World Journal of Agricultural Sciences 5 (4): 432-435, 2009
ISSN 1817-3047

Effect of Different Animal Manures on *Meloidogyne incognita* (Kofoid and White) on Tomato

K. Pakeerathan, G. Mikunthan and N. Tharshani

Department of Agricultural Biology, Faculty of Agriculture, University of Jaffna, Sri Lanka

Abstract: Root-knot nematode, *Meloidogyne incognita* are generally regarded as silent enemies in soil and cause losses up to 80% in heavily infested vegetable fields. Stunting, yellowing and a general unthrifty appearance are the symptoms developed above ground slowly over time and remain unnoticed until plants are well developed. Infested tomato wilt or die in hot, dry weather causing losses in yield ranging from 28-68%. A screen house study was conducted to test the effect of different animal manures on the eco-friendly management of *M.incognita* on tomato. Recommended dosage of manures, biological control agent and chemical nematicide were compared with control. The results revealed that goat manure was the best alternative for the management of *M.incognita* and more or less equally effective to carbofuran. It is not only suppressing the gall formation but also improve crop growth and biomass production. While bio agent, *Tricoderma viride* and poultry manure ranked third and fourth, respectively in managing *M.incognita*. This management study revealed that organic amendments improve the plant growth and check the nematode infestation in vegetable fields.

Key words: Galls · Goat manure · *Meloidogyne incognita* · Tomato · Root-knot

INTRODUCTION

Root-knot nematodes infect a wide range of crops particularly vegetables and cause losses up to 80% in heavily infested fields [1]. Short life cycle of six to eight weeks enables to survive well in presence of a suitable host. Host plants have varying degree of susceptibility. In susceptible plants, nematode population builds up to a maximum usually as crop reach maturity [2]. And in some cases the plants die even before reaching maturity [3].

Root-knot nematodes (*Meloidogyne* sp) are one of the major pathogens of tomato worldwide and limit fruit production [4], estimated yield losses ranging from 28 to 68% [5]. The control of plant parasitic nematodes is a difficult task, has mainly depended on chemical nematicides for decades and remarkable reduction of nematode population has been achieved [6, 7]. Although soil nematicides are effective and fast-acting, they are detrimental to the environment and human health [8]. In addition to that they are relatively unaffordable to many small-scale farmers.

Inventing alternative strategies for management of root-knot nematodes has been emphasized to researchers, farmers and scientists that do not pollute the environment [9]. There are lots of alternative strategies that have been reported by the crop protectionist such as application of soil organic amendments of crop residues and animal manures [10], heat treatment, soil solarization and crop rotation with non hosts for managing root-knot nematodes [3].

Application of organic amendments in the soil is not only beneficial to nematode management but also improving the plant growth and productivity [11]. On the other hand, application of organic substrates leads to build-up of beneficial micro flora around the rhizosphere, which will help to reduce the plant parasitic nematodes in the soil. Other best alternatives are the usage of root-knot nematode resistant varieties, breeding of resistant varieties from the traditional cultivars, application of biological control agents that are able to parasitize on nematode eggs or juveniles and proper application of nutrients to the plant to keep the plant healthy and vigour, if weak nematode attack will be high [12]. They are environmentally safe and economically viable means of managing root-knot nematode and have comparatively better yield than infected susceptible crop varieties.

This study was aimed to eco-friendly management of root-knot nematode *Meloidogyne incognita* by using animal manures.

Corresponding Author: Kandiah Pakeerathan, Department of Agricultural Biology, Faculty of Agriculture, University Of Jaffna, Zip code: 40000, Sri Lanka Mob:+94 776969511

MATERIALS AND METHODS

In the present investigation a laboratory study was carried out at the Department of Agricultural Biology, Faculty of Agriculture, University of Jaffna during October 2008 to March 2009. The root-knot nematode *Meloidogyne incognita* (Kofoid and White) inoculum for this experiment was obtained from the infected tomato field. Uprooted tomato plants of KC1 variety containing root galls were washed free of adhering soil particles and the root tissues teased apart with forceps to remove pear shape adult females. Isolated females were surface sterilized in 1:1500 (v/v) aqueous solution of sodium hypo-chloride and transferred in to a (moisture chamber) tissue paper attached with sieve placed in to a Petri plates containing sufficient amount of water. The Moisture chamber was transferred in to incubator at 25±5°C for 5 days.

