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RESEARCH ARTICLE

HOST SUITABILITY OF CERTAIN ORNAMENTAL PLANTS TO THE ROOT-KNOT NEMATODE, *Meloidogyne incognita* AND RENIFORM NEMATODE, *Rotylenchulus* reniformis UNDER GREENHOUSE CONDITIONS

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Abstract

Two greenhouse experiments were conducted to evaluate ten ornamental plant species namely, *Amaranthus tricolor*, *Coleus blumei*, *Ocimum basilicum*, *Gomphrena globosa*, *Catharanthus roseus*, *Dianthus caryophyllus*, *Tagetes erecta*, *Plectranthus amboinicus*, *Pelargonium odoratissimum* and *Pelargonium grandiflorum* for their susceptibility or resistance to *Meloidogyne incognita* and *Rotylenchulus reniformis* infection. Based on the relationship between host growth response and reproduction factor (Rf) plant species of *T. erecta* was rated as highly resistant to both nematode species. However, plant species of *C. roseus* and *P. odoratissimum* were rated as resistant hosts to both nematode species. Plant species of G. *globosa* was rated as resistant or highly resistant host to *M. incognita* and *R. reniformis* respectively. Moreover, *P. amboinicus* was ranked as highly susceptible (HS) to *M. incognita* and *R. reniformis* as well. Plant species of *P. grandiflorum* was rated as resistant to *M. incognita* and susceptible to *R. reniformis*. Though, *A. tricolor* and *C. blumei* ranked as susceptible to *M. incognita*, and tolerant to *R. reniformis*. On the other hand, *D. caryophyllus* was found to be highly susceptible and susceptible to *M. incognita*, and *R. reniformis* respectively. Conversely, *O. basilicum* ranked as tolerant host to *M. incognita* and highly susceptible host to *R. reniformis*.

Introduction

Ornamental plants are of greater importance as they are cultivated in nurseries, landscapes and home gardens for the display of their flowers and decorative purposes. During the two last decades, a great attention has been paid for the medicinal and aromatic plants as natural therapy sources to replace the chemical ones. Ornamental plants are subjected to be attacked with several plant parasitic nematodes of which few of them cause serious problems. The root-knot nematodes, *Meloidogyne* spp. are by far the most cosmopolitan pathogens and have been reported as serious pests on ornamental plants in many regions of the world (Khanna and Jyoti, 2004; Deimi et al.,2008; Brito et al., 2010; El-Sherbiny,2011and Meressa,2014) causing chlorotic and stunted growth, smaller and fewer leaves and flowers, galling formation, root proliferation, failure to respond to fertilizers because of root damage and eventually death and reduction in yield (Ibrahim and Al-Yahya, 2002; Rathour, et al., 2003 and Tariq et al., 2007). The reniform nematode, *Rotylenchulus reniformis*, the stunt nematode, *Tylenchorhynchus* spp., the lesion nematodes, *Pratylenchus* spp., the leaf nematode, *Aphelenchoides* spp. and the spiral nematode, *Helicotylenchus* spp. have been associated with the decline of some ornamental plants (Madej, 2000; El Deriny, 2009; Rashid and Azad, 2013 and Al-Sayed et al., 2014).

Root-knot and reniform nematodes are the most important pests parasitizing most of the surveyed ornamental plant species in Dakahlia governorate, Egypt (Mostafa et al., 2008 and El Deriny, 2009). Use of resistant cultivars is considered as safe alternative method for nematode control. Therefore, the present study was carried out to study the host suitability of ten ornamental plant species grown in Egypt to *M. incognita* and *R. reniformis* infection under greenhouse conditions.

MATERIAL AND METHODS

Two greenhouse experiments were conducted at Nematological Research Unit (NERU) in order to evaluate ten ornamental plant species namely, Chinese amaranth (*Amaranthus tricolor*); coleus (*Coleus blumei*); sweet basil (*Ocimum basilicum*); globe amaranth (*Gomphrena globosa*); periwinkle, (*Catharanthus roseus*); carnation (*Dianthus caryophyllus*); marigold (*Tagetes erecta*); mountain thyme (*Plectranthus amboinicus*); rose geranium (*Pelargonium odoratissimum*) and geranium (*Pelargonium grandiflorum*) for their susceptibility or resistance to the root knot nematode, *M. incognita* and reniform nematode, *R. reniformis* infection. Scientific and family name for each plant species are shown in Table (1).

