RUFORUM Working Document Series (ISSN 1607-9345), 2018, No. 17 (1): 733-737.
Available from *http://repository.ruforum.org*

Research Application Summary

Effect of root knot nematode, *Meloidogyne* spp. on the growth and productivity of tea clones in Meru County of Kenya

Mogeni, I. H., Muiru, W. M. & Kimenju, J. W.
University of Nairobi, Department of Plant Science and Crop Protection, P.O. Box 29053-00625, Nairobi, Kenya
Corresponding author: himogenis@gmail.com

Abstract

Plant parasitic nematodes have been reported in tea plantations in Kenya and have been associated with loss of tea plants in some areas. Nematodes associated with tea have been found to be well distributed in Ngere catchment of Murang'a County, Kangaita catchment of Kirinyaga County and Imenti catchment of Meru County. This study was conducted to establish the effect of the root knot nematodes on the growth parameters and productivity of the common tea clones and the recently released, high yielding clones in Kenya. These clones include TRFK 31/8, TRFK 301/4, TRFK371/3, TRFK430/90, and TRFK 306/1 (purple tea). The experimental plants were reared for three years before the experiment was carried out. The experiment was set up using the randomized complete block design. Two thousand eggs of *Meloidogyne* spp. were used to inoculate each potted plant and one potted plant was not inoculated to act as control. Growth parameters like stem girth, length of internode and number of new leaves were recorded. Data were statistically analyzed using Genstat edition 14. The nematodes affected significantly the growth parameters and yield of the high yielding, newly released clones TRFK 301/4, TRFK371/3, TRFK 430/90 and TRFK 306/1. The tea clone TRFK 31/8 was least affected and therefore considered resistant to the nematode attack while clone TRFK 430/90 was the most affected and therefore susceptible to nematode attack. Clone TRFK 430/90 is unsuitable for cultivation in areas infested with root knot nematodes while clone TRFK 31/8 is the most suited clone to manage root knot nematodes by resistance.

Key words: Kenya, plant parasitic nematodes, productivity, tea yield

Résumé

Des nématodes parasites des plantes ont été signalés dans les plantations de thé au Kenya et ont été associés à la perte de théiers dans certaines régions. Il a été constaté que les nématodes associés au thé étaient bien répartis dans le bassin versant de Ngere du comté de Murang'a, le bassin de Kangaita du comté de Kirinyaga et le bassin versant d'Imenti du comté de Meru. Cette étude a été menée pour établir l'effet des nématodes à galles sur les paramètres de croissance et la productivité des clones de thé communs et des clones à haut rendement récemment publiés au Kenya. Ces clones comprennent TRFK 31/8, TRFK 301/4, TRFK371 / 3, TRFK430 / 90 et TRFK 306/1 (thé violet). Les plantes expérimentales ont été élevées pendant trois ans avant la réalisation de l'expérience. Les plantes expérimentales ont été poussées pendant trois ans avant la réalisation de l'expérience. L'expérience a été mise en place en utilisant le dispositif de blocs complets randomisés. Deux mille œufs de Meloidogyne spp ont été utilisés pour inoculer chaque plante en pot et une plante

en pot n'a pas été inoculée pour agir comme témoin. Des paramètres de croissance comme la circonférence de la tige, la longueur de l'entre-nœud et le nombre de nouvelles feuilles ont été enregistrés. Les données ont été analysées statistiquement en utilisant la version 14 du logiciel Genstat. Les nématodes ont affecté de manière significative les paramètres de croissance et le rendement des clones à haut rendement nouvellement publiées TRFK 301/4, TRFK371 / 3, TRFK 430/90 et TRFK 306/1. Le clone de thé TRFK 31/8 a été le moins affecté et donc considéré comme résistant à l'attaque des nématodes tandis que le clone TRFK 430/90 était le plus affecté et donc sensible à l'attaque des nématodes. Le clone TRFK 430/90 ne convient pas à la culture dans les zones infestées de nématodes à galles alors que le clone TRFK 31/8 est le clone le plus adapté pour gérer les nématodes à galles par résistance.

Mots clés: Kenya, nématodes parasites des plantes, productivité, rendement du thé

Introduction

Tea is a major cash crop in Kenya contributing up to 26% of total national exports and is cultivated mainly through the small scale holder system. It is mainly grown in Mt. Kenya region, the Aberdares, Nandi hills, Kericho, Kisii highlands and along the Nyambene hills (TBK, 2003). Otieno *et al.* (2002) documented the outbreak of root knot nematodes in Kenya's Kerugoya and Imenti areas. It was noted that these areas were previously under coffee or forests. The attack was severe leading to decline in the plant's health and die back. Kamunya *et al.* (2008) conducted a study and reported that root knot nematodes were responsible for death of some tea clones in nursery conditions.

