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Survey of Plant Parasitic Nematodes Associated with Sweet Potato in Niger

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Abstract: A survey was conduced in the three main producing regions of sweet potato in Niger in order to determine the most import plant-parasitic nematodes species that attack the crop. The analysis of soil and roots samples collected from the rhizosphere of sweet potato in three to five sites in each region revealed the presence of only four species of plant-parasitic These are *Tylenchorhynchus indicus*, *Criconemella curvata*, *Tylenchus* sp., and *Hirschmanniella oryzae*. *T. indicus* seems to be the most important species because it was both frequent and abundant on sweet potato throughout the three regions.

Key words: Niger, plant parasitic nematodes, sweet potato

INTRODUCTION

In Niger, sweet potato is the second most important tuber crop after cassava. The main production regions are Bengou, Baleyara and Ayerou. In total these regions produce 65% of the sweet potato in Niger. The crop is usually grown on low lands with loamy clay or hydromorphological loamy sand soils. It occupies an estimated area of 2,500 ha with 40,725 tons of production (Anonymous, 2002). This gives an average yield of 16.3 t/ha. Compared to those obtained in research station, about 37.0 t/ha (Anonymous, 2001), this average yield is low. This large difference could be explained in part by the impacts of insect pests and diseases. For instance, 75% yield losses were attributed to the weevil, *Cylas puncticolis*. A disease caused by a complex of unidentified viruses was described as the most important disease of sweet potato in the main growing areas of the crop (Doumma *et al*., 2008). Little is known about fungal and bacterial diseases and plant parasitic nematodes affecting sweet potatoes in Niger.

The objective of this work is to identify the plant-parasitic nematodes species associated with sweet potato in the three major producing areas in the Western regions of Niger and to estimate their relative importance.

MATERIALS AND METHODS

The study was conducted, from April to May 2009, in the three main producing regions of sweet potato in the western part of Niger: Bengou, Ayerou and Beleyara (Fig. 1).

Sites selection and presentation of environment: Within each of the three areas, the largest sweet potato producing localities were identified with the help of the agricultural extension services, and were selected to conduct the survey. In all the localities (Fig. 1), sweet potato is grown mainly during the dry cold season, with the exception of Baleyara where it is grown throughout the year.

Bengou area: Bengou is located at about 300 km southeast of Niamey, the capital city. The average altitude is 300 m. It annually receives about 700 mm of rain. The three selected sampling sites (Bengou, Kouaratégui and Gnakoy-Tounga) are situated in the Dallol Foga valley, an ancient river bed that is temporary flooded during the rainy season (June to October). The dominant woody vegetation on the sites is composed of: *Nerocaria macrophylla and palmyra* (*Borassus aethiopium*). The most common weeds are: *Typha australis*, *Oryza longistaminata*, *Imperata cylindrica*, *Heliotropium* sp., *Manguifera indica*, *Solanum angustifera*, *Cynodon dactylon*, *Cyperus rotundus*, *Ludwigia* sp., *Portulaca oleracea and Triantema portulacastrum*.

Ayerou area: Ayerou is located at 200 km north-west of Niamey. The area receives an average annual rainfall is 300-350 mm. The three selected sampling sites are, Aliam, Goyowe and Saffane. The woody vegetation is dominated by *Acacia* r*adiana*, *A. nilotica*, *A. albida* and *Hyphaene thebaica*. The main weeds are *Typha australis*, *Echinochloa stagnina*, *E. colona*, *Oryza longistaminata*, *Cynodon dactylon*, but *Ledwigia Heliotropium* sp. *Polygonum senegalensis*. *Cyperus* spp., *Ipomoea* spp. and *Panicum clandestinum* are also frequent.

Beleyara area: Beleyara is located at 100 km northeast of Niamey. The area receives an average annual rainfall of