First experiment

Eighty plastic pots of 15 cm-d filled with 800cm3. steam sterilized sandy loam soil (1:1) (v:v) were used in this experiment, where forty eight pots were each planted with five seeds from each of the following plants, Chinese amaranth, sweet basil, globe amaranth, periwinkle, carnation and marigold and thinned to one plant after twenty days from planting . The other thirty two pots were separately planted with cuttings of each of coleus, mountain thyme, rose geranium and geranium (one cutting / pot). Eight pots were used for each plant species, where four of them were inoculated with 2000 second stage juveniles (J2) of M. incognita two months after planting, while the other four pots were left free of nematode inoculum and served as control. Nematode inocula were obtained from a pure stock culture propagated on coleus, *C. blumei* in a greenhouse. The inocula were introduced to plants by pippeting the inoculum suspension in three holes made around the seedlings. All pots were randomized arranged in block design and horticulturally treated the same. Pots received water as needed. Experiment was terminated 45 days after nematode inoculation then plants were harvested and roots were washed free from adhering soil. Data dealing with length and fresh weight of shoot and root and shoot dry weight were measured. Roots were stained with acid fuchsin (Byrd et al., 1983) and examined for the developmental stages, females, galls and egg masses under stereomicroscope. Root galling or egg masses were rated on a scale of 0 to 5 where 0= no galls or egg masses, 1= 1-2, 2=3-10 ,3= 11-30, 4= 31-100 ,5= more than 100 galls or egg masses per root system (Taylor and Sasser, 1978). Soil of each pot were processed for nematode extraction by sieving and modified Baermann technique (Goodey, 1957). Reproduction factor (Rf) was calculated as Pf/Pi (number of second stage juveniles /final nematode population densities in soil and root).

Table 1: List of ornamental plant species undertaken in the present investigation.

English name (common name)	Scientific name	Family name
Carnation	*Dianthus caryophyllus*	Caryophyllaceae
Chinese amaranth	*Amaranthus tricolor*	Amaranthaceae
Coleus	*Coleus blumei*	Lamiaceae
Mountain thyme	*Plectranthus amboinicus*	Lamiaceae
Geranium	*Pelargonium grandiflorum*	Geraniaceae
Globe amaranth	*Gomphrena globosa*	Amaranthaceae
Marigold	*Tagetes erecta*	Compositae
Periwinkle	*Catharanthus roseus*	Apocynaceae
Rose geranium	*Pelargonium odoratissimum*	Geraniaceae
Sweet basil	*Ocimum basilicum*	Lamiaceae

Second experiment

The same methodology as outlined in the previous experiment was repeated with the reniform nematode, *R. reniformis* with inocula accounted to be 500 immature females per pot. Nematode inocula were obtained from a pure stock culture propagated on cowpea (*Vigna unguiculata*) in a greenhouse. Plants were allowed to grow for 45 days after nematode inoculation at 25.5±6.5˚C. At the end of the experiment, plants were harvested and roots were washed free from adhering soil. Data dealing with length and fresh weight of shoot and root and shoot dry weight were measured. Roots were stained as previous mentioned and examined for immature and mature females, and egg masses under stereomicroscope. Soil of each pot were processed for nematode extraction by sieving and modified Baermann technique (Goodey, 1957) and number of vermiform nematodes were recorded. Reproduction factor (Rf) was calculated as Pf/Pi (number of immature females/ number of vermiform and mature females in soil and root).

Host suitability was evaluated on the basis of percentage of reduction in total plant fresh weight (biomass) as an indicator of plant damage and Rf as an indicator of nematode reproduction as follows:
0-10% reduction in plant growth ; Rf=0 plant is categorized as Highly Resistant (HR); Rf<1 plant is categorized as Resistant (R); Rf>1 plant is categorized as Tolerant (T);
11-30% reduction in plant growth; Rf> 1 plant is categorized as Susceptible (S) and
>30% reduction in plant growth; Rf>1 plant is categorized as Highly Susceptible (HS).

Statistical Analysis

Data were subjected to analysis of variance (ANOVA) (Gomez and Gomez,1984) followed by the Duncan's multiple range test to compare means (Duncan, 1955).

