Management of root-knot nematodes on Yam with *Trichoderma viride*

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Abstract

Root-knot nematodes (Meloidogyne spp.) are one of the most economically damaging agents on yam producing fields which could lead to 100 % yield loss. The use of biocontrol agents such as fungi is among the sustainable methods recommended to manage the menace of root-knot nematode infection on yams. The potential of three isolates of Trichoderma virideto reduce soil populations of Meloidogyne spp. was evaluated at three yam producing locations in Ghana. Trichoderma viride was isolated from soil sampled from Atebubu (A), Kintampo (K) and Wenchi (W). Trichoderma viride suspensions at a concentration of 1.7 x 107spores/ml isolate was inoculated on three yam varieties one month after planting. Inoculation of T. viride resulted in significant reduction in Meloidogyne populations at all the locations on all the three yam varieties. At Atebubu, all the three isolates (A, K, W) reduced Meloidogyne populations by 78.8%, 66.8% and 66.2% respectively on Pona. Higher suppressive effects of 90% and 85.6% were achieved by isolate K on Afebetua at Atebubu and Kintampo respectively. Isolates A recorded the minimum control effect of 30.4% on Afebetua at Wenchi. No nematodes were recovered from the peels of inoculated tubers at harvest.

Key words: Dioscorea rotundata, Meloidogyne spp, Root-knot nematodes, Trichoderma viride

Gestion des nématodes cécidogènes à *Trichoderma viride*

Résumé

Les nématodes à galles (Meloidogyne spp.) sont l'un des agents les plus dommageables sur le plan économique dans les champs des producteurs d'igname, ce qui pourrait entraîner une perte de rendement de 100%. L'utilisation d'agents de lutte biologique tels que les champignons est parmi les méthodes durables recommandées pour gérer la menace de l'infection par les nématodes cécidogènes sur les ignames. Le potentiel de trois isolats de Trichoderma virideto réduit les populations de Meloidogyne spp. a été évalué dans trois sites de production qui vient d'ignames au Ghana. Trichoderma viride a été isolé à partir du sol échantillonné à partir d'Atebubu (A), Kintampo (K) et Wenchi (W). Des suspensions de Trichoderma viride à une concentration de 1,7 x 107spores / ml d'isolat ont été inoculées sur trois variétés d'ignames un mois après la plantation. L'inoculation de T. viride a entraîné une réduction significative des populations de Meloidogyne à tous les emplacements sur les trois variétés d'ignames. A Atebubu, tous les trois isolats (A, K, W) ont réduit les populations de Meloidogyne de 78,8%, 66,8% et 66,2% respectivement sur Pona. Des effets suppresseurs plus élevés de 90% et 85,6% ont été obtenus par l'isolat K sur Afebetua à Atebubu et Kintampo respectivement. Les isolats A ont enregistré l'effet de contrôle minimum de 30,4%

sur Afebetua à Wenchi. Aucun nématode n'a été récupéré des pelures des tubercules inoculés lors de la récolte.

Mots-clés: Dioscorea rotundata, Meloidogyne spp, Nématodes à galles, Trichoderma

Introduction

Root-knot nematodes (*Meloidogyne* spp) play significant role in yam production worldwide. These nematodes inhabit soils and in plant parts and their feeding habits incite galls or swells on yam tubers leading to quality reduction and yield loss. Reduction of 20 - 30% in tuber weight at harvest and over 50% loss of yam tuber at storage has been reported (Kwoseh *et al.,* 2005; Amusa *et al.,* 2003). In Ghana, most cultivars of yam are attacked by root-knot nematodes (Hemeng, 1975) and several management options including chemicals, cultural methods have been employed to control root-knot nematodes. The use of biocontrol agents such as fungi is among the sustainable methods recommended to manage the menace of root-knot nematodes infections. The fungi *Trichoderma* are found in nearly all agricultural soils and are reportedto possess biocontrol abilities against root-knot nematodes (Izuogu and Abiri, 2015). *Trichoderma* species have been evaluated for management activity against plant parasitic nematodes (Al-Hazmi and Tariq Javeed 2016) and metabolites of *T. Viride* have been reported to be effective in controlling nematodes in tomato according to Sharon *et al.* (2001). This study was undertaken to evaluate the potential of three isolates of *Trichoderma viride* to reduce soil populations of *Meloidogyne spp.* on three white yam (*Dioscorea rotundata*) varieties in three locations of Ghana.

Methodology

Isolation of Trichodermaviride

The study areas were Atebubu, Kintampo and Wenchi, all located within the Forest Guinea Savanna Transition zone of Ghana. *Trichderma viride* was isolated from soil samples collected from the three locations. Using serial dilution technique, five-fold dilutions of each of the soil samples was prepared with distilled water. One millilitre of each solution at 1 x 10 - 5 and 10 - 4 was pipetted onto Potato Dextrose Agar (PDA) plate and incubated at 28 ± 2°C for four days. After the period of incubation, *Trichoderma viride* was isolated onto fresh PDA plates and cultured for four days. *Trichoderma viride* was re-isolated and stored on fresh PDA plates in the refrigerator at 4°C until used.

