ISSN 0100-2945 DOI: http://dx.doi.org /10.1590/0100-29452022822

Revista Brasileira de Fruticultura

Plant protection

First report of *Meloidogyne incognita* infecting white Pitahaya plants

Victor Hugo Moura de Souza[1] Mário Massayuki Inomoto[2], Aline Mayara Gonçalves Barros Silva[3], Tiarla Graciane Souto[4]

Abstract - In July 2020, during a survey carried out in a small farm located in Laranjal Paulista, state of São Paulo (Brazil), more than 20 white pitahaya plants [*Hylocereus undatus* (Haw.) Britton and Rose (syn. *Selenicereus undatus* (Haw.) D.R. Hunt] were found with stunting symptoms and showing chlorotic-yellowish stems, some of them already decaying. Roots exhibited numerous galls, indicating *Meloidogyne* sp. infection. Nematodes were recovered from 200 cm³ and 7 g of roots: 1.7 *Meloidogyne* juveniles (J_2) per cm³ of soil and 954 eggs + J_2 per g of roots were found. The perineal pattern of 10 females pointed to *M. incognita*. Additionally, esterase phenotype was obtained through isozyme electrophoresis, using another 10 females, which identified *M. incognita*. To our knowledge, this is the first report of *M. incognita* infesting pitahaya plants (*Hylocereus* spp.) and, based on our results, *M. incognita* could be a potential threat to the crop.

Index terms: Diagnosis; dragon fruit; *Hylocereus undatus*; root-knot nematode; morphology; esterase phenotype.

Primeiro relato de *Meloidogyne incognita* em Pitaia-branca

Resumo - Em julho de 2020, durante visita em área de pequeno produtor localizada em Laranjal Paulista, São Paulo (Brasil), foram observadas mais de 20 plantas de pitaia-branca [*Hylocereus undatus* (Haw.) Britton e Rose (syn. *Selenicereus undatus* (Haw.) D.R. Hunt] apresentando enfezamento e cladódios cloróticos, com porções do caule em declínio. As raízes exibiam numerosas galhas, indicando típica infecção por *Meloidogyne* sp.. Nematoides foram recuperados de amostras de solo (200 cm³) e 7 g de raiz: 1,7 juvenis (J_2) por cm³ de solo, e 954 ovos + J_2 de *Meloidogyne* por grama de raiz foram obtidos. O padrão perineal de 10 fêmeas apontou para *M. incognita*. Adicionalmente, o fenótipo de esterase foi obtido por meio de eletroforese de isoenzima. Essa foi realizada com 10 fêmeas adicionais, confirmando a identificação por *M. incognita*. Ao nosso conhecimento, este é o primeiro relato de *M. incognita* infestando plantas de pitaia *(Hylocereus* spp.). e, baseado em nossa observação em campo, *M. incognita* pode ser um patógeno potencial a esta cultura.

Termos para indexação: Diagnose; fruta-do-dragão; *Hylocereus undatus*; nematoide de galhas; morfologia; eletroforese de isoenzimas.

Corresponding author:
victorhugomour@gmail.com

Received: July 01, 2021
Accepted: September 01, 2021

[1]Post-Doctoral researcher, Department of Plant Pathology and Nematology, Escola Superior de Agricultura "Luiz de Queiroz" – University of São Paulo – Piracicaba, Brazil. Email: victorhugomour@gmail.com (ORCID 0000-0002-7576-4676)

[2]Professor, Department of Plant Pathology and Nematology, Escola Superior de Agricultura "Luiz de Queiroz" – University of São Paulo – Piracicaba, Brazil. Email: inomoto@usp.br (ORCID 0000-0001-9870-8194)

[3]PhD student in Plant Pathology, Department of Plant Pathology and Nematology, Escola Superior de Agricultura "Luiz de Queiroz" – University of São Paulo – Piracicaba, Brazil. Email: alinesilvaagro@gmail.com (ORCID 0000-0002-7669-3363)