RESULTS AND DISCUSSION

Host Suitability of Ten Ornamental Plants to the Root Knot Nematode, *Meloidogyne incognita*

The influence of *M. incognita* infection on the growth of ten ornamental plant species is depicted in Table 2. Results revealed that four of the screened plant species viz. Chinese amaranth: *A. tricolor*, coleus: *C. blumei* , carnation: *D. caryophyllus*, and mountain thyme: *P. amboinicus* were obviously affected by *M. incognita* infection in terms of length, fresh shoot weight, root weight, total plant fresh weight and shoot dry weight with different degrees. Among these plant species, *P. amboinicus* (32.93%) was highly affected and exhibited the highest percentage reduction values in total plant fresh weight and shoot dry weight (44.40%) followed by *D. caryophyllus* (32.50%) and *C. blumei* (20.27%) in total plant fresh weight . Nevertheless a slight decrease in plant fresh weight was recorded for *P. odoratissimum*(0.50%), *T. erecta* (0.72%), *O. basilicum* (1.57%) and *P. grandiflorum* (2.29%). However, both *O. basilicum* and *P. odoratissimum* showed no reduction in shoot dry weight. On the other hand, plant species of *G. globosa* and *C. roseus* showed no reduction in growth criteria i.e fresh shoot length, total plant fresh weight and shoot dry weight as well (Table2).

The studied ornamental plant species differed greatly in their abilities to support *M. incognita* populations (Table 3). Of ten screened plant species, *T. erecta* had Rf value equal to zero. However, mountain thyme (*P. amboinicus*) exhibited the highest Rf value (5.35) followed by *O. basilicum* (1.27) and *C. blumei* (1.23) then *D. caryophyllus* (1.13). Plant species having 1>Rf >0 were *G. globosa* (0.05) *C. roseus* (0.09), *P. odoratissimum* (0.42) and *P. grandiflorum* (0.62).

Moreover, number of galls and egg masses recovered from roots differed among tested plant species. It was evident that no galls or egg masses were recovered from roots of the plant species *T. erecta*. However, the greatest number of galls were recorded on *C. blumei*, *P. amboinicus*, *A. tricolor* and *D. caryophyllus* respectively with root gall index (RGI) =5.0. Similar trend was achieved with number of egg masses for the same plant species except *D. caryophyllus* with egg masses index (EI) =5.0.

Generally based on the relationship between host growth response and reproduction factor, *T. erecta* was rated as highly resistant host (HR) to *M. incognita* since plant growth was fairly affected and no nematode or galls was detected in the root of plant species. *P. odoratissimum, P. grandiflorum* , *C. roseus* and *G. globosa* were rated as resistant host (R) since plant growth fairly affected and reproduction factor (Rf)< 1. The species *O. basilicum* was rated as tolerant host (T) since plant growth was fairly affected with reproduction factor >1. The species *A. tricolor* and *C. blumei* were rated as susceptible host (S) since plant growth was moderately affected with reproduction factor >1. The plant species *D. caryophyllus* and *P. amboinicus* were rated as highly susceptible host (HS) since plant growth was highly affected with reproduction factor >1.

Host Suitability of Ten Ornamental Plants to the Reniform Nematode, *Rotylenchulus reniformis*

The reaction of the previous species of ornamental plants for resistance or susceptibility to *R. reniformis* infection is shown in Table 4 and 5. Results revealed that out of the ten assessed plant species, four of them namely *P. amboinicus*, *D. caryophyllus*, *O. basilicum*, and *P. grandiflorum* were found to be affected by *R. reniformis* infection in terms of length, fresh shoot weight, root weight, total plant fresh weight and shoot dry weight with different degrees (Table 4). Among these plant species, *O. basilicum* (35.3; 28.33%) and *P. amboinicus*(31.41; 34.88%) were significantly affected and exhibited the highest percentage reduction values in total plant fresh weight and shoot dry weight respectively. However, moderate reduction was noticed with *D. caryophyllus* followed by *P. grandiflorum* with total plant fresh weight 21.50 and 16.09%, respectively. Nevertheless, a slight decrease in total fresh weight was recorded with *P. odoratissimum* (0.35%) and T. *erecta* (2.39%). On the other hand, plant species of *A. tricolor*, *C. roseus* and *G.globosa* showed no reduction in growth criteria i.e fresh shoot length and weight, total plant fresh weight and shoot dry weight (Table 4).

