Plant parasitic nematodes associated with Coffee in Kenya, host resistance and tolerance to root knot nematodes

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Abstract:
Coffee is one of the most important cash crops in Kenya as a foreign currency earner. A steady decline in coffee production has been attributed to biotic and socio-economic constraints. Among the less studied biotic constraints is nematodes and this survey was conducted to determine the plant parasitic nematodes associated with coffee in Kenya. The effect of crop management levels, coffee cultivars and agro-ecological zones on the abundance and distribution of nematodes was also evaluated in the major coffee growing regions in North Rift, Nyanza, Eastern and central highlands of Kenya. In addition, greenhouse studies were also conducted to evaluate the local coffee germplasm for resistance to root knot nematodes, Meloidogyne incognita and the role of nutrition on coffee tolerance to damage by root knot nematodes. Ten coffee cultivars provided by Coffee Research Foundation were tested for resistance to the root knot nematode M. incognita under greenhouse conditions (25 ± 2 ℃) at the field station of College of Agricultural and Veterinary Sciences, University of Nairobi. Nematodes were extracted using modified centrifugal sugar floatation technique while nutrient analysis was done using Mehlich technique. Nematodes were then fixed, mounted on Cobb's slide, enumerated and identified to genus level. The effect of NPK fertilizer on nematode infection was evaluated by growing seedlings of cultivar SL 28 in sterile sandloam potting mixtures amended with NPK fertilizer at 2.5g/kg soil. Meloidogyne incognita was inoculated at varying inoculum suspension densities of 0, 1000, 2000 and 5000 eggs and juveniles per seedling. Another study was undertaken in the greenhouse to investigate the influence of phosphorus and nitrogen on coffee tolerance to Meloidogyne incognita. Coffee seedlings were grown in sterile loam/sand mixture amended with four rates of P at 0, 1.15, 2.3 and 3.45 g of P/kg of soil and 0, 0.22, 0.44 and 0.66 g of N/kg of soil at all possible combinations and inoculated with a mixture of 5000 Meloidogyne incognita eggs plus juveniles. After 90 days Plant growth and the disease severity were evaluated. The experiment was repeated once and data analyzed. Nineteen genera of plant parasitic nematodes were recovered from coffee rhizosphere including nematodes belonging to the genera Tylenchulus spp., Meloidogyne spp., Tylenchorhynchus spp., Pratylenchus spp., Tylenchus spp., Rotylenchus spp., Hemicyclophora. A analysis showed that the mean population densities of plant parasitic nematodes and nematode community composition were variable (p=0.01) among coffee growing zones, management practices and soil chemical properties, in particular, pH, sodium (Na), phosphorus (P), potassium (K) and manganese (Mn). There was no significant (p=0.01) effect of varieties on nematode abundance. The most dominant plant parasitic nematodes including Meloidogyne, Helicotylenchus, Trichodorus and Longidorus were predominant in the lowly managed and neglected coffee farms. Nematodes in the genera Tylenchorhynchus, Scutellonema, Tylenchulus, Rotylenchus, Pratylenchus, Meloidogyne and Xiphinema significantly (p<0.01) build up in soils with low levels of potassium (K) and phosphorus (P). Galling indices (GI), egg mass indices (EMI) and nematode populations recovered from soil samples used to pot 10 different coffee genotypes indicated a range of
responses from resistant to highly susceptible. Three Robusta breeder's lines: Robusta Tree 1, Robusta Tree 2 and Robusta Tree 3 cultivars were rated resistant with galling indices 1.2 - 3.0 while, K7 and Rll were rated as moderately resistant. P application resulted to enhanced root development, plant growth and lower juvenile counts compared to plants under nutrient deficient conditions. Plant height, fresh weight of roots and shoots increased with increasing P rates (1.1S, 2.3g Plkg of soil) at optimum N rate (0.44g Nlkg soil), but decreased at triple rate of P (3.4Sg Plkg soil) except the fresh root weight. Nematode population in the soil was significantly (p=0.05) reduced at higher rates of phosphorus (P) and nitrogen (N). Application of NPK significantly (p<0.05) influenced negatively M incognita population dynamics in the soil as well as galling indices but positively all the growth parameters; namely; height, internode, fresh shoot and root weights. There was an overall increase in plant growth and seedling tolerance to nematode damage. This study has demonstrated among other things, the potential of host resistance in the management of nematodes, the role of nutrition in pathogen population dynamics in coffee roots and the impact of sustainable nematode management practices on crop productivity.