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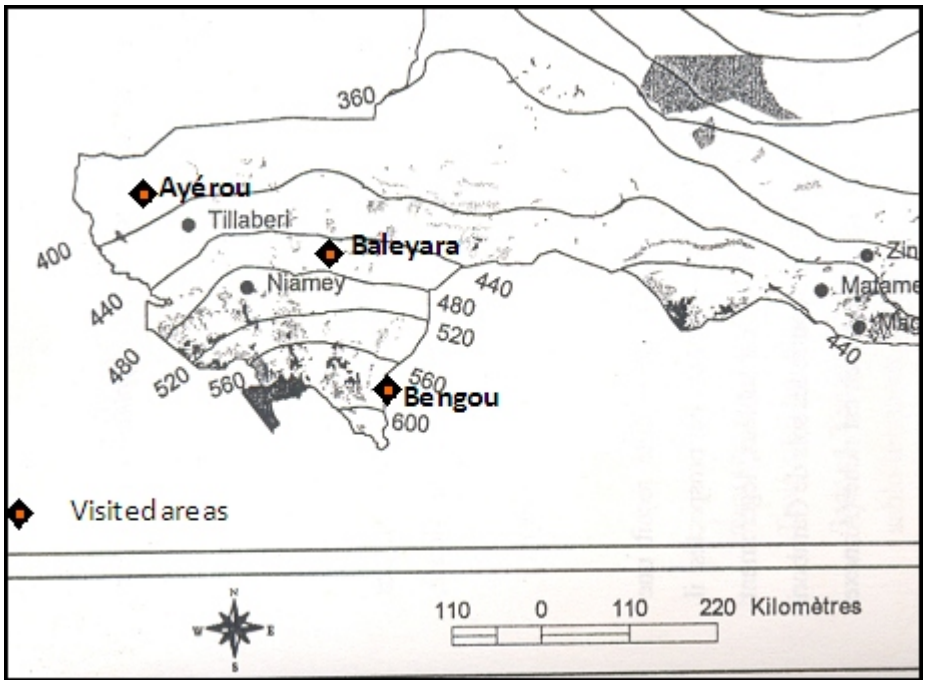

Fig. 1: Localization of the survey areas

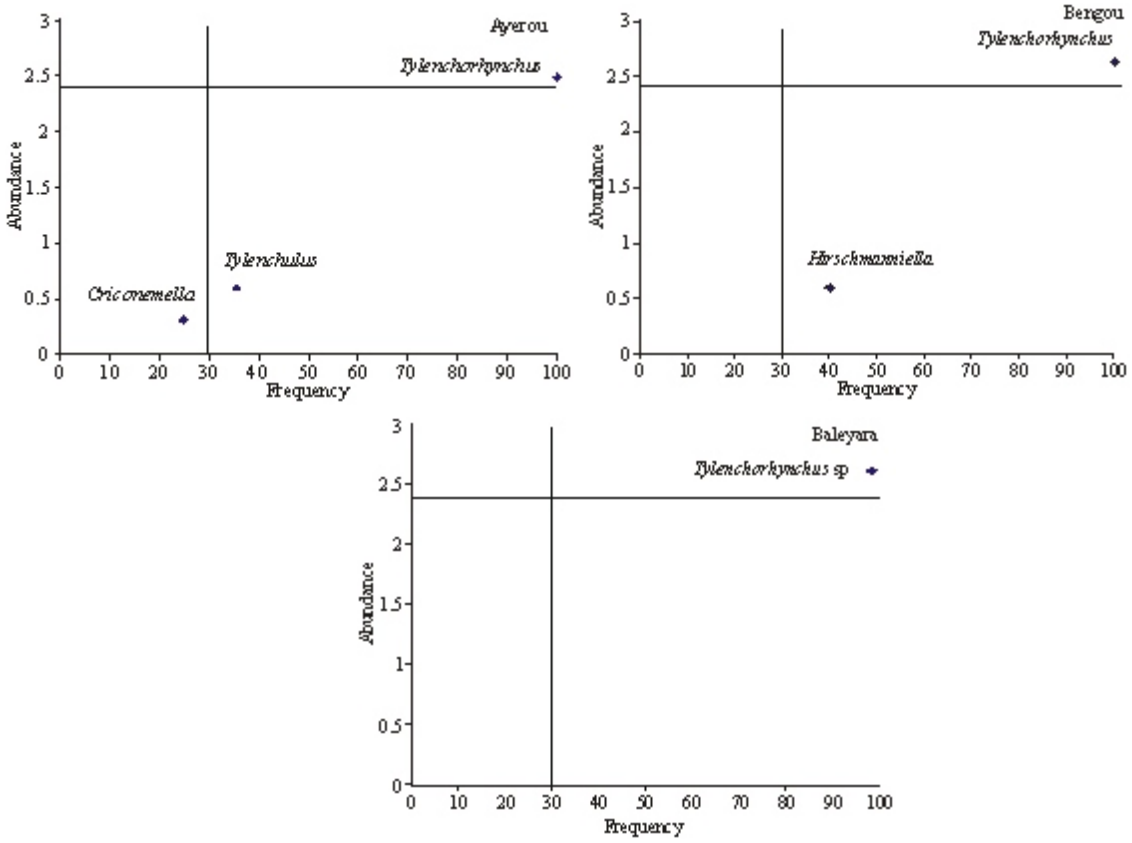

Fig. 2: Frequency and abundance of parasitic nematodes associated with sweet potatoes

450-500 mm. Five sampling sites were selected, Baleyara, Tamjir, Ngawra, Wangara and Zangargar. The woody vegetation is composed of *Acacia albida Manguifera indica, Prosopis juliflora* and *Nerocaria macrophylla*. The most common weeds are: *Cyperus* spp., *Cynodon dactylon*, *Oryza longistaminata*, *Ipomoea* spp. and *Panicum clandestinum*.

