Management of root-knot nematode (*Meloidogyne incognita*) in bottle gourd using different botanicals in pots

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Abstract A pot experiment was conducted to study the efficacy of different botanicals in varying doses for management of root-knot nematode, *M. incognita* in bottle gourd. The results exhibited that madar (*Calotropis procera*) and neem (*Azadirachta indica*) leaves application proved to be more effective in improving plant growth characters and reducing root-knot index and final nematode population. Among the doses tested, higher dose of 1.5 % (w/w) was more effective than lower ones.

Keywords Botanicals · Bottle gourd · *M. incognita* · Management

Introduction

Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.], an important paratropical species of cucurbitaceous family is a good source of nutritional components and income to the farmers. As an alternative to chemical pesticides specially for the purpose of protecting crops against nematodes and also for the conservation of biodiversity, botanicals may stand as the most promising sources of bioactive products of plant origin. However, occurrence of root-knot nematodes on bottle gourd adversely affect both yield as well as quality of the produce. Use of chemical nematicides to control these nematodes always poses a serious health hazards. Hence, attempts were made to manage the nematodes using botanicals in pots.

Materials and methods

A pot experiment was conducted at Anand Agricultural University, Anand in earthen pots of 15 cm diameter, disinfected with 4 % formaldehyde (Formalin 40 EC). After drying, pots were filled with nematode infested soil (1 kg/pot) having 283 J₂/100 cc soil along with chopped fresh leaves of different botanicals viz, T₁-chives (*Allium schoenoprasum*), T₂-wood apple (*Aegle marmelo*), T₃-custard apple (*Annona squamosa*), T₄-neem (*Azadirachta indica*), T₅-madar (*Calotropis procera*), T₆-cluster fig tree (*Ficus racemosa*), T₇-peepal tree (*Ficus religiosa*), T₈-drumstick (*Moringa olifera*), T₉-Pungam tree (*Pongamia glabra*) and T₁₀-chaste tree (*Vitex negunda*) at 0.5(D₁), 1.0(D₂) and 1.5(D₃) % (w/w) dose making 30 treatments of botanicals and 1 control. Thus, 31 treatments were tried in Completely Randomized Design keeping 4 repetitions. The pots were watered regularly for proper decomposition. After 15 days, 1 seed of bottle gourd cv. ABG 1 was sown/pot. Watering and plant protection measures were taken as per the requirement. The plants were removed carefully after 45 days of sowing and observations were recorded and analysed.

Results and discussion

Effect of botanicals (B)

Persual of data presented in Table 1 revealed that maximum vine length was recorded in *C. procera* application (T₅), however, it was at par with *A. indica* (T₄) and *A. marmelo* (T₂). Minimum and significantly the lowest vine length was recorded in *F. religiosa* (T₇). It was followed by *M. olifera* (T₈), *F. racemosa* (T₆), *V. negunda* (T₁₀) and *A.*

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Table 1 Effect of different botanicals on plant growth characters and nematode multiplication on bottle gourd

S. no.	Treatment	Plant growth characters				
		Vine length (cm)	Fresh shoot weight (g)	Fresh root weight (g)	RKI(0–5) ^a	Soil nematode population
Botanicals (B)						
1.	T ₁	13.0	1.85	1.55	3.22	2,589
2.	T ₂	14.0	1.90	1.66	2.38	2,369
3.	T ₃	11.0	1.60	1.50	3.00	2,620
4.	T ₄	15.0	2.06	1.69	2.33	1,500
5.	T ₅	15.0	2.27	1.71	2.33	1,266
6.	T ₆	11.0	1.44	1.50	4.00	2,680
7.	T ₇	8.0	1.09	1.48	5.00	3,227
8.	T ₈	10.0	1.29	1.40	5.00	3,192
9.	T ₉	12.0	1.77	1.54	3.23	2,441
10.	T ₁₀	11.0	1.39	1.50	4.00	2,734
	S.Em. (±)	0.34	0.06	0.09	0.15	440
	C.D. (<i>P</i> = 0.05)	1.00	0.17	0.25	0.43	124
Doses (D)						
1.	0.5 % (D ₁)	9.4	1.23	1.13	4.13	2,898
2.	1.0 % (D ₂)	13.0	1.65	1.69	3.73	2,416
3.	1.5 % (D ₃)	15.0	2.12	1.72	3.30	1,954
	S.Em. (±)	0.18	0.03	0.05	0.08	241
	C.D. (<i>P</i> = 0.05)	0.53	0.09	0.14	0.43	683
	Interaction (B × D)	S	S	S	NS	NS
	Interaction (B × D)					
1.	T ₁ D ₁	11.0	1.48	1.34	4.00	3,208.00
2.	T ₁ D ₂	12.0	1.83	1.62	3.66	2,492.00
3.	T ₁ D ₃	17.0	2.27	1.64	3.00	2,107.00
4.	T ₂ D ₁	11.0	1.53	1.39	3.66	2,511.00
5.	T ₂ D ₂	14.0	1.77	1.68	3.00	2,611.00
6.	T ₂ D ₃	17.0	2.40	1.69	2.66	1,926.00
7.	T ₃ D ₁	10.0	1.31	1.32	4.33	3,166.00
8.	T ₃ D ₂	14.0	1.98	1.59	4.00	2,498.00
9.	T ₃ D ₃	14.0	2.00	1.61	3.66	2,195.00
10.	T ₄ D ₁	11.0	1.41	1.41	2.66	1,818.00
11.	T ₄ D ₂	15.0	1.81	1.69	2.33	1,612.00
12.	T ₄ D ₃	18.0	2.98	1.71	2.00	1,074.00
13.	T ₅ D ₁	12.0	1.61	1.42	3.00	1,792.00
14.	T ₅ D ₂	15.0	2.10	1.70	2.33	1,083.00
15.	T ₅ D ₃	18.0	3.09	1.72	1.66	923.00
16.	T ₆ D ₁	9.0	0.84	1.32	4.66	2,655.00
17.	T ₆ D ₂	12.0	1.53	1.59	4.33	2,135.00
18.	T ₆ D ₃	13.0	1.97	1.61	4.00	1,926.00
19.	T ₇ D ₁	5.0	0.66	1.31	5.00	2,983.00
20.	T ₇ D ₂	8.0	1.23	1.59	4.66	2,450.00
21.	T ₇ D ₃	10.0	1.38	1.61	4.33	2,083.00
22.	T ₈ D ₁	8.0	1.32	1.27	5.00	3,895.00
23.	T ₈ D ₂	13.0	1.40	1.55	4.66	3,250.00
24.	T ₈ D ₃	11.0	1.46	1.56	4.33	2,750.00
25.	T ₉ D ₁	8.0	1.29	1.34	4.33	3,974.00
26.	T ₉ D ₂	9.0	1.45	1.62	4.00	3,450.00

Table 1 continued

S. no.	Treatment	Plant growth characters				
		Vine length (cm)	Fresh shoot weight (g)	Fresh root weight (g)	RKI(0–5) ^a	Soil nematode population
27.	T ₉ D ₃	15.0	2.06	1.63	3.33	2,350.00
28.	T ₁₀ D ₁	9.0	0.88	1.32	4.66	2,965.00
29.	T ₁₀ D ₂	13.0	1.39	1.59	4.33	2,571.00
30.	T ₁₀ D ₃	13.0	1.60	1.61	4.00	2,200.00
	S.Em. (±)	0.59	0.10	0.08	0.26	216
	C.D. (<i>P</i> = 0.05)	1.68	0.30	0.25	NS	NS
	Control vs. Rest	9.00	0.53	1.03	5.00	4,108.00
		12.33	1.67	1.51	3.72	2,420
	S.Ed. (±)	0.77	0.15	0.23	0.36	109
	C.D. (<i>P</i> = 0.05)	1.56	0.31	0.47	0.75	223.78
	C.V. (%)	8.00	12.00	19.00	12.00	15.46

^a 0 free, 5 maximum disease intensity

Fig. 1 Effect of various doses of madar leaves (*Calotropis procera*) on management of root-knot nematodes in bottle gourd in pots