Nematodes have been reported in tea plantations in Kenya and have been associated with loss of tea plants in some areas (TBK, 2013). A study conducted by Wachira *et al.* (2014) in Ngere catchment of Murang'a County found out that nematode species associated with tea were well distributed in tea farms. Other studies conducted by Kamunya *et al.* (2008) found that nematodes were also well distributed in Kangaita, Kirinyaga County and Imenti, Meru County and were responsible for the declining population of tea in the areas. The study also reported that *Meloidogyne* spp. was responsible for total death of tea plants of clone TRFK 303/577 in nursery conditions. Nematodes have also been found to be responsible for declining populations of tea in other parts of the world. In India, root knot nematodes species *Meloidogyne javanica, Meloidogyyne incognita* and *Meloidogyne brevicauda* have been found to be well distributed in tea farms and have been linked to declining populations of tea plants.

Plant parasitic nematodes (PPNs) cause injury to plants as they feed on them. The nematodes have a hollow feeding structure, with a stylet and a pharynx that have undergone morphological and physiological adaptations to suit the nematode's mode of feeding. They feed by forming diverse and sometimes complex feeding relationships with their host plants (Luc *et al.,* 2005).

In general, PPNs use their stylet to mechanically injure plants through piercing as they withdraw and ingest nutrients from plants (Guagler *et al.,* 2004). In the process of feeding or in the attempt to obtain food from plants, the nematodes may also inject secretions into the plant cells weakening or modifying those plants.

Root knot nematodes are best controlled using resistant tea clones (TBK, 2003). Studies by Kamunya *et al.* (2008) showed that various tea clones have varying degrees of resistance to root knot nematode attack. Clone TRFK 303/577 was reported to be the most susceptible. This study investigated reactions of recently released tea clones to infection by *Meloidogyne* spp.

Materials and methods

The experiment was set up in a randomized complete block design using 2-year old clones under field conditions. A total of five clones including four of the commonly grown (TRFK 31/8, TRFK 301/4, TRFK 371/3, TRFK 430/90) and one specialty (TRFK 306/1) clone were used in the study. Nematodes (*Meloidogyne* spp.) were used to inoculate on potted tea plants by introducing their eggs to the plant's root zone and their effects on the plants observed for a period of twenty-four weeks. Un-inoculated plants served as controls. The treatments were replicated three times. Two thousand eggs/J2s were used to inoculate each potted plant. The eggs/J2s were obtained from bioassay plants using Sodium hypochlorite method as described by Hussey and Barker (1973). Growth parameters such as stem girth, number of leaves and internode length were measured fortnightly and recorded for 24 weeks. Disease severity and the level of physical stress on the plants was noted and recorded. The data obtained were analyzed using Genstat edition 14.

Results

Root knot nematodes had no significant impact on the growth parameters of tea clone 31/8 (Table 1). In tea clone 301/4, the root knot nematodes caused a significant reduction on the number of new leaves while the internode length and stem girth were not significantly affected (Table 1). In tea clone 371/3, only the stem girth was negatively affected by the root knot nematode while the internode space and number of new leaves suffered an insignificant reduction (Table 1). For clone 430/90, there was a significant reduction in all the growth parameters (Table 1). For tea clone 306/1, the nematode had a significant reduction effect on the number of new leaves while the effect on the other two parameters was not significant (Table 1).

Discussion

Clone TRFK 31/8 was tolerant to nematode attack. This clone yielded highly despite the nematodes attack. It also did not exhibit any sign of physical stress like chlorosis, wilting and die back. Stem girth, internode length and number of new leaves in this clone were also not significantly affected. Clones TRFK 301/4, TRFK371/3 and TRFK 430/90 were most affected with respect to number of harvestable new leaves and showed other physical disorders with 430/90 exhibiting the most severe aboveground symptoms. In these clones, stem girth and number of new leaves produced by the tea plants were significantly reduced. The new leaves are the harvestable product of interest to the farmers. Thus, a reduction in number of leaves means reduction in productivity and decline in

production per area leading to direct loss to farmers. The findings in this study are consistent with those of the studies carried out by Kamunya *et al.* (2008) in nematode infested areas of Kenya. Kamunya *et al.* (2008) noted that clone TRFK 31/8 did not show any above ground symptoms under nematode infestation. The study also established that clone 301/4 and 303/577 were most affected and showed severe above ground symptoms and galling of the roots (Kamunya *et al.,* 2008). Nematodes were also reported to cause slow decline and death of tea bushes in Sri Lanka (Gnanapragasam, 2002). Similar effects were also reported Orisajo (2012) in Nigeria.

