Research Application Summary

Evaluation of root- knot nematode management strategies based on their distribution in tomato fields in Mwea, Kenya

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Abstract

Tomatoes (*Solanum lycopersicum*) are mainly grown by small scale farmers in most arable areas in Kenya with the main production areas being in Central Province. Tomato production in Kenya is hampered by a variety of pests and diseases among other factors. Plant parasitic nematodes (PPN), particularly root knot nematodes (RKN) are a serious pest problem in smallholder tomato farms in Kenya. Nematode management is primarily dependent on the application of chemical nematicides. These nematicides are often broadcasted uniformly on the cultivated fields regardless of the relative nematode distribution in the farm. However nematode populations are usually not uniformly distributed. Uniform field-wide applications of nematicides can therefore result in wasteful expenditure as well as adverse environmental effects. Identification of specific areas within individual fields for targeted nematicide application may allow producers to reduce the amount of nematicides applied for nematode control and lower production costs. This study evaluated different nematode management strategies for varying nematode densities in Mwea, Kenya. Nematode resistant tomato varieties Assila, Sandokan and a susceptible variety, Riogrande as well as varying applications of Mocap (Ethoprophos) were evaluated and the most effective management options identified.

Key words: Nematicide, Nematode density, Tomato (*Solanum lycopersicum*), root-knot nematodes (*Meloidogyne* spp.)

Résumé

Les tomates *(Solanum lycopersicum)* sont principalement cultivées par les petits exploitants agricoles dans la plupart des régions arables au Kenya avec les principales zones de production se trouvant dans la province centrale. La production des tomates au Kenya est entravée par une variété de parasites et de maladies, entre autres facteurs. Les nématodes parasites des plantes (PPN), en particulier les nématodes à galles (RKN), sont un problème sérieux des ravageurs dans les petits domaines de culture des tomates au Kenya. La gestion des nématodes dépend essentiellement de l'application de nématicides chimiques. Ces nématicides sont souvent diffusés uniformément sur les champs cultivés indépendamment de la distribution relative des nématodes dans l'exploitation agricole. Cependant les populations de nématodes ne sont généralement pas réparties uniformément. Les applications uniformes des nématicides sur l'étendue du champ peuvent donc entraîner des dépenses inutiles ainsi que des effets environnementaux négatifs. L'identification des zones spécifiques à l'intérieur des champs individuels pour l'application ciblée des nématicides peut permettre aux producteurs de réduire la quantité des nématicides appliquée pour lutter contre les nématodes et permettre les coûts de production plus faibles. Cette étude a évalué les différentes stratégies de gestion des nématodes pour des densités variables de nématodes à Mwea, au Kenya. Les variétés de tomate résistantes aux nématodes, Assila et Sandokan, et une variété sensible, Riogrande, ainsi que diverses applications de Mocap (Ethoprophos) ont été évaluées et les options de gestion les plus efficaces identifiées.

Mots clés: Nématicide, densité des nématodes, tomate *(Solanumlycopersicum)*, nématodes à galles (*Meloidogyne* spp.)

Background

Tomato production in Kenya is hampered by a variety of pests and diseases with plant parasitic nematodes (PPN), particularly root knot nematodes (RKN) being among the most serious production constraint. The application of chemical nematicides is an important nematode management option among others such as crop rotation and cultural practices. Nematicides are in most cases applied uniformly across fields without considering that nematodes are spatially distributed. Nematode populations are usually not uniformly distributed in infested fields. They exhibit an uneven and patchy distribution, depending on various soil and crop related factors. The spatial dependence of nematode in fields allows maps of nematode distribution to be developed (Evans *et al*., 1999). This can facilitate targeted nematicide application and allow growers to reduce the amount of nematicides applied or more effective use of other management options (Evans *et al*., 1999). This study was therefore conducted to map the distribution of nematodes in fields in Mwea, and also to assess the effectiveness of different nematode management options for targeted application in the field.

Literature Summary

Yield loss due to *Meloidogyne* spp. on tomato range from 40 to 46% (Reddy *et al* 1985. Plants infected with *RKN* show typical symptoms of root galling, stunted growth and poor yields. They form synergies with plant pathogenic fungi and bacteria causing great yield loss (Rivera and Aballay, 2008). Methods of nematode management are affected by edaphic factors which influence their distribution and abundance at the plant rhizosphere. Research has shown that sandy soil requires higher amounts of organic amendments and other nematicidal components while loamy or clay soil require lower amounts. Damage in cotton in the USA was found to be greater in course than in fine-textured soils (Koenning *et al*., 1996). RKN control is primarily dependent on the area-wide application of nematicides (Koenning *et al*., 2004). Researchers have successfully developed such cost-effective “site-specific nematicide placement” (SNP) systems for Southern Root Knot Nematode and the Columbia lance nematode (CLN) *Hoplolaimus columbus*, that are now being adapted by cotton growers in several states in the USA (Mueller *et al*., 2010). This study therefore was aimed at evaluating nematode management strategies for effectiveness against varying nematode densities in Mwea, Kenya.

Study Description

A baseline survey of root knot nematodes present in tomato fields in Riambogo region of Mwea was carried out by sampling soil and plants from tomato fields in the area. PPN from both soil and plant samples were identified and enumerated. Their spatial and temporal distribution was also determined by geo-referencing all sampling points and sampling both at the beginning and the end of the season. Specific areas on the farm with no, high and low RKN densities were identified and used for the experiments. Both field and greenhouse experiments were conducted to evaluate different nematode management strategies based on the varying densities of RKNs tomato varieties Assila, Sandokan and Riogrande as well as application of Mocap (Ethoprophos) were evaluated. These management options were also evaluated under greenhouse conditions to determine their relative effectiveness.

Research Application

The study found that Root knot nematodes were the most prevalent parasitic nematodes associated with tomato fields in Mwea. There was a significant difference between the mean fruit weights of the varieties with the variety Assila combined with 2 gm Mocap, consistently having the largest mean fruit weight under three root-knot nematode densities (Table 1).

Table 1.

Nematode density	Variety	Mocap rate	Mean Fruit Weight/plant (gms)
No RKN	Rio Grande	No Mocap	2,394.83[bcdef]
		Mocap 2gms	2,535.70[cdefg]
	Sandokan	No Mocap	2,756.67[efg]
		Mocap 2gms	2,645.83[defg]
	Assila	No Mocap	3,300.00[fg]
		Mocap 2gms	3,355.90[g]
Low RKN	Rio Grande	No Mocap	1,037.63[a]
		Mocap 2gms	1,646.30[abc]
	Sandokan	No Mocap	2,563.53[cdefg]
		Mocap 2gms	2,568.07[cdefg]
	Assila	No Mocap	2,607.13[defg]
		Mocap 2gms	3,273.83[fg]
High RKN	Rio Grande	No Mocap	1,021.17[a]
		Mocap 2gms	1,521.17[ab]
	Sandokan	No Mocap	1,569.73[ab]
		Mocap 2gms	1,744.30[abcd]
	Assila	No Mocap	1,853.37[abcde]
		Mocap 2gms	2,375.83[bcdef]

The study will result in the development of a more sustainable, cost effective and environmentally friendly nematode management strategy that is applied according to the nematode densities in the specific fields. This will ultimately result in increased yields and reduced nematode management costs for tomato producers in Mwea.

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