THE ROOT-KNOT NEMATODE, *MELOIDOGYNE INCOGNITA*, ON *PSORALEA CORYLIFOLIA* IN INDIA

Zakaullah Khan*[1], Ashok Kumar[2], M. Mahamood[3], Bharat Gawade[1], and N. K. Gautam[2]

[1]Division of Plant Quarantine, National Bureau of Plant Genetic Resources, New Delhi 110 012, India; [2]Division of Germplasm Evaluation, National Bureau of Plant Genetic Resources, New Delhi 110 012, India; [3]Department of Zoology, AMU, Aligarh 202002, U.P., India; *Corresponding author: znema@yahoo.com

ABSTRACT

Khan, Z., A. Kumar, M. Mahamood, B. Gawade, and N. K. Gautam. 2014. The root-knot nematode, *Meloidogyne incognita*, on *Psoralea corylifolia* in India. Nematropica 44:81-84.

Psoralea corylifolia, also known as babchi, is a medicinal herb that grows throughout much of the world. A severe infestation of root-knot nematodes (RKN), identified as *Meloidogyne incognita* Race 1, was observed on *P. corylifolia* plants cultivated at the Agriculture Farm of the National Bureau of Plant Genetic Resources, Issapur, New Delhi, India. Roots of infected plants were heavily galled, and soil samples collected from the rhizosphere of affected plants yielded 536-845 second-stage juveniles (J2)/200 cm^3 soil. The severe root galling and presence of a high population density of J2 in the soil around symptomatic plants indicates that RKN can be a potentially damaging pest of *P. corylifolia*. These findings will assist *Psoralea* growers in recognizing RKN as an economic threat to the crop and should increase growers' awareness of the need to take soil samples from prospective babchi fields prior to planting. Some possible management strategies are discussed.

Key words: babchi, infestation, root-knot nematode.

RESUMEN

Khan, Z., A. Kumar, M. Mahamood, B. Gawade, and N. K. Gautam. 2014. El nematodo formador de agallas en las raíces, *Meloidogyne incognita*, en *Psoralea corylifolia* en la India. Nematropica 44:81-84.

Psoralea corylifolia, también conocida como babchi, es una hierba medicinal de amplia distribución mundial. Se observó una severa infestación de nematodos formadores de nódulos en las raíces (RKN), identificados como *Meloidogyne incognita* raza 1 en plantas de *P. corylifolia* cultivadas en el "Agriculture Farm of the National Bureau of Plant Genetic Resources, Issapur, New Delhi, India". Las raíces de las plantas infectadas estaban severamente noduladas y las muestras de suelo recolectadas de la rizosfera de plantas afectadas contenían 536-845 juveniles de segundo estadío (J2)/200cm^3 suelo. La severa nodulación y la presencia de altas densidades de población de J2 en el suelo cercano a plantas sintomáticas indica que estos nematodos pueden dañar potencialmente a *P. corylifolia*. Estos resultados asistirán a los productores de *Psoralea* en el reconocimiento del nematodo formador de nódulos en las raíces como una amenaza económica del cultivo y debería incrementar la conciencia entre los agricultores sobre la necesidad de tomar muestras de suelo en posibles campos de cultivo previas a la plantación. Se discuten posibles estrategias de manejo.

Palabras clave: babchi, infestación, nematodo formador de nódulos en las raíces.

Psoralea corylifolia Linn. (syn: *Cullen corylifolium* Linn.) is a small, erect, annual herb that is grown throughout the world. Commonly known as babchi in India, the crop is sown during June-July, matures in April, and attains heights up to 1.5 m. The seed is surrounded by a sticky, oily pericarp, which contains a variety of furocoumarins including psoralens, essential oil, coumarins, alkaloids, flavonoids, and terpenoids (Khushboo *et al*., 2010). All parts of this herb, including roots, stems, leaves, seeds, and blooms, are useful. The plant has been used for centuries in traditional Ayurvedic and Chinese systems of medicine in the treatment of leucoderma, psoriasis, vitiligo, asthma, ulcers, kidney disorders, and as an aphrodisiac and an anti-inflammatory (Li *et al*., 2000; Khushboo *et al*., 2010). Also known as "Kushtanashini" (leprosy destroyer) in Ayurveda, babchi seeds have also been used in the Indian system of medicine in the treatment of leprosy and other skin diseases (Nair *et al*., 1987; Sah *et al*., 2006).

Nematodes are established constraints in the cultivation of many medicinal, aromatic, and spice plant

species (Haseeb, 1994). However, there is very limited information available regarding the nature and extent of nematode disease problems in *Psoralea* (Sultan *et al*., 2010). Root-knot nematodes (*Meloidogyne* spp.) are some of the most damaging plant-parasitic nematodes and are capable of attacking a wide range of crop plants as well as many weed species. Infected plants show typical symptoms that include root galling, stunting, and nutrient deficiency (Dasgupta and Gaur, 1986). *Meloidogyne* spp. are sedentary endoparasites of roots, feeding and developing within galls. Infection may also predispose plants to infection by soil-borne, root-infecting pathogens.

In October 2012 during a routine disease survey at the Issapur Agriculture Farm of the National Bureau of Plant Genetic Resources, New Delhi, India, a severe infestation of root-knot nematodes was found in *P. corylifolia*. Stunted, chlorotic, and wilted plants were observed in plots growing on the farm (Fig. 1 and 2). The symptoms appeared in patches, which is a typical characteristic of nematode infection because of their clustered distribution. Roots were randomly collected from the affected areas, and soil samples were collected from the rhizosphere in the same areas. About 20 composite soil and root samples were collected. Each sample consisted of 4 to 6 cores of soil, collected to a depth of 25 cm, and 10 to 20 g of infected root tissues. Migratory stages of root-knot nematodes (RKN), i.e. second stage juveniles (J2) and males of the associated RKN species, were isolated from 200 cm^3 of soil from each sample by suspending them in water in a plastic bucket and passing suspension through nested sieves of 100 (150 µm) and 400 (38 µm) mesh and finally separating the nematodes from residue collected on 400-mesh sieve by Baermann funnel method (Southey, 1986). The J2 were counted under stereoscopic microscope at 40× magnification. Root samples were washed thoroughly with tap water and observed for the presence of root galls. Severity of root galling on infected plants was assessed on a 0–5 rating scale according to the percentage of galled tissue, in which 0 = no infection; 1 = 1–20%; 2 = 21–50%; 3 = 51–80%; 4 = 81–90%; and 5 = 91–100% (Barker, 1985). The species of associated RKN was identified as *M. incognita* Race 1 on the basis of differential host test (Hartman and Sasser, 1985). Perineal pattern characteristics of mature females were also used to identify the species (Eisenback, 1985). For that, infected roots of *P. corylifolia* were stained with 0.1% cotton blue in lactophenol (Hooper, 1986). Mature females of RKN were dissected out from stained roots and slides of perineal patterns (10 to 20) from each sample were prepared as described by Hartman and Sasser (1985). Slides of perineal patterns were examined under compound light microscope (Olympus BX 51, Japan) at high magnification (10 x 100×). The perineal patterns were characterized by the presence of high, squarish dorsal arch with smooth to slightly wavy striae, and absence of lateral lines, which are typical characteristics of *M. incognita* as given by Eisenback (1985).

All of the 20 soil samples collected from infested plots yielded high populations of *M. incognita* J2, with population densities ranging from 536-845 J2/200 cm3 of soil with an average density of 726.5 ± 81.86 J2/200 cm^3 (= 3.6 J2/cc soil). The entire root system of the infected plants was heavily galled (Fig. 3) and covered with necrotic tissues (Fig. 4), gall rating was 4-5 (encompassing 90-100% of root systems). It is concluded that RKN can be a damaging pest of *P. corylifolia*. Proper management strategies should be taken in *P. corylifolia* cultivation to minimize the damage caused by this nematode.

The crops that were grown in the site before *P. corylifolia* may have been critical to the nematode infestation level. The *P. corylifolia* plots had a history of monoculture (3 yr) in the site. Prior to the babchi, the field was cultivated with vegetable crops (tomato, pumpkin, ash gourd, and bottle gourd). This suggests that RKN may have been present in the preceding crops, which are known as RKN susceptible. This might have led to the high population density of RKN in the present study.

Few eco-friendly and feasible strategies are available for RKN management on babchi. Growing a non-host crop in rotation with *P. corylifolia* could be a good way to control the nematodes. Unfortunately, rotation is not as easy for controlling root-knot nematodes as with many other crops because of its extremely wide host range that includes many weeds. However, careful planning of crop rotation sequences in combination with fallowing and soil solarization during peak summer could reduce nematode numbers below economic levels. Annual crops that could be useful in crop rotation include wheat, barley, sudangrass, rapeseed, and mustard. In addition, certain marigolds (*Tagetes* spp.) suppress nematodes when included in crop rotation. Marigold cultivars of *Tagetes patula*, *T. erecta*, *T. signata*, and a *Tagetes* hybrid (varieties include Single Gold, Polynema, Tangerine, etc.) are effective against RKN (Ploeg, 1999; 2002). Proper site selection to avoid highly infested sites can also achieve a healthy crop with better yield. Growers are advised to have the soil from proposed fields for production of *P. corylifolia* tested for nematodes before planting.

LITERATURE CITED

Barker, K. R. 1985. Nematode extractions and bioassays. Pp. 19–35 *in* K. R. Barker, C. C. Carter, and J. N. Sasser (eds.) An advanced treatise on *Meloidogyne*, Vol. II. Methodology. Raleigh, USA: North Carolina State University Graphics.

Dasgupta, D. R., and H. S. Gaur. 1986. The root-knot nematodes *Meloidogyne* spp. in India. Pp. 139-171 *in* G. Swarup and D. R. Dasgupta (eds.) Plant parasitic nematodes of India problems

and progress. New Delhi: Indian Agricultural Research Institute.

Eisenback, J. D. 1985. Diagnostic characters useful in the identification of the four most common species of root-knot nematode (*Meloidogyne* spp.). Pp. 95-112 *in* K. R. Barker, C. C. Carter, and J. N. Sasser (eds.) An Advanced Treatise on *Meloidogyne*, Vol. II. Methodology. Raleigh, USA: North Carolina State University Graphics.

Haseeb, A. 1994. Plant parasitic nematodes of medicinal and aromatic plants. Pp. p98-119 *in* T. Singh and P. C. Trivedi (eds.) Vistas in Seed Biology. Allahabad, India: Printwell Publisher.

Hartman, K. M., and J. N. Sasser. 1985. Identification of *Meloidogyne* species on the basis of differential host test and perineal pattern morphology. Pp. 69-77 *in* K. R. Barker, C. C. Carter, and J. N. Sasser (eds.) An advanced treatise on *Meloidogyne*, Vol. II. Methodology. Raleigh, USA: North Carolina State University Graphics.

Hooper, D. J. 1986. Preserving and staining nematodes in plant tissues. Pp 81-86 *in* D. J. Hooper (ed.) Laboratory methods for work with plant and soil nematodes. London, UK: Ministry of Agriculture Fisheries and Food, Her Majesty's Stationery Office.

Khushboo, P. S., V. M. Jadhav, V. J. Kandam, and N. S. Sathe. 2010. *Psoralea orylifolia* Linn. "Kushtanashini". Pharmacognosy Review 4:69–76.

Li, H. W., L. H. W. Zhu, W. Yuan, and W. Y. Zhu. 2000. Effects of traditional Chinese medicine compounds for treating vitiligo on mushroom tyrosinase activity in vitro. Journal of Clinical Dermatology 29:133-35.

Nair, P. R., M. N. S. Namboodri, and V. A. Prabhakaran. 1987. Clinical evaluation of Ayurvedic preparations in vitiligo. Journal of Research in Ayurveda and Siddha 8:30-38.

Ploeg, A. T. 1999. Greenhouse studies on the effect of marigolds (*Tagetes* spp.) on four *Meloidogyne* spp. Journal of Nematology 31:62-69.

Ploeg, A. T. 2002. Effect of selected marigold varieties on root-knot nematode and tomato and melon yields. Plant Disease 86:505-508.

Sah, P., D. Agrawal, and S. P. Garg. 2006. Isolation and identification of furocoumarins from the seeds of *Psoralea corylifolia* L. Indian Journal of Pharmaceutical Sciences 68:768-71.

Southey, J. F. 1986. Laboratory Methods for work with Plant and Soil Nematodes. London, UK: Ministry of Agriculture Fisheries and Food, Her Majesty's Stationery Office.

Sultan, M. S., S. K. Sharma, and N. K. Dhillon. 2010. Identification of nematode problems in medicinal, aromatic, and spice plants in Punjab, India. Trends in Biosciences 3:56-57.

Fig. 1. Plot cultivated with *Psoralea corylifolia* showing patches of *Meloidogyne incognita* infestation. Foliar symptoms include chlorotic, wilted, and dead plants.

Fig. 2. Individual infected plant at high magnification showing yellowing and dying of leaves.

Fig. 3. Roots of *Psoralea corylifolia* infected with *Meloidogyne incognita* showing heavy root galling on entire root system.

Fig. 4. Root galls on infected roots at higher magnification showing necrosis of galled tissues.

Received: 05/XI/2013
Recibido:

Accepted for publication: 31/III/2014
Aceptado para publicación: