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Evaluation of some medicinal and aromatic plants to root-knot nematode, *Meloidogyne javanica* infection

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Abstract

Eleven species of medicinal and aromatic plants were tested for their host suitability to root- knot nematode, *Meloidogyne javanica* under greenhouse conditions. The nematode species succeeded in developing and multiplying on almost the tested plants. Host suitability was assessed 60 days after inoculation on basis of root gall index (GI) and reproduction factor (Rf). Six species namely, *Mentha piperita*, *Mentha viridis*, *Ocimum sanctum*, *Hibiscus sabdariffa*, *Hibiscus sabdariffa*, *Cymbopogon citratus* were recorded as immune to *M. javanica*, no galls and nematode found on these plants. Whereas, *Ocimum caryophyllatum* and *Mentha longifolia* were considered as very resistant hosts with Rf values of 0.61 and 1.69. Tested species, *Pimpinella anisum*, considered had as moderately resistant with Rf value of 2.82 followed *Ocimum basilicum* regarded as slightly resistant with Rf value of 3.70. Though *Rosmarinus officinalis* had susceptible host to nematode infection with Rf value 8.43. Moreover, there was significant reduction in both shoot and root weights of the tested all plant species.

Keywords: *Meloidogyne javanica*, medicinal and aromatic plants, immune, very slightly, moderately resistant, susceptible.

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1. Introduction

The medicinal and aromatic plants are important as natural compounds in pharmaceutical, food and cosmetic and health, basic and applied research in the field of plant pests and diseases as an important step in the process of increasing the quantity and quality of medicinal plants products seems necessary. Among plant pathogens, nematodes parasites capable of high pathogenicity and the damage is estimated that annually about one hundred million dollars (Park *et al.,* 2004). More nematode damage by nematodes genus *Meliodogyne* spp. is (Ripoll *et al.,* 2003). Root-knot nematodes *(Meliodogyne* spp.*)* are spreading around the world. More and more of these nematodes in areas with warm weather short and winters can be found. Root-knot nematodes are over 2,000 species of plants, all crops; attack and global product agricultural production by about 5% lower (Izadpanah *et al*., 2010). Over the years natural remedies in particular, basis medicinal plants and even in some cases the treatment was considered and while raw materials were used in the pharmaceutical industry. Pharmaceutical industry needs to obtain active ingredients of so much that it is possible to obtain from nature makes it impossible (Nasresfahani *et al.,* 2015). Pandey *et al.* (2001) reported that the effect of the root- knot nematode (*Meloidogyne incoguita*) infection was different between lowest, moderate and high degree resistance by variation the variety of mint plants (*Mentha* spp.). Park *et al.* (2004) found that *Achyranthes japonica Nakai, Atractylodes japonica* Koidz*.*, *Hibiscus manihot* L., *Ricinus communis* L. and *Sophora flavescens* Ait were resistant to *Meloidogyne hapla.* Mostafa (2005) reported that *Catharuthus alba, Catharamthu major*, Damsis, Castor bean, Roselle and Garlic cv. chiense were highly resistant hosts for *Meliodogyne incognita.* Adegbite *et al.* (2008) reported that the decreasing agronomic parameters recorded for the untreated Roselle cv. The result of the stunting action of root-knot nematode (*M. incognita*). Baida *et al.* (2011) showed that *Anethum graveolens* (Dill), *Pimpinella anisum* (Fennel), *Hyssopus offcinalis* (Hyssop), *Origanum majorana* (Marjoram), *Ocimum basilicum* (Green Basil), *Ocimum basilicum* (Purple Basil) and *Thymes common* (Thyme) were resistant to *M. incognita* and *M. javanica.* Mostafa *et al.* (2014) showed that *Ocimum basilicum* ranked as tolerant host to *Meloidogyne incognita.* The aim of this study was to the reaction of eleven medicinal and aromatic plant species to the nematode *Meloidogyn javanica.*

2. Materials and methods

The Population of root- knot nematode, *Meloidogyne javanica* was maintained and propagated on tomato *solanum lycopersicum* cv. Rutgers. Nematode eggs were extracted from galled roots using in 1% the sodium hypochlorite NaOCl method **(**Hussey and Barker, 1973). Identification of *Meloidogyne* spp. was examined by microscope. Females were gently picked up and placed over a drop of lactophenol on a clean slide. Female posterior tail was cut with help of a sharp knife. Females were identified on the basis perineal pattern system (Eisenback

