STUDY OF NEMATODES ASSOCIATED WITH THE VEGETABLE CROPS IN SOME LOCALITIES IN TIARET (WEST OF ALGERIA)

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Abstract

The present study aims to examine the nematode population at some stations of vegetable crops of the province of Tiaret. The results of the study showed various species of nematodes associated with vegetable crops in the Algerian steppe especially the province of Tiaret and Djelfa. We counted eleven genres of phytophagous nematodes represented by Aphelenchus, Aphelenchoides, Ditylenchus, Tylenchus, Psilenchus, Pratylenchus, Tylenchorhynchus, Paratylenchus, Cephalobus, Dorylaimus, Rabtidis and Helicotylenchus. The densities of these nematodes vary by location and method of sampling and the nature of the soil. The Cephalobus, Dorylaimus, Ditylenchus and Aphelenchus are the most common and abundant in the three stations of study. These taxa seem to adapt to different types of vegetable soils. Their existence may be subject to significant damage to installed cultures. Furthermore the use of ecological indicators of structure (Frequency and Abundance) class nematodes in 04 groups:

- Nematodes abundant and frequent, dangerous for the vegetable crops.
- low abundance and frequent Nematodes, less harmful and adapts to different soil types
- abundant and infrequent nematodes, their presence in some soils, can be dangerous for the vegetable crops.
- Nematodes low abundance and infrequent occasionally meet their densities are low and have little or no damaging. Vegetable crops appear not to be their special host.

Key words: nematodes phytopages, not phyatophages nematodes, vegetable crops, Tiaret, Algeria.

INTRODUCTION

Vegetable crops under greenhouses appear as one of the most promising sectors of the Algerian agriculture. The areas occupied by these crops in Algeria are constantly evolving, they increased from 345,558 ha in 2004 to 363,030 ha in 2005 for field crops for the greenhouse crops have increased from 0.02 ha in 1970 to 5500 ha 1990 (Benhamou, 1990), to 6862.87 ha in 2004 (Agricultural statistics, 2004) and 6736.67 ha in 2005 (Agricultural statistics, 2005). Vegetable crops are in second place after cereals in the daily consumption of Algerians (El-Kebiri, 1993).

In the Algerian steppe areas reserved to vegetable crops seem to be of considerable local importance. The District of Tiaret and that of Djelfa have large potential for vegetable production in large quantities due to climatic and soil conditions are very favorable in particular represented by abundant sunshine throughout the year and the diversity of conditions such environments spread to satisfy not only domestic needs but also the food industry (Agricultural statistics, 2007). Apart from the best climatic conditions offered shelter greenhouses developments cultures, they also create an environment conducive to the spread of disease and pullulation many pests such as nematodes, the most abundant organisms in the world and almost common in soils (De Guiran, 1983). These nematodes cause considerable damage and decreases in yields on many crops. The damage depends on the density pullulations in the soil it varies depending on climate, soil conditions, cultural practices (Scotto La Massese, 1986).

This work aims to study the diversity of the communities of phytophagous nematodes of
vegetable crops in two regions of the steppe in western Algeria or market garden begins to take certain importance in recent years "case of onion plantations in the Rechaigua region "); since awareness phytophagous nematodes leads to better understand the risks associated with their introductions or their disseminations to guard by putting in place the methods of focused struggles.

MATERIALS AND METHODS

In order to inventory the phytophagous nematodes associated with vegetable crops the steppe of western Algerian in province of Tiaret and evaluate their densities, their diversity and their structures. The experimental method is made of functions of the following steps:
- outputs on field and collection of soil samples and when possible it is accompanied by whole plant at the selected sites.
- Extraction of soil nematodes by the method of flotation and sedimentation methods buckets (Dalmasso, 1966).
- Characterisation of phytophagous nematodes (counting and identification) under a binocular microscope based on the identification key (Jacob and Middepiaats, 1988).

The samples have been made in different vegetable crops with three stations in province of Tiaret "Rechaigua, Ksar El If Echellala and Houes". Our methodology consists of a faunal comparison, for this we have adopted two sampling modes. A simple sample: one sample is taken per plot weighing more than one kilogram which will be placed in a sealed bag and labeled. A composite sample consisting of soil samples of about 200 g to one sample every 10 meters on the diagonal of the plot are taken and combined into one in a sealed referenced bag. All samples of soil and roots are made in the rhizosphere of plants at a depth between 10 and 30 cm of soil.

