ISSN 2236 – 4420

Occurrence of *Fusarium oxysporum* in African mahogany in Brazil

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Abstract: African mahogany plants presented lesions at the stem apex, especially on the shoots and young leaves. These progressing lesions became dark, causing the leaves to dry and fall with subsequent pointer death. The material with the symptoms was collected and sent for analysis. The pathogenicity of the isolates was confirmed by inoculation in healthy plants using a solution of $1.3x10^7$ conidia mL^{-1}. Seventy-two hours after inoculation, typical symptoms, observed in the field, were reproduced. This is the first report of *Fusarium oxysporum* in African mahogany in Brazil.

Key words: *Khaya ivorensis* A. Chevalier, Forest phytopathology, Pointer death.

Ocorrência de *Fusarium oxysporum* em mogno africano no Brasil

Resumo: Plantas de mogno africano apresentaram lesões no ápice caulinar, sobretudo em brotações e folhas mais novas. Estas lesões ao progredirem tonaram-se escuras ocasionando secamento e queda das folhas com posterior morte do ponteiro. O material com os sintomas foi coletado e encaminhado para análise. A patogenicidade dos isolados foi confirmada via inoculação em plantas sadias, utilizando solução de $1,3x10^7$ conídios mL^{-1}. Setenta e duas horas após a inoculação, os sintomas típicos, observados em campo, foram reproduzidos. Este é o primeiro registro de *Fusarium oxysporum* em mogno africano no Brasil.

Palavras chave: *Khaya ivorensis* A. Chevalier, Fitopatologia florestal, Morte do ponteiro.

African mahogany (*Khaya ivorensis* A. Chevalier) belongs to the Meliaceae family, same family as the Brazilian mahogany (*Swietenia macrophylla* King). It is a native species to the humid tropical plains of West Africa, where it forms extensive forests in Congo, Guinea, Ivory Coast, Ghana, Togo, Benin, Nigeria and Cameroon (Ribeiro, Ferraz & Scolforo, 2017). The specie has great economic importance, due to the technological and aesthetic characteristics of its wood, employed in the furniture industry, shipbuilding, civil construction, manufacture of panels and laminates (Pinheiro et al., 2011).

The *Khaya ivorenses* specie was introduced in Brazil in the 1970s, in the North region, with the objective of replacing Brazilian mahogany, intensively exploited by the timber sector at the time and at risk of extinction. Besides the fast growth, the main advantage of the African mahogany in relation to the Brazilian was due to the resistance to *Hypsipyla grandella* Zeller (Lepidoptera: Pyralidae), the main pests of *Swietenia macrophylla* (Klein et al., 2016).

Currently, the wide acceptance and high price of the wood of the *Khaya ivorenses* in the national and international markets have led to investments in commercial plantations throughout Brazil (Ribeiro, Ferraz & Scolforo, 2017). However, the expansion of the crop and the exposure of *Khaya ivorensis*, as well as other exotic species, to new climatic and environmental conditions refer to the emergence of pests and diseases so far not reported (Tremacoldi et al., 2013).

The main pests cited causing damage to *Khaya ivorenses* in Brazil are leaf-cutting ants (*Atta spp*.) and arapuá bees (*Trigona spinipes* Fabr.) (Klein et al., 2016). Regarding the occurrence of phytopathogens, the records so far refer to the areolate stain, caused by the fungus *Thanatephorus cucumeris* (Frank) Donk; leaf spot caused by the fungus *Cylindrocladium parasiticum* Crous; brown spot, caused by the fungus *Cercospora* sp.; burning of the wire caused by the fungus *Pellicularia koleroga* Donk; zoned spot caused by the fungus *Sclerotium coffeicola* (Stahel) Bull.; cortex cancer, caused by fungus *Lasiodiplodia theobromae* (Patouillard) Griffon & Maublanc and white root rot caused by the fungus *Rigidoporus lignosos* (klotzsch) Imazeki (Poltronieri et al., 2000 & Tremacoldi et al., 2013).