[4]PhD student in Plant Pathology, Department of Plant Pathology and Nematology, Escola Superior de Agricultura "Luiz de Queiroz" – University of São Paulo – Piracicaba, Brazil. Email: tiarla.souto@gmail.com (ORCID 0000-0002-5940-7716)

Pitahaya or pitaya (*Hylocereus* spp. and *Selenicereus* spp .) is a native American cactus that produces a sweet fruit known as dragon fruit, which is very appreciated due to its attractive color and pleasant taste. Therefore, some pitahaya species have been cultivated in many countries, mainly in the tropics (ORTIZ-HERNÁNDEZ; CARRILLO-SALAZAR, 2012). In Brazil, the production of this exotic fruit is relatively recent, starting in 2005. Recent data have pointed that the state of São Paulo leads production and cropped area in the country (NUNES et al., 2014; NEPOMOCENO et al., 2019; PROHORT, 2019). White pitahaya [*Hylocereus. undantus* (Haw.) Britton and Rose (syn. *Selenicereus undatus* (Haw.) D.R. Hunt)] is the most cultivated species, and is characterized by its white pulp and pink/red color peel (ORTIZ-HERNÁNDEZ; CARRILLO-SALAZAR, 2012; DUARTE et al., 2015). White pitahaya has recently gained attention due to its probable health benefits, and a study with mice fed with high-fat diet found that its juice attenuates insulin resistance and hepatic steatosis (SONG et al., 2016).

As pitahaya cultivation is recent in Brazil, reports on the occurrence of diseases are vital to support farmers. Among plant pathogens, parasitic nematodes are commonly found in farms and are major pests to Brazilian agriculture, notably the root-knot nematode (*Meloidogyne* spp.). Until recently, no reports of these pests infesting pitahaya were available. However, in 2020, *M. javanica* (Treub 1882) Chitwood 1949 was reported infesting yellow pitahaya *Hylocereus megalanthus* (K. Schum. ex Vaupel) Ralf Bauer [syn. *S. megalanthus* (K. Schum. ex Vaupel) Moran] in Brazil (NASCIMENTO et al., 2020). The authors observed several galls in the root system, especially in secondary ones. Their study brings an alert about the occurrence of *Meloidogyne* species in pitahaya crops. However, no additional information is currently available addressing this subject in Brazil.

In July 2020, during a survey carried out in a small farm located in Laranjal Paulista, state of São Paulo (Brazil), more than 20 *H. undatus* plants were found with stunting symptoms and showing chlorotic-yellowish stems, some of them already decaying (Fig. 1a). Roots exhibited numerous galls, indicating *Meloidogyne* sp. infection (Fig. 1b). In addition, galled roots were observed in numerous other crops in the area, including bell pepper (*Capsicum annuum* L.), yellow passionfruit (*Passiflora edulis* Sims f. *flavicarpa* Deg.) and papaya (*Carica papaya* L.).

Figure 1. 1A) Pitahaya plants infested with *Meloidogyne incognita* showing chlorotic-yellowish stems. Some of them were already decaying . 1B) Pitahaya roots showing galls due to *M. incognita* infestation.