Preparation of inoculum

To produce *Trichoderma* spore suspension (inoculum), 100 ml of distilled water was added to 10-day-old cultures. Mycelia and conidia were carefully scraped from the media by gentle surface agitation with a flamed inoculation needle. Spores produced were harvested by filtration through sterilized muslin cloth. Spore concentration was measured with haemocytometer and adjusted to 1.7 x 107 spores per ml. Three different spore suspensions of Trichoderma sp. from Atebubu (A), Kintampo (K) and Wenchi (W) were prepared.

Field inoculation

Three white yam varieties (Pona, Dente, Afebetua) were planted in 20 mounds per plot on 12 m x 12 m plot size with 1m distance between and within mounds and 2 m distance between in Randomized Complete Block Design (RCBD) blocks and replicated 5 times. After one month of planting, *Trichoderma inoculum* was inoculated at 25

ml per plot (5 ml per mound on 5 mounds in a plot). Five mounds served as control.

Assessment of Meloidogyne spp. populations from soil

The experimental fields were naturally infested with nematodes. Using the extraction tray method by Whitehead and Hemming (1965) modified Bearmann's tray method, populations of *Meloidogyne* spp. in the soil were determined before planting (P1) and at harvest (P2) of the yam varieties. Data were analysed using GenStat 8.1.

Results and Discussions

All the three isolates of *Trichoderma viride* significantly reduced populations of *Meloidogyne* spp. in soil on all the three yam varieties in the three locations (Figs. 1, 2, and 3). Isolates of *Trichoderma* spp. having suppressive effect on nematode in the soil have been observed by Izuogu and Abiri (2015) on soybean and Sharon *et al.* (2001) on tomato. Reduction of *Meloidogyne* spp. populations in percentages is presented in Table 1. All three isolates of *Trichoderma viride* (A, K, W) effectively reduced populations of *Meloidogyne* spp. in soil by more than 50% on all the three yam varieties in all locations. At Atebubu, all the three isolates (A, K, W) reduced the pest populations by 78.8%, 66.8% and 66.2% respectively on Pona; 76.9, 75.4% and 85.8% respectively on Dente; and 79.1, 90.3 and 80.4 respectively on Afebetua. However, at Wenchi, less than 50% reduction of the pest populations was recorded by isolates A (30%) and K (49%) on Afebetua. Higher suppressive effects were achieved by isolate K on Afebetua at Atebubu (90%) and Kintampo (85.6%).

Conclusion

The effectiveness of *Trichoderma viride* as a biocontrol agent against root-knot nematodes (*Meloidogyne* spp.) has been established by the present investigation. All the three isolates of *Trichoderma viride* were effective in managing the pest in the three locations. The

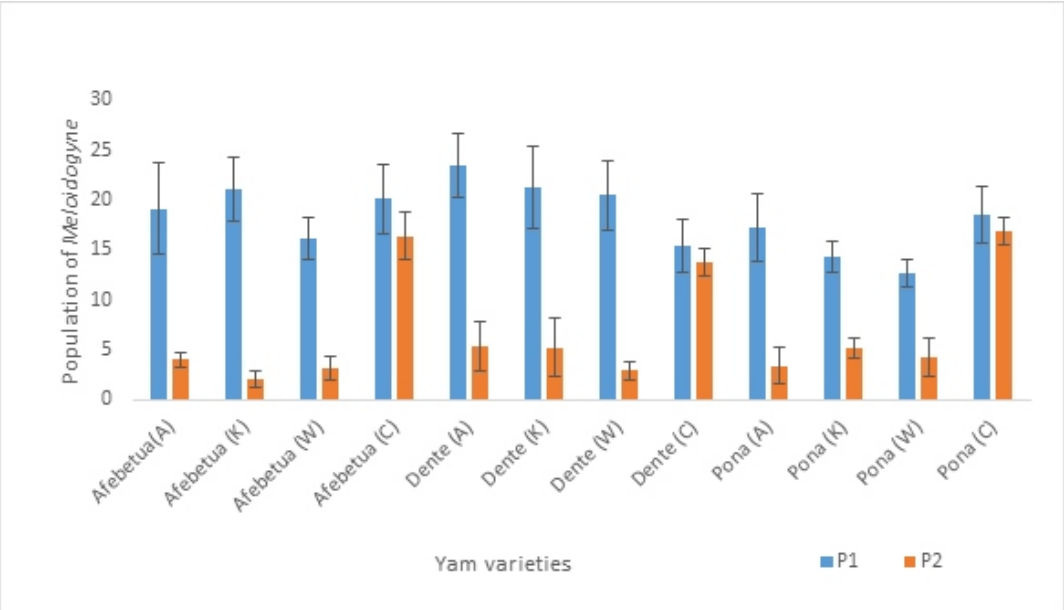

Figure 1: Populations of *Meloidogyne spp.* before planting and at harvest of three yam varieties treated with three *T. Viride* isolates at Atebubu