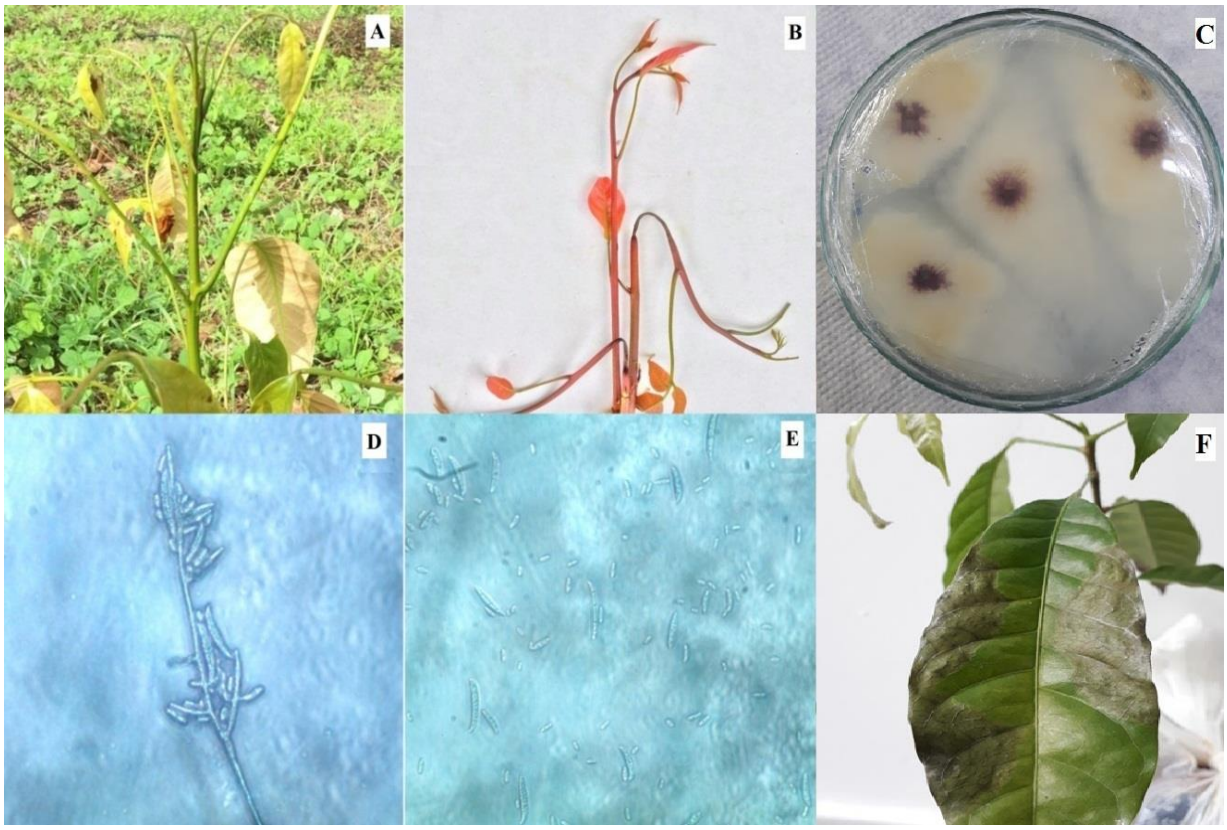
In this sense, in view of the economic attractiveness and the expansion of the cultivation of *Khaya ivorenses* by the country, the objective of this work was to record the first occurrence of *Fusarium oxysporum* Schlecht in *Khaya ivorenses* in Brazil.

The analyses were carried out from April to June 2019 in isolates obtained from five-year-old *Khaya ivorenses* plants, grown in spacing 6,0 m x 6,0 m, in conjunction with bananas (*Musa* sp.) and acai (*Euterpe oleracea* Mart.), localized on a farm in the municipality of Cantá, Roraima, Brasil (02° 28’ 46’’ N e 60° 34’ 41’’ W).

The sampled area belongs to the ecological system of the dense forests of the Amazon region, under the influence climate of the type Aw, rainy tropical, according to Köppen classification, characterized by annual averages of precipitation, relative humidity and ambient temperature of 1,750 mm, 70% and 27.5, respectively.

The *Khaya ivorenses* plants presented lesions in the stalk apex, especially in the buds and newer leaves. These lesions as they progressed were dark, causing drying and falling leaves with later death of the pointer (Figure 1A, 1B.).

Figure 1 - A and B, Symptoms in African mahogany (*Khaya ivorensis* A. Chevalier) plants, caused by *Fusarium oxysporum* in the field; C, colony of the fungus in the middle of BDA in Petri dish; D and E, conidiophores and conidium (optical microscope, 200x); F, injuries resulting from artificial inoculation (Photos: Edgley S. da Silva and Mauricio L. Augusti). Boa Vista, Roraima, Brazil, 2019.