(A) Shoot

(B) Root

squamosa (T₃). Maximum fresh shoot weight was obtained by *C. procera* (T₅) followed by *A. indica* (T₄) application, both significantly differed from each other. Minimum fresh

shoot weight was recorded in *F. religiosa* (T₇) application. The treatment of *M. olifera* (T₈), *F. racemous* (T₆) and *V. negunda* (T₁₀) were at next to *F. religiosa* (T₇) and at par

Fig. 2 Effect of various doses of neem leaves (*Azadirachta indica*) on management of root-knot nematodes in bottle gourd in pots

with each other. Fresh root weight was significantly less in all the treatments over control. The difference for root weight within botanicals were significant. Maximum fresh root weight was obtained by *C. procera* (T₅) followed by *A. indica* (T₄) and *A. marmelo* (T₂) treatments.

Close perusal of data showed that the lowest root-knot index was recorded in *C. procera* (T₅) application, however, it was at par with *A. indica* (T₄), and *A. marmelo* (T₂). *Ficus religiosa* (T₇) and *M. olifera* (T₈) had maximum root-knot index followed by *F. racemosa* (T₆) and *V. negunda* (T₁₀) (Table 1).

For soil nematode population, minimum soil nematode population was recorded by *C. procera* (T₅) followed by *A. indica* (T₄). Next in order were *A. marmelo* (T₂), *P. glabra* (T₉) and *A. schoenoprasum* (T₁) applications while maximum soil nematode population were recorded in *F. religiosa* (T₇) followed by *M. olifera* (T₈), both being at par with each other (Table 1).

Effect of doses (D)

With regard to doses of different botanicals, it had significant effect on vine length, fresh shoot and root weight,

root-knot index, and soil nematode population. There was gradual increase in vine length with an increase in dose of botanicals. Maximum vine length was recorded in highest dose (1.5 % w/w) while minimum in lowest dose (0.5 % w/w) (Table 1). Shoot and root weight was increased with an increase in the doses. Significantly minimum shoot weight was recorded in lowest dose of 0.5 % w/w as compared to the doses of 1.0 and 1.5 % (w/w). As botanicals dose increased, there was corresponding decrease in root-knot index. In case of soil nematode population, doses had significant effect on soil nematode population. Higher dose was more effective in reducing root-knot disease and final nematode population over lower ones (Table 1).

Interaction effect (B × D)

Botanical treatment of *C. procera* with dose of 1.5 % (T₅D₃) showed maximum vine length, fresh shoot and root weight. However, it was statistically at par with the highest dose of *A. indica* (T₄D₃), *A. marmelo* (T₂D₃) and *A. schoenoprasum* (T₁D₃) for vine length with 1.0 and 1.5 % dose of all botanicals. *A. indica* (T₄D₃) for root-knot index and soil nematode population were found non significant.

The overall results indicated that among different botanicals, madar (*C. procera*) followed by neem (*A. indica*) proved to be the best in improving the plant growth and development and reducing host infestation than the other treatments. The effectiveness of botanicals was increased with an increase in their doses. Among three doses, the higher dose (1.5 % w/w) proved to be more effective in improving the plant growth characters and reducing root-knot index and final soil nematode population.

The effectiveness of botanicals like, *A. indica* and *C. procera* has been reported by Ramkrishnan et al. (1997) who observed increase in plant growth characters and reduction in the population of root-knot nematode in okra. Similarly, significant reduction of gall formation and less number of females in brinjal roots due to addition of chopped leaves of *C. procera* and *R. communis* was reported by Nandal and Bhatti (1990). Chakraborti (2000) reported reduction in the fecundity of *M. incognita* in pointed gourd due to application of neem (as pure Azadirachtin/leaf/cake) treatment. Green manuring with naffatia (*I. fistulosa*) or water hyacinth (*E. crassipes*) or aak (*C. procera*) or congress grasss (*P. hysterophorus*) each @ 3 kg/m² before flowering, 15 days prior to seeding has been found effective for management of root-knot disease

in nematode infested tomato nursery (Anonymous 1992). The botanical like madar (*C. procera*) probably released some alkaloids during decomposition which might be toxic to nematodes and at the same time enhanced the microbial population in the soil besides providing major elements required for plant growth were reported by Prem Kumar and Nair (1976) Figs. 1, 2.

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