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NEW REPORTS

First report of *Lasiodiplodia theobromae* rot in ripe jack fruit (*Artocarpus heterophyllus* Lam.) in Sri Lanka

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Abstract

Several ripe jack fruits, harvested from a row of trees grown along the wayside in a 150 acre-fruit cultivation in Madatugama (off Dambulla, Central Province, Sri Lanka), were observed with large, up to about 15 cm diameter, blackish and isolated multiple lesions on the syncarp or the outer peel in June 2018. A black color fungus, associated with the diseased syncarp tissues and inner fruitlets underneath the lesions, was isolated on PDA and identified as *Lasiodiplodia theobromae* (Pat.) Griffon and Maubl.≡ *Botryodiplodia theobromae* Pat. The disease was diagnosed as *Lasiodiplodia* fruit rot. This is the first report of the *Lasiodiplodia* fruit disease in jackfruit in Sri Lanka.

Keywords *Artocarpus heterophyllus* · *Lasiodiplodia* fruit rot · Jack fruit · *Lasiodiplodia theobromae*

Jackfruit (*Artocarpus heterophyllus* Lam., Family Moraceae), native to South India, is an important tree crop in the tropical and sub-tropical regions. Trees in Asian countries are mostly grown in home gardens (Sangchote et al. 2003). The main economic product is the fruit, but the tree is used for timber, fodder, dyes and traditional medicine (Haq 2006). The young fruits are green or greenish-yellow in color and after ripening, the fruits become yellowish brown. The mature fruit is large, the average weight of the fruit is 5–12 kg, but can weigh up to 50 kg. The fruit at various stages of maturity is consumed as a vegetable.

The jack tree is known to be affected by several fungal diseases. The male flowers and young fruits are infected by *Rhizopus stolonifer, R. oryzae* or *R. artocarpi* resulting in Rhizopus fruit rot, especially under warm, humid and wet conditions (Pandey et al. 1979). The symptoms at advanced stages are characteristic black, rotten, shrunken, and sometimes mummified fruit. Infection by *Colletotrichum gloeosporioides*, the cause of anthracnose, is most common in ripe fruits (Sangchote et al. 2003). Trees are susceptible to brown root and crown rot incited by *Phellinus noxius*, root rots caused by *Pythium splendens* and *Rhizoctonia* sp. *Phytophthora palmivora* is known to cause decline of jack tree with symptoms of trunk cankers, wilting and die-back of the canopy and, in many cases, tree death (Borines et al. 2014).

The objective of the present study was to characterize and diagnose the ripe rot observed in the jack fruit and identify the pathogen associated with the disease.

Collection of diseased fruits

Several ripe jackfruits, harvested from trees grown along the wayside within a fruit cultivation in Madatugama (off Dambulla, Matale District, Central Province), had several, large, darker and isolated lesions on the surface of the syncarp or the outer peel in June 2018. The diseased fruits were photographed and delivered to the National Institute of Fundamental Studies, Hantana, Kandy (Kandy District, Central Province) on the same day for laboratory examination.

Symptom description and pathogen isolation

External symptoms of the disease were first described. The internal symptoms were examined after cutting the fruits vertically in to two halves. The symptoms were recorded and photographed. The fungus was isolated from diseased tissues excised from the syncarp (outer peel) and the fruitlets. Small tissue segments (0.5×0.5 cm^2), cut from the advancing edge of lesions, were surface sterilized in 1% sodium

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hypochlorite (Clorox©, USA) for 3 min and transferred onto PDA medium under aseptic conditions. The plates were incubated (26 ± 2 °C) for one week and the pathogen grown out of the diseased tissues was examined and sub-cultured on fresh PDA medium. Colony characteristics were noted in 3–4 weeks-old cultures and the morphology of vegetative and reproductive structures was studied under light microscope (Bio Blue.Lab, Euromax, Netherlands). Length and breadth of 50 randomly selected conidia were measured using camera software (Olympus Model No: BX 53 with cellSens micro-imaging software) and averages were determined. Diamentions of pycnidia were also recorded.