Source: research data

Ten plants with symptoms were randomly selected in the field. The damage to the plants was photographed and the material with symptoms (branches and stems) was collected and transported in plastic bags to the Phytopathology Laboratory of Embrapa Roraima, Boa Vista (RR), for analysis. Indirect isolation was carried out in PDA (potato-dextrose-agar) culture medium, evenly distributing the fragments in Petri dishes, which were kept for five days in a type B.O.D germination oven, about optimal light and temperature conditions.

The identification of microorganisms was performed by cultural and morphological characterization, using optical light microscopy. From the isolated colonies of dark red coloring were obtained, with conidiophores and conidia characteristic of the fungus *F. oxysporum* (Ventura, 2000) (Figure 1C, 1D e 1E.).

From the isolates, the inoculum was multiplied in PDA and, after five days, the microorganism was inoculated in twenty healthy *Khaya ivorenses* seedlings, 75 days old, produced at Embrapa Roraima specifically to be inoculated. For this purpose, the plants were submitted to asepsis (sodium hypochlorite, 2%, 2 minutes), followed by needle wounds disintegrated in the apical buds. A solution of $1.3x10^{7}$ mL^{-1} conidia was sprayed on the injured spots and the plants were packed in a humid chamber for 72 hours.

Seventy-two hours after inoculation, the typical symptoms observed in the field were reproduced (Figure 1F.). From the region of the lesion interface to the tissue reisolated *F. oxysporum*, proving the relationship of pathogenicity of the isolates obtained with the African mahogany.

The genre *Fusarium* is classified in the kingdom Eumycota, division Ascomycota, class Euascomycetes, order Hipocreales, family Hypocreaceae including species producing hyaline macroconids, usually septate, characterized by

their distinct basal and apical cells, which are of great importance in the taxonomy of the species (Kang et al., 2014).

F. oxysporum produces macroconoids in short fialids, located directly on the hyphae or final branches of conidiophores, are canoe-shaped with pointed, slightly curved extremities, with a thin wall and the presence of two to five septa, predominantly with three septa. The microconides are single-celled in oval or ellipsoid form, straight or slightly curved, produced in short lashes that come out, most often, laterally from the grouped hyphae on the head (Poltronieri et al., 2000). All of these characteristics that concern the etiology of the fungus are possible to be observed in figures 1D and 1E.

The plants showed lesions at the stem apex, especially at the edges of the younger leaves. These lesions as they progressed became dark, causing drying and falling of these leaves. Another characteristic observed was the senescence (highlight) of the pointer before it dried (Figure 1F.). The symptoms observed in this study are similar to those found by Poletto et al. (2006) in yerba mate plants affected by *F. oxysporum*, which described that the trees showed symptoms of yellowing, necrosis and falling leaves, especially the older ones. It should be noted, however, that the symptoms observed here were found mostly in the youngest leaves of African mahogany.

The conditions of the study site (precipitation, relative humidity and room temperature of 1,750 mm, 70% and 27.5 °C, respectively) are favorable for the occurrence of the pathogen. The *F. oxysporum* is a soil inhabitant and lives saprophytically on the old leaves remaining on the plant or on the fallen leaves on the ground, being able to survive for several years in the form of chlamydioses. The conidia are disseminated mainly by wind, infested seeds and the splatter of rainwater or irrigation. Prolonged rainy periods, high relative humidity and mild temperatures are conditions that favor the development of this microorganism (Verzignassi, Poltronieri & Benchimol, 2009).

The geographical distribution of the *F. oxysporum* is widespread, and is common in tropical and subtropical regions, where it causes diseases in several cultures of economic interest, including forestry, as: root rot in yerba mate (*Ilex paraguariensis* A. St.-Hil.) (Poletto et al., 2006), tipping in seedlings of *Eucaliptus grandis* W. Hill ex Maiden (Auer & Santos, 2011), damping-off in *Acacia mangium* Wild. (Widyastuti, Harjono & Surya, 2013), damping-off in *Pinus spp*. (Maciel et al., 2017) and vascular withers in *Tectona grandis* L.f. (Borges et al., 2018).

Forestry crops in Roraima gained greater proportions from the 1990s onwards, and the traffic of seeds, wood and machinery gained new directions and with them the possibility of new pests and diseases entering the State. Only 30,000 hectares of *Acacia mangium* were planted in the State, with doubtful origins of seeds and seedlings (Tonini, Halfeld-Vieira & Silva, 2010), which may have been the gateway to *F. oxysporum*. Care is now focused on the cultivation of African mahogany, as Roraima currently has more than 5,000 hectares planted and with prospects for increasing the area.

