Research Application Summary

Using *Crotalaria* species for the management of root-knot nematodes of vegetables in Western Kenya

Cheruiyot, H.K.[1], Ochuodho, J.O.[2], Omami, E.[1], Njira Njira[2] & Kipkoech, A.K.[1]
[1]Chepkoilel University College, School of Agriculture and Biotechnology, P. O. Box 1125, Eldoret, Kenya
[2]Moi University, P. O. Box 3900, Eldoret, Kenya
Corresponding author: hcheriuyot38@yahoo.com

Abstract

Vegetable production western Kenya is constrained by soil-borne pathogens including plant-parasitic nematodes. Almost all vegetable production fields in are infested with root-knot nematodes. There is therefore need to design measures for sustainable management of nematodes of which the use of resistant *Crotalaria* species is one option. *Crotalaria* species are poor host or non-host to many plant-parasitic nematodes This study aims at investigating the host suitability of ten *Crotalaria* species to root-knot nematodes under both greenhouse and field conditions. The efficacy of the most resistant Crotalaria spp. in management of root-knot nematode applied either as pre-plant cover crop, leaf extracts or soil amendment will be determined. A nematode management package arising from this study will be disseminated to smallholder farmers.

Key words: *Meloidogyne* spp., nematode hosts, plant parasitic nematodes, soil amendments

Résumé

La production des légumes dans l'ouest du Kenya est limitée par les agents pathogènes du sol, y compris des nématodes phytoparasites. Presque tous les champs de production de légumes sont infestés par des nématodes à galles. Il est donc nécessaire de concevoir des mesures pour la gestion durable des nématodes dont l'utilisation des espèces résistantes de *Crotalaria* est une option. Les espèces de *Crotalaria* sont de mauvais hôtes ou ne sont pas de hôtes de nombreux nématodes phytoparasites Cette étude vise à étudier la pertinence d'accueil de dix espèces de *Crotalaria* aux nématodes à galles à la fois dans la serre et dans le champ. L'efficacité de la plupart des espèces de *Crotalaria* dans la gestion des nématodes à galles, appliquées comme plantes de couverture de pré-semis, des extraits de feuilles ou de la modification du sol, sera déterminée.

Un progiciel de lutte contre les nématodes découlant de cette étude sera diffusé auprès des petits agriculteurs.

Mots clés: *Meloidogyne* spp., hôtes des nématodes, nématodes phytoparasites, amendements du sol

Background

Vegetables form an essential part of the human nutrition. The World Health Organisation recommends a daily intake of 400-600g of vegetables. In western Kenya, production of indigenous vegetables is extremely low. Soilborne pathogens including plant-parasitic nematodes are cited as major biotic production constraints for vegetables in the region. Nematode infection affects water and mineral conductivity into the plant besides increasing disease severity. Interestingly, several *Crotalaria* species are non-host to most nematode species. Therefore *Crotalaria* species may be included in vegetable production systems to suppress nematode population build up in soil . Unfortunately, such factors as genetic variation within the nematode species, crop cultivars, cropping season, method of application (pre-plant cover crop, intercrop or soil amendment), field history, cover cropping system and edaphic factors have been found to cause variable efficacy of *Crotalaria species* in nematode suppression (Wang *et al.*, 2002). The project aims at screening ten *Crotalaria* species for resistance to root-knot nematodes (*Meloidogyne* spp.).

Literature Summary

Several crotalaria species are non-host to most plant parasitic nematodes and have been reportedly used to suppress soil nematode populations. These species may be applied either as plant cover crop (trap crop), intercrop or as soil amendment in vegetable production systems. For instance, *Crotalaria spectabilis* grown as pre-plant can significantly reduce the population of *Meloidogyne hapla.* However, this crop species is extremely susceptible to *M. javanica*. Soil amendment with seeds of *C. spectabilis* can suppress *Meloidogyne javanica* better than non-amended soil. There are also reports of suppression of *Radopholus reniformis* by *Crotalaria juncea* (Wang *et al.*, 2002).

