HOST STATUS OF MEDICINAL PLANTS FOR *MELOIDOGYNE HAPLA*

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ABSTRACT

Park, S. D., J. C. Kim and Z. Khan. 2004. Host status of medicinal plants for *Meloidogyne hapla*. Nematropica 34:39-43.

Twenty-two species of medicinal plants were tested in pots for their host suitability to *Meloidogyne hapla* under greenhouse conditions. Each plant was inoculated with 5,000 freshly hatched second-stage juveniles. Host suitability was assessed 60 days after inoculation on the basis of root gall index (GI) and reproduction factor (Rf). Twelve species namely, *Angelica dahurica*, *Arctium lappa*, *Astragalus membranaceous*, *Carthamus tinctorius*, *Codonopsis lanceolata*, *C. pilosula*, *Coriandran sativum*, *Glycyrrhiza uralensis*, *Leonurus sibiricus*, *Ligusticum tenuissimum*, *Ostericum koreanum* and *Peucedanum japonicum* were recorded as susceptible to *M. hapla* with GI, 2.6-5.0 and Rf, 1.3-10.6. Three species, *Cassia tora*, *Coix lachryma-jobi* and *Perilla frutescens* were immune, no gall and nematode found on these plants. Five species, *Achyranthes japonica*, *Atractylodes japonica*, *Hibiscus manihot*, *Ricinus communis* and *Sophora flavescens* were considered as resistant with Rf value of 0.3-0.6. *Aster scaber* and *Agastache rugosa* were tolerant and hypersensitive, respectively.

Key words: Host status, Korea, Medicinal plants, *Meloidogyne hapla*.

RESUMEN

Park, S. D., J. C. Kim y Z. Khan. 2004. Estado del huésped de plantas medicinales para Meloidogyne hapla. Nematropica 34:39-43.

Veintidós especies de plantas medicinales fueron ensayadas en macetas para conveniencia de huésped para *Meloidogyne hapla* bajo condiciones de invernadero. Cada planta fue inoculada con 5000 juveniles de segundo estado recién nacidas. La conveniencia de huésped fue asesorada 60 días después de la inoculación, y fue basada en el índice de agalladuras y el factor de reproducción (Rf). Doce especies, *Angelica dahurica*, *Arctium lappa*, *Astragalus membranaceous*, *Carthamus tinctorius*, *Codonopsis lanceolata*, *C. pilosula*, *Coriandran sativum*, *Glycyrrhiza uralensis*, *Leonurus sibiricus*, *Ligusticum tenuissimum*, *Ostericum koreanum* y *Peucedanum japonicum* fueron registrados como sensibles a *M. hapla*, con GI de 2.6-5.0 y Rf de 1.3-10.6. Tres especies, *Cassia tora*, *Coix lachryma-jobi* y *Perilla frutescens*, eran inmunos, nose encontraron agalladuras ni nemátodos en estas plantas. Cinco especies, *Achyranthes japonica*, *Atractylodes japonica*, *Hibiscus manihot*, *Ricinus communis* y *Sophora flavescens*, fueron consideradas como resistentes con valores de Rf de 0.3-0.6. *Aster scaber* y *Agastache rugosa* eran tolerante y hipersensible, respectivamente.

Palabras clave: Estado del huésped, Korea, plantas medicinales, *Meloidogyne hapla*.

INTRODUCTION

Medicinal plants are an important agricultural commodities in Korea; their cultivation is spread over 9,985 hectares (Ministry of Agriculture and Forestry, Korea, 2003). However, due to limited arable lands in Korea, some fields have been continuously cultivated with the same species of medicinal plants for several years. In such a monoculture system, soil borne diseases, especially, nematodes often become an important constraint for susceptible hosts. Although comprehensive lists of nematode pests of medicinal plants and their distribution have been compiled (Kim *et al.*, 1987; Park *et al.*, 1993; 1998), but the study of nematodes as pests of medicinal plants has received little attention.

The northern root-knot nematode, *Meloidogyne hapla* Chitwood, is widely distributed in the fields of medicinal and ornamental plants in Korea and is considered to be economically important to several species of medicinal plants (Kim *et al.*, 1987; Park *et al.*, 1993, 1998). Although host resistance has been evaluated for peanut (*Arachis hypogaea* L.), pepper (*Capsicum annuum* L.), cucumber (*Cucumis sativus* L.) and tomato (*Lycopersicon esculentum* Mill.) to *M. hapla* in Korea (Cho *et al.*, 1986), the host status of medicinal plants has remained unexplored, except for Korean angelica (*Angelica gigas* Nakai), Peony (*Paeonia lactiflora* Pall.) and yam (*Discorea batatas* Decaisn.) which are highly susceptible (Han, 1994; Park *et al.*, 1999).

