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Host status of weeds for *Pratylenchus coffeae*

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Abstract: Background: Populations of yam dry rot nematodes *Scutellonema bradys*, *Pratylenchus coffeae* and *P. brachyurus* can be sustained on weed hosts.

Objective: Evaluate the reaction of 10 weeds frequently found in Alagoas to *P. coffeae* under greenhouse conditions.

Methods: Two experiments were carried out in a completely randomized design, with 11 treatments, constituted of 10 weed species and the control (*Dioscorea cayenensis*) with eight replications. Plants were inoculated with 2,000 nematode specimens, nematode populations were evaluated in roots and soil 60 days after inoculation and the reproduction factor (RF) defined as RF = final population/initial population was calculated.

Results: *Euphorbia hyssopifolia showed RF=0* and was considered as non-host, whereas *Chenopodium album*, *Amaranthus* sp., *Panicum maximum*, *Eleusine indica*, *Senna occidentalis*, *Emilia coccinea* and *Richardia brasiliensis*, showed RF<1, being rated as poor hosts. *Ricinus communis* and *Macroptilium lathyroides* showed RF>1 only in the second trial and were classified as good hosts.

Conclusion: *Ricinus communis* and *M. lathyroides* are potential sources of nematode inoculum for dry rot disease development.

Keywords: *Dioscorea* spp.; Dry rot disease; Alternative hosts; Nematode management

Yam (*Dioscorea* spp.) has great socio-economic importance in Brazil, especially in the Northeastern region of the country, where it is commonly used as a food source and the tubers have important aggregated value when compared to other sources of carbohydrates, such as sweet potato (*Ipomoea batatas* (L.) Lam.) and cassava (*Manihot esculenta* Crantz) (Siqueira, 2011). It is also important due to the labor demand during the crop cycle, mainly during harvest stage, generating jobs and income.

Among the diseases affecting yam in Brazil, the dry rot is considered the most damaging, causing symptoms of necrosis in commercial and seed tubers. The causal agents of the disease are the plant-parasitic nematodes *Scutellonema bradys* (Steiner & LeHew) Andrássy, *Pratylenchus coffeae* (Zimmermann) Filipjev & Schuurmans Stekhoven and *P. brachyurus* (Godfrey) Filipjev & Schuurmans Stekhoven (Moura, 2016). In the state of Alagoas, Brazil, mixed populations of these species were reported and the disease is disseminated in the main production areas (Muniz et al., 2012).

The disease management methods include the use of nematode-free planting material and crop rotation with antagonist plant species (Moura, 2016). Studies concerning the use of botanical extracts (Lima et al., 2019; Farias et al., 2020; Magalhães et al., 2020) and the utilization of sodium hypochlorite for the treatment of propagative material have also been evaluated (Almeida et al., 2020).

Other issue related to the dry rot disease which interferes directly in the disease intensity are weeds, which can act as alternative hosts, supporting the survival of nematode in the fields (Lordello et al., 1988). In Brazil, there is little information on the host range of weeds for the yam dry rot nematodes, for instance the studies of Carmo et al. (2014) with *S. bradys* and Almeida et al. (2019), which included *S. bradys* and *Pratylenchus* spp. Considering weeds can represent sources of nematode inoculum, new studies will allow for an understanding of the reaction of these plant species to the causal agents of the disease, and additionally, to recommend management practices aiming to control these host plants and consequently to reduce nematode populations for the next cropping season.

In this context, the objective of the present study was to evaluate the reaction of 10 weeds commonly found in Alagoas to *P. coffeae* under greenhouse conditions.

Greenhouse experiments were performed twice at Federal University of Alagoas, in Rio Largo, AL, Brazil, from February to April (trial 1) and from April to July 2021 (trial 2), with monthly average temperatures ranging from 25.2 to 27.5 °C and 24.3 to 25.2 °C, respectively.

Seeds of weeds (Table 1) were sown directly in plastic pots containing approximately 3 L of a 3:1 mixture of soil and sterilized filter cake, and thinned to one plant per

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pot after the emergence. Sprouting yam seed tubers (*D. cayenensis* cv. da costa) with an average weight of 39.6 g in the first trial and 52.1 g in the second one, were included as control.