Cumulative effect of different allelochemicals produced in a mixed cropping system including *Crotalaria* have shown better capacity to suppress root knot nematodes in soil compared to pure stands (Schroth *et al*., 2000). *Crotalaria* spp. also enhances plant health by enhancing resistance to other biotic and abiotic stresses. An association of vasicular arbuscular

myccorrhizal fungi has been shown to increase plant absorption of phosphorus and water which reduces yield loses due to nematodes by improving Phosphorus availability within the host and/or antagonistic interactions with the fungal pathogens.

Suppression of nematode populations has been sustainably reduced by nematophagous fungi, *Verticillium clamydosporium* and *Nematophthora gynophila* (Bridge, 1996). *Crotalaria* spp. also enhance nutrient recycling which in essence promotes plant tolerance to nematode attack (Wang *et al.,* 2002).. One approach of deploying *Crotalaria* for nematode is to intercrop a vegetable crop with *Crotalaria,* a strategy known to suppress *Meloidogyne* populations beans (*Phaseolus vulgaris*) (Desaeger and Rao, 2000). Natural products with nematicidal potential have been confirmed by testing the effects of plant extracts (from leaves ,stems, fruits and seeds), oil extracts, plant exudates and plant volatiles on nematodes that attack plants (Ahmad *et al*., 2006). Application of chopped plant parts to soils also show nematicidal effects to root knot nematodes, hence reduce infection of plants. A similar approach could be tried as a strategy to manage nematodes under a vegetable cropping system.

Study Description

Field experiments were carried out in three counties in Western Kenya, namely, Bungoma, Kakamega and Busia where 40 farmer fields were identified per county. Pure cultures of nematodes were multiplied and maintained on a nematode susceptible tomato (*Lycopersicon esculenta*) variety *Rutgers* under green-house conditions. The experiments were carried out to assess the suitability of the various *Crotalaria species* to plant-parasitic nematodes, assess the efficacy of application methods of *Crotalaria* species in management of root-knot nematodes and to quantify inocula thresholds of nematodes in vegetable crops. *Crotalaria* species were planted in separate wooden boxes containing autoclaved forest soil. Nematodes were inoculated on the base of seedlings on five holes made around the individual plants five days after planting. Nematode numbers were determined eight weeks later using gall numbers or the Seinhorst equation,

$$Pf = M (1-e^{-a})$$

where Pf=final population, M = maximum nematode population, a = maximum multiplication rate and e = natural logarithm (2.1416) (Seinhorst,1967).

In assessing the efficacy of different application methods, the *Crotalaria* species were applied in different ways, namely, as a pre plant, leaf extracts or soil amendment. As a leaf extract, the aerial parts of different *Crotalaria* spp. were chopped and their nematistatics and nematicidal effects determined. ELISA type plates were used. In each of these plates, 50ml of the plant extract was added against 50µl nematode inoculum. For the soil amendment, nematode infestation was studied on four different vegetable types by growing them on boxes amended with the resistant *Crotalaria* spp. Nematode inoculum was then applied to the plants with in different pots containing different organic amendments and allowed to grow followed by extraction and quantification of nematodes from soils. Quantification was done under the microscope. As a pre-plant, *Crotalaria* species was grown in pots, ploughed back as green manure before the different vegetables were grown. Inoculation was then done and assessment done by quantification after extraction.

To quantify the inocula thresholds of the nematode, four vegetable species were planted: black night shade (*Solanum nigrum*), Jute mallow (*Corchorus oliforius)*, spider plants (*Cleome gynandra*) and spinach (*Spinacia oleracea)*. Inoculation with nematode inocular on These plants were inoculated with nematodes progressively assessed for growth (plant height, stem diameter, leaf size and length) was done as the plant matures. A control using water as inoculum was included.

Research Application

By the end of the project, the most resistant *Crotalaria* species should have been determined. At the same time, a suitable application method of this species will also have been identified (either as a pre-plant, cover crop or intercrop). Ultimately, it is expected that with the adoption of a resistant *Crotalaria* variety and a suitable method, the production of vegetables in western Kenya will increase.

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