Chemical nematicide use is one of the primary means of control for plant-parasitic nematodes. However, the potential negative impact on the environment and ineffectiveness after prolonged use have led to a total ban or restricted use of most nematicides and an urgent need for safe and effective options (Zuckerman and Esnard, 1994). As a result, there has been increased interest in the development of other effective and environmentally friendly methods for controlling nematodes including resistant plants and crop rotations. Information on host suitability of medicinal plants for *M. hapla* is important for continued sustainable production and to determine if alternate management practices are required. The objective of the present work was to evaluate the host status to *M. hapla* of twenty-two species of medicinal plants, which are commonly cultivated in Korea.

MATERIALS AND METHODS

A single population of *Meloidoyne hapla* was maintained on tomato (*Lycopersicon esculentum* Mill) cv. Rutgers, in greenhouse at Medicinal Experiment Station, Uison, Korea. Nematode eggs were extracted from roots in 1% NaOCL and incubated for 4 days using modified Baermann trays to obtain second-stage juveniles (J_2) for inoculation (Hussey and Baker, 1973; Rodriguez-Kabana and Pope, 1981). Three seeds of each species of the medicinal plants (Table 1) were planted into 10 cm diam. plastic pots containing 500 ml of steam-sterilized field soil, sand and compost (2:1:1). After two weeks plants were thinned to one per pot and inoculated with 5,000 freshly hatched J_2 of *M. hapla* suspended in 30 ml water. J_2s were added

Table 1. Designation of resistance based on plant damage and host efficiency.

Plant damage (gall index)	Host efficiency (R factor)	Degree of resistance designation (DR)
≤2	≤1	Resistant
≤2	>1	Tolerant
>2	≤1	Hypersusceptible
>2	>1	Susceptible

Plants with nematode reproduction (R = 0) and root galling index (GI = 0) were categorized as immune.

to soil around the roots in each pot by removing topsoil to a depth of 2-3 cm, pipetting nematode suspension on to the exposed roots and the roots were covered with soil. Control pots received only water. Each medicinal plant treatment was replicated five times. Pots were arranged in complete randomized blocks design on benches in a greenhouse maintained at 23-26°C. Plants were watered daily and fertilized once with urea (0.15 g/kg of soil) 30 days after inoculation. The experiment was terminated 60 days after inoculation. Plants were carefully uprooted from pots and the roots were washed gently with tap water. Root galls (GI) per plant root system

Table 2. Host status of medicinal plant species for *Meloidogyne hapla*, analyzed 60 days after inoculation with 5,000 juveniles (J_2) per plant.

Medicinal plants						
Scientific name	Common name	Family	GI	SD	Rf	DR
Achyranthes japonica Nakai	Speed Well	Amaranthaceae	1.6	0.49	0.5	R
Agastache rugosa Kuntz	Giant hyssop	Labiatae	3.2	0.40	0.8	H
Angelica dahurica Benth. et Hooker f.	Angelica	Umbelliferae	5.0	0.00	9.3	S
Arctium lappa L.	Common burdock	Compositae	4.2	0.40	3.6	S
Aster scaber Thunb.	Rough aster	Compositae	1.0	0.40	2.0	T
Astragalus membranaceus Bunge	Locoweed	Leguminosae	2.6	0.49	1.3	S
Atractylodes japonica Koidz.	Atractylodes	Compositae	1.2	0.40	0.3	R
Cassia tora L.	Golden shower	Leguminosae	0.0	0.00	0.0	I
Carthamus tinctorius L.	Safflower	Compositae	3.0	0.63	1.8	S
Codonopsis lanceolata Trautv.	Lance asiabell	Companulaceae	5.0	0.00	10.6	S
C. pilosula (Franch.) Nannfeldt	Pilose asiabell	Companulaceae	3.8	0.40	3.3	S
Coix lachryma-jobi L.	Job's tear	Gramineae	0.0	0.00	0.0	I
Coriandrun sativum L.	Coriander	Umbelliferae	4.4	0.49	3.5	S
Glycyrrhiza uralensis Fisch. et DC.	Licorice	Leguminosae	3.4	0.49	2.5	S
Leonurus sibiricus L.	Motherwort	Labiatae	4.0	0.00	5.2	S
Ligusticum tenuissimum Nakai	Chinese lovage	Umbelliferae	3.2	0.40	2.3	S
Hibiscus manihot L.	Sunset hibiscus	Malvaceae	1.2	0.40	0.3	R
Ostericum koreanum Kitagawa	Korean ostericum	Umbelliferae	3.4	0.40	2.4	S
Perilla frutescens Brit.	Beefsteak plant	Labiatae	0.0	0.00	0.0	I
Peucedanum japonicum Thunb.	Divaricata	Umbelliferae	5.0	0.00	8.4	S
Ricinus communis L.	Castor	Euphorbiaceae	1.6	0.49	0.5	R
Sophora flavescens Ait	Sphora	Leguminosae	1.8	0.40	0.6	R