Nematological analysis: In each site, samples were taken by walking randomly in the field. A sample is composed of five sub samples that were bulked. Depending on the size of the site, five or seven samples were collected. The samples were taken in the rhizosphere of the sweet potato plants at a depth of 5-20 cm, using a trowel (Barker, 1985). Each sample (1 kg of wet soil + roots) was placed in a labeled plastic bag. The plastic bags were immediately put in an ice chest to protect them against the sun rays; and they were sent to the Nematology Laboratory of the Regional Centre for Agronomic Research of Kollo for nematode extraction.

Each soil sample was thoroughly mixed. Then, an aliquot of 250 cm^3 was taken and used for the nematode extraction. Nematodes were extracted from the soil and roots by the methods of elutriation and the Seinhorst cloud chamber (Seinhorst, 1950, 1962) respectively. Roots were dried after the nematode extraction and their dry weight measured.

The importance of each species or genus of nematodes has been determined from the Diagram Frequency/Abundance of Fortuner and Merny (1973). The frequency (F) is the percentage of samples that contain a given species or genus (Fig 2). This parameter was calculated by using the following formula:

$$F = e/n \times 100$$

where
e = total number of samples containing a given species of nematode
n = total number of sample at given site

Abundance (A) of a nematode species is the average density per sample in which the nematode was found, and it is calculated by using the following formula:

$$A = \sum X_i/e$$

where
X_i = number nematodes per liter of soil or gram of root
e = number samples in which the given nematode was present. Then the A values were log transformed

A species is considered abundant and frequent when it was present in at least 30% of samples with at least 300 individuals per liter of soil or 20 individuals per gram of dry root.

RESULTS AND DISCUSSION

Plant-parasitic nematodes species encountered: From 102 samples examined, only four species of plant-parasitic nematodes were found in the rhizosphere of the sweet potato plants. They are *Tylenchorhynchus* indicus, *Criconemella curvata* and *Tylenchus* sp and *Hirschmanniella* oryzae. These nematodes belong to four different families, grouped in the order Tylenchida (Table 1). The first three species are ectoparasite while *H. oryzae* is an endoparasite. With only four species found, the parasitic nematodes associated with sweet potato, have a low biodiversity. These results are in contrast to previous reports. Zakari (2008) found over 10 species of plant-parasitic nematode on sweet potato grown on the loamy clay soils of the tidal plain of Gabougoura and Kareygorou. Likewise, Haougui and Kollo (2006) reported 12 species of nematodes on sweet potatoes in Tillabery. These differences could be explained by the fact in this study, the fields surveyed are submerged for about four months. The submersion may have reduced the populations of many species of nematodes to undetectable levels.

Quantitative analysis: *Tylenchorhynchus indicus* sp. is the only nematode species that was present in all regions on the sweet potato (Table 2). It has been found in all sites surveyed and in all samples with a frequency of 100%. Its average abundance was 313 individuals per dm^3 of soil in Ayerou, 436 and 425 in Bengoua and Baleyara respectively. In all the sites, it's population density represents more than 97,5% of the total number of parasitic nematodes found in the rhizosphere of sweet potato (Fig. 3). This species is frequent and abundant meaning that it is adapted both to the environment and the plant (Fortuner and Merny, 1973). It seems to be the most important species on sweet potato in these particular ecosystems with high humidity. It appears to be adapted to wide range of soil conditions as it was found on irrigated rice in the River Niger valley, in association with *Hirshmanniella* and *Longidorus* (Haougui and Basso, 2008); it was also observed on dry lands on rain-fed crops like millet, sorghum and cowpea (Beaujard and Martiny, 1995), on citrus (Haougui and Kollo, 2005) and on vegetables throughout the country (Haougui and Bizo, 2009). *Criconemella curvata* and *Tylenchus indicus* have been found only in Goyowe (Ayerou area) where they were neither frequent nor abundant. Their respective

Table 1: Systematic position of parasitic nematodes species encountered in the rhizosphere of sweet potato different sites

Order	Families	Genera	Espies
Tylenchida	Belonolaimidae	*Tylenchorhynchus*	*T. indicus*
	Pratylenchidae	*Hirschmanniella*	*H. oryzae*
	Criconematidae	*Criconemella*	*C. curvata*
	Tylenchidae	*Tylenchus*	*Tylenchus* sp.

