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Faunal Study of Nematodes in Market Gardening in the Koulikoro Region in Mali

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Abstract: ***Market gardening is faced with numerous abiotic and biotic constraints. Among which, water insufficiency and parasites. Among these parasites, nematodes constitute the most important group after insects. They cause various symptoms such as: stunting of roots, induction of root gall formation, wilting of plants etc. For sustainable management of these worms, a faunal study was carried out in 2 permanent market gardening sites in the Koulikoro region: Diégnè and Katibougou. Two extraction techniques were used: sieving and modified Baermann. From the soil analysis 7 genera of nematodes were encountered: Pratylenchus, Tylenchus, Helicotylenchus, Meloidogyne, Scutellonema, Tylenchorhynchus and Paratylenchus. They were found in all sites.***

Keywords: Nematodes, market gardening, faunal study, Koulikoro, crops

1. Introduction

Nematodes are found in all terrestrial and aquatic habitats, but they are often overlooked due to their microscopic size. Many species are highly specialized in parasitism of vertebrates including humans, invertebrates such as insects and especially plants. Plant parasitic nematodes are microorganisms most often invisible to the naked eye in soil and roots. They cause dieback diseases on crops accompanied by non - specific symptoms for the most part. Symptoms include chlorosis, dwarfism, vegetative delay, reduced yield, etc. These yield reductions due to nematodes can reach 25 to 40% in the absence of nematicide treatment [1].

Nematodes, although small, are present in large numbers, even several hundred to several million, and cause considerable damage to crops, particularly in tropical zones. They also indirectly cause harm to human health and the environment through the control methods used with the application of highly toxic pesticides. In Mali, surveys in market gardening sites in different regions showed the presence of several genera of nematodes, namely *Meloidogyne, Criconemella, Helicotylenchus, Pratylenchus, Paratylenchus* and *Heterodera* [2]. The objective of this study is to evaluate the distribution of plant - parasitic nematodes of market garden crops by conducting a nematological survey in two localities in the Koulikoro region: Diégnè and Katibougou.

2. Materials and Methods

2.1 Study sites

Two permanent market gardening sites in the Koulikoro region: Diégnè and Katibougou, were chosen for the collection of soil samples (Table 1). Samples were taken using a systematic method using a soil auger. Table 1: Geographic coordinates of the prospected sites Two permanent market gardening sites in the Koulikoro region: Diégnè and Katibougou, were chosen for the collection of soil samples (Table 1). Samples were taken using a systematic method using a soil auger.

Table 1: Geographic coordinates of the prospected sites

Market gardening sites		Geographic coordinates
Koulikoro region	Diégnè	12, 48305N; 6, 793708W
	Katibougou	128527N; 7535309W

2.2. Nematological data

2.2.1. Sample collection

Sampling was carried out in the rhizosphere of the crops, using systematic sampling using a 6 cm diameter auger, at a depth of 25 cm. This type of sampling takes into account the field as a whole and the aggregate distribution of nematodes. Ten soil samples per crop plot, or 5 per diagonal, were taken at the two Sites. These samples are then placed in plastic bags labeled with the name of the site, a sampling number, and the name of the culture, all well sealed with a thread. The samples were then collected in a cooler and transported to the laboratory for extraction.

2.2.2. Extraction of nematodes

In the laboratory, a 500g subsample is taken from each of the samples from the rhizosphere of the crops to be analyzed. The remaining soil is kept moist to be analyzed in the event of accidents. The sub - sample of soil is well homogenized by hand and cleared of all large debris using a 2 mm mesh sieve before passing to the nematological analysis. To extract the nematodes we used two techniques: the modified Baermann technique and the sieve technique.

The modified Baermann technique

The sample was placed on “Kleenex” type paper, then on a PVC sieve with a mesh size of 1 mm. The whole thing is placed on a plate, water is then added to moisten it completely. After 48 hours, all of the water in the container is passed through a 38 µm mesh sieve so as to maintain a suspension of approximately 25 ml. From this suspension a 5 ml aliquot solution is observed under a microscope at 40x magnification.

The sieve technique

The homogenized subsample is placed in a bucket of 5 liters volume, suspended in one liter of water and shaken well. The solution was subsequently decanted for one minute, the supernatant filtered through a series of three sieves: a 150µm sieve, a 75µm sieve and a 38µm sieve which retained the nematodes. After a settling period of two hours, the suspension was reduced to a pellet of approximately 5 ml using a pasteur pipette fitted with a bulb. The volume of water is maintained at the base or adjusted to 25ml to obtain an ad hoc concentration of nematodes suitable for good observation under a stereoscope.

