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ANTAGONISTIC PLANTS FOR THE MANAGEMENT OF THE ROOT-KNOT NEMATODE, *Meloidogyne graminicola* IN RICE-ONION SYSTEM

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ABSTRACT

A microplant experiment with the following treatments: Tagetes sp., two species of *Crotalaria* (*C. incana* and *C. mucronata*), rice and fallow, was conducted to determine the effects of *Tagetes* and *Crotalaria* plants on the population and development of the rice root-knot nematode, *Meloidogyne graminicola*. In the two trials conducted, it was observed that no galls were formed on the roots of *Tagetes* and *Crotalaria* plants 60 and 90 days after soil infestation. The rice plants however, had a mean root gall of 305.70 at harvest (90) days. Onion grown on the plots planted previously with *Tagetes* and *Crotalaria* did not show root galls, however, galls were observed in onion planted in microplots previously planted with rice. Fresh weight of onion were higher in *Tagetes* and *Crotalaria*-treated plots compared to the plots planted to rice and the clean fallow treatments, however differences were insignificant. This could be due to the nematode control and to the added fertility when the biomass of these plants was incorporated in the soil before onion was planted. Rice planted in these treatments showed significant reduction in the number of galls and nematode density in the soil after 60 days. These results showed that planting *Tagetes* sp. or *Crotalaria* spp. in nematode-infested soil is effective and also feasible in managing the rice-knot nematode.

Key words: Antagonistic plants, Root-knot nematode, *Meloidogyne graminicola, Tagetes, Crotalaria incana. C. macronata*, fallow, rice, onion

INTRODUCTION

Many genera of plant parasitic nematodes are associated with rice but not all are proven of potential economic importance. Among the nematodes associated with rice, the root-knot nematode, *Meloidogyne graminicola* has been considered one of the most destructive. Infected rice root tips become swollen and hooked. Above ground symptoms include tip drying, leaf bronzing, chlorosis, growth reduction, unfilled spikelets, reduced tillering and poor yield (Babatola, 1984). Yield reduction of upland rice as reported is about 3-32% (Barsalote and Gapasin, 1995). In the Philippines, the nematode is widely distributed occuring in about 40% of the 18 provinces surveyed (Soriano and Prot, 1992). In 1994, *M. graminicola* was found in rice growing areas in Central Luzon (Unpublished report).

Rice is normally grown twice a year where there is continuous irrigation. In Central Luzon, specifically in Nueva Ecija, farmers practice the rice-vegetable cropping pattern. Problems of pests in rice being carried over in vegetables can not be avoided. *M. graminicola*, which has become a pest of rice also infest several vegetable crops including weeds (Gapasin et al., 1996; Zamora and Gapasin, 1996). Most farmers in San Jose and Bongabon, Nueva Ecija grow onion after rice and *M. graminicola* has been reported a potential pest in onion (Gapasin et al., 1996). Therefore management of the nematode is of prime importance.

Several management options are available against the root-knot nematode like chemical, cultural, physical, mechanical, use of resistant varieties and biological control. Antagonistic plants have been used effectively in the management of some species of nematode in the soil. Caswell et al. (1991) reported a decline of *Rotylenchulus reniformis* population after *Crotalaria juncea* and *Tagetes patula* were grown. The mode of action of alpha-terthienyl and related compounds may explain the suppressive effects of *Tagetes* species. Root lesion nematode (*Pratylenchus penetrans*) were nearly eliminated from the plots with marigold (Tagetes patula L. cv Sparky).

This study was conducted to determine the effects of *Tageles* sp. and *Crotalaria* sp. on the population and development of the rice root-knot nematode, *Meloidogyne graminicola*.

