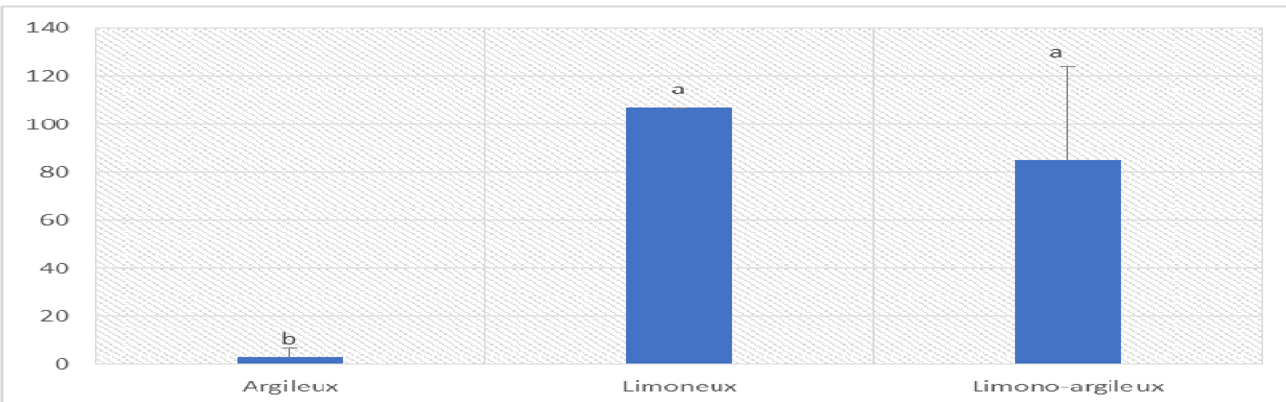

Fig 4: Average cysts/300g of soil-by-soil type

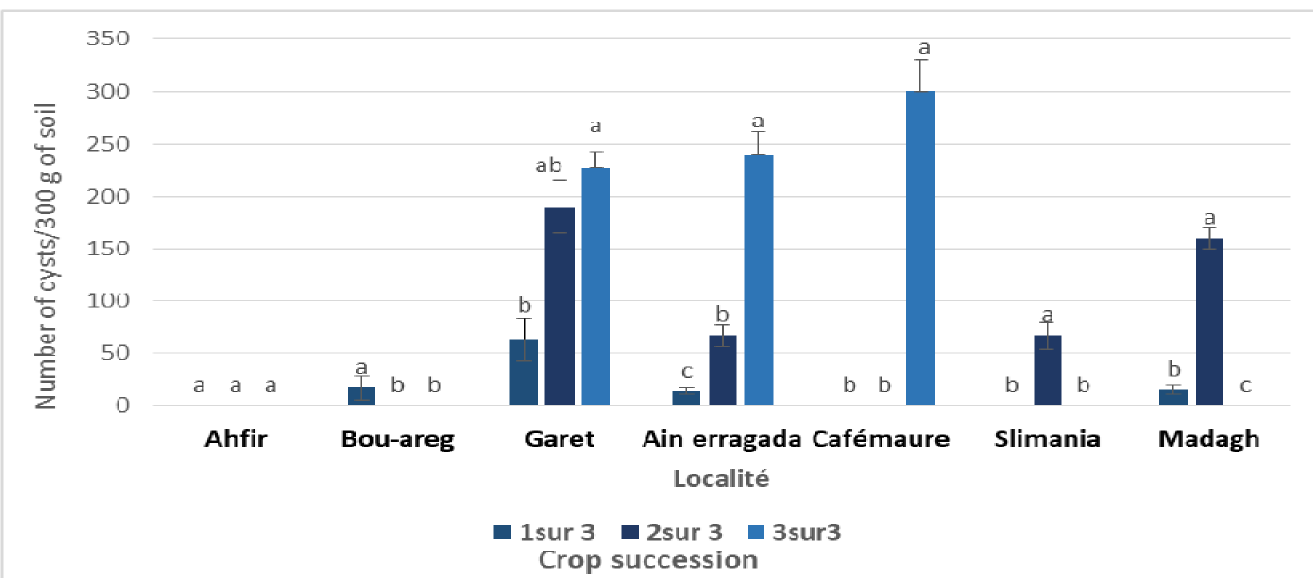

Fig 5: Average cyst density/300g soil by crop succession

The plain of Bouareg recorded the highest attacks (100%), followed by the plain of Garet (85%) then the plain of Triffa (64%). The high infestations were observed in Triffa followed by Garet and Bouareg with respectively 300, 116 and 14 cysts /300g of soil. The infestation rate was variable from one area to another, this difference may be due to several factors: crop succession, soil type etc.

Infestations were severe in loamy soils with a maximum density of 107 cysts per 300g of soil. These results were consistent with the analysis of variance (ANOVA I) which showed no significant difference in the infestation rate in loamy and silty-clay soils (p>5%). However, heavy-textured clay soils were the least infested with a maximum density of 3 cysts per 300 g of soil (Fig 4). These results were consistent with those obtained by El Bekkay (1994), El Allam (2000) and Belkacem (2002) who concluded that high infestations were recorded in fine-textured plots (silty, silty-clay and clay soils), with a maximum density of 300 cysts/300g soil.

The number of cysts on beet roots varies according to localities and crop succession. The localities of Garet, Reggada and Laatamna were the most infested with sugar beet cyst nematode, while Ahfir and Bouareg were the least affected. Crop succession was considered among the major factors affecting cyst nematode development. In our study, the infestation rate was highly significant (p=0) according to the type of succession (Fig 5). High infestations were recorded in plots where beets returned 2 out of 3 years (113 cysts per 300 g soil) and 3 out of 3 years (251 cysts per 300 g soil). These results are similar to those found by El Bekkay (1994) El Allam (2000).

Surveys conducted among farmers revealed the presence of 4 main crop precedents: cereals which occupy the first place (60%) followed by market gardening (26%), sugar beet (10%) and legumes (4%).

The presence of weeds, especially species belonging to the Brassicaceae, Polygonaceae and Chenopodiaceae, can harbor and conserve cyst nematode inoculum in the absence of the host crop. High density (300 cysts/300 g soil) of this nematode was recorded in a plot where weeds dominate the beet.

Conclusion

This study carried out in the Moulouya perimeter allowed to update the knowledge on the state of infestation of sugar beet plots by the cyst nematode *Heterodera schachtii* and to identify the factors favoring their development. The nematological analyses show that 2/3 of the sugar beet plots in the perimeter are attacked by the cyst nematode *Heterodera schachtii*. The survey of sugar beet growers in the perimeter revealed that the type of crop succession remains the main factor influencing the distribution of nematodes and their degree of infestation. Concerning the type of soil, this nematode was present in silty, silty-clay soils.

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