

The Pecan Root-Knot Nematode, *Meloidogyne partityla* Kleynhans, 1986¹

J. A. Brito², R. Kaur³, D. W. Dickson³, J. R. Rich⁴ and L. A. Halsey⁵

INTRODUCTION: Pecan, *Carya illinoensis* (Wangenh) K. Koch, is a member of the Juglandaceae along with walnut and hickory. The name "pecan" comes from the Native American word *pacane*, meaning "nut so hard as to require a stone to crack." Pecan is native to the southern United States and is an important nut crop throughout much of the region. Total pecan production in the US is 131 million pounds; a \$140 million value with growers receiving \$1.07/lb (USDA 2002). Improved pecans are produced in 13 of the 14 states that grow pecans, with Georgia (27-37%), New Mexico (25-28%), and Texas (15-20%) as the leading states (USDA 2002). Other states producing significant quantities of pecans are Arizona, Alabama, California, Mississippi and Florida (USDA 2002). In Florida, commercial pecan production is centered in the northern tier of counties, with little production in other parts of the state.

The pecan root-knot nematode, *Meloidogyne partityla* Kleynhans, was first found infecting pecan in 1986 in South Africa (Kleynhans 1986). However, other species of root-knot nematodes, *Meloidogyne* spp., reproduce and cause disease on pecan, including *M. incognita* (Hendrix and Powell 1968), *M. arenaria* (Carithers 1978), and *M. javanica* (Pinochet *et al.* 1993). It is hypothesized that the pecan root-knot nematode was introduced into South Africa from the United States with importation of infected pecan seedlings in 1912, 1939 and 1940 (Kleynhans 1986).

DISTRIBUTION: *Meloidogyne partityla* has been reported only in South Africa and in the United States, where it has caused significant economic damage to pecan in Texas (Star *et al.* 1996), New Mexico (Thomas *et al.* 2001), Georgia (Nyczepir *et al.* 2002), and Arizona and Oklahoma (NMSU 2006). In 2005, *M. partityla* was found in Florida infecting pecan seedlings in Jefferson County (Levin 2005). Additional surveys are required to determine the distribution of the pecan root-knot nematode in southern United States.

HOST STATUS: While very little is known about possible hosts or the pathogenicity of the pecan root-knot nematode, it is believed to have a very narrow host range. Only pecan, hickory, and walnut trees have been reported as hosts of this nematode (Starr *et al.* 1996). In a host status study conducted under greenhouse conditions, Marais and Heyns (1990) reported that beans (*Phaseolus vulgaris*), peas (*Pisum sativum*), cowpea (*Vigna* sp.), tomato (*Lycopersicon lycopersicum*), weeping love grass (*Eragrostis curvula*), and peach (*Prunus persica*) were non-hosts of *M. partityla*.

MORPHOLOGICAL CHARACTERISTICS AND DIAGNOSIS: *Meloidogyne partityla* females are pear-shaped, white-colored, and sometimes transparent (Fig. 1A); whereas the males are vermiform in shape and transparent. **Females:** Body length 616-993 µm; body width 331-596 µm; stylet length 14.6-20.0 µm; stylet cone length 7.7-11.2 µm. Perineal patterns hexagonal, dorsal arch low to medium high (Fig. 1B), sometimes broadly rounded; striae relatively coarse with fine annulation outside the pattern, wavy to zig-zag; lateral field areas often bulged out, lateral fields recessed, dorsal and ventral striae meet at an angle; perineum free from striae. **Males:** Body length 723-1954 µm; body width 22.3-32.0 µm; stylet length 16.9-21.4 µm; tail length 3.7-10.0 µm. **Second-stage juveniles:** Body length 383-494 µm; body width 14.7-19.6 µm; stylet length 10.3-12.4 µm; stylet base to head end 14.1-17.5 µm; tail length 45.0-63.5 µm; hyaline tail length 11.4-18.8 µm. Fine annulation on the body, coarse and irregular on tail; lateral field with 4 lines each. Second-stage juveniles have fine annulation on their body, with coarse and irregular on tail. The lateral fields have four lines each and these lines fade opposite to the hyaline portion of tail. **Eggs:** Length 82.0-116.0 µm; width 36.7-49.2 µm (Kleynhans 1986).

¹ Contribution No. 484, Bureau of Entomology, Nematology and Plant Pathology, Nematology Section.

² Nematologist, Division of Plant Industry, P. O. Box 147100, Gainesville, FL 32614.

³ Post Doc. Assoc. and Professor, respectively, Entomology and Nematology Dept., University of Florida, Gainesville, FL 32611.

⁴ Professor, University of Florida, North Florida REC, 155 Research Road, Quincy, FL, USA 32351-95003.

⁵ County Extension Director and Agriculture Extension Agent, 275 North Mulberry Street, Monticello, FL 32344.

