Control of root-knot nematode, *Meloidogyne incognita* by urea coated with Nimin or other natural oils on mung, *Vigna radiata* (L.) R. Wilczek

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ABSTRACT

The present study was undertaken to evaluate the effect of soil amendment with urea coated with nimin (neem-based product with neem-triterpenes) and oils of neem, castor, and rocket- salad on the root-knot nematode, *Meloidogyne incognita*, and plant growth of mung in pots. Soil amendment with urea coated with different doses *viz.,* 0.02g, 0.04g and 0.06g/pot of nimin and oils of neem, castor rocket-salad significantly reduced the development of the root-knot nematode and thereby improved plant growth and increased chlorophyll content of mung leaves at 1% and 5% level of signicicance. The highest improvement was observed in plants treated with urea coated with nimin than neem oil, castor oil and rocket-salad. A significant reduction in root-nodulation was also observed as a result of soil amendment with urea coated with different doses of nimin and plant oils at 1% and 5% level of significance. Soil amendments with urea coated with the larger doses of the treatments were more effective than soil amended with smaller doses.

Key words: Chlorophyll, control, natural oils, nimin, plant growth, root-knot nematode, root-knot index, soil amendment, *Vigna radiata*

INTRODUCTION

The mung bean (= mung or green gram or golden gram) is the seed of *Vigna radiata* (L.) R. Wilczek. Different species of nematodes have been reported to infect and cause serious damage. But the information of the loss caused by the nematodes on mung is scanty. Several control measure such as regulatory, physical, chemical, cultural and biological methods have been employed for the control of nematodes on mung and other pulse crops but these control measures have one or other limitations. Soil amendment with oil-cakes of neem, castor, mustard, and other plant products and manures have been successfully used for the control of plant-parasitic nematodes (Alam, 1990; Akhtar and Mahmood, 1996; Wani, 2006; Tejada *et al*., 2006, 2009; Deepa *et al.,* 2011; Mohan, 2011; Sivakumar and Gunasekaran, 2011**;** McGeehan, 2012). However, the bulk amounts required for control of nematodes is a practical disadvantage. Nematicides are detrimental to human and environmental health. Use of nematicides has not been found economical for mung. Seed coatings with neem oil, neem formulations and products from obtained from different plants, have also been used for the control of plant parasitic nematodes (Leela *et al*., 1992; Akhtar and Mahmood, 1995a,b; Javed *et al*., 2008; Ayeni and Adeleye, 2011; Sivakumar and Gunasekaran, 2011). It has been reported that application of appropriate concentration of nimin (a neem based urea coated material) with urea can promote crop yield and reduce the number of nematodes (Akhtar and Alam, 1993b; Kondo *et al.*, 2005). Nimin, a neem-containing triterpenes that act as nitrogen inhibitors and thus ensures slow release of nitrogen by leaching and also ensures continuous supply of nitrogen to the plants. The basic concept of controlled-release or slow-release fertilizers is that they release their nutrient contents at more gradual rates that permit maximum uptake and utilization of the nutrient while minimizing losses due to leaching, volatilization or excessive turf growth. The efficacy of urea fertilizer coated with Nimin and different oils have not been ascertained earlier on the root-knot nematode infecting mung. Therefore, a study was undertaken to assess the effects of soil amendment with urea coated Nimin and oils of neem (*Azadirachta indica* A. Juss), castor (*Ricinus communis* L.) and rocket-salad (*Eruca sativa* L.*)* on the root-knot nematode, *Meloidogyne incognita* (Kofoid *et* White) Chitw. and plant growth of mung (*vigna radiata*.L) cv. Local

MATERIALS AND METHODS

Different doses, *viz.,* single strength (SS), double strength (DS) and triple strength (TS) were prepared by mixing 1, 2 or 3 g of 'Nimin'(a neem based product of Gorej Soaps, Ltd., Mumbai, India, rich in triterpenoids) and natural oils obtained from dried seeds of neem, castor and rocket-salad with 100 g of urea separately. The urea coated with different treatments as above were added to each 15cm pots at the rate of 2 g/pot. Thus the

pots received 0.02, 0.04 or 0.06 g natural oils respectively. Seeds of mung, *Vigna radiata* (L.) R. Wilczek cv. local was sown in these pots. One week after germination thinning was done to keep one plant per pot. Twenty-day old seedlings were each inoculated with 2,000 freshly hatched second stage juveniles (J_2) of *M. incognita* (Kofoid *et* White) Chitwood. The experiment was conducted on cemented floor out doors with temperature in the range 20-25°C.

