Nematol. medit. (1997), 25: 125-128

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USE OF *SARGASSUM* SPECIES FOR THE CONTROL OF *MELOIDOGYNE JAVANICA* IN OKRA

by
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Summary. Brown seaweed *Sargassum tenerrimum*, *S. swartzii* and *S. wightii* inhibited juvenile hatching of *Meloidogyne javanica* and caused juvenile mortality *in vitro*. Soil amendment with *S. tenerrimum*, *S. swartzii* and *S. wightii* with or without biocontrol agents viz., *Paecilomyces lilacinus*, *Pseudomonas aeruginosa* and *Bradyrhizobium japonicum*, significantly ($P<0.05$) reduced nematode infection in okra roots. Use of *P. aeruginosa* with *S. swartzii* or *S. wightii* showed greater plant height and fresh weight of shoot as compared to biocontrol agents or seaweed used alone.

The huge quantities of seaweeds like *Sargassum* spp., that occur along the Pakistan coast bordering the North Arabian sea (Thompson and Tirmizi, 1988; Shameel and Tanaka, 1992) present a serious environmental problem. Seaweeds have been used as crop fertilizers because they contain greater potash and nitrogen than farm yard manure (Chapman and Chapman, 1980) and they are also known to contain biochemical compounds which have potential as biocidal agents (Colwell, 1983). Liquid preparations of the brown alga *Ecklonia maxima* significantly reduced root knot infestation and increased the growth of tomato plants (Featomby-Smith and Standen, 1983). Extract of *Ascophyllum nodosum* has been reported to reduce *Radopholus similis* infection on citrus (Tarjan, 1977).

Experiments on the use of *Sargassum* spp., for the the control of *Meloidogyne javanica* (Treub) Chitw. in okra [*Abelmoschus esculentus* (L.) Moench] are reported here.

Materials and methods

Sargassum tenerrimum J. Ag., *S. swartzii* (Turn.) C. Ag., and *S. wightii* Grev., collected from Bholeji, Karachi, were washed, dried under shade and percolated in ethanol (1 kg of each species). After two weeks, the extracts were filtered through cotton wool and the filtrates concentrated in a Rotary Vacuum Evaporator (Eyela) under reduced pressure at 37 °C.

The effect of seaweed extracts on the hatching of *M. javanica* juveniles was examined by a modification of the method of Husain and Masood (1975). Concentrations of seaweed extract at 0.01, 0.1, 1.0 and 10.0 mg/ml were prepared in ethanol and transferred to watch glasses (2 ml/watch glass) and left for 48 hrs to evaporate the organic solvent. A signle egg mass of *M. javanica*, cultured on brinjal (*Solanum melongena* L.) was placed in each watch glass with 2 ml distilled water. After 48 hrs the number of nematode juveniles which hatched were recorded

TABLE I - *Effect of different concentration of* Sargassum spp. *on juvenile hatching and mortality of* Meloidogyne javanica.

Treatment	No. of juveniles hatched		Mortality %
	Seaweed extract	Distilled water	
Control	53	13	0
S. tenerrimum			
10.0 mg/ml	0	0	63
1.0 mg/ml	1	1	20
0.1 mg/ml	10	3	3
0.01 mg/ml	37	3	0
S. swartzii			
10.0 mg/ml	2	0	94
1.0 mg/ml	6	9	78
0.1 mg/ml	30	7	19
0.01 mg/ml	50	0	0
S. wightii			
10.0 mg/ml	7	4	59
1.0 mg/ml	11	8	3
0.1 mg/ml	14	12	3
0.01 mg/ml	18	17	0
LSD 0.05	15.4	6.8	21.7

using a stereomicroscope. The egg mass was then placed in another watch glass containing 2 ml distilled water and after 48 hrs hatching of juveniles was recorded to ascertain whether the effect of seaweed extract was to inhibit or simply to delay hatching.

Nematicidal activity was tested by a modified method of Meyer *et al.*, (1982) using 0.01, 0.1, 1 and 10 mg/ml concentrations of seaweed extract prepared in ethanol. Two ml of each concentration were transferred to a small watch glass and left for 48 hrs to evaporate the organic solvent. Twenty hand picked second stage juveniles of *M. javanica* were placed in each watch glass, containing 2 ml of glass distilled water. Watch glasses without extract served as a control. Each treatment was replicated three times. The numbers of juveniles that were killed were recorded using a stereomicroscope.