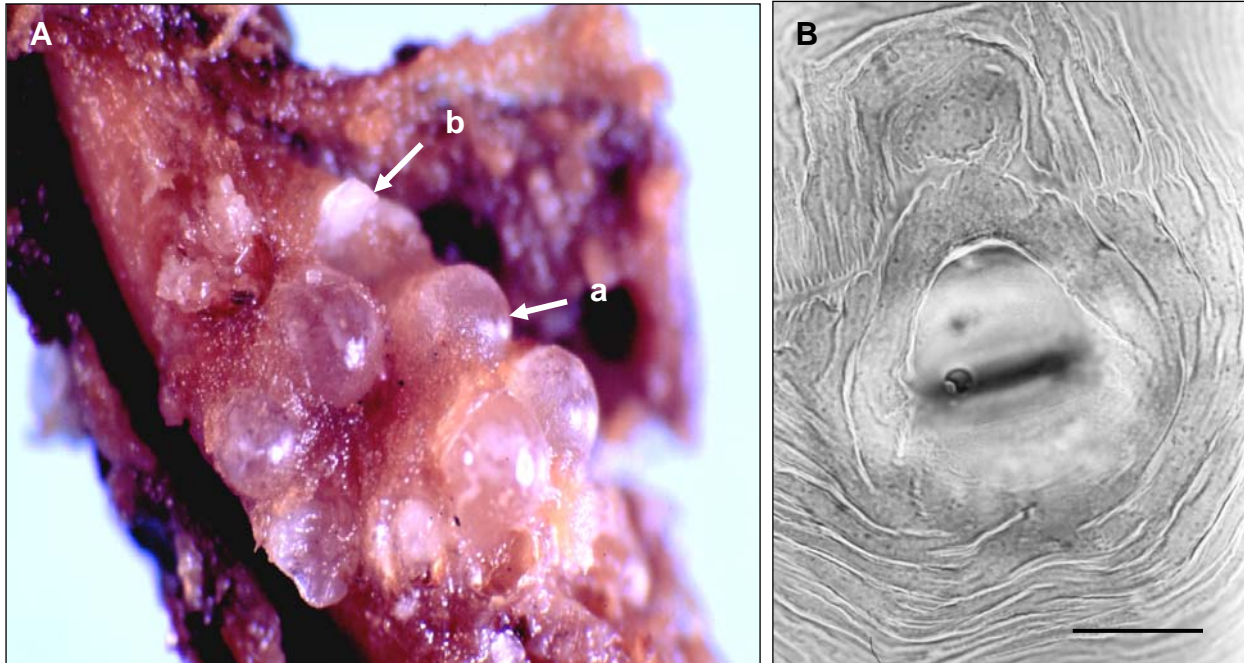


Fig. 1. The pecan root-knot nematode from Florida. A) A close-up of swollen females showing the posterior portion of the body (a) and egg masses (b) on an infected pecan root segment; B) A microphotograph of a perineal pattern of *M. partityla* from Florida fitting that reported in the original description of this species. Scale bar = 18 μ m. Photography credit: Fig. 1A, J. A. Brito and J. Lotz, DPI; Fig. 1B, J. A. Brito, DPI.

Isozyme analyses of individual female root-knot nematodes, especially esterase (EST), provide fast and reliable diagnostic information for the differentiation of the pecan root-knot nematode from the other common species of root-knot nematodes that occur in Florida. For example, the EST phenotype (Mp3) from *M. partityla*, which is species specific, can be easily used to distinguish this nematode from *M. arenaria*, *M. floridensis*, *M. graminis*, *M. graminicola*, *M. incognita*, *M. javanica* and *M. mayaguensis*. Another isozyme, malate dehydrogenase (MDH) can also be used to separate *M. partityla* from *M. graminicola*, *M. graminis* and *M. mayaguensis*; however, MDH has a lower diagnostic value than EST because the MDH phenotype (N1) from *M. partityla* is identical to *M. arenaria*, *M. javanica*, *M. floridensis*, and *M. incognita*. This fact should be considered especially in cases of mixed root-knot nematode species.

SYMPTOMS AND DAMAGE: Pecan seedlings infected with the pecan root-knot nematode are likely to show patchy areas of stunted growth (Fig. 2A). Pecan plants infected with *M. partityla* exhibit leaf yellowing, stunted growth and dead branches in the upper canopy (Fig. 2B). Infected plants exhibit root swellings and prominent galls on major roots as well as young roots (Fig. 2C-F). These galls harbor the different stages of development of the nematodes, including the females (Fig. 1B). Nyczepir *et al.* (2003, 2004) found that in the Georgia pecan-growing region, infested pecan seedlings were stressed and exhibited dead branches in the upper canopy. This type of canopy damage is commonly referred to as “mouse ear disorder” and has been associated with infection by *M. partityla*. The U.S. Department of Agriculture, Agricultural Research Service, Nematology Laboratory in Beltsville, Maryland, and New Mexico State University have found that *M. partityla* caused a recent decline in yields from mature pecan trees in New Mexico (Thomas *et al.* 2001).