Pratylenchus coffeae inoculum was obtained from naturally infected yam tubers from producing areas in the state of Alagoas. The tubers were washed and the tuber skin was removed before the peel was cut into pieces and processed according to Coolen, D'Herde (1972). Nematode identification was performed based on morphological and morphometric characters (n=20): the female body length was of 656.48 µm (548.20–727.22 µm); stylet length = 14.9 µm (12.89–17.41 µm); vulva position= 79.6% (79–90%); labial region with two annuli; tail tip predominantly truncate; and abundant males were present (Gonzaga et al., 2016).

Table 1 - Family, scientific and common names of weeds tested in the experiments.

Family	Scientific name	Common name
Asteraceae	*Emilia coccinea* (Sims) G. Don.	Scarlet tasselflower
Euphorbiaceae	*Euphorbia hyssopifolia* L.	Hyssop Leaf Sandmat
Euphorbeaceae	*Ricinus communis* L.	Castor bean
Fabaceae	*Senna occidentalis* L.	Septicweed
Fabaceae	*Macroptilium lathyroides* L.	Phasey bean
Rubiaceae	*Richardia brasiliensis* Gomes	White eye
Poaceae	*Eleusine indica* (L.) Gaertn.	Goosegrass
Poaceae	*Panicum maximum* Jacq.	Guinea grass
Amaranthaceae	*Chenopodium album* L.	Goosefoot
Amaranthaceae	*Amaranthus* sp.	Amaranth

Plants were inoculated at the stage of sixth and eighth pair of real leaves (dicotyledonous) and 3-5 tillers (monocotyledoneous), by adding 2,000 specimens of *P. coffeae*, in two holes 2 cm deep in the soil around the stem of each plant. The experiments were arranged in a completely randomized design, with 11 treatments and eight replications.

Sixty days after inoculation the roots were separated from the aerial portion and then washed carefully, blotted dry on paper towel and weighed to obtain the root fresh weight and, subsequently, cut into 2 cm fragments, and triturated in a blender, followed by centrifugation in sugar solution and kaolin (Coolen, D'Herde, 1972). Nematodes were extracted from soil samples (100 cm^3) according Jenkins (1964). The number of nematodes was counted using Peters slides under an inverted light microscope.

The total number of nematodes counted per each replication from roots and soil was used to calculate the reproduction factor (RF = final population/initial population), with weed host status categorized as non-host (RF=0), poor host (RF<1) and good host (RF>1) (Seinhorst, 1965). Data were transformed to log (x + 1), and subjected to analysis of variance. The means were compared by Tukey test at 5% probability, using the software SISVAR 5.6 (Ferreira, 2011).

The host response of the 10 weeds to *P. coffeae* infection showed differences ($P \leq 0.05$) for fresh root weigh, number of nematodes per gram of roots, final population density and RF (Table 2).

Table 2 - *Reaction* of weeds inoculated with 2,000 specimens of *Pratylenchus coffeae*.

Plant species	Experiment I				Experiment II			
	RFW	N/g root	FP	RF	RFW	N/g root	FP	RF
Dioscorea cayenensis (control)	66.69 a	21.50 b	1420.0 a	0.710 a	38.47 a	164.75 b	6185.00 a	3.09 b
Ricinus communis	41.31 a	25.62 b	986.25 a	0.493 b	16.51 b	457.00 a	8767.50 a	4.38 a
Macroptilium lathyroides	9.58 c	61.12 a	343.75 b	0.172 c	3.79 d	1069.50 a	4045.00 a	2.02 c
Chenopodium album	2.50 ef	1.88 d	6.25 d	0.003 d	2.00 e	20.88 d	61.25 c	0.03 d
Amaranthus sp.	3.09 de	8.25 c	22.50 c	0.011 d	3.16 de	67.62 c	115.00 b	0.05 d
Panicum maximum	14.90 b	1.12 d	15.00 c	0.008 d	23.96 b	8.50 d	208.75 b	0.10 d
Eleusine indica	5.62 cd	8.62 c	32.50 c	0.016 d	4.41 cd	39.38 d	142.50 b	0.07 d
Senna occidentalis	6.72 c	1.75 d	10.00 d	0.005 d	6.70 c	16.50 d	118.75 d	0.05 d
Emilia coccinea	1.48 f	0.00 e	0.00 e	0.000 d	0.99 f	15.50 c	23.75 d	0.01 d
Euphorbia hyssopifolia	1.35 f	0.00 e	0.00 e	0.000 d	0.15 g	5.00 e	5.00 d	0.00 d
Richardia brasiliensis	1.66 ef	0.12 e	1.38 e	0.008 d	0.43 fg	0.12 e	1.25 d	0.00 d
CV %	14.7	39.4	30.0	50.5	14.6	25.2	19.1	38