Thus, soil and pitahaya root samples were collected and transported to the Laboratory of Nematology, located at the Department of Plant Pathology and Nematology (ESALQ/USP). The farmer also provided three pitahaya-rooted cuttings, which were used to extract additional females and maintain *Meloidogyne* populations. Roots were carefully washed in tap water and egg masses were easily spotted (Figure 2A). Nematodes were recovered from 200 cm³ of soil (JENKINS; TAYLOR, 1967) and 7 g of roots (COOLEN; D'HERDE, 1972): 1.7 *Meloidogyne* juveniles (J_2) per cm³ of soil and 954 eggs + J_2 per g of roots. Conversely, most galls were found empty probably due the decayed state of the root system, but a few mature females were recovered (Fig. 2B). Ten perineal patterns were obtained, showing slightly squared high dorsal arch. Striae were smooth to wavy and no lateral lines were observed. Striae bending near the vulva edges were also visible (Figure 3). These characteristic traits pointed to *M. incognita* (KOFOID; WHITE, 1919; CHITWOOD, 1949) (EISENBACK, 1984). To validate our results, esterase phenotype analysis was carried out. For this, 10 mature whitish females were handpicked from roots, placed in extraction solution and maintained on ice. Then, *M. javanica* was included as standard (CARNEIRO et al., 2016) and females were removed from green onions (*Allium fistulosum* L.) of roots, previously maintained as infested host plants in greenhouse. Isozyme electrophoresis was conducted using a continuous system (ALFENAS; BRUNE, 2006; MACHADO et al., 2010). *Meloidogyne javanica* exhibited the typical J3 phenotype and females removed from pitahaya exhibited the I1 phenotype, indicating *M. incognita*.

Figure 2. *Meloidogyne incognita* egg masses (A) and females inside the gall (B) on pitahaya root system.

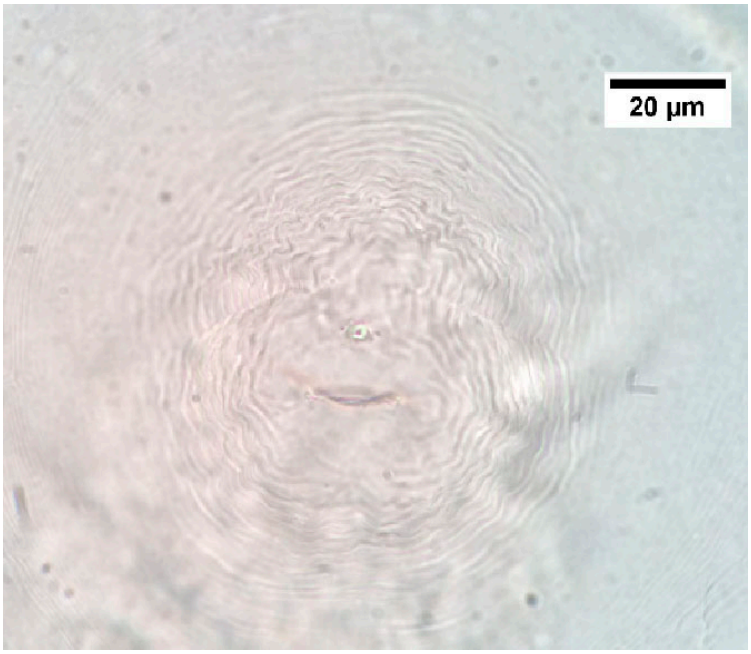

Figure 3. Perineal pattern of *Meloidogyne incognita* recovered from pitahaya roots.

We were particularly concerned because the farmer propagated pitahaya planting stem cuttings in pots containing contaminated soil from the field. However, as a result of this research, the farmer started to propagate pitahaya by planting stem cutting directly in the field. To our knowledge, this is the first report of *M. incognita* infesting white pitahaya plants. In addition, only the stunt nematode (*Tylenchorhynchus agri* Ferris) and *M. javanica* were listed as pathogens of *H. monacanthus* (Lem.) Britton and Rose (syn. *S. monacanthus* (Lem.) D.R. Hunt, syn. *H. polyrhizus* (F.A.C. Weber) Britton and Rose) (BALENDRES; BENGOA, 2019, originally reported by ZHANG et al. 2018) (NASCIMENTO et al. 2020). Based on stem and root symptoms of infected pitahaya observed in this survey, *M. incognita* could be a potential threat to white pitahaya. This is particularly concerning because *M. incognita* is a polyphagous nematodes widespread in tropical countries.

Acknowledgment

This work was supported by Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq and the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – CAPES.

References

ALFENAS, A.C.; BRUNE, W. Eletroforese em gel de amido. *In*: ALFENAS, A.C. **Eletroforese e marcadores bioquímicos em plantas e microrganismos**. Viçosa: Editora UFV, 2006. p.151-182.

