CONTROL OF ROOT-KNOT NEMATODES IN KENYA WITH ALDICARB AND SELECTED ANTAGONISTIC PLANTS

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Summary. Glasshouse and field tests were conducted to compare the efficacy of the nematicide aldicarb and the antagonistic plants *Tagetes minuta, Datura metel, D. stramonium* and *Ricinus communis* against *Meloidogyne javanica* on tomato. The nematicide had the most suppressive effect on gall formation and gave the highest shoot growth and fruit yield. *R. communis* had a significantly greater inhibitory effect on gall formation than did *T. minuta D. metel* or *D. stramonium*. Tomato plants grown with any of the four antagonistic plants were better than controls.

Root-knot nematodes are serious pests of vegetables in Kenya but effective control methods are lacking (Oduor-Owino *et al.,* 1995). Soil treatment with nematicides has given some control and increased yields but nematicides are increasingly being banned from the world market (Sayre, 1986). This has led to an increasing need for alternative control tactics that are safe, economically attractive and which can be used in integrated pest management programmes (IPM). Preliminary results (Oduor-Owino *et. al.*, 1995) showed that the use of antagonistics plants may provide viable alternatives. Glasshouse and field tests were therefore conducted to evaluate the effects of these plants and the nematicide aldicarb on tomato growth, nematode galling intensity and on the numbers of root-knot nematodes in the soil.

MATERIALS AND METHODS

A glasshouse test was conducted using eggs of *Meloidogyne javanica* (Treub) Chitw. obtained from roots of tomato (*Lycopersicon esculentum* Mill) cv. Moneymaker, grown in 15 cm-diameter plastic pots filled with naturally infested soil (Hussey and Barker, 1973). About 3000 eggs were incorporated into each one litre portion of autoclaved soil (63% sand, 17% clay 20% silt, pH 5.6). The infested soil was divided into two portions: the first portion was treated with aldicarb at the rate of 1 g a.i./2 l soil and mixed thoroughly one week before planting. The second portion of autoclaved soil was left un-treated to serve as control.

One litre of nematode infested soil (with or without aldicarb) was transferred into 18 cm diameter plastic pots at the rate of 1 g per pot. Three-week-old-seedlings of tomato cv. Moneymaker and the plants, *Datura stramonium* L., *Ricinus communis* L., *D. metel* L. and *Tagetes minuta* L. were then transplanted into the pots. One tomato seedling was transplanted per pot, and two seedlings of the nematicidal plants were then transplanted on either side of the tomato seedlings, except in pots where aldicarb was mixed with the soil. Fertilizer (N:P:K: 20:10:10) was applied at the rate of 1 g/pot at planting.

All the pots were arranged on a glasshouse bench in a randomized block design with four replicates per treatment and were kept moist by watering twice per week. Sixty days after transplanting, the tomato plants were carefully harvested and shoot heights and dry weights determined. Galling was assessed on a 0-5 rating scale (Taylor and Sasser, 1978). The number of galls per gram root weight and nematodes per 300 ml soil were also determined. Data were analysed by a two-way analysis of variance (ANOVA).

A field experiment was conducted in plots that were heavily infested with root-knot nematodes, particularly *M. javanica,* (521 juveniles per 300 ml soil). The field had been planted with tomato cv. Moneymaker for two successive years. Low population densities (4-5 per 300 ml soil) of *Criconemoides sp., Helicotylenchus sp., Hoplolaimus sp., Pratylenchus sp.* and *Tylenchorhynchus sp.* were detected.

The soil in the field was fertilized with N:P:K: (20:10:10) at the rate of 40 kg/ha and then subdivided into 4x20m plots. Aldicarb granules were applied in 30 cm furrows at the rate of 9 kg/ha. Ten 3-week-old tomato seedlings were transplanted in each plot with two seedlings of *D. stramonium, D. metel, R. communis* or *T. minuta* on either side of the tomato plants. The treatments (Table II) were arranged in a randomized block design with four replicates. The experiment was terminated 120 days after planting and the fresh weights of tomato fruits, tomato shoot heights, dry weights and number of galls per gram root weight assessed. Data were analysed by a two-way analysis of variance (ANOVA).

