COMPARATIVE EFFICACY OF SOME OIL SEED CAKES AND EXTRACTS AGAINST ROOT-KNOT NEMATODE (*MELOIDOGYNE GRAMINICOLA*) INFECTION IN RICE

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Summary. Screen-house investigations were conducted to study the influence of seed cakes of castor, neem and *Simarouba glauca,* at 2.5 and 5 g/kg soil as soil application and seed extracts of *S. glauca* at 2.5 and 5% as root dip and soil drench treatment on the plant growth characters of rice and build up of root-knot nematode, *Meloidogyne graminicola*. Application of castor cake at 5 g/kg soil enhanced plant growth parameters even in the presence of the nematode. Fewest egg masses of *M. graminicola* were recorded after neem cake soil application at 5 g/kg soil, root dip + soil drench with 5% and 2.5% seed extract of Simarouba, and soil application of Simarouba cake at 5 g/kg soil.

The root-knot nematode, *Meloidogyne graminicola* Golden *et* Birchfield is a widely distributed nematode pest of rice (*Oryza sativa* L.). It has been recorded infesting rice in nurseries, uplands, and irrigated and deepwater production (Bridge and Page, 1985; Rao *et al*., 1986; Prasad *et al*., 1990). Musabyimana and Saxena (1999) have reported that application of neem cake at 100 g/plant reduced the numbers of *Pratylenchus goodeyi* Sher *et* Allen and *Meloidogyne* spp. in banana. Tiyagi *et al*. (2002) found that the biodegradation of oil cakes of neem, castor, linseed, groundnut and mustard, applied to soil at 110 kg N/ha, effectively controlled populations of *Meloidogyne incognita* (Kofoid *et* White) Chitw*., Rotylenchulus reniformis* Linford *et* Oliveira*, Tylenchorhynchus brassicae* Siddiqi, *Helicotylenchus indicus* Siddiqi, and soil-inhabiting pathogenic fungi infesting *Trigonella foenum-graecum* L., and *Phaseolus aureus* Roxb. Several workers have demonstrated the efficacy of neem and castor cakes and other organic sources given as soil amendments in the management of nematode parasites (Mian and Rodriguez Kabana, 1982; Ahmad, 1989; Vemana *et al*., 1999; Singh and Goswami, 2001; Ansari *et al*., 2002; Randhawa *et al*., 2002; Nagesh and Parvatha Reddy, 2003; Somavanshi and Gupta, 2003). Recently, *Simarouba glauca* DC*.,* a native tree of South America, has been reported to possess pesticidal properties in quassinoids present in the seed cake and extracts (Regional Research Laboratory, 2002). Hence, in the present studies, investigations were carried out on the influence of soil amendments with some non-edible oil cakes or with oil cake and extract of *S. glauca* on the rice root-knot nematode, *M. graminicola*.

MATERIALS AND METHODS

A pot experiment was arranged in a screen-house in completely randomized block design (CRD) to accommodate soil application of seed cakes of castor (*Ricinus communis* L.), neem (*Azadirachta indica* A. Juss.), and *S. glauca* at two rates *viz*. 2.5 and 5 g per kg soil (equivalent to 5 and 10 tons per hectare, respectively), and root soaking of seedlings for six hrs in 2.5 and 5% *S. glauca* seed extract followed by soil drench (at 10 ml per kg soil) with the same extract (Table I). To get the extract, one kg of powdered *S. glauca* seed kernels was defatted by extraction with hexane to get 570 g oil and 300 g cake. The defatted cake was exhaustively extracted with methanol and, on removal of the methanol by distillation, at atmospheric pressure initially and finally under vacuum, 70-75 g of brownish syrupy extract free from methanol was obtained. Water dilutions of 2.5 and 5% of the extract were used in the experiment. Steam sterilized soil (sand:silt:clay = 78:10:12) was mixed thoroughly with respective oil cake or the extract (at 10 ml per kg soil) of *S. glauca* and 500 g of each mixture was placed in earthenware pots (7.5 × 5 cm). One twenty-day-old seedling of rice cv. T(N)-1 was planted per pot. Five days after establishment of the seedlings, five pots at each concentration of soil application of cake or extract were inoculated with 100 freshly hatched infective juveniles of *M. graminicola* per pot and five further pots were left uninoculated. At the end of the experiment (45 days after nematode inoculation), shoot height, shoot weight, root weight, root volume of the plants and number of galls caused by the nematode were recorded. Root volume was measured by dipping the whole root system in water in a graduated measuring cylinder and the amount of water displaced by the root was recorded in millilitres (ml). The roots were fixed in 4% formaldehyde solution, stained in lactophenol blue, cleared in lactophenol and the egg masses of the nematode counted with the help of a stereozoom microscope. The data was analyzed by ANOVA and treatments were compared using the critical difference (CD).