BALENDRES, M.A; BENGOA, J.C. Diseases of dragon fruit (*Hylocereus* species): etiology and current management options. **Crop Protection**, Amsterdam, v.126, p.1-32, 2019.

COOLEN, W.A.; D'HERDE, C.J. D. **A method for the quantitative extraction of nematodes from plant tissue culture**. Ghent: Ghent State Agric. Research Centre; 1972. 77p.

DUARTE, M.H.; QUEIROZ, E.R.; ROCHA, D.A.; COSTA, A.C.; ABREU, C.M.P. Quality of pitaya (*Hylocereus undatus*) submitted to organic fertilization and stored under refrigeration. **Brazilian Journal of Food Technology**, Campinas, v.20, e2015115, 2017.

EISENBACK, J.D. Diagnostic characters useful in the identification of the four most common species of root-knot nematodes (*Meloidogyne* spp.) *In*: SASSER, J.N.; C.C.; CARTER. **An advanced treatise on *Meloidogyne*:** biology and control. Raleigh: North Carolina State University Graphics, 1985. p. 95–112.

JENKINS, W.R.; TAYLOR, D.P. **Plant nematology**. New York: Reinhold Pub. Corp, 1967. p.270.

MACHADO, A.C.Z ; SIQUEIRA, K.M.S. ; ARAÚJO FILHO, J.V. **Methods and techniques in plant nematology: a practical review on methods and techniques in plant -nematology**. Saarbrucken: VDM Verlag, 2010. 181p.

NASCIMENTO, D.D.; LOPES, A.P.M.; FERREIRA, R.J.; CARVALHO, V.R.; BOMBONATO, L.T.; DINIZ, D.B.; SILVA, A.A.; WILCKER, S.R.S.; SOARES, L.M. First Report of *Meloidogyne javanica* Infecting *Hylocereus megalanthus* in Brazil. **Plant Disease**, St. Paul, v.104, n.9, p.2526, 2020.

NEPOMOCENO, T.A.R.; PIETROBON, A.J. FERREIRA, C.A.; ZANELATTO, J. O cultivo e a comercialização de pitaya (*Hylocereus* sp.) no Brasil, com enfoque no estado do Paraná. *In*: SEMANA DE ENGENHARIA AGRONÔMICA – SEAGRO, 13, 2019, Cascavel. **Abstract** [...]. Cascavel: FAG Centro Universitário, 2019. p.17-20.

NUNES, E.N.; SOUSA, A.; S. B.; LUCENA, C.M.; SILVA, S.M.; LUCENA, R.F.P.; ALVES, C.A.B.; ALVES, R.E. Pitaia (*Hylocereus* sp.): uma revisão para o Brasil. **Gaia Scientia**, João Pessoa, v.8, n.1, p.90-98, 2014.

ORTIZ-HERNÁNDEZ, Y.D.; CARRILLO-SALAZAR, J.A. Pitahaya (*Hylocereus* spp.): a short review. **Comunicata Scientiae**, Bom Jesus, v.3, n.4, p.220-237, 2012.

PROHORT. Programa Brasileiro de Modernização do Mercado Hortigranjeiro. **Ministério da Agricultura. Dados 2018/2019**. Brasília, 2019. Disponível em: dw.ceasa.gov.br. Acesso em: 12 maio 2021.

SONG, H.; ZHENG, Z.; WU, J.; LAI, J.; CHU, Q.; ZHENG, X. White pitaya (*Hylocereus undatus*) juice attenuates insulin resistance and hepatic steatosis in diet-induced obese mice. **Plos One**, San Francisco, v.11, n.2, e0149670, 2016.

ZHANG, Y.; LU, X.; HUANG, J.; LIU, Z. First report of a stunt nematode (*Tylenchorhynchus agri*) from pitaya (*Hylocereus polyrhizus*) in Guangxi Province of China. **Plant Disease**, St Paul, v.102, n.12, p.2662, 2018.