Tested ornamental plant species differed greatly in their abilities to support *R. reniformis* populations (Table 5). Most of them had Rf values higher than 1.0. Of the evaluated ten plant species, *G. globosa* and *T. erecta* had Rf value equal to zero. *P. amboinicus* had the highest Rf value at 12.12 followed by *C. blumei* (4.40) and *D. caryophyllus* (3.78) then *O. basilicum* (3.15). Plant species with 0< Rf <2 were *C. roseus* (0.01), *P. odoratissimum* (0.61) and A. tricolor (1.95). On the other hand, number of egg masses observed on roots differed among tested plant species. It was evident that no R. *reniformis* egg masses were recovered from roots of *C. roseus*, *D. caryophyllus*, *G. globosa* and *T. erecta* although a few or greater numbers of juveniles and vermiform adults were detected in the soil of the plant species i.e. *C. roseus* and *D. caryophyllus*, respectively. The highest number of egg masses were recorded on the roots of *C. blumei* (123.0), *A. tricolor* (67.0) and *P. amboinicus* (52.0).

Table (2): Plant growth of ten ornamental plant species as influenced by *Meloidogyne incognita* infection under greenhouse conditions.

Plant species	Treatments	Length (cm.)		Fresh weight (g.)		Total plant fresh w. (g.)	Red. %	Shoot Dry wt. (g.)	Red. %
		Shoot	Root	Shoot	Root				
A. tricolor	N	81.30 a	27.30 b	30.00 d	6.00 d	36.00 e	11.11	5.30 a	0.00
	CK	79.50 a	32.60 a	32.60 d	7.90 c	40.50 d	---	4.60 ab	---
C. roseus	N	13.00 jkl	20.00 ef	2.50 i	0.40 k	2.90 j	0.00	0.70 hij	0.00
	CK	12.00 kl	8.00 i	2.10 i	0.10 k	2.20 j	---	0.50 ij	---
C. blumei	N	34.00 cd	34.60a	35.90 c	10.50 b	46.40 c	20.27	2.20 f	40.54
	CK	48.80 b	31.80 a	42.80 b	15.40 a	58.20 b	---	3.70 cd	---
D. caryophyllus	N	11.00 l	23.30 bcde	1.40 i	1.30 ij	2.70 j	32.50	0.31 j	8.80
	CK	22.60 gh	22.40 cde	2.60 i	1.40 hij	4.00 j	---	0.34 j	---
G. globosa	N	27.50 ef	16.00 fg	7.80 h	0.90 jk	8.70 i	0.00	1.30 gh	0.00
	CK	25.00 fg	9.00 hi	6.80 h	0.60 jk	7.40 i	---	1.20 hi	----
O. basilicum	N	30.30 de	25.30 bcd	12.60 g	3.70 f	16.30 h	1.57	2.00 fg	0.00
	CK	35.10 c	21.50 de	13.90 g	2.66 g	16.56 h	---	1.20 hi	---
P. grandiflorum	N	16.00 ijk	26.30 bc	24.40 e	2.20 gh	26.60 f	2.92	4.20 bc	10.64
	CK	22.70 gh	20.30 ef	24.60 e	2.80 g	27.40 f	---	4.70 ab	---
P. odoratissimum	N	25.50 fg	26.50 bc	17.60 f	2.50 g	20.10 g	0.50	3.20 d	0.00
	CK	27.80 ef	25.30 bcd	18.20 f	2.00 ghi	20.20 g	---	3.00 de	---
P. amboinicus	N	24.50 fg	16.50 fg	38.60 c	5.60 de	44.20 c	32.93	2.40 ef	44.40
	CK	34.30 cd	16.00 fg	60.80 a	5.10 e	65.90 a	---	4.32 bc	---
T. erecta	N	18.60 hi	14.50 g	2.94 i	1.20 ij	4.14 j	0.72	0.84 hij	5.62
	CK	16.30 ij	13.30 gh	2.87 i	1.30 ij	4.17 j	---	0.89 hij	---

N= 2000 J2 of *M. incognita*. CK= without nematodes Each value is the mean of four replicates
Means in each column followed by the same letter(s) significantly are not different ($P<0.05$) by Duncan's multiple range test.

Based on the relationship between host growth response and reproduction factor (Rf), *G. globosa* and *T. erecta* were rated as highly resistant hosts (HR) to *R. reniformis* since plant growth was unaffected or fairly affected and Rf equal zero. The species *C. roseus* and *P. odoratissimum* were rated as resistant hosts (R) to *R. reniformis* since plant growth was unaffected or fairly affected and Rf <1. The species *A. tricolor* and *C. blumei* were rated as tolerant hosts (T) to *R. reniformis* infection since plant growth was unaffected and reproduction factor >1. *D. caryophyllus* and *P. grandiflorum* were rated as susceptible hosts (S) to *R. reniformis* since plant growth was moderately affected and reproduction factor > 1. *O. basilicum* and *P. amboinicus* were rated as highly susceptible hosts (HS) since plant growth are highly affected and reproduction factor > 1.

Table (3): Host suitability of ten ornamental plants to *Meloidogyne incognita* infection under greenhouse conditions.

Plant species	Nematode population in			Rf *	No. of galls/ Root	RGI **	No. of Egg masses / root	EI**	Host category ***
	Soil	Root							
		Develop. stages	Females						
A. tricolor	1221.5d	162.3 a	636.8 c	1.01	574.0 b	5.0	298.0 c	5.0	S
C. roseus	145.0 f	21.0 c	12.0 d	0.09	30.3 cd	3.5	9.3 de	2.25	R
C. blumei	956.0 de	58.3 b	1450.3 a	1.23	1322.0 a	5.0	730.0 a	5.0	S
D. caryophyllus	2068.0 c	81.3 b	103.8 d	1.13	177.3 c	5.0	94.5 d	4.25	HS
G. globosa	85.0 f	5.5 c	2.0 d	0.05	6.5 de	2.25	1.5 d	1.0	R
O. basilicum	2453.3b	7.5 c	72.3 d	1.27	54.0 cd	4.0	28.5 de	3.25	T
P. grandiflorum	1212.0 d	12.5 c	12.5 d	0.62	18.3 d	3.0	9.5 de	2.25	R
P.odoratissimum	830.0 e	9.3 c	5.3 d	0.42	11.0 d	2.25	3.0 de	1.75	R
P. amboinicus	9608.0 a	81.8 b	1005.3 b	5.35	672.0 b	5.0	503.5 b	5.0	HS
T. erecta	0.0 f	0.0 c	0.0 d	0.00	0.0 d	0.0	0.0 e	0.0	HR

*Reproduction factor (Rf) = final population / Initial population
** Egg masses index (EI) scale:: 0= no galls or egg masses, 1= 1-2, 2= 3-10, 3= 11-30, 4= 31-100 and 5= more than 100 galls or egg masses / root system.
Means in each column followed by the same letter(s) significantly are not different (P<0.05) by Duncan's multiple range test.

Root-knot and reniform nematodes are of the most important pests parasitizing most of the surveyed ornamental plant species in Dakahlia governorate, Egypt (Mostafa et al., 2008 and El Deriny, 2009). Of the ten assessed plant species, *P. amboinicus* (Rf= 5.35) and *D. caryophyllus* (Rf= 1.13) were found to be highly susceptible to *M. incognita*, resulting a remarkable decrease to plant growth. Our results with the susceptibility of mountain thyme, *P. amboinicus* to *M. incognita* did not differ with those of Maciel and Ferraz (1996) who reported the susceptibility of *P. barbatus* to *M. incognita* and *M.* javanica. Plant species of Dianthus differ in their susceptibility to *M. incognita* infection since the present result with *M.* incognita on *D. caryophyllus* are confirmed by the findings of Walker et al. (1994) Cho et al., (1996); Johnson et al. (2003), and Meressa (2014). Khanna and Jyoti, (2004) reported the susceptibility of carnation cv. Red Corso to *M. incognita*. The nematode not only causes quantitative losses, it also delays yield and affects the quality of the flowers - flower size is reduced significantly and this leads to poor commercial grading. Conversely the present result contradict with that obtained by McSorley and Frederick (1994) who reported that *D. chinensis* was found to be poor host to root-knot nematodes.

Coleus, *C. blumei* is a perennial aromatic herb that was severely damaged by root-knot nematode species (McSorley and Frederick,1994). Herein, *C. blumei* (Rf=1.23) was found to be susceptible to *M. incognita* and plant biomass was significantly affected (32.50%). On the other hand, periwinkle, C. roseus (Rf= 0.09), globe amaranth, *G. globosa* (Rf= 0.05) and rose geranium, *P. odoratissimum* (Rf=0.42) and *P.grandiflorum* (Rf=0.62) were found to be resistant to *M. incognita*. These results are in accordance with those reported by Gandarilla et al. (1991) and McSorley and Frederick (2001) in respect to *M. incognita* on *C. roseus* and William (2003) who reported that *C. roseus* and *G. globosa* was poor or non- preferable host to *M. incognita*. Marigolds, *Tagetes* spp. have been the most studied among bedding plants suppressing population densities of root-knot nematodes. However, efficacy varied with nematode species and marigold cultivar (McSorley and Frederick,1994). The plant species, *T. erecta* (Rf=0) was found to be highly resistant since no galls or egg masses were found on root and plant growth was fairly affected. These results are supported by the

Table (4). Plant growth of ten ornamental plant species as influenced by *Rotylenchulus reniformis* infection under greenhouse conditions.

Plant species	Treatments	Length (cm.)		Fresh weight (g.)		Total plant fresh w. (g.)	Red. %	Shoot Dry wt. (g.)	Red. %
		Shoot	Root	Shoot	Root				
A. tricolor	N	81.30 a	26.40 bc	43.90 b	11.40 c	55.30 c	0.00	6.90 a	0.00
	CK	79.50 a	32.60 a	32.60 d	7.90 d	40.50 e	---	4.60 b	---
C. roseus	N	12.80 g	15.00 hi	2.50 i	0.40 hi	2.90 k	0.00	0.60 ghi	0.00
	CK	12.00 g	8.00 k	2.10 i	0.10 i	2.20 k	---	0.50 ghi	---
C. blumei	N	44.30 c	29.10 ab	40.60 c	18.00 a	58.60 b	0.00	3.60 cde	2.70
	CK	48.80 b	31.80 a	42.80 bc	15.40 b	58.20 b	---	3.70 cde	---
D. caryophyllus	N	14.30 g	20.00 efg	2.04 i	1.10 ghi	3.14 k	21.50	0.20 i	33.30
	CK	22.60 f	22.40 cde	2.60 i	1.40 gh	4.00 k	---	0.30 hi	---
G. globosa	N	26.30 ef	19.30 efg	6.90 h	0.70 hi	7.50 j	0.00	1.70 f	0.00
	CK	25.00 ef	9.00 jk	6.80 h	0.60 hi	7.40 j	---	1.20 fgh	---
O. basilicum	N	28.90 e	20.00 efg	8.75 h	1.96 fg	10.71 i	35.30	0.86 ghi	28.33
	CK	35.10 d	21.50 def	13.90 g	2.66 f	16.56 h	---	1.20 fg	---
P. grandiflorum	N	15.80 g	21.50 def	19.89 f	3.10 f	22.99 g	16.09	3.70 cd	21.27
	CK	22.70 f	20.30 ef	24.60 e	2.80 f	27.40 f	---	4.70 b	---
P. odoratissimum	N	25.50 ef	26.50 bc	18.00 f	2.13 fg	20.13 g	0.35	2.90 de	3.30
	CK	27.80 e	25.30 bcd	18.20 f	2.00 fg	20.20 g	---	3.00 de	---
P. amboinicus	N	28.50 e	18.00 fgh	40.30 c	4.90 e	45.20 d	31.41	2.80 e	34.88
	CK	34.30 d	16.00 ghi	60.80 a	5.10 e	65.90 a	---	4.32 bc	---
T. erecta	N	15.50 g	12.00 ijk	2.80 i	1.27 ghi	4.07 k	2.39	0.90 fghi	0.00
	CK	16.30 g	13.30 ij	2.87 i	1.30 ghi	4.17 k	---	0.89 fghi	---

N= 500 immature females of *R. reniformis*. CK= without nematodes Each value is the mean of four replicates. Means in each column followed by the same letter(s) significantly are not different ($P<0.05$) by Duncan's multiple range test.

findings of Prasad and Haque (1982) McSorley and Frederick (1994). Walker et al. (1994) stated that marigold was resistant to *M. incognita*. Yet, several nematicidal compounds have been isolated from marigolds (Gomez-Rodriguez et al 2003; Olabiyi et al. 2006 and Hooks et al. 2010). *Amaranthus*, is a cosmopolitan genus of bedding plant comprising of approximately 60 species. Chinese amaranth, *A. tricolor* (Rf=1.01) ranked as susceptible host to *M. incognita* in which plant biomass was moderately affected (11.11%). This result is in accordance with those reported by Rukshshana and Mian, (2012) and Steyn et al.(2013). Sweet basil, *O. bacilicum*, is a herbaceous species rich in aromatic essential oils and is valuable that has been tested for their host suitability. In the present study, *O. basilicum* was rated as tolerant host to *M.incognita*. However, plant species *O. basilicum* was reported to be resistant to *M. incognita* and *M. javanica* (Baida et al.,2011) and documented as non host to *M. incognita* by Ardakani and Mirinejad (2013).