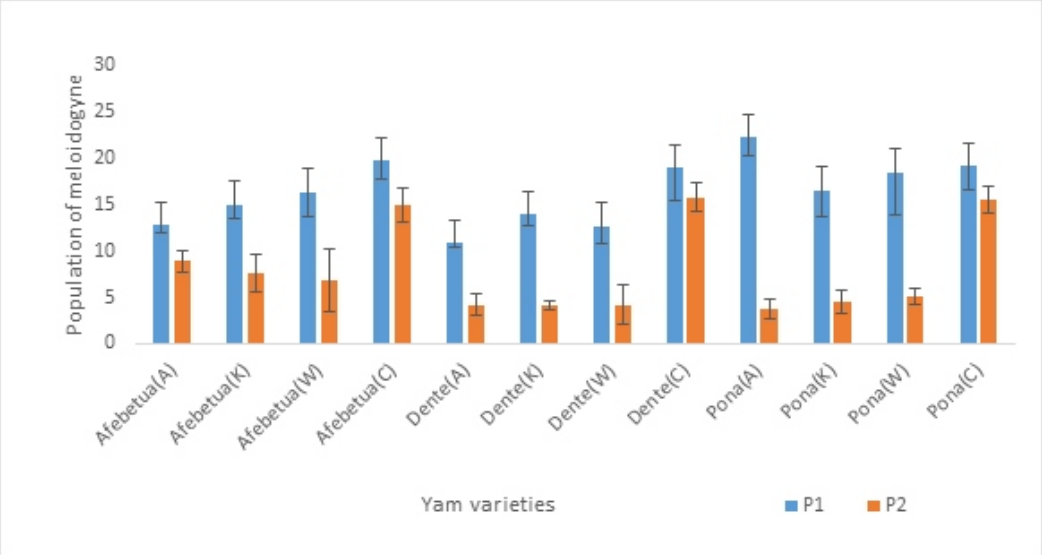

Figure 2: Populations of *Meloidogyne spp.* before planting and at harvest of three yam varieties treated with three *T. Viride* isolates at Wenchi

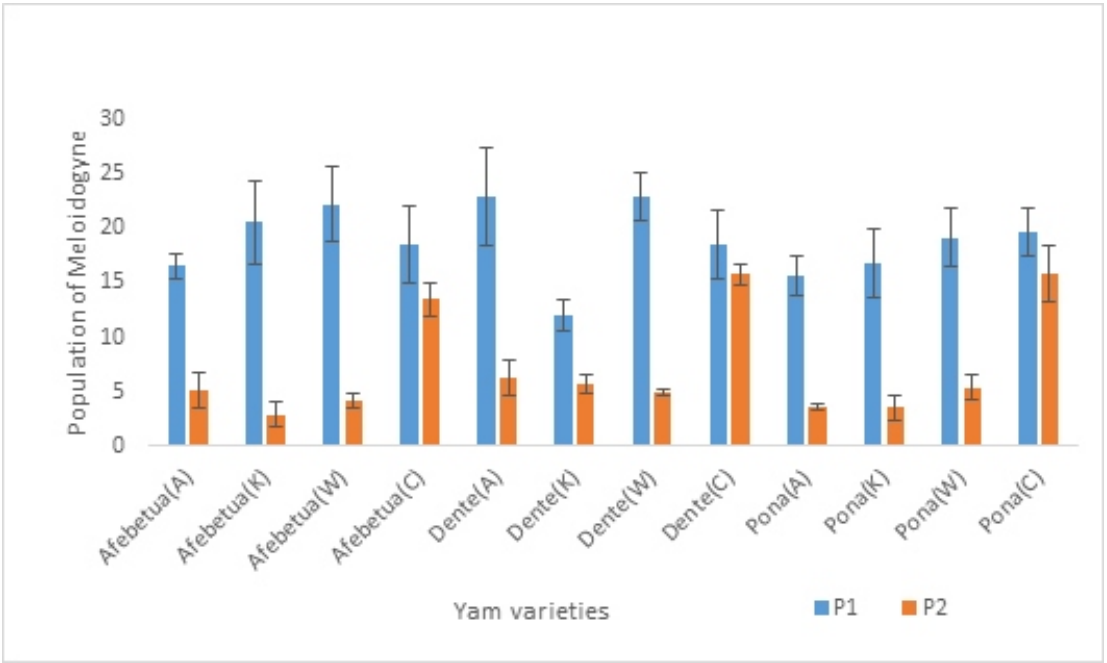

Figure 3: Populations of *Meloidogyne spp.* before planting and at harvestof three yam varieties treated with the three *T. Viride* isolates at Kintampo

Table 1: Percentage reduction in root-knot nematodes on the three yam varieties at the three locations

LOCATION	VARIETY	ISOLATE		
		A	K	W
Atebubu	Pona	78.8	66.8	66.2
	Dente	76.9	75.4	85.8
	Afebetua	79.1	90.3	80.4
Kintampo	Pona	77.1	78.8	71.5
	Dente	72.1	52.3	78.2
	Afebetua	68.6	85.6	81.1
Wenchi	Pona	83.2	73.1	72.3
	Dente	61.2	70.2	66.7
	Afebetua	30.4	49.0	58.1

present investigation is an important step in developing the indigenous fungi *T. viride* as commercial formulation for managing *Meloidogyne* spp. in yam producing fields.

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