RESULTS

Mixed cropping with *D. metel, D. stramonium T.*

minuta and *R. communis* and soil treatments with aldicarb reduced (P=0.05) the galling index, numbers of nematodes in the soil, and the number of galls per g root weight (Table I). The lowest and highest galling intensity was observed on tomatoes harvested from nematicide-treated pots and controls, respectively. Plants grown in aldicarb treated soil were heavier and taller than those from other treatments (Table I). *D. metel* and *R. communis* had greater (P=0.05) suppressive effects on the development of galls and the number of nematodes per 300 ml soil than *T. minuta* or *D. stramonium*.

Field test results (Table II) also indicate that aldicarb, *T. minuta, D. stramonium, D. metel* and *R. communis* reduced (P=0.05) the number of galls and nematodes and enhanced plant growth compared with the controls. The fewest galls and nematodes were in aldicarb-treated soils. In general, the nematicide was more effective in suppressing nematode development than was mixed cropping with *Tagetes, Datura* or *Ricinus species*. These plants supported only poor tomato growth with significantly lower shoot heights, dry weights and fruit yields compared with the nematicide treatment. *D. metel, D. stramonium* and *R. communis* were more effective than *T. minuta* plants but each of them was better than the control.

DISCUSSION

Although the nematicidal plants were less effective than aldicarb in suppressing nematode populations, they might be still be appropriate for use in mixed cropping systems for nematode control. These plants are widely available in Kenya and are also easy to use. Of particular interest would be the use of *R. communis* and *D. metel* in integrated nematode control. The flowers of *D. metel* are used against asthma and are a source of income for some growers in Kenya (Kokwaro, 1976). Equally important is *R. communis* which has proven effective in stimulating the antagonistic potential of a wide range of fungal antagonists against root-knot nematodes (Oduor-Owino *et al.,* 1995). In general, all the four plant species used in this study stimulated tomato growth and this justifies their inclusion in intercropping systems.

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Table I. Effect of soil treatment with aldicarb and antagonistic plants on tomato in soil infested by root-knot nematodes in glasshouse.

Soil treatment	Shoot height (cm)	Shoot dry weight (g)	Gall index (0-5)	Galls (no g root)	Nematodes/300 ml soil
Soil + *M. javanica* eggs	44.5 c	1.4 e	4.6a	524.0a	600.1a
Soil only, untreated	99.8a	4.8 b	0.0 c	0.0 d	0.0 e
Soil + *M. javanica* + aldicarb	15.3a	5.9a	1.2 c	24.4 d	18 d
Soil + *M. javanica* + *D. metel*	79.6 d	3.7 c	2.3 b	79.6 c	179 c
Soil + *M. javanica* + *T. minuta*	70.4 b	2.6 d	2.2 b	130.9 b	320 b
Soil + *M. javanica* + *D. stramonium*	72.4 b	3.4 c	2.5 b	89.6 c	182 c
Soil + *M. javanica* +*R. communis*	71.0 b	3.7 c	1.6 c	75.0 c	165 c

Means with same letters within each column are not significantly different by Duncan's Multiple Range Test for P=0.05.

Table II. Effect of soil treatment with aldicarb and antagonistic plants on of tomato in soil infested by root-knot nematodes in the field.

Treatment	Shoot height (cm)	Shoot dry weight (g)	Fruit yield (g)	Gall (no g root)	Nematodes/300 ml soil
Untreated (control)	80.4 d	41 d	400.3 e	70 a	154 a
Aldicarb	189 a	135.1a	3800.5a	4.7 d	6.6 d
D. metel	160 b	90.3 b	2590.1 b	6.5 c	18.3 bc
T. minuta	109 c	46.1 d	761.1 c	12.1 b	22.4 b
D. stramonium	152 b	69.3 c	2030.4 b	10.1 b	19.4 c
R. communis	163 b	92 b	3000 b	6.1 c	16 c

Means with same letters within each column are not significantly different by Duncan's Multiple Range Test for P=0.05.

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