PREVENTION AND NEMATODE MANAGEMENT: Sanitation practices should be implemented to avoid the spread of this nematode within and between nursery stock producing sites and pecan orchards. Planting material should be produced in areas free of this nematode to avoid pathogen introduction by pecan seedlings planted in uninfested nurseries and pecan orchards. To avoid this nematode problem, sites that do not have a history of pecan culture are best choices for seedling production. However, prior to establishment of pecan seedling production, all sites should be sampled to determine the presence or absence of this nematode. Growers should contact the Division of Plant Industry or county extension agents and nematologists at University of Florida for proper sampling and

nematode species identification. Because infected plants are likely to show patches of yellowing and stunted growth, all machinery used to manage either the planting material or pecan orchards should be cleaned before being used in uninfested areas. Avoidance of the nematode problem through exclusion is the most economical and effective control method. Once present, no nematicidal options are available for management of this nematode in seedling nurseries or pecan orchards. Since *M. partityla* is thought to have a very narrow host range, rotation intervals of two or more years without pecan, may be useful to manage this nematode.

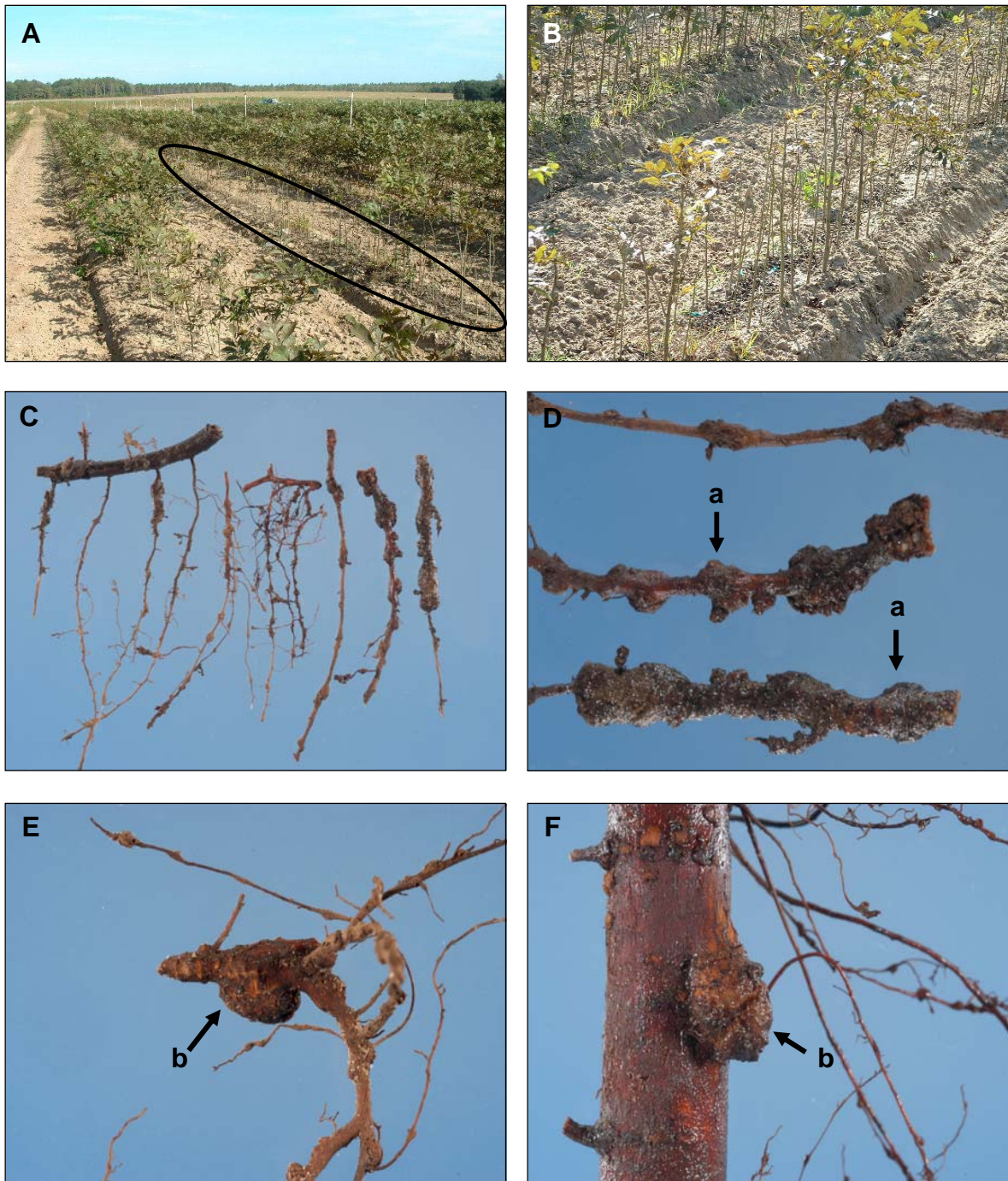


Fig. 2. Symptoms on pecan caused by *M. partityla* in Florida. A) An overall view of a pecan seedling production site infested with *M. partityla*; B) Close-up view of infected pecan seedlings showing leaf yellowing and stunting; C) Infested roots with prominent galls; D) Close-up view of root galls (a) on pecan seedlings; E) callus (b) infected with *M. partityla*; F) Close-up view of callus (b) infected by *M. partityla* females.

Photography credit: Figs. 2A-B, J. R. Rich, UF; Figs. 2C-F, M. Beckman and J. A. Brito, DPI

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