Table 2: distribution of parasitic nematodes per site

Zones	Sites	*Tylenchorhynchus indicus*	*Criconemella curvata*	*Tylenchus* sp	*Hirschmanniella oryzae*
Ayerou	Aliam	+	-	-	-
	Goyawé	+	+	+	-
	Safani	+	-	-	-
Bengou	Bengou	+	-	-	+
	Gna-Tounga	+	-	-	-
	Kouara Tégui	+	-	-	-
Baleyara	Baleyara	+	-	-	-
	Tamjir	+	-	-	-
	Ngawa	-	-	-	-
	Wangara	-	-	-	-
	Zangargar	+	-	-	-

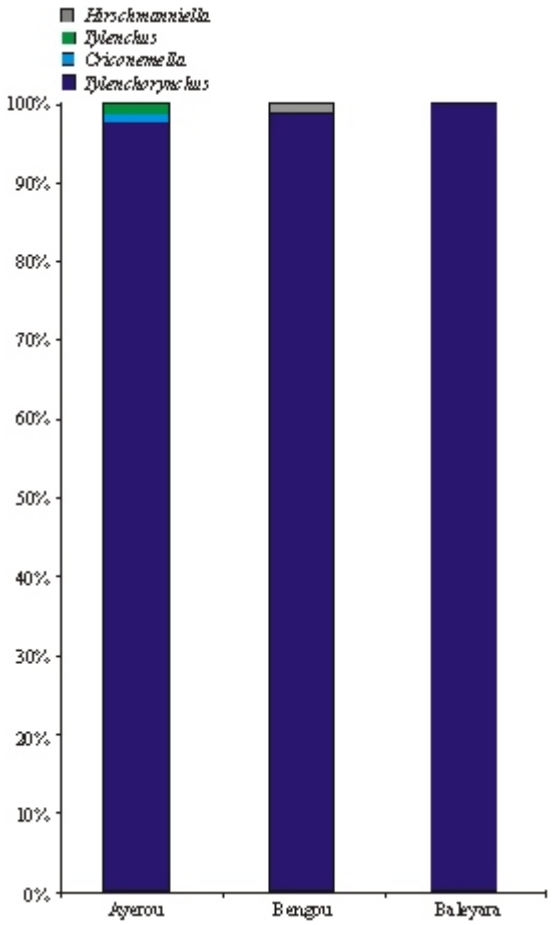

Fig. 3: Structure of the parasitic nematodes communities on sweet potatoes in in the main growing region of the crop in Niger

frequencies are 25 and 37.5%, respectively. *Criconemella curvata* is also a species found in many regions of Niger on both irrigated and rain-fed crops, but always with very low population densities (Haougui, 1999). However, several authors cited sweet potato as a good host for *C. curvata* (Hollis and Joshi, 1976; Jatala and Bridge, 1990). *Tylenchus* was also found associated with irrigated rice in Niger by Haougui and Basso (2008). But, this is the first time that it is reported on sweet potatoes in that country. *Hirschmanniella oryzae* was found only in the region of Bengou with a frequency of 40% and an abundance of 61 individuals per of soil. It is a species adapted to the environment but not a parasite of sweet potato, hence its absence in roots. The presence of *Hirschmanniella oryzae* (the rice nematode) is a well known parasite of rice and other grasses. Therefore its presence could be explained by the cultivation of rice before sweet potato, and the occurrence of the wild rice species, *Oryza longistaminata* in the area of Bengou. A similar situation was found during a previous survey on plant parasitic nematodes associated with vegetables crops, tomatoes and peppers, in the region of Zinder (900 km to the east of Niamey). The author explained the presence of *H. oryzae* by the occurrence of it weed hosts, *O. barthii* and some other semi aquatic grass species.

CONCLUSION

In this survey conducted in the three main sweet potato growing areas of Niger, the plant-parasitic nematodes associated with this crop have a low biodiversity since only four species of parasitic nematodes were found in the rhizosphere of the plants. *Tylenchorhynchus indicus* appears as the most important nematode species associated with sweet potato in Niger. It is widespread in the main sweet potato growing areas with a relatively high abundance. However, its effects on the growth and yields of sweet potato are not yet determined. Therefore, it is necessary to study its bio-ecology and pathogenecity to sweet potatoes in these particular biotopes.

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