MATERIALS AND METHODS

Microplots with an area of 2.4 x 0.75 meters were prepared and inoculated with 1,000 eggs of *M. graminicola* and later sown with 30 seeds of rice (var. UPLRi5). The rice plants were allowed to grow in the microplots for 60 days. Rice plants were harvested and their galled roots together with the egg masses were evenly buried in the plots. Constant watering was done to enhance egg hatching to build-up the nematode population in the microplots. After one week seeds of *Crotalaria incana, C. mucronata, Tagetes* sp. and rice (UPLRi5) were sown in the microplots. A clean fallow treatment was included and the treatments were replicated three times. The plants were allowed to grow for 90 days. After 60 days, 10 plants from each of the microplots were harvested and the roots were washed carefully in running water and later cut into small pieces. From each root system, 5 grams were taken and the number of galls were counted and assayed for nematode larvae using the modified Baermann funnel method. Likewise, ten-200 g soil was taken from each plot and the nematode larvae were extracted using also the modified Baermann funnel method. The larvae extracted from the roots and soil were counted under the stereomicroscope with the aid of a hand tally counter. The same procedures were followed when plants were harvested at 90 days. Two trials were conducted.

One month seedlings of bulb onion (var. Yellow Granex) were planted in the microplots after harvesting the plants in the different treatments. The onion plants were allowed to grow for 90 days. The fresh weight, number of galls and nematode population in the soil were collected and statistically analyzed. Rice seeds were then sown in the microplots for bioassay. The rice plants were allowed to grow for 60 days and number of galls and nematode population in the soil were collected and statistically analyzed.

RESULTS AND DISCUSSION

Crotalaria spp. and *Tagetes* sp. effectively reduced nematode densities in soil and affected development of the root-knot nematode in the microplot experiment (Tables 1 and 2). No galls were formed in the roots of these plants suggesting that they are antagonistic to the rice root-knot nematode while the roots of rice after 60 days were heavily galled with mean galls of 49.30 and 81.96 in the first and second trials, respectively. The number of galls in the rice plants at 90 days increased and had mean galls of 305.70 and 267.90 in the first and second trials, respectively. The number of galls in the rice plants at 90 days increased and had mean galls of 305.70 and 267.90 in the first and second trials, respectively. The increasing trend of nematode density was also observed in the roots. Nematode density in the soil was low in *Crotalaria* spp and *Tagetes* sp. treatments while those grown to rice increased tremendously in both trials. Chitwood (1993) reported that naturally occuring phytochemicals with biological activity against plant parasitic nematodes include polythienyls, alkaloids, phenolics, polyacetylenes, fatty acids, terpenoids and others. Several workers have shown the efficacy of *Tagetes* in suppressing nematodes in soil. Cultivation of marigolds (Tagetes spp.) significantly suppressed the population and build-up of noxious nematodes (Oostenbrink, 1960; Alam et al., 1977). Likewise, McSorley and Frederick (1994) reported little or no galling or egg production from any *Meloidogyne* isolate on *Lageratum houstonianum* cv. Blue Mink, *Lobularia maritima* cv. Rosie O'Day, or *Tagetes patula* cv. Dwarf Primrose. Two compounds [α-terthienyl and 5-(3-buten-1-ynyl)-

Table 1. Effect of *Tagetes, Crotalaria* and clean fallow treatments on the number of galls and *M. graminicola* population in roots and soil 60 and 90 days after soil infestation. (1[st] Trial.)

Treatments	Numbe of Galls	Nematode Density in Roots	Nematode Density in Soil
60 days			
Tagetes sp.	0.00a	0.00a	5.23a
Crotalaria mucronata	0.00a	0.00a	7.46a
Crotalaria incana	0.00a	0.00a	6.23a
Clean fallow	-	-	3.20a
Rice (UPLRi5)	49.30b	199.10b	496.30b
90 days			
Tagetes sp.	0.00a	0.00a	2.56a
Crotalaria mucronata	0.00a	0.00a	2.56a
Crotalaria incana	0.00a	0.00a	2.96a
Clean fallow	-	-	2.53a
Rice (UPLRi5)	305.70 b	354.70b	368.60b

5 g per root system and 200 g soil per plant; 10 sample plants per plot

Table 2. Effect of *Tagetes. Crotalaria* and clean fallow treatments on the number of galls and *M. graminicola* population in roots and soil 60 and 90 days after soil infestation. (2[nd] Trial.)