For obtaining second stage juveniles (J_2), egg masses of the nematode were picked from the roots of tomato plants growing in concrete culture beds. The egg masses were then placed in 7.5-cm-diameter sieves of 1 mm pore size and lined with double layer of tissue paper and placed in 10-cm-diameter Petri plates containing enough water. The Petri plates were maintained at room temperature (25±1°C) for 3 days and thereafter the water containing the emerged J_2 of the nematode was collected.

The number of J_2 per unit volume of the water suspension was determined by counting them in a counting dish under a stereoscopic microscope. Appropriate amounts of the J_2 suspensions were added to the roots of the test plants by making holes around the root system so that each plant received 2000 J_2 of the nematode. There were five replicates for each treatment including the control. Three months after inoculation the experiment was terminated. Then plants were carefully uprooted and roots washed gently. Roots and shoots were separated by cutting and then their lengths and weights were determined separately. For determining dry weight, roots and shoots were dried in an oven at 60 °C separately. Chlorophyll content of fresh leaf samples, randomly collected from each plant was recorded by the method described by Hiscox and Israelstam (1979). Root-knot index was assessed on a 0-5 scale according to Sasser *et al*. (1984) as follows: 0 = no gall, 1 = 1-2 galls, 2 = 3-10 galls, 3 = 11-30 galls, 4 = 31-100 galls and 5 = more than 100 galls per root system. Root nodule index was also assessed according the following rating scale: 0 = no nodules, 1 = 1-10 nodules, 2 = 11-30 nodules, 3 = 31-50 nodules, 4 =51-100 nodules and 5 =>100 nodules per root system. Data obtained from the experiment was analysed statistically for critical difference (C.D.) at P=0.05 and P=0.01 as per the procedure described by Panse and Sukhatme, (1978).

RESULTS AND DISCUSSION

It was observed from the results that soil amendment with urea coated with either 'Nimin' and oils of neem, castor rocket-salad caused significant reduction in the root-knot development caused by *M. incognita* (Table 1). Nimin coated urea at higher doses proved to be highly effective in reducing the root-knot development followed by urea coated with neem

Table 1. Effect of soil amendment with urea coated with nimin and other natural oils on the root-knot nematode, *Meloidogyne incognita*, and growth of mung plants.

Treatment	Dose/pot (g)	Plant length (cm)			Dry weight (g)			Chlorophyll (mg/g)			Root-knot index (0-5)	Root nodule index (0-5)
		Shoot	Root	Total	Shoot	Root	Total	Chl. a	Chl.b	Total (a+b)		
Nimin	0.02	32.0	18.7	50.7	2.2	0.2	2.5	0.510	0.474	0.984	2.6	3.6
	0.04	34.9	20.0	54.9	2.3	0.8	3.1	0.518	0.492	1.010	2.0	4.0
	0.06	38.7	20.8	58.5	2.1	1.2	3.3	0.524	0.498	1.012	1.0	4.3
Neem oil	0.02	30.6	18.7	48.3	1.9	0.8	2.7	0.493	0.433	0.926	3.0	3.3
	0.04	33.1	18.1	51.2	2.0	0.8	2.8	0.510	0.476	0.986	2.6	3.6
	0.06	36.2	18.3	54.5	2.3	1.1	3.5	0.529	0.493	1.022	1.1	4.3
Castor oil	0.02	30.8	15.2	46.0	1.9	0.7	2.6	0.484	0.437	0.921	3.3	2.8
	0.04	32.1	15.9	48.0	2.0	0.7	2.7	0.497	0.439	0.936	2.3	3.0
	0.06	34.2	16.9	51.1	2.2	1.1	3.3	0.519	0.475	0.994	1.3	3.3
Rocket-salad oil	0.02	25.7	15.8	41.5	1.9	0.6	2.5	0.478	0.422	0.900	3.6	2.3
	0.04	27.0	16.6	43.6	1.9	0.7	2.6	0.492	0.452	0.944	2.6	2.6
	0.06	28.9	18.2	47.1	2.2	1.3	3.5	0.515	0.474	0.989	1.6	3.0
Urea alone		26.2	13.0	39.2	1.9	0.5	2.6	0.466	0.399	0.855	4.0	2.0
Untreated		25.0	12.8	37.8	1.8	0.5	2.4	0.289	0.223	0.512	4.6	1.0
C.D.(P=0.05)				3.56			0.48			0.34	0.082	0.65
C.D.(P=0.01)				4.84			0.66			0.48	0.108	0.85