Experiments were conducted in ten litre of pots each containing six Kg of autoclaved soil mixed with different animal manures, biological agent and nematicide (Table 1) at the recommended dosage. Three weeks old tomato seedlings of KC1 variety were planted in to each of the pots. The single egg mass was used as inocula for every pots and was inoculated one day after transplanting. All pots were arranged in to six groups containing six treatments with four replicates.

Vermicompost was obtained from Department of Agricultural Biology vermiculture unit, goat and poultry manures were obtained from potential dairy as well as poultry rearing farmers.These pots were randomized. This experiment was carried out using the experimental design of RCBD. Data of plant height, number of galls per root system and plant dry weight were measured. Dunnet mean separation was done by using SAS package.

Daily mean temperature and rain fall were recorded. Height of plants was measured weekly until flowering. The plants were carefully dug out at the time of 50% of flowering and Plant fresh weight, plant dry weight were measured and gently washed to remove soil from roots. Plant roots were examined carefully under stereomicroscope and number of galls per root system was counted. Root-knot index was determined using a scale described by Sasser *et al*., [13]. Scale of 0 = No galling; 1 = 1-10 galls; 2 = 11-20; 3 = 21-30; 4 = 31-100 galls and 5 = more than 100 galls.

Table 1: Organic amendments used for nematode management

Amendments (treatments)	Rate of application
Vermicompost	800 Kg/ha
Goat manure	800 Kg/ha
Poultry manure	800 Kg/ha
Carbofuran (furadan)	10 kg/ha
Green mould (*Trichoderma viride*)	50ml/kg
Control	------

RESULTS AND DISCUSSION

Organic amendments reduce the root infection of nematode by various ways such as act as physical barrier to nematode movement, change diversity of root micro flora and their population and change physical and chemical properties of soil. The effect of chemicals such as carbofuran (furadan) and biological agents like *Trichoderma* sp and *Pseudomonas* sp are different.

Gall formation was significantly different ($p<0.05$) in carbofuran and goat manure from compare to control (Table 2). In tomato gall formation was the lowest (9) in chemical treatment (Fig. 1) confirming that carbofuran has nematicidal property. Hence, quick knock down effect of chemicals lead to high mortality of juveniles and eggs of *M.incognita*.

Goat manure ranked second in number of galls counted (10.75) and had well developed root system. These observations revealed that development of healthy root system and aggregating ability of soil particles is high in goat manure. For healthy root system requires major important elements such as phosphorus and potassium which are high in goat manure (P=0.7%, K=1.9%) and low in vermi-compost (P=0.47%, K=0.7%). Sufficient supply of these macro elements enhances the development of healthy root system which suppresses the nematode infection. Hence number of galls was low in goat manure and high in vermicompost.

Pellet like structure of goat manure increases the soil aggregation but it was very poor in vermicompost because vermicompost is a well decomposed material. Hence free movement of nematode was restricted in goat manure. In poultry manure (N=3%), rate of ammonia

Table 2: Effect of different organic amendments on root-knot nematode

Treatment	Plant height(cm)	Plant fresh Weight(g)	Number of Galls
Vermicompost	57.52^{a}	109^{a}	91^{c}
Goat manure	52.025^{a}	130.25^{a}	10.75^{a}
Poultry manure	40.07^{b}	59.62^{b}	34.75^{b}
Trichoderma viride	36.9^{c}	72.66^{b}	27.5^{b}
Carbofuran	32.82^{c}	96.12^{a}	9^{a}
Control	31.6^{c}	79.85^{b}	98.5^{c}

(Dunnet mean separation, $\alpha=0.05$)