Table I. Effects of various treatments on the growth parameters of rice and development of *Meloidogyne graminicola*.

	Treatment	Shoot height (cm)	Shoot weight (g)	Root weight (g)	Root volume (ml)	Number of galls (per plant)	Number of egg masses (per plant)
T1	Soil application of castor cake at 5 g per kg soil	76	8.5	6.2	6.5		
T2	Soil application of castor cake at 5 g per kg soil + 100 nematodes	73	7.5	4.2	4.4	6.4	5.5
T3	Soil application of castor cake at 2.5 g per kg soil	75	7.8	5.5	5.7		
T4	Soil application of castor cake at 2.5 g per kg soil + 100 nematodes	72	5.7	3.1	3.6	15.3	14.3
T5	Soil application of neem cake at 5 g per kg soil	58	5.5	1.5	2.2		
T6	Soil application of neem cake at 5 g per kg soil + 100 nematodes	57	5.5	0.4	0.2	1.2	3.0
T7	Soil application of neem cake at 2.5 g per kg soil	73	7.1	2.0	1.5		
T8	Soil application of neem cake at 2.5 g per kg soil + 100 nematodes	68	6.5	1.5	3.0	3.1	6.7
T9	Soil application of Simarouba cake at 5 g per kg soil	70	8.2	5.6	6.2		
T10	Soil application of Simarouba cake at 5 g per kg soil + 100 nematodes	65	7.9	2.0	3.0	4.4	4.6
T11	Soil application of Simarouba cake at 2.5 g per kg soil	73	7.5	4.2	5.3		
T12	Soil application of Simarouba cake at 2.5 g per kg soil + 100 nematodes	54	6.3	2.0	3.3	10.7	18.6
T13	Root-dip for 6 hrs + soil drench with 5% seed extract of Simarouba	40	4.5	0.5	1.0		
T14	Root-dip for 6 hrs + soil drench with 5% seed extract of Simarouba + 100 nematodes	32	4.2	0.7	1.2	1.1	3.2
T15	Root-dip for 6 hrs + soil drench with 2.5% seed extract of Simarouba	72	7.3	4.0	3.4		
T16	Root-dip for 6 hrs + soil drench with 2.5% seed extract of Simarouba +100 nematodes	70	4.5	2.0	2.0	3.3	4.2
T17	Untreated control	50	5.5	3.0	3.3		
T18	Untreated control + 100 nematodes	46	4.4	2.0	3.1	20.7	21.5
CD at 5%		11.4	1.6	2.0	1.8	3.1	2.2

RESULTS AND DISCUSSION

The results revealed that the shoot height varied from 32 to 76 cm among treatments. The lowest height was recorded for plants grown in the Simarouba 5% seed extract root dip + soil drench treatment and with nematodes (T14), which was not significantly different from that for plants in Simarouba 5% seed extract root dip + soil drench treatment without nematodes (T13) and the untreated control with nematodes (T18), but was significantly different from other treatments (Table I). Maximum shoot height was recorded in the castor cake 5 g/kg soil treatment (T1). Among the treatments that received nematode inoculum, plants receiving castor cake treatment at 5 g/kg soil (T2) were the tallest.

Shoot weight varied between 4.2 and 8.5 g among treatments. The greatest shoot weight (8.5 g) was recorded for the soil application of castor cake at 5 g/kg soil (T1) and it was least (4.2 g) in the Simarouba 5% seed extract root dip + soil drench treatment and with nematodes (T14) (Table I). Among the treatments that received nematode inoculum, shoot weight in the Simarouba cake treatment at 5 g/kg soil (T10) was similar to that for the treatment with castor cake at 5 g/kg soil (T2), neem cake at 2.5 g/kg soil (T8) and Simarouba cake at 2.5 g/kg soil (T12), and was significantly greater than in other treatments.