The extraction method used is that of buckets (Dalmasso, 1966) method called flotation and sedimentation. The evaluation of the total density is after enumeration and morphological identification essentially based on the observation of some discriminative characters (the length and shape of the pen, the shape of the head, the tail, the body length, layout esophageal gland in relation to the intestine) under a binocular microscope.

Nematode populations in the soil are expressed in number of nematodes per dm$^3$ (N/dm$^3$) (Merny and Luc, 1973).

Statistical analysis of data

The analysis of nematode populations subservient to the various vegetable crops was the subject of a statistical treatment using factorial correspondence analysis (FCA) and hierarchical ascending classification (HAC) by software "PAST". The frequency and abundance was established on the principle of Fortuner and Merny (1973).

RESULTS

1. Inventory and structure of phytophagous nematodes of vegetable crops in some stations.
1.1. Inventory phytophagous nematodes vegetable crops.
1.1.1. Overall density of nematodes identified in composite and single samples.

Our study was performed in 03 stations of the province of Tiaret known to vocation by vegetable crops namely Ksar Chellala, and Rechaiga Si Haoues. The samples were focused on picked up ground (simple and composite) in the rhizosphere of vegetable crops.

The nematode analysis revealed the presence of 11 genera of nematodes in the simple soil sample. They are represented by Aphelenchus, Aphelenchoides, Ditylenchus, Tylenchus, Psilenchus, Pratylenchus, Tylenchorhynchus, Paratylenchus, Cephalobus, Dorylaimus, Rabtidis and Helicotylenchus.

Table I covers different densities of taxa encountered in the 02 single and composite samples. It appears from these results that the densities of nematodes identified vary depending of the stations prospected. The most represented phytophagous in our study sites are Aphelenchus, Ditylenchus, Cephalobus, Dorylaimus, Tylenchorhynchus and Tylenchus. They have been detected in more than 50% of the stations. However, for the remaining taxa (Aphelenchoides, Psilenchus, Meloidogyne,
Psilenchus, Pratylenchus, Paratylenchus) They are limited to a few sites (~50%).

The highest densities are recorded in the Tylenchorhynchus Ksar Chellala station (1940 N/dm³) and for by way of example Pratylenchus in the same station; with a density not exceeding 440 N/dm³.

Moreover, the results show that the diversity varies from one site to another and in the two sampling modes.

Also in Rechaigua station phytophagous nematodes are maintained at relatively low densities levels, the most represented taxa is the kind Ditylenchus with densities ranging from 260 to 60 N/dm³ and those for all prospected crops in this station.

At the station Si Haoues, our investigations have carried on a single type of a large surface area leguminous crops lenses that appear to be free of all nematode infestations, only the kind Ditylenchus was collected in numbers ranging from 160 to 60 N/dm³ respectively for the composite sample and simple.

### 3.1.1.2. Overall density of nematodes identified in Rechaigua station.

#### 1. Cases of the composite sample.

The results of the composite samples revealed the presence of 10 kinds of nematodes, Ditylenchus, Aphelenchus, Tylenchus, Psilenchus, Pratylenchus, Tylenchorhynchus, Cephalobus, Dorylaimus Helicotylenchus, and gender Rabtidis (Figure 1 and Table 1).

Large populations are observed for the kind Cephalobus, Dorylaimus, Ditylenchus, Tylenchus, with densities of 1780 N/dm³, 440 N/dm³, 180 and 184N/dm³ respectively in the tomato, pepper crops, on tomato and pepper. To genres Rabtidis, Aphelenchus and Helicotylenchus, we recorded respective densities 120 N/dm³ on tomato and 60 N/dm³ on pepper and 20 N/dm³ on tomato and pepper. For the genus of Pratylenchus densities are in the order of 80 N/dm³ of pepper cultivation.

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1. **Inventory and overall densities of phytophagous nematodes in three locations in the province of Tiaret**

Table 1. Density (N/dcm³) of free nematodes in the soil sampled in the province of Tiaret