2.2.3. Fixation of nematodes

Nematodes were killed by immersion in a boiling solution of FA composed of 10 ml formalin; glacial acetic acid 1 ml; distilled water 89 ml, [2]. The technique consists of adding the heated FA solution to the suspension of nematodes at equal volume in a small bottle fitted with a cap. Nematodes were counted using a stereoscope at 40x magnification.

2.2.4. Identification of parasitic nematodes

This generic determination of plant - parasitic nematodes was made using determination keys: [3]; [4] and discriminating morphological characters reported by [5]. The enumeration of nematode genera was carried out under a stereoscope. From a suspension of nematodes adjusted to 25 ml, an aliquot solution of 5 ml (v) is taken and placed in a counting box with a grid bottom for counting. The importance of each nematode genus was determined by calculating the density of nematodes per site (average number of individuals/kg of soil).

2.3. Data processing

From a suspension of 25 ml (V), an aliquot solution of 5 ml (v) is taken and placed in a counting box with a grid bottom for counting. After enumeration, the population numbers were expressed in number of nematodes / dm3 of soil (N/dm3) according to the formula:

$$N = \frac{V}{v} X\ 5$$

The importance of each nematode genus was determined by calculating the average density per site. An analysis of variance was carried out to compare the means by site and gender.

3. Results

3.1. Nematodes encountered

The 20 samples from the two plots were analyzed and the plant - parasitic nematodes extracted.7 genera have been identified: *Pratylenchus, Meloidogyne, Scutellonema, Tylenchorhynchus, Paratylenchus, Helicotylenchus,* and *Tylenchus*. The average densities per site provide information on the importance of nematofauna encountered per site. Four of them are ectoparasites (*Scutellonema, Tylenchorhynchus*, and *Helicotylenchus*). Depending on the diet, the endoparasites are divided into sedentary (*Meloidogyne*), migratory (*Pratylenchus*).

3.2. Importance of phytonematodes

Total nematode densities per kg of soil vary from one site to another. Statistical analysis of the results reveals 700 nematodes per kg of soil and 505 nematodes per kg of soil respectively in Katibougou and Diégnè (figure 1). The analysis of variance of the means shows that there is no significant difference between these densities (ANOVA, P = 0.50). Regarding generic densities, a variation was noted. The highest densities were noted for *Helicotylenchus* in Katibougou with 350 individuals per kg of soil, *Pratylenchus* and *Tylenchus* in Diégnè 225 nematodes per kg of soil.

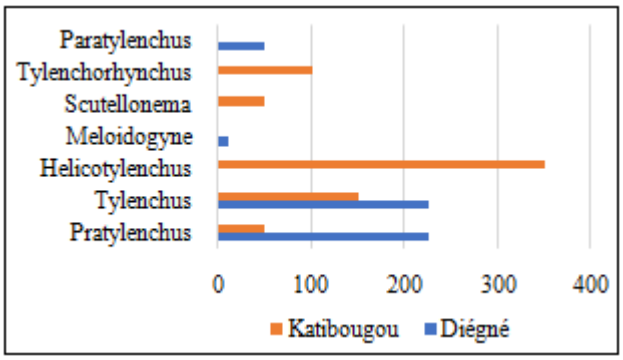

Figure 1: Average density of soil parasitic nematodes by site

4. Discussions

The results obtained during this study show the importance of nematodes associated with vegetable crops in the 2nd administrative region of Mali. Of the 7 genera encountered *Helicotylenchus*, *Pratylenchus* and *Tylenchus* are the densest. Studies in two localities in the same region showed the presence of 8 genera of phytonematodes on crops. Among these nematodes *Meloidogyne* and *Tylenchorhynchus* were the densest [6]. In other countries, faunal surveys have revealed the presence of several genera of plant - parasitic nematodes associated with crops which reduce yield by causing economically significant losses. Thus in Algeria, research relating to nematodes associated with the olive tree showed more significant results in terms of diversity: 18 genera were reported by [7]; five years later a similar study reported that 10 genera were encountered on the same crop [8]. On the other hand, in Morocco, studies have revealed greater diversity. In this country, 12 genera have been found [9]. All these authors are unanimous that these parasites attack all market garden crops and are responsible for yield losses of 14%, or in monetary terms a sum of 100 billion US Dollars per year [10].

5. Conclusion

This study confirms the diversity of parasitic nematofauna on crops. These results show that nematodes of the *Helicotylenchus* and *Pratylenchus* genus are the most important on market gardening crops in the Koulikoro region. The 7 genera encountered in this study appear to be the most abundant on crops. They are characterized by a very wide host range which includes market gardening, cereal crops, legumes, etc. Regarding ectoparasitic nematodes, the most important are *Tylenchorhynchus* and *Helicotylenchus*. These data are undoubtedly useful sources

of information to guide prevention and control programs against these pests of vegetable crops in Mali.

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