Research Application Summary

Towards development of site specific technologies for identification of fields infested with root-knot nematodes (RKN) under tomato cropping system in Mwea, Kenya

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Abstract

This study was conducted in Mwea, central Kenya with the aim of developing a soil-characteristic-based site specific technology for identification of root-knot nematode (RKN) *Meloidogyne* spp. infested soils. This involved analysis of edaphic factors to determine the RKN distribution patterns in this major tomato (*Solanum lycopersicon* L.) production area. Results revealed that the RKN distribution pattern was highly correlated with the soil pH and electrical conductivity, making site specific farming possible.

Key words: Plant parasitic nematodes, root-knot nematodes, site specific farming, tomato

Résumé

Cette étude a été menée à Mwea, au Kenya central dans le but de développer une technologie du site spécifique basé sur les caractéristiques du sol pour l'identification des sols infestés de *Meloidogyne* spp. des nématodes à galles (RKN). Il s'agissait d'une analyse des facteurs édaphiques pour déterminer les modèles de distribution de RKN dans cette zone majeure de production de la tomate *(Solanum lycopersicon* L.*)*. Les résultats ont révélé que le modèle de distribution de RKN a été fortement corrélé avec le pH du sol et la conductivité électrique, rendant l'agriculture des sites spécifiques possible.

Mots clés: Plant parasitic nématodes, nématodes à galles, l'agriculture des sites spécifiques, tomate

Background

Kenya's economy is fuelled by agriculture with horticulture being the main contributor. For a long time, tomato producers in central Kenya have experienced increased losses due to root-knot nematodes (RKN) yet tomato is a high value crop both economically and nutritionally with a dietary value in respect to niacin, carotene, thiamine, and vitamin C. Nematodes limit agricultural production in many parts of the world (Saxena, 2004) and losses caused to vegetable crops is of great concern.

Current knowledge of the interactions of plant parasitic nematodes (PPN) with edaphic factors in food production areas of East Africa is still limited yet these factors affect nematode densities and incidences.

Literature Sujmmary

In any agricultural or natural ecosystem, the spatial pattern of PPN has a horizontal and vertical distribution (Been and Shomaker, 2006). This provides an opportunity to practice precision farming which involves the use of right inputs at the right time and the right quantity applied in the right way (Roul, 2001). This allows farmers to monitor pest and disease prevalence in their farms and manage them in a completely controlled manner. This study will explore the possibility of using such an approach to manage RKN in central Kenya.

Study Description

The study area, Mwea, in Kirinyaga County, located 81 km SE (125^{o}) of Nairobi is found in an agro-ecological Low Midland Zone. Soil sampling was carried out following the procedure adopted from Dropkin (1980) in geo-referenced plots in a stratified random manner which is preferred for most ecological work (Yates and Finney, 1942) to obtain representative data (Kent and Coker, 1992). Spatial and temporal distribution of PPN was compared for both irrigated vs. rain fed fields, and also for the dry vs. rainy seasons. This was done between May and December 2011 in seven tomato production sites with different soil types in Kiumbu, Giathigiriri, Mbombaini, Riambogo, Kiamanyeki, Ndindiruku and Ngurubani areas of Mwea.The centrifugal-floatation method (Jenkins, 1964) was used to extract nematodes from a 200 cm^3 soil sub-sample. Three fractions (sand, silt and clay) of soil were determined for each sample using the hydrometer method (Bouyoucos, 1986). Standard soil analyses were carried out to determine soil pH for each soil sample in a 1:2.5 soil water suspension using a calibrated Fieldscout pH meter (Spectrum technologies, Inc). Electrical conductivity (EC) was also determined using a calibrated Fieldscout EC meter (Spectrum technologies, Inc) in a saturated soil paste.

Research Application

According to the DCCA, the eigenvalues for the four axes were 0.166, 0.021, 0.386, and 0.260, respectively (Table 1). Cumulative percentage variance of species data from axis 1 and 2 were 10.5, explaining 22.4% of total variance. Since only the first two eigenvalues reported were canonical, the first two axes were employed to draw the DCCA ordination diagram (Fig 1.).