<table>
<thead>
<tr>
<th>Stations</th>
<th>Culture</th>
<th>Type of sampling</th>
<th>Total number of nematodes</th>
<th>Différents genres de nématodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ksar Chellala</td>
<td>Oignon</td>
<td>Composite</td>
<td>3600</td>
<td>260 0 200 0 0 60 0 20 760 440 60 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simple</td>
<td>3900</td>
<td>380 0 160 20 0 200 100 20 640 120 0 0</td>
</tr>
<tr>
<td></td>
<td>Fève</td>
<td>Composite</td>
<td>8460</td>
<td>40 0 120 0 140 200 520 40 120 200 40 60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simple</td>
<td>16640</td>
<td>60 0 160 0 0 440 1440 0 0 140 460 40</td>
</tr>
<tr>
<td></td>
<td>Ail</td>
<td>Composite</td>
<td>2100</td>
<td>480 0 120 80 0 180 140 0 400 180 20 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simple</td>
<td>2700</td>
<td>300 0 120 60 0 120 60 0 920 200 120 0</td>
</tr>
<tr>
<td></td>
<td>Tomate</td>
<td>Composite</td>
<td>2500</td>
<td>0 0 140 0 0 0 0 0 1788 440 120 20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simple</td>
<td>3250</td>
<td>120 0 260 80 0 0 0 0 2800 20 0 0</td>
</tr>
<tr>
<td></td>
<td>Oignon (Parcelle 1)</td>
<td>Composite</td>
<td>260</td>
<td>0 0 40 20 0 0 0 0 0 160 40 0 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simple</td>
<td>1120</td>
<td>40 0 140 40 0 0 0 0 0 560 340 0 0</td>
</tr>
<tr>
<td></td>
<td>Oignon (Parcelle 2)</td>
<td>Composite</td>
<td>560</td>
<td>0 0 120 0 0 0 0 0 0 340 100 0 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simple</td>
<td>640</td>
<td>20 0 120 60 0 0 0 0 0 320 120 0 0</td>
</tr>
<tr>
<td></td>
<td>Poivron (Parcelle 3)</td>
<td>Composite</td>
<td>400</td>
<td>0 0 60 20 0 0 0 0 0 280 40 0 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simple</td>
<td>540</td>
<td>40 0 60 120 0 0 0 0 0 180 120 20 0</td>
</tr>
<tr>
<td></td>
<td>Poivron (Parcelle 4)</td>
<td>Composite</td>
<td>1080</td>
<td>60 0 180 20 0 0 0 0 0 360 280 0 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simple</td>
<td>1360</td>
<td>180 0 180 140 0 80 60 0 560 140 0 20</td>
</tr>
<tr>
<td>Si Haoues</td>
<td>Lentilles</td>
<td>Composite</td>
<td>1120</td>
<td>240 0 140 0 0 0 0 0 580 160 0 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simple</td>
<td>800</td>
<td>0 0 60 0 0 0 0 0 660 60 20 0</td>
</tr>
</tbody>
</table>
2. For simple sample

Examining the figure below shows a strong dominance of Cephalobus kind with a density of 2800 N/dcm$^3$ on tomato crop. The kind Dorylaimus comes in 2nd place with a density of 340 N/dcm$^3$ on onion crop (Parcel 1), the genus Ditylenchus with a density of 260 N/dcm$^3$ on tomato crop the kind Aphelenchus is represented exclusively on culture tomato with a density on the order of 120 N/dcm$^3$. As for the other genres are represented by low densities as Tylenchus and Pratylenchus respectively with densities 80 and 20 N/dcm$^3$ on growing tomato and onion (Parcel 2).

The analysis of dendrograms (Figure 3) identifies three groups for both sampling "the composite and simple", but these groups are not similar. For composite samples Group 1 (G1) essentially brings together two stations onion crops "Parcel 2 and 3" and the tomato field with the presence of 05 nematode taxa particular the following genres: Tylenchus, Dorylaimus Helicotylenchus , and Cephalobus Rabtidis.

Group 2 (G2) is formed only by Psilenchus kind associated with the onion crop land 1. As for Group 3 (G3), we note the presence of 04 genera represented by Tylenchus, Ditylenchus, Aphelenchus and Pratylenchus on one type of crop (pepper).

The analysis of Figure 4 distinguishes 03 groups that are similar to those obtained by hierarchical classification, and those for composite samples and simple.

AFC composite groups reveals the following groups: Group (1) G1 generates Tylenchus genres Dorylaimus, Cephalobus, Helicotylenchus and Rabtidis on following crops Onion (Parcel 2 and 3) and Tomato.

The Group (2) G2 is made exceptionally by the kind Psilenchus on onion crop only in that culture and those for the two sampling techniques adopted simple and composite.

As for the group (3) G3 is formed by 04 Tylenchorhynchus genres Aphelenchus, Ditylenchus and Pratylenchus only growing in peppers.

The generated groups are as follows: Group (1) represented by G1 and Ahenchoiodes Cephalobus only three onion plots (1, 2 and 3). The Group (2) G2 formed by 05 Aphelenchus genres Tylenchus, Ditylenchus, Tylenchorhynchus and Dorylaimus tomato crop.