Treatments	Numbe of Galls	Nematode Density in Roots	Nematode Density in Soil
60 days			
Tagetes sp.	0.00a	0.00a	63.11a
Crotalaria mucronata	0.00a	0.00a	43.66a
Crotalaria incana	0.00a	0.00a	55.22a
Clean fallow	-	-	23.88a
Rice (UPLRi5)	81.96b	253.66b	283.66b
90 days			
Tagetes sp.	0.00a	0.00a	28.88a
Crotalaria mucronata	0.00a	0.00a	33.44a
Crotalaria incana	0.00a	0.00a	26.66a
Clean fallow	-	-	20.66a
Rice (UPLRi5)	305.70 b	354.70b	316.44b

5 g per root system and 200 g soil per plant; 10 sample plants per plot

2,2'-bithienyl] from *Tagetes* were found effective against several nematodes including root-knot species. The alkaloid monocrotaline in *Crotalaria* may be inhibitory to nematodes (Chitwood, 1993). Nematode density in the soil were tremendously reduced by the treatments. The clean fallow treatment had the lowest nematode density in the soil after 60 and 90 days. This was expected since the plots were weeded and turning the soil may have profound effect on the nematode larvae due to the heat of the sun. The result of the microplot experiment confirms the efficacy of these antagonistic plants in reducing root galls thus affecting the nematode development and reducing significantly the nematode densities in the soil. *Tagetes* sp. and *Crotalaria* spp. can be effective in suppressing the rice root-knot nematode population in the soil. Planting these antagonistic crops during fallow period in nematode infested soil is feasible.

Onion grown in the *Crotalaria* spp. and *Tagetes* sp. treatments had higher fresh weight compared to the clean fallow and rice treatments, however, differences were insignificant (Table 3). Likewise, no galls were observed in onion roots grown under the different treatments except those grown in the rice treatment. The nematode density in these treatments was also low compared to the rice treatment, however, differences were insignificant. This increase could be due to the added fertility afforded by the decomposed plants since their biomass was incorporated in the soil after harvest and may also be due to nematode control. Mulches of decaying organic matter can improve the growth of plants and in some cases actually reduced the damage caused by the nematode due to some metabolic by-products in the decomposition of organic matter (Watson, 1944 and Smith and Batista, 1942). Rice grown after onion in *Tagetes*, *Crotalaria* and fallow plots has significantly lower numbers of galls and nematode density in the soil compared to the plots planted to rice (Table 4). This result clearly shows the antagonistic effects of *Tagetes* and *Crotalaria*. The carry over effects of these antagonistic plants are long lasting and therefore feasible in managing the rice root-knot nematode.

Table 3. Effect of *Tagetes*, *Crotalaria* and clean fallow treatments on fresh weight of bulb union, number of galls and *M. graminicula* population in soil after 90 days.

Treatments	Fresh weight (g)	Number of Galls	Nematode Density in Soil
Tagetes sp.	10.11	0.00	17.33
Crotalaria mucronata	10.80	0.00	20.99
Crotalaria incana	10.45	0.00	25.67
Clean fallow	6.92	0.00	16.00
Rice (UPLRi5)	6.49	12.47	32.44

5 g per root system and 200 g soil per plant; 10 sample plants per plot

Table 4. Effect of *Tagetes*, *Crotalaria* and clean fallow treatments on number of galls in rice and *M. graminicula* population in soil after 60 days.

Treatments	Number of Galls	Nematode Density in Soil
Tagetes sp.	6.70	9.60
Crotalaria mucronata	13.87	13.07
Crotalaria incana	6.40	9.43
Clean fallow	6.63	8.40
Rice (UPLRi5)	86.20	54.03
LSD (.01)	12.18	14.84

5 g per root system and 200 g soil per plant; 10 sample plants per plot

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