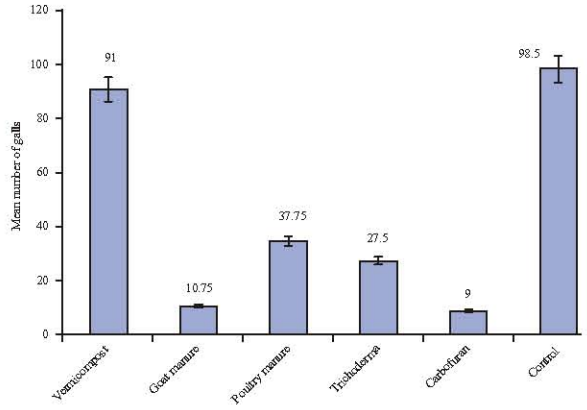

Fig. 1: Extent of galls in different treatments

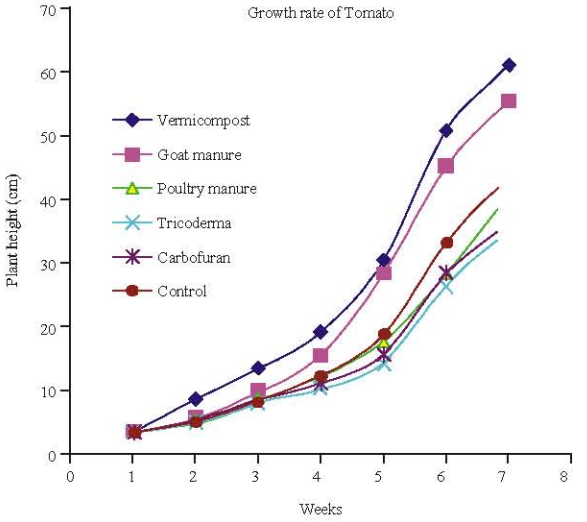

Fig. 2: Growth rate of tomato in different organic amendments

production was very quick and high compared to others if left exposed to environment. Nematodes are susceptible to ammonia gas [13].

Application of *Trichoderma viride* was ranked third in reducing number of galls compared to carbofuran and goat manure. *Trichoderma* sp infect on eggs [14] and juveniles of *Meloidogyne* sp [15]. Environmental conditions such as temperature and moisture had an effect on the pathogenicity of *T. viride*.

Organic soil amendments increases not only the growth of tomato plant but also useful to eco-friendly management of root-knot nematode [1, 16]. Results showed (Fig. 2) that both vermi-compost and goat manure were significantly induced the growth of seedling at its

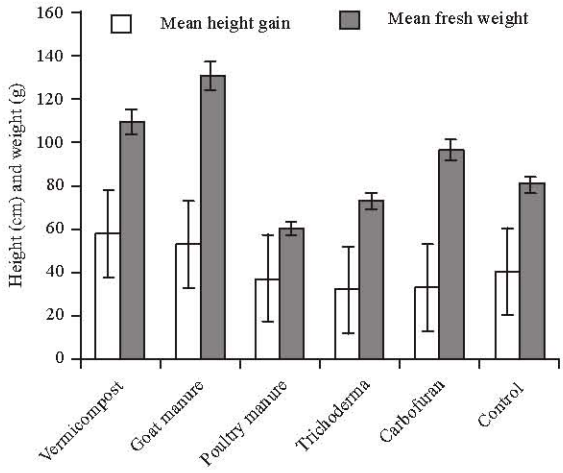

Fig. 3: Plant weight and height combination in different treatments

early stages (second and third week). This was because of both manures are having high amount of nitrogen (1.94% in vermicompost and 4.9% in goat manure) which is important for plant growth. Even though plant growth was the highest (61 cm) in vermicompost because contributors to supply micronutrients that are essential for plant growth, apart from this stimulatory effect of vermicompost for nutrient up take, growth and yield, which are linked with secretion of earthworms and associated microorganisms mixed with the cast.

Biomass is an important parameter that influence on yield of the crop. Results showed that increment of biomass was highest (130.25 gram) in goat manure (Fig. 3), it consisted high N, P, K which are important for biomass production.

Among the organic amendments goat manure was the best alternative in the eco-friendly management of *M. incognita* compared to chemicals and other amendments tested due to the lowest gall formation, high growth rate and highest biomass gain.

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