The Group (3) G3 is represented by Pratylenchus, Psilenchus on pepper culture.
3.1.1.4. Overall density of nematodes identified in Ksar Chellala station. 

1. Cases of the composite sample.

The results shown in the figure below show that the genus is predominant Cephalobus with a density of about 760 N/dcm$^3$ on onion crop, followed by genre, Tylenchorynchus 580 N/dcm$^3$ on bean culture. Garlic cultivation has two nematode genera namely Aphelenchus and Rabtidis 480 N/dcm$^3$ with respective average densities of 480 N/dcm$^3$ and 460 N/dcm$^3$.

The genre Dorylaimus often onion crop with a density of 440 N/dcm$^3$, as to Ditylenchus genera, Tylenchus on garlic cultures with respective densities 220 and 80 N/dcm$^3$; also on culture bean we note the presence of Helicotylenchus and Aphelenchus 60 and 40 N/dcm$^3$.

On the basis of Euclidean distances and with respect to a similarity of 38.37% on the axis 1 and 2.13% along the axis 02. The classification gave 03 distinct groups and those for the two types of sampling composite and simple (Figures 7 and 8).

For composite samples, Group 1 (G1) essentially brings together the onion crops, with the presence of 04 nematode taxa particular the following genres: Aphelenchus, Ditylenchus, Cephalobus and Dorylaimus. Group 2 (G2) is formed only by the kind Tylenchus and Rabtidus associated with garlic culture. As for Group 3 (G3), we note the presence of 05 genera represented by Pratylenchus, Helicotylenchus, Tylenchorencus, Paratylenchus and Psilenchus on bean culture. For the single samples there are 03 distinct groups precedents. The Group (1) G1 formed by 03 genera Pratylenchus, Aphelenchus and Cephalobus on Onion culture.

The Group (2) G2 formed by Pratylenchus and Tylenchus on Garlic culture, while Group (3) G3 is represented by Ditylenchus, Psilenchus, Pratylenchus, Rabtidis, Dorylaimus and Helicotylenchus on bean culture.

Analysis of the AFC composite groups reveals the following groups: Group (1) G1 generates genres Aphelenchus, Ditylenchus, Cephalobus and Dorylaimus.

The Group (2) G2 is made exceptionally by 02 genres of naked garlic culture. As for the group (3) G3 is formed by 05 genres: Pratylenchus, Helicotylenchus, Tylenchorynchus, Paratylenchus and Psilenchus on Culture bean.

For the second type of single sampling there are 03 different groups:
The groups are released as follows: Group (1) G1 represented by Tylenchorhynchus, Aphelenchus and Cephalobus only on onion crops.

- The Group (2) G2 formed by 02 Paratylenchus and Tylenchus genres of garlic culture.

- The Group (3) G3 is represented by 06 genres Pratylenchus, Psilenchus, Ditylenchus, Rabtidis Dorylaimus and Helicotylenchus on culture bean culture.

3.1.1.5 Overall density of nematodes identified in Si Haoues station

1. Cases of the composite sample

On this station, one culture sample was taken due to the large area devoted to this crop. The review of the following histogram shows the presence of 04 genres significant at this type of composite sampling and are as follows (Figure 9): Cephalobus 580 N/dcm³, Aphelenchus 240 N/dcm³, Ditylenchus 140 N/dcm³ and Dorylaimus 160 N/dcm³

2.2 For simple sample.

For simple sample is almost similar to the previous lack of Aphelenchus only one note to be replaced by the kind Rabtidus with a relatively low density is 20 N/dcm³ only (Figure 10).

The most important kind consists Cephalobus 660 N/dcm³, Ditylenchus and Dorylaimus 60 N/dcm³

DISCUSSIONS

The completion of this study allowed us to identify eleven types of nematode "phytophagous and not phytophagous" in distributed vegetable soils in both porbeagle different stations of the province of Tiaret. They are represented by: Aphelenchus, Aphenchoides, Ditylenchus, Tylenchus, Psilenchus, Pratylenchus, Tylenchorhynchus, Paratylenchus, Cephalobus, Dorylaimus,
Rabtidis and Helicotylenchus. The results obtained on the inventory of parasitic nematodes vegetable crops join a species found point of view those Netscher and Luke (1974). The highest average total of the phytophagous nematodes recorded in this study is observed \(16640 \text{ N/dm}^3\) distributed as follows:

Our observations have shown the presence of the more genres represented as Cephalobus with a density of \(2800 \text{ N/dm}^3\), Dorylaimus, with a density of \(440 \text{ N/dm}^3\), Ditylenchus with a density of \(260 \text{ N/dm}^3\) and Aphelenchus with a density of \(480 \text{ N/dm}^3\).

The Cephalobus and Dorylaimus genre are the most representative genres in both regions studied. However, there is a total absence Meloidogyne and Heterodera although both regions are oriented cereals. The abundance and frequency of this type of vegetable crops in Niger (Diongue, 1986). Furthermore, the populations of Pratylenchus are shown to be important in both regions, however in Ksar Challala station their densities reached \(440 \text{ N/dm}^3\). Through, they reached \(160 \text{ N/dm}^3\) in the Ain Ouassara station in the Djelfa region.

The frequency of this kind with a rate of 33.3% was reported in Garden Soils of Senegal (Sawadogo et al., 1993). In contrast, studies on banana in Burkina Faso [14] and in Ivory Cost (Fargette and Quenherve, 1988) were able to show that this kind grows poorly on this crop. *Pratylenchus thornei* was the dominant species in the soil and in the roots of wheat in arid areas of Israel. Which could explain its presence in the plain, cereal region (Orion et al., 1984).

The genre Ditylenchus presented high densities in Ksar Challala station in the province of Tiaret, these have reached \(260\text{N/dm}^3\) on onion plantations. In contraste in the Ain Ouassara station beans, they are estimated to \(600\text{N/dm}^3\). About the genre of Aphelenchus it was reported in the two regions with densities of \(480\text{N/dm}^3\) in Ksar Challala station, and \(200\text{N/dm}^3\) in the Ain Ouassara station on bean crops.

For the genre of Tylenchorhynchus, it was recorded a density of bean culture \(1940 \text{ N/dm}^3\) in Ksar Challala station, the Ain Ouassara on pea culture is of the order of \(120\text{N/dm}^3\). On the other hand, the investigations into tomato respectively in Mauritania and Senegal have detected the presence of Tylenchorhynchus (Netscher and Luc, 1974; Diongue, 1986). It is recognized that these phytophagous nematodes are parasitic nematodes in agro ecosystems. They have a deleterious effect on plant growth and yields (Verschoor, 2001).

The use of ecological indices of structures such it has been previously described by the use of the frequency and abundance were classified phytophagous nematodes in two groups in the surveyed sites.

Scanty nematodes and frequent, they are active parasitic of vegetable crops. They met in the two locations, on different types of soil, but with low population levels. Scanty and infrequent nematodes considered minor pests. Their parasitism on vegetable crops seem less important than the first group. These species are rarely observed and too few to have any economic significance include, of Tylenchorhynchus in Ksar Challala station with a density of \(1940 \text{ N/dm}^3\). Calculating the diversity index Shannon Weaver helped confirm that the nematofauna is quite diverse in the two regions studied.

As for the equal distribution, it shows that there is a balance between the species studied habitats, except the kind Psilenchus present only on crop beans at the Ksar Challala station and absent in the other stations of the region. Regarding the diversity at the stations. We record a nematofauna rather diverse. For equal distribution values tend to 1, it means that there is a balance between the species found in these habitats studied in the two regions studied.

**CONCLUSIONS**

The results of this study revealed various species of nematodes associated with vegetable crops in the Algerian steppe including in province of Tiaret. We counted eleven genres of phytophagous and frequent nematodes represented by Aphelenchus, Aphenchoides, Ditylenchus, Tylenchus, Psilenchus, Pratylenchus, of Tylenchorhynchus, Paratylenchus, Cephalobus, Dorylaimus, Rabtidis and Helicotylenchus.

The densities of these nematodes and frequent may vary by location and method of sampling and the nature of the soil.
The Cephalobus, Dorylaimus, Ditylenchus and Aphelenchus are the most frequent and abundant in the three stations of study. These taxa seem to adapt to different types of vegetable soils. Their existence may be subject to significant damage to installed cultures. Furthermore the use of ecological indicators of structure (Frequency and Abundance) class nematodes in 04 groups:

- Nematodes abundant, dangerous for market gardening.
- Scarce Nematodes, less harmful and adapts to different soil type
- Abundant and infrequent nematodes, their presence in some soils, can be dangerous for market gardening.
- Nematodes scanty and infrequent occasionally meet their densities are low and have little or no damaging. Vegetable crops appear not to be their special host.

At the end of this study, it seems important to advise gardeners, the application of proper rotation, or use of fallow or resistant varieties that may constitute a simple and effective alternative the species of phytophagous nematodes in these little infested areas to avoid the phenomena of adaptation and resistance.

REFERENCES