For statistical analysis data were transformed to log (x + 1). Means followed by the same letter within the column do not significantly differ by the Tukey test at 5% probability. RFW – Root Fresh Weight (g); N/g root – Nematode per gram of root; FP – Final Nematode Population (soil + root); RF – Reproduction Factor.

The genus *Pratylenchus* includes about 68 valid species of worldwide distribution that parasitize a wide variety of plants and in the absence of a host crop they can survive on weeds, helping in the maintenance, multiplication and spread of the nematode within a field, resulting in greater damage to susceptible crops (Castillo, Vovlas, 2007). In the present study *Euphorbia hyssopifolia showed RF=0* and was considered as non-host. *Chenopodium album, Amaranthus* sp., *Panicum maximum*, *Eleusine indica*, *Senna occidentalis*, *Emilia coccinea* and *Richardia brasiliensis*, showed RF<1, being rated as poor hosts. Among the plant species evaluated, *Ricinus communis* and *Macroptilium lathyroides* showed similar reaction, with RF<1 in the first trial and RF>1 in the second, being considered as poor hosts and good hosts respectively (Table 2). Such discrepancy may be attributed to the difference between the nematode populations used in the current work, once they were obtained from the same municipality but from different farms. Pathogenic variability in *P. coffeae* has been previously reported (Mizukubo et al., 2003). The higher number of both nematode's populations and RF, verified in the second trial for *R. communis* and *M. lathyroides* corroborating Conduta et al. (2020), who observed a negative correlation between the number of *P. brachyurus* per gram of soybean (*Glycine max* (L.) Merril) root and fresh root weight.

The susceptibility of some weeds tested in the current study to other *Pratylenchus* species was previously reported, for instance, *R. communis* to *P. neglectus* (Rensch) Filipjev & Schuurmans Stekhoven (Al-Rehiayani, Hafez, 1998); *Amaranthus* spp., *P. maximum* and *E. indica* to *P. brachyurus* and *P. zeae* Graham (Bellé et al., 2015; Bellé et al., 2017) under greenhouse conditions. On the other hand, under field conditions in the state of Alagoas, Almeida et al. (2019), did not detect the presence of yam dry rot nematodes in roots of *E. hissopifolia* and *E. indica*, while *E. coccinea* and *R. brasiliensis* were parasitized for both *S. bradys* and *Pratylenchus* spp. These findings were partially confirmed in the present study. It is also important to point out that weeds such as *S. occidentalis, M. lathyroides*, *R. brasiliensis*, *E. indica, C. album,* and *Amaranthus* sp., were reported as hosts for the root-knot nematodes (Rich et al., 2009).

The weed species *Amaranthus* sp., *C. album, P. maximum, E. indica, S. occidentalis, E. coccinea, E. hyssopifolia and R. brasiliensis* supported the smallest RF of *P. coffeae* in both experiments. Studies should be performed aiming to elucidate their mechanisms of resistance. On the other hand, *Ricinus communis* and *M. lathyroides* showed high potential to act as sources of nematode inoculum for the development of dry rot disease. Then, the role of weeds should be considered in the disease management, both during and after the yam growth cycle. No record was found on *M. lathyroides* as host for *Pratylenchus* spp.

Authors' contributions

ASA: performed the experiments and writing. MCA: contributed in the conducting of the experiments. GMF: made the statistical analyses. RCS: writing-review. MFSM: writing-review and formatting.

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