Each value is a mean of five replicates.
Inoculum level of *Meloidogyne incognita* = 2000 J_2/pot.

oil, castor oil, and rocket-salad respectively. The highest reduction in the root knot index was observed in the plants of mung raised from pots amended with urea coated with Nimin at higher doses (P=0.05). It was followed by plants raised from pots amended with urea coated with other natural oils. The lower doses also showed significant reduction in root galling as compared to control. However, the lower doses of all the treatments reduced root galling to a lesser extent. The highest root-knot index was observed in plants grown in pots without any treatment.

A significant improvement in plant growth of mung was also observed at 1% and 5% level of significance due to application of urea coated with Nimin and oils of neem, castor and rocket-salad as compared to plants without any treatment. The highest plant growth was observed in plants raised from pots amended with urea coated with Nimin at higher doses than by plants treated with neem oil, castor oil, and rocket-salad oil. The least plant growth was observed in plants without any treatment.

The chlorophyll content of the leaves also increased significantly as compared to untreated control at 1% and 5% level of significance due to the application of urea coated with Nimin and oils of neem, castor and rocket-salad respectively. However, the maximum chlorophyll content was found in plants raised from pots amended with urea coated with Nimin at higher doses. The significant increase in chlorophyll content was also observed at lower doses but it was lesser than the higher doses of urea coated with Nimin and other natural oils. The least chlorophyll was found in plants without any treatment.

The soil amendment with urea coated with different doses of Nimin and plant oils brought about significant increase in *Rhizobium* root nodule index at both 1% and 5% level of significance as compared to untreated plants. The application of Nimin coated urea at higher doses increase the number of root nodule index more followed by plants treated with plant oils. The least root nodule index was observed in non-treated plant.

It is thus clear from the results that soil amendment with Nimin coated urea and urea coated with natural oils brought about significant reduction in root-knot index and improvement in root nodulation, plant growth and chlorophyll content of leaves of mung. The higher doses proved more efficient than lower doses. It is probable that nematode control efficacy by Nimin and different oils might be due to the presence of nematode-toxic compounds or many bioactive compounds that are released during breakdown of oils (Akhtar and Mahmood, 1997; Patil *et al*., 2010). The nematode control with Nimin and neem oil is understandable because neem is known to be rich in nematode toxic chemicals: e.g. azadirachtine, nimbine, nimbidine, kemferol, etc. The increased plant growth and chlorophyll content might be due sustained release of nitrogen from urea in the presence of nimin and plant oils as has been observed in other studies with urea coated with other materials (Acquaye and Inubushi, 2004; Pack *et al.,* 2006; Patil *et al*., 2010; Sartain, 2011). Other essential oils, such as mustard oil, sunflower oil, kranj oil, chalmongra oil, etc. also proved to be nematicidal (Sangwan *et al.*, 1990; Leela *et al*., 1992). Therefore, the application of urea coated with Nimin and plant oils could be sound alternate methods of nematode control in India as it may reduce the cost of application of organic amendment thereby increase the net profit of crop. However, more investigations are needed to suggest its application under field conditions.

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