GI = Gall index (0-5); 0 = no gall; 1 = 1-2 galls; 2 = 3-10 galls; 3 = 11-30 galls; 4 = 31-100 galls; 5 = >100 galls per root system.
SD = Standard deviation; Rf = Reproduction factor; DR = Degree of resistance; S = Susceptible; H = Hypersusceptible; R = Resistance; T= Tolerant; I = Immune.

were counted and an index of 0-5 was assigned (0 = no galls, 1 = 1-2, 2 = 3-10, 3 = 11-30, 4 = 31-100, 5 = >100 galls per root system) (Taylor and Sasser, 1978). In addition eggs were extracted from each root system by shaking roots in 1% NaOCL for 4 minutes (Hussey and Barker, 1973) and counted to determine final population density for each plant. After root ratings were completed, root systems of each plant were stained with acid fuchsin (Byrd *et al.*, 1983). Numbers of developing stages of juveniles and mature females were recorded. J_2 populations of *M. hapla* in soil were also estimated by extracting nematodes from 200 g soil from each pot using centrifugal-flotation techniques (Caveness and Jensen, 1955).

The reproduction factor, Rf = Pf/Pi, was calculated, Pf being the final population count (eggs + juveniles + females and developing stages) and Pi, the original inoculum of 5,000 J_2. Based on the gall index and reproduction factor, the host suitability (degree of resistance) of medicinal plants species was allocated according to the modified scheme of Canto-Saenz (Sasser *et al.*, 1984) (Table 1).

RESULTS AND DISCUSSION

Twenty-two species of medicinal plants tested in this study varied in their host suitability for *Meloidogyne hapla* (Table 2): 12 species were susceptible, three immune and one each was hypersensitive and tolerant. Among the susceptible species, *Angelica dahurica* Benth. et Hooker f., *Codonopsis lanceolata* Trautv. and *Peucedanum japonicum* Thunb. were the most susceptible host with heavy galling (GI = 5) and high reproduction factors (Rf > 8). *Arctium lappa* L., *Astragalus membranaceous* Bunge, *Carthamus tinctorius* L., *Codonopsis pilosula* (Franch.) Nannfeldt, *Coriandrun sativum* L., *Glycyrrhiza uralensis* Fisch. et DC., *Leonurus sibiricus* L., *Ligusticum tenuissimum* Nakai, *Ostericum koreanum* Kitagawa, were susceptible host with Rf-values between 2 and 4.

Three species of medicinal plants, *Cassia tora* L., *Coix lachryma-jobi* L. and *Perilla frutescens* Brit. were recorded as immune to *M. hapla*, no gall and nematodes were found on roots of these plants. Based on GI and Rf-value, *Achyranthes japonica* Nakai, *Atractylodes japonica* Koidz., *Hibiscus manihot* L., *Ricinus communis* L. and *Sophora flavescens* Ait were as resistant, and *Aster scaber* Thunb. was tolerant to *M. hapla*. One species, *Agastache rugosa* Kuntz appeared to be hypersensitive, showing significant damage (GI > 2), but the Rf-value remained below 1.

Our results suggest that species of medicinal plants immune or resistant to *M. hapla* are available in Korea, which could be used in cropping sequences to maintain nematode population at low levels. If these findings are taken into account when growing medicinal plants in *M. hapla* infested fields this nematode can be managed effectively.

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Received: *28.I.2004*
Recibido:

Accepted for publication: *7.VII.2004*
Aceptado para pulicación: