Meloidogyne javanica and *M. arenaria* on calla (*Zantedeschia aethiopica*) in Brazil

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Abstract *Meloidogyne javanica* and *M. arenaria* were identified morphologically and through isozyme profiles from root samples collected from a garden in the municipality of Londrina, Paraná State, Brazil. To our knowledge, this is the first record of *M. javanica* and *M. arenaria* on calla in Brazil.

Keywords Occurrence · Identification · Root-knot nematodes · Ornamentals

The common calla, *Zantedeschia aethiopica*, which is native to South Africa, is a monocotyledonous ornamental plant member of the family Araceae (Cronquist 1981). In Brazil, it is commercially cultivated as ornamental foliage for gardens, and its production is concentrated in the southeast region (Landgraf and Paiva 2009).

Like other ornamentals, *Z. aethiopica* is attacked by many pests and pathogens, including plant-parasitic nematodes. It is known that *Meloidogyne* species are important pathogens on a large number of crops worldwide and their importance to ornamentals in Brazil are pronounced (Oliveira 2001). According to Oliveira (2001), *M. javanica*, *M. incognita*, *M. arenaria*, *M. hapla*, and *M. petuniae* are the major species attacking ornamental plants in Brazil. Indeed, *Meloidogyne* species are known pathogens of calla plants in other countries. López-Chaves and Salazar-Figueroa (1988) reported calla as new host of *Meloidogyne javanica* in Costa Rica, and *M. arenaria* was first seen in calla in Romania (Romascu et al. 1977).

In September 2012, root samples of calla were received in the Laboratory of Nematology, at Instituto Agrônômico do Paraná, IAPAR, derived from a garden on Londrina, Paraná state, Brazil (23°18'36"S, 51°09'46"W). Roots were free of galls, showing only thickened portions not typical of *Meloidogyne* spp. attack (Fig. 1a). An examination of small sections of gently washed roots with a stereomicroscope in the magnificent of 40× showed, after tissue dissection, many globose females (Fig. 1b). Above-ground symptoms of wilting or yellowing were absent in the samples.

Females were recovered from roots with a fine needle and used for morphological studies, through perineal patterns of 20 females (Hartman and Sasser 1985). Identification was completed using isozyme reaction of 18 females, individually, in a polyacrylamide gel electrophoresis stained for esterase (EST) (Esbenshade and Triantaphyllou 1990). These microscope slides of perineal patterns were deposited in the IAPAR Nematode Collection (INC), Londrina, Paraná, Brazil (accession numbers IPR-CAL-81 and IPR-CAL-82).

Both perineal patterns and esterase phenotypes were consistent with those described for *Meloidogyne javanica* (Treub, 1885) Chitwood, 1949 and *Meloidogyne arenaria* (Neal, 1889) Chitwood, 1949 (Hunt and Handoo 2009; Carneiro and Almeida 2001). Morphological evaluation for *M. javanica* (Fig. 2a) showed the perineal pattern rounded, with low dorsal arch trapezoid shape, striae smooth interrupted by a pair of incisures on both sides, corresponding to lateral fields, clearly demarcated from striae by more or less parallel lines; tail whorl often distinct. Perineal pattern for *M. arenaria* (Fig. 2b) showed a rounded format with fine to coarse striae, the dorsal arch was low, flattened with striae smooth or slightly wavy, generally forming shoulders on lateral portion of arch; lateral incisures absent or unclear. The esterase phenotypes were composed of two isoforms (A2; Rm: 1.25, 1.35) for *M. arenaria* and three isoforms for *M. javanica* (J3; Rm: 1.0, 1.3, 1.4) (Fig. 3).

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Fig. 1 Symptoms of *Meloidogyne javanica* and *M. arenaria* parasitism in roots of calla (*Zantedeschia aethiopica*). **a** Atypical galls in roots (arrow). **b** Root-knot nematodes females inside a root tissue (arrows)

Fig. 2 Perineal patterns of *Meloidogyne javanica* (**a**) and *M. arenaria* (**b**) extracted from calla roots

To our knowledge, this is the first report of *M. arenaria* and *M. javanica* infecting common calla in Brazil. Both nematode species are important pathogens on several crops in Brazil, including ornamentals (Oliveira 2001). However, as shoot damage on calla plants analysed in the present work was not verified, further pathogenicity tests are necessary in order to confirm crop damage. On the other hand, this finding has great importance for growers. Since calla is propagated by bulbs, this can serve as both an efficient way of spreading the pathogens over long distances, and the introduction of these nematode species to uninfested areas.

Fig. 3 Esterase phenotypes of *Meloidogyne javanica* and *M. arenaria* detected in calla (J3: *M. javanica*; A2: *M. arenaria*; J3*: *M. javanica* reference isolate)

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