The smallest root weight was found after treatment with neem cake at 5 g/kg soil and nematodes (T6) and the greatest after castor cake application at 5 g/kg soil (T1) (Table I). Among the treatments that received the nematode inoculum, castor cake treatment at 5 g/kg soil (T2) had the highest root weight and was comparable to soil treatment with castor cake at 2.5 g/kg soil (T4) and significantly superior to all the other treatments. Similar observations were recorded for root volume.

The number of galls per plant varied between 1.1 to 20.7 among the treatments. Fewest (1.1) galls were recorded in the treatment with Simarouba 5% seed extract root dip + soil drench treatment (T14), which was not significantly different from neem cake application at 5 g/kg soil (T6) and 2.5 g/kg soil (T8) and Simarouba 2.5% seed extract root dip + soil drench (T16). These treatments were significantly different from all the other treatments. Significantly more galls (20.7) were recorded in the untreated control (T18) than in all other treatments.

Data on the number of egg masses in various treatments showed that significantly fewer egg masses per plant (3.0) were recorded after neem cake soil application at 5 g/kg soil (T6) than in the untreated control (T18), and the figure was comparable to those for root dip + soil drench with 5% (T14) and 2.5% (T16) seed extract of Simarouba and soil application of Simarouba cake at 5 g/kg soil (T10). The greatest number of egg masses per plant was recorded in the untreated control (T18).

Hameed (1968) observed a reduction of the population of *Meloidogyne* sp. on tomato with pre-plant application of mustard oil cake. Similar reports on effective control of *Hoplolaimus indicus* Sher with extracts of whole and de-oiled cakes of groundnut, safflower, sesamum, castor, mustard, brinjal and tomato (Deshmukh and Parshad, 1969), several parasitic nematode species with neem cake and neem extracts in vegetables (Alam, 1993) and *Pratylenchus goodeyi* and *Meloidogyne* spp. on banana (Musabyimana and Saxena, 1999) have been made. The mechanisms of control due to soil amendment with oil cakes and chicken litter to soil were reviewed by Mian and Rodriguez Kabana (1982), who indicated that decomposition products such as formic acid, acetic acid and phenolic compounds are toxic to the plant parasitic nematode, *Meloidogyne arenaria* (Neal) Chitw. In the present studies, application of castor cake at 5 g/kg soil enhanced plant growth parameters even in the presence of the nematode. Such enhancement of growth could be attributed to either improvement in soil conditions resulting in greater root growth, thereby enhancing the utilization of soil nutrients, or to changes in the biotic and abiotic environment of plants that alter the host/parasite relationship, minimizing nematode damage as suggested by Adamu and Manga (2004). The occurrence of fewest egg masses of *M. graminicola* following neem cake application at 5 g/kg soil, root dip + soil drench with 5% and 2.5% seed extracts of Simarouba, and soil application of Simarouba cake at 5 g/kg soil may be due to the presence of bioactive principles in neem seed cake that inhibit the hatchability, penetration and development of the nematodes (Mojumder, 1995) and the influence of quassinoids in seed extracts of Simarouba (Regional Research Laboratory, 2002). Reductions in plant growth in treatments with Simarouba extracts also may be attributed to the influence of quassinoids.

In summary, these observations show that the treatment with castor cake at 5 g/kg soil improved plant growth even in the presence of nematode infection. Also, fewer galls and egg masses of *M. graminicola* occurred in treatments with seed extracts and cake of Simarouba, which suggests that Simarouba seeds possess nematicidal properties. Since *S. glauca* seeds contain up to 16% extractable edible oil (Ramachandra Rao, 2003) and the extracts and defatted oil cake show bioactivity against the rice leaf folder, *Cnaphalocrosis medinalis* Guence (Regional Research Laboratory, 2002) and the rice root-knot nematode, *M. graminicola* (present investigations), further studies on the associated principles in the defatted cake and extracts contributing to nematode or insect control may help establish a commercial basis for farmers to grow *S. glauca.*

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