With reference to *R. reniformis* infection, *P. amboinicus* or *O.basilicum* were found to be highly susceptible to nematode infection, respectively. However, *G. globosa* and *T. erecta*, were found to be highly resistant to *R. reniformis* in which reproduction factor was zero. On the other hand, *C. roseus* (Rf=0) and *P. odoratissimum* (Rf=0.61) were rated as resistant hosts and plant growth was slightly affected. These results are in accordance with those reported by Caswell et al. (1991); Patel et al.(1993) and Khalil (2000) with respect to *R. reniformis* on marigold and periwinkle. Moreover, *C. blumei* ranked as tolerant host to *R. reniformis*. Rashid and Khan (2013) noted that the highest reduction in plant growth of *C. blumei* was recorded at a level of 8000 immature females/kg soil and the lowest was at 500 immature females/kg soil.

The susceptibility of bedding plants to root-knot and reniform nematodes must be recognized in order to avoid damage or unintentional build-up of high nematode population densities (McSorley and Frederick,1994). Based on findings of the present investigation it may be concluded that both mountain thyme, *P. amboinicus* and carnation, *D. caryophyllus* with medicinal values can be so severely damaged by *M. incognita* and *R. reniformis* that biological or integrated control has been considered as substantial option. On the other hand, such resistant plants i.e. *C. roseus* , *G. globosa*, *T.erecta* and *P. odoratissimum* that did not show susceptibility to the target nematodes, *M. incognita* and *R. reniformis* can be planted alternately with susceptible crops in soils infested by these nematodes. Our results provide initial guidelines for selecting bedding plants that minimize build-up from either *M. incognita* or *R.reniformis*.

Table (5): Host suitability of ten ornamental plant species to *Rotylenchulus reniformis* infection under greenhouse conditions.

Plant species	No. of nematodes in soil	No. of females in root	Rf*	No. of Egg-masses / root	Host category **
A. tricolor	874.0 e	99.5 b	1.95	67.0 b	T
C. roseus	2.5 g	0.0 d	0.01	0.0 d	R
C. blumei	2040.0b	139.0 a	4.40	123.0 a	T
D. caryophyllus	1892.0 b	0.8 d	3.78	0.0 d	S
G. globosa	0.0g	0.0 d	0.00	0.0 d	HR
O. basilicum	1568.0c	7.8 d	3.15	6.5 d	HS
P. grandiflorum	1325.5 d	9.8 d	2.67	9.3 d	S
P. odoratissimum	296.0 f	11.3 d	0.61	9.3 d	R
P. amboinicus	5988.0 a	70.8 c	12.12	52.0 c	HS
T. erecta	0.0g	0.0 d	0.00	0.0 d	HR

* Reproduction factor (Rf) = final population / Initial population..

**Host category based on the relationship between host response and R factor as follows:

0-10% reduction in plant growth; RF=0 Highly Resistant (HR)
RF<1 Resistant (R)
RF>1 Tolerant (T).

11-30% reduction in plant growth; RF> 1 Susceptible (S).

>30% reduction in plant growth ; RF>1 Highly Susceptible (HS).

Means in each column followed by the same letter(s) significantly are not different (P<0.05) by Duncan's multiple range test.

Table (6): Relative susceptibility of ten ornamental plant species to *Meloidogyne incognita* and *Rotylenchulus reniformis.*

Plant species	*M. incognita*	*R. reniformis*
A. tricolor	S	T
C. roseus	R	R
C. blumei	S	T
D. caryophyllus	HS	S
G. globosa	R	HR
O. basilicum	T	HS
P. grandiflorum	R	S
P. odoratissimum	R	R
P. amboinicus	HS	HS
T. erecta	HR	HR

Highly Resistant (HR), Resistant (R), Tolerant (T), Susceptible (S), Highly Susceptible (HS)

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