Dry seaweed (*Sargassum* spp.,) was powdered in an electric blender and mixed with sandy loam soil, pH. 8, to give concentrations of 0.5 and 1% w/w. The soil mixtures were put in 8 cm diam. plastic pots, 250 g per pot, which were watered daily and kept at 50% water holding capacity (Keen and Raczkowski, 1921). After three weeks, aqueous suspensions of *Paecilomyces lilacinus* (Thom) Samson (10^7 cfu ml^{-1}) multiplied on Potato Dextrose Agar, *Pseudomonas aeruginosa* (Schroeter) Migula (10^8 cfu ml^{-1}) multiplied on Nutrient Agar and *Bradyrhizobium japonicum* (Kirchner) Jordan (10^8 cfu ml^{-1}) multiplied on Yeast Extract Mannitol Agar were drenched in to each pot, 25 ml/pot. Five seeds of okra were sown in each pot. Egg masses of equal size of *M. javanica* were inoculated near the roots of the okra seedlings, 10 egg masses per pot. Pots with soil but without dried sea-

weed served as control. Each treatment was replicated four times and the pots were randomized on a screen house bench. Plants were uprooted after six weeks growth and root knot galling was recorded on a 0-5 scale (Taylor and Sasser, 1978). Data on plant growth were also recorded. Data were subjected to analysis of variance (ANOVA) followed by least significant difference (LSD) (Gomez and Gomez, 1984).

Results and discussion

Maximum retardation of juvenile hatching was produced by *S. tenerrimum* (100%) followed by *S. swartzii* (94%) used at 10 mg/ml. Effect of extract increased with increase in concentration of extract. Low dosage treatment, 0.01 mg/ml, had less effect on juvenile hatching, as more juveniles hatched in the extract and fewer in water (Table I).

Greater juveniles mortality was observed with *S. swartzii* (94%) followed by *S. tenerrimum* (63%) at 10 mg/ml. Juvenile mortality declined with decrease in extract concentration and no mortality was observed at 0.01 mg/ml dilution (Table I).

Soil amendment with *S. tenerrimum*, *S. swartzii* and *S. wightii* significantly ($P<0.05$) reduced the infection of the root knot nematode on okra roots. *S. tenerrimum* was more effective than *S. swartzii* and *S. wightii*. Use of biocontrol agents viz., *P. lilacinus*, *B. japonicum* and *P. aeruginosa* also significantly ($P<0.05$) reduced gall formation on okra roots. Seaweed extracts had no adverse effect on the efficacy of biocontrol agents except for *S. tenerrimum* which reduced the efficacy of rhizobia. Greater plant heigth was observed where *S. swartzii* was used with *P. aeruginosa* or *S. wightii* with *P. lilacinus*. Highest fresh weight of shoot was produced where *S. wightii* was used with *P. aeruginosa* followed by *S. tenerrimum* with *P. lilacinus* (Table II).

TABLE II - *Effect of* Sargassum spp. *and biocontrol agents in the control of root knot nematode on okra.*

Treatment	Fresh weight of shoot (g)	Height of shoot (cm)	Root knot index
Sargassum tenerrimum (ST)	2.9	27.4	0.35
S. swartzii (SS)	2.7	26.7	1.30
S. wightii (SW)	2.4	24.4	1.25
Paecilomyces lilacinus (PL)	3.5	26.3	0.81
Bradyrhizobium japonicum (BJ)	1.9	26.0	0.75
Pseudomonas aeruginosa (PA)	2.1	26.7	0.72
ST + PL	4.0	27.5	0.37
ST + BJ	3.1	25.4	1.75
ST + PA	3.5	26.1	0.88
SS + PL	3.2	28.1	0.62
SS + BJ	3.2	27.7	0.70
SS + PA	3.1	31.3	0.45
SW + PL	3.0	29.3	0.56
SW + BJ	3.2	27.7	0.18
SW + PA	4.2	27.1	0.38
Control	1.8	23.1	2.5
LSD 0.05	1.7	3.9	0.76

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Accepted for publication on 18 April 1997.