Table 1. Characteristic values and species-environment correlation coefficients on DCCA axis.

Characteristic values	Axis 1	Axis 2	Axis 3	Axis 4
Eigenvalue	0.166	0.021	0.386	0.26
Species-environment correlations	0.572	0.291	0	0
Cummulative percentage variance of species data	9.3	10.5	32.2	46.7
Cumm. percentage variance of species-environment relation	78.3	88.5	0	0

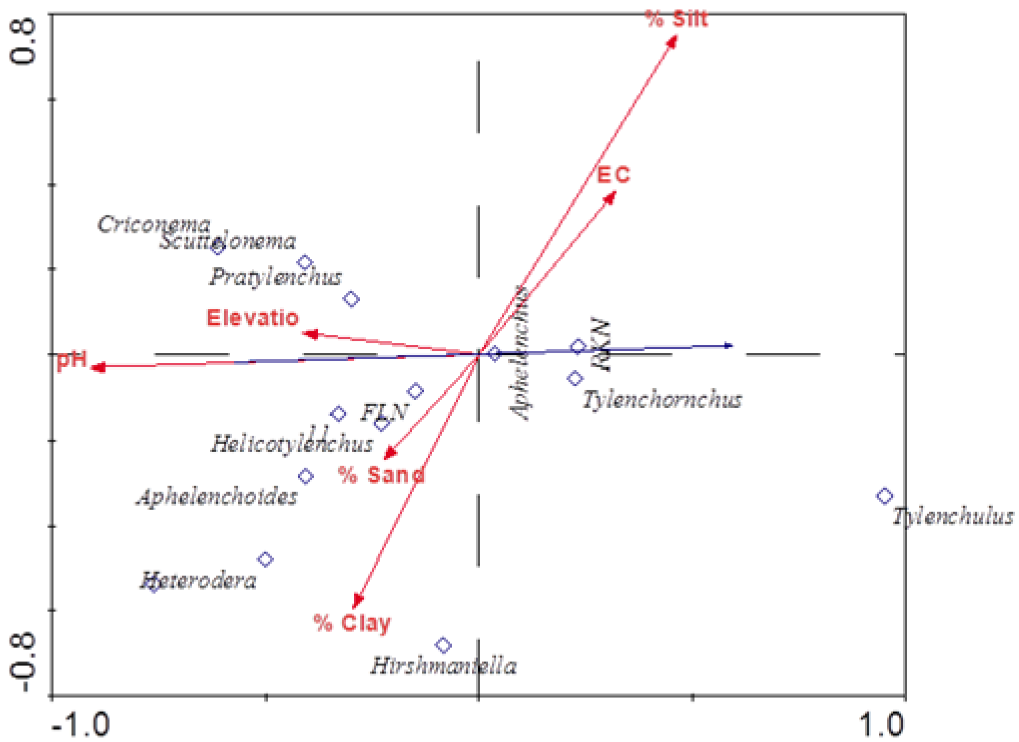

Figure 1. Detrended Canonical Correspondence Analysis ordination diagram of plant parasitic nematode genera in Mwea. The arrows represent the environmental variables and the diamonds the nematode genera.

Results showed that EC and pH are the most important factors determining the distribution of RKN (Fig.1). Axis 1 represents changes in elevation, pH and EC and axis 2 represents the changes in texture. At axis 1, EC and silt increased gradually from left to right but sand and clay moved in the opposite direction. At axis 2, elevation gradually increased upwards. Silt and clay were less important factors impacting the RKN distribution pattern. These ordination results indicate that soil pH, electrical conductivity, % sand and elevation were influenced to plant parasitic nematode distribution with soil pH and EC having a greater explanatory power in relation to RKN occurrences. An increase in soil EC and a decrease in soil pH corresponded to an increase in RKN densities.

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