Conclusion

Plant Parasitic nematodes (PPN) reduce on-farm tea productivity although the effect varies with clone. In this study the most susceptible clones were TRFK 301/4, TRFK371/3 and TRFK 430/90 while clone TRFK 31/8 was tolerant.

Acknowledgement

We acknowledge KTDA Research and Development Department for assisting in setting up the experiment and Kionyo tea factory for providing experimental plants and site. This paper is a contribution to the 2018 Sixth African Higher Education Week and RUFORUM Biennial Conference.

References

Gaugler, R., and Anwar, B. 2004. Nematode Behavior. Oxfordshire, UK: CABI

Gnanapragasam N. C. and Mohoti, M. M. 2005. Nematode Parasites of Tea. In: Luc, M. Sikora, R. A. and Bridge, J.(Eds.), Plant Parasitic Nematodes in subtropical and Tropical Agriculture. 2nd Edition. CABI.

Kamunya, S. M., Lang'at, J. K., Muoki, R. C., Nyabundi, K., Wachira, F. N., Otieno, W. and Sudi, V. 2008. Performance of tea clones established in root knot nematode host spots under varying treatment regimes. *Tea* 29 (1): 13-22.

Table 1. Effect of root knot nematode on the stem girth, internode length and number of new leaves (growth parameters) of tea clones TRFK 31/8, TRFK 301/4, TRFK 371/3, TRFK 430/90 and TRFK 306/1

	Clone TRFK 31/8			Clone TRFK 301/4			Clone TRFK 371/3			Clone TRFK 430/90			Clone TRK 306/1		
Treatment	SG	IL	NL	SG	IL	NL	SG	IL	NL	SG	IL	NL	SG	IL	NL
A	9.35^{a}	18.2^{a}	214^{a}	5.35^{a}	15.93^{a}	166.20^{a}	5.93^{a}	34.80^{a}	160.00^{a}	4.375^{a}	4.78^{a}	146.20^{a}	6.85^{a}	18.10^{a}	88.00^{a}
B	10.72^{a}	15.1^{a}	104^{a}	5.28^{a}	16.10^{a}	170.70^{a}	6.03^{a}	29.50^{a}	140.00^{a}	4.750^{a}	5.20^{a}	145.00^{a}	7.05^{a}	16.40^{a}	99.80^{a}
Control	11.02^{a}	11.2^{a}	93^{a}	6.10^{a}	19.90^{a}	610.50^{b}	9.20^{b}	25.90^{a}	183.00^{a}	6.80^{b}	13.50^{b}	290.00^{b}	7.50^{a}	16.40^{a}	231.00^{b}
LSD	2.78	9.61	121.00	1.16	4.43	66.00	2.08	19.22	70.00	1.43	1.89	114.60	2.97	14.98	24.44
C.V%	15.50	37.50	51.10	12.00	14.80	12.10	17.00	38.00	25.10	15.60	13.90	34.20	24.00	55.40	10.10
P Value	0.36	0.28	0.092	0.47	0.12	<.001	0.013	0.403	0.376	0.012	<.001	0.033	0.863	0.656	<.001

Means followed by different letters within the same column are significantly different. SG – Stem girth, IL- Internode length, NL – New leaves, Treatments A and B – inoculated with 5,000 eggs of *Meloidogyne* spp., Control – Free of nematodes

Kankam, F. and Adomako, J. 2014. Influence of inoculum levels of root knot nematodes (*Meloidogyne* spp.) on tomato (*Solanum lycopersicum* L.). *Asian Journal of Agriculture and Food Science* (ISSN: 2321 – 1571) 2 (2): 171-178.

Luc, M., Sikora, R. A. and Bridge, J. 2005. Plant parasitic nematodes in Subtropical and Tropical Agriculture. 2nd Ed., CABI International, Wallingford, Oxford, UK. 871 pp.

Orisajo, S. B. 2012. Distribution of plant parasitic nematodes associated with tea in Nigeria. *World Journal of Agricultural Sciences* 8 (5):459-463

Otieno, W., Sudoi, V., Wachira, F., Mamati, G. and Chalo, R. 200. A report on outbreak of root knot nematodes on tea in Kerugoya and Imenti. *TRFK Quaterly Bulletin* 7 (3): 6-8.

Mondal, T. K. 2014. Breeding and biotechnology of tea and its wild species. Springer 2014. 1-8pp.

TBK. 2013. TBK June News. Posted on 18 June 2013 http://www.teaboard.or.ke/news/2013/28.06.2013.html Accessed on 14, July 2014