et al., 1981). Three Seeds of each species of the medicinal and aromatic were planted in clay pots of 25 cm diameter, filled with mixture of loamy and sand soil (2:1 v:v) for two weeks. After germination plants in each pot were thinned to one healthy seedling and inoculated with approximately 3000 newly hatched juveniles (J2) of *M. javanica* per pot. Each inoculated plants was replicated four times. The un-inoculated plants pots served as controls. All pots were randomizing on a bench in greenhouse. Plants were allowed to grow during the normal growing season at greenhouse temperature of 20±5 °C, for 60 days or 30±5 for 45 days after inoculation. At the end of the experiment roots of plants were carefully freed from soil and washed. The roots were then cut into hypochlorite NaOCl method and counted (Hussey and Barker, 1973). Females were gently picked up and placed over a drop of lactophenol on a clean slide. While the root gall index(RGI)and egg- mass index (EI) were estimated according to the scale given by (Taylor and Sasser, 1978) as follows: 0=no galls or egg-masses, 1=1-2 galls or egg-masses, 2= 3-10 galls or egg-masses, 3= 11-302 galls, 4= 31-100 2 galls or egg-masses and 5= > 100galls or egg-masses. Host susceptibility was measured according to (Hadisoeganda and Sasser, 1982). As the follows: 0= Immune host (I), 0.0-1.0= highly resistant (HR), 1.1-3.0= very resistant (VR), 3.1-3.5= moderately resistant (MR), 3.6-4.0=slightly resistant (SR) and 4.1-5.0 susceptible **(S).** Numbers of galls developmental stages with females, egg masses in the root system and numbers of eggs /egg-mass, rate of nematode (bulid-up) were determined for each cultivars – nematode treatment processed for nematode extraction **(Southey 1964)**. Plant growth criteria involving fresh weights of both roots and shoots and their percentages of reduction were also calculated. Data were compared by Duncan's multiple- range test (Duncan's, 1955).

3. Results and Discussion

Eleven species medicinal and aromatic plants were tested for their susceptibility to root- knot nematode, *M. javanica* infection. Data presented in Table (1) showed that the behavior of *M. javanica* varied greatly according to the host type and the nematode species succeeded in developing and multiplying on almost the tested plants. Six species were classified as immune (I) (peppermint *Mentha piperita*, spearmint *Mentha viridis*, holy basil *Ocimum sanctum*, dark roselle *Hibiscus sabdariffa*, pastel roselle *Hibiscus sabdariffa* and lemongrass *Cymbopogon citratus*), horsemint *Mentha longifolia* and pink basil *Ocimum caryophyllatum* as very resistant (VR), anise *Pimpinella anisum* as moderately resistant (MR), sweet basil *Ocimum basilicum* as slightly resistant (SR). While, rosemary *Rosmarinus officinalis* was classified as susceptible **(S)** host gained the highest values of nematode in egg production and final population among the tested plants. The calculated values of rate nematode reproduction and percentages of egg production were plants (1.69 &17.47%) horsemint (VR) and pink

basil (VR) (0.61 & 4.84 %), (2.82 & 32.78%) anise (MR), (3.70 & 43.44%) sweet Basil (SR). On the other hand, *M. javanica* failed to reproduce and multiply on plants peppermint *M. piperita*, spearmint *M. viridis*, holy basil *O. sanctum*, dark roselle *H. sabdariffa*, pastel roselle *H. sabdariffa* and lemongrass *C. citratus*. Whereas, rosemary *R.officinalis* had the highest values Numbers of galls, developmental stages with females, egg masses in the root system and numbers of eggs /egg mass, rate of nematode reproduction and percentage of egg production recorded that (8.43 & 100%) of nematode criteria.

Table (1): Susceptibility of some medicinal and aromatic plants species to the root - knot nematode *Meloidogyne javanica* under greenhouse conditions.

Medicinal and Aromatic plants species		No. galls /root	Nematode population					Nematode final population (P_f)	Rate of nematode reproduction (P_f / P_I)	Egg Production %	Host Category
Common name	Scientific name		Juveniles in soil / pot	Nematodes develop Stage / root	Adult female / root	N. of egg masses / root	N. of eggs /egg mass				
Peppermint	*Mentha piperita*	0 f	0 c	0 c	0 f	0 d	0 d	0	0.00	0.00	I
Spearmint	*Mentha viridis*	0 f	0 c	0 c	0 f	0 d	0 d	0	0.00	0.00	I
Horsemint	*Mentha longifolia*	22 d	691 a	2 bc	19 d	19 c	230 c	5082	1.69	17.47	VR
Sweet basil	*Ocimum basilicum*	49 b	194 b	6 b	42 b	41 b	265 c	11107	3.70	43.44	SR
Pink basil	*Ocimum caryophyllatum*	12 e	623 a	4 bc	7 e	5 d	242 c	1844	0.61	4.84	VR
Holy basil	*Ocimum sanctum*	0 f	0 c	0 c	0 f	0 d	0 d	0	0.00	0.00	I
Dark roselle	*Hibiscus sabdariffa*	0 f	0 c	0 c	0 f	0 d	0 d	0	0.00	0.00	I
Pastel roselle	*Hibiscus sabdariffa*	0 f	0 c	0 c	0 f	0 d	0 d	0	0.00	0.00	I
Lemongrass	*Cymbopogon citratus*	0 f	0 c	0 c	0 f	0 d	0 d	0	0.00	0.00	I
Rosemary	*Rosmarinus officinalis*	85 a	196 b	14 a	72 a	66 a	379 a	25296	8.43	100.00	S
Anise	*Pimpinella anisum*	30 c	245 b	3 bc	27 c	25 c	328 b	8475	2.82	32.78	MR

Means in each column followed by the same letter(s) are not significantly different by (p=0.05) according to Duncan's multiple range test.

The influence of the root-knot nematode *M. javanica* on plant growth of fresh weights of shoots and roots of eleven plant species as well as percentage reductions (expressed here as fresh weight shoots and roots) when compared with healthy once were registered in Table (2).The highest reduction in shoots and roots fresh weights were recorded in rosemary *R. officinalis* (28.69% & 45.57%) and sweet basil *O. basilicum* (24.17% & 34.65%) were highly significantly affected by the nematode infection when compared with their controls. The percentage of reductions in shoots and roots fresh weights in such plants were anise *P. anisum* (16.77% & 23.43%), horsemint (12.94% & 19.08%)

and pink basil *O. caryophyllatum* (13.52% & 16.37%).

Table (2): Plant growth of some medicinal and aromatic plants species as influenced with the infection of the root-knot nematode *Meloidogyne javanca* under greenhouse conditions.

Medicinal and aromatic plants species		Length (cm)						Fresh weight (gm)					
		Shoot			Root			Shoot			Root		
Common name	Scientific name	Infected	non infected	Decrease %	Infected	non infected	Decrease %	Infected	non infected	Decrease %	Infected	non infected	Decrease %
Peppermint	*Mentha piperita*	22.25	23.00	3.26	8.625	8.50	-1.47	1.45	1.47	1.19	1.32	1.34	1.32
Spearmint	*Mentha viridis*	33.25	33.25	0.00	35.75	35.50	-0.70	12.25	12.30	0.40	18.42	18.45	0.13
Horsemint	*Mentha longifolia*	25.62*	30.62	16.31	10.75	12.32	12.74	2.96	3.40	12.94	3.15	3.76	19.08
Sweet basil	*Ocimum basilicum*	37.87**	50.25	24.62	17.87**	22.50	20.55	11.01*	14.52	24.17	1.51*	2.04	34.65
Pink basil	*Ocimum caryophyllatum*	32.50**	37.75	13.90	22.00	25.50	13.72	8.95	10.35	13.52	1.29	1.51	16.37
Holy basil	*Ocimum sanctum*	48.50	47.75	-1.57	45.12	45.25	0.27	10.08	10.16	0.78	2.42	2.50	2.98
Dark roselle	*Hibiscus sabdariffa*	42.50	42.25	-0.59	51.25	51.50	0.48	15.32	15.35	0.16	3.59	3.65	1.67
Pastel roselle	*Hibiscus sabdariffa*	48.62	48.37	-0.52	47.25	47.50	0.52	15.42	15.45	0.16	3.82	4.07	6.40
Lemongrass	*Cymbopogon citratus*	80.50	82.50	2.42	33.25	33.75	1.48	13.30	13.42	0.83	4.08	4.12	0.91
Rosemary	*Rosmarinus officinalis*	19.50**	31.75	38.58	14.00*	18.62	24.81	4.39*	6.16	28.69	3.64	5.31	45.57
Anise	*Pimpinella anisum*	39.50**	48.25	18.13	5.75	7.00	17.85	1.24*	1.49	16.77	1.28	1.58	23.43

* Significant at 0.05 level of probability. ** Highly significant at 0.01 level of probability.

Whereas, the lowest reductions in shoots and roots fresh weights were recorded on spearmint *M. viridis*, lemongrass *C. citratus*, dark roselle *H. sabdariffa*, pastel roselle *H. sabdariffa*, peppermint *M. piperita*, holy basil *O. sanctum* were immune to *M. javanica* which showed that horsemint *M. longifolia* and pink basil *O. caryophyllatum* as very resistant (VR), anise *P. anisum* as moderately resistant (MR), sweet basil *O. basilicum* as slightly resistant (SR). Except rosemary was susceptibility (S). These results are in agreement with those of Moura *et al*. (1990), Moreno *et al.* (1992), Vawdrey and Stirling (1992), Baida *et al*. (2011), Mostafa (2005) and Mostafa *et al.* (2014).

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