As there are no registered and recommended fungicides for African mahogany in Brazil, some control strategies should be employed, such as: a) using healthy seedlings, b) carrying out periodic inspections on newly implanted crops, c) eliminating if sprouts with symptoms of pathogen attack, d) eliminate fallen old leaves on the ground, e) as well as perform application of Bordeaux mixtures in the period of higher rain incidence.

This is the first record of *Fusarium oxysporum* in african mahogany in Brazil.

References

Auer, C. G., & Santos, A. F. (2011). Doenças em eucalipto destinadas à produção de energia na Região Sul do Brasil. *Pesquisa Florestal Brasileira*, 31 (68), 373-379. Doi: 10.4336/2012.pfb.68.373.

Borges, R. C. F., et al. (2018). Vascular wilt of teak (*Tectona grandis*) caused by *Fusarium oxysporum* in Brazil. *Phytopathologia Mediterranea*, 57 (1), 115−121. Doi: 10.14601/Phytopathol_Mediterr-20896.

Kang, S., Demers, J., Jimenez-Gasco, M. M., & Rep, M. (2014). *Fusarium oxysporum*. Genomics of Plant-Associated Fungi and Oomycetes. *Dicot Pathogens*, 5 (1), 99-119. Doi: 10.1007/978-3-662-44056-8_5.

Klein, D. R., et al. (2016). Aspectos gerais e silviculturais de *Cordia americana*, *Aspidosperma polyneuron*, *Toona ciliata* e *Khaya* spp. *Revista de*

Ciências Agroveterinárias, 15 (2), 155-164. Doi: 10.5965/223811711522016155.

Maciel, C. G., et al. (2017). *Fusarium oxysporum* e *F. verticillioides* causing damping-off in *Pinus spp*. *Revista Ciência Agronômica*, 48 (1), 134-141. Doi: 10.5935/1806-6690.20170015.

Pinheiro, A. L., et al. (2011). *Ecologia, silvicultura e tecnologia de mogno africano (Khaya spp.)* (102p). Viçosa, MG: Sociedade Brasileira de Agrossilvicultura.

Poltronieri, L. S., et al. (2000). *Identificação de doenças em mogno africano no Estado do Pará* (Circular Técnica, n. 18, 13p). Pará: Embrapa Amazônia Oriental.

Poletto, I., et al. (2006). Zoneamento e identificação de *Fusarium* spp. causador de podridão-de-raízes em plantios de erva-mate (*Ilex paraguariensis* A. St.-Hil.) na região do Vale do Taquarí-RS. *Ciência Florestal*, 16 (1), 1-10. Doi: 10.5902/198050981882.

Ribeiro, A., Ferraz Filho, A. C., & Scolforo, J. R. S. (2017). African Mahogany (*Khaya spp*.) cultivation and the Increase of the Activity in Brazil. *Floresta e Ambiente*, 24, e00076814. Doi: 10.1590/2179-8087.076814.

Tonini, H., Halfeld-Vieira, B. A., & Silva, S. J. R. (Ed.) (2010). *Acacia mangium: características e seu cultivo em Roraima* (145p). Boa Vista. Embrapa Informações Tecnológicas e Embrapa Roraima.

Tremacoldi, C. R., et al. (2013). Cancro em mogno africano no estado do Pará. *Pesquisa Florestal Brasileira*, 33 (74), 220-224. Doi: 10.4336/2013.pfb.33.74.415.

Ventura, J. A. (2000). Taxonomia de *Fusarium* e seus segredos. Parte II - Chaves para identificação. *Revisão Anual de Patologia de Plantas*, 8 (1), 303-338.

Verzignassi, J. R., Poltronieri, L. S., & Benchimol, R. L. (2009). Mancha-alvo em mogno-africano no Brasil. *Summa Phytopathologica*, 35 (1), 70-71. Doi: 10.1590/S0100-54052009000100015.

Widyastuti, S. M., Harjono, H., & Surya, Z. A. (2013). Initial infection of *Falcataria moluccana* leaves and *Acacia mangium* phyllodes by *Uromycladium tepperianum* fungi in a laboratory trial. *Jurnal of Manajemen Hutan Tropika*, 19 (3), 187-193. Doi: 10.7226/jtfm.19.3.187.

Recebido em: 03/01/2020
Aceito em: 23/03/2021