Confirmation of pathogenicity

A suspension of conidia (1×10^{-3} ml^{-1}) was prepared by scraping the mycelium of 4 week-old culture, suspending in sterile distilled water and filtering through sterile muslin cloth. Three drops (20 µl) of conidia were applied on to sites, wounded (1 cm deep) using a fine needle, in the syncarp or the peel of each mature jack fruit obtained from the same tree as the original diseased fruit. The fruits were kept inside moistened and sealed polythene bags for the first 24 h. The fruits were then taken out and stored in cardboard boxes for about another week and the fruits were observed daily for symptom development. Once the lesions appeared, the fungus was re-isolated from the lesions in the artificially inoculated sites on PDA and the fungus grown out was compared with the original isolate.

Symptoms

Externally several, well-isolated, large infected areas could be seen on the syncarp (outer skin) of the harvested ripe jack fruits. The infected areas were circular to oval shaped, about 10–15 cm diameter lesions with blackish centres and reddish-brown diffused margin (Fig. 1). Rotting had progressed about 5–7 cm deeper in to the fleshy perianth parts of the fruitlets, starting from the syncarp, and due to fungal colonization, the affected fleshy perianths have turned black and softer (Fig. 1). The rot at early stages appeared yellowish brown and enlarged rapidly into larger dark brown soft areas with further fruit ripening.

The mature jackfruits, artificially inoculated with conidia of the *L. theobromae* isolate after wounding, developed dark brown color lesions within a week when the fruits had attained fully ripened stage. The fungus, re-isolated from diseased tissues, was morphologically identical to that of the original isolate.

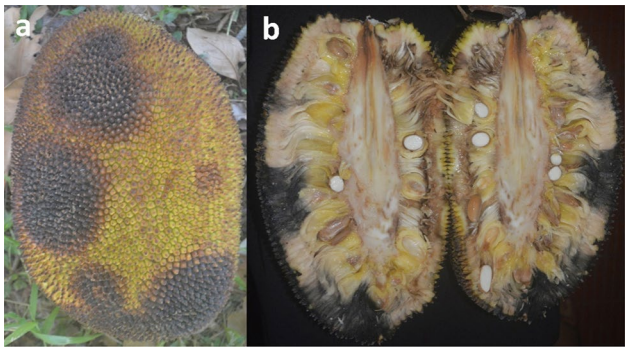

Fig. 1 **a** A ripe jack fruit after harvest showing external symptoms of *Lasiodiplodia* rot with large, round, blackish and isolated lesions, **b** Internal symptoms of a vertically-halved diseased fruit showing blackish fungal growth and rotting of inner tissue deeper into the perianth of the fruits

Colony and asexual reproductive morphology

Two weeks old colonies were black and fluffy on PDA, with abundant aerial mycelium, and the reverse side too was black in color; pycnidia 2–2.5 mm wide, simple, ostiolate, covered with numerous protective setae (Fig. 2). The fungus usually grew well on PDA and produced pycnidia and conidia within 3–4 weeks. Conidia were initially hyaline and aseptate, ellipsoid-ovoid, with granular content, apex broadly rounded, remaining hyaline and later becoming dark brown, one septate, thick walled, base truncate or round and longitudinally striate. The length and breadth of conidia were 24.87 ± 1.82 (20 –28) × 16.42 ± 1.26 (13 – 18 µ). Conidiophores hyaline, simple, conidiagenous cells hyaline, aseptate and cylindrical; paraphysis numerous and slender (Fig. 2).

Using cultural and morphological characteristics of the asexual redroductive structures, the fungus was identified as *Lasiodiplodia theobromae* (Pat.) Griffon and Maubl.≡ *Botryodiplodia theobromae* Pat. The disease was diagnosed as the *Lasiodiplodia* fruit rot of jackfruit. The disease had been recorded previously in Taiwan by Ni et al. (2008). Being a wound pathogen (Ni et al. 2008), *L. theobromae* requires a crack or injury to enter fruits and develop the disease.

The disease appears to be not very uncommon in Sri Lanka. Jackfruits with the same symptoms were subsequently observed in other areas, including Kandy (Central Province). To the best of our knowledge, the disease has not been previously reported in Sri Lanka. This is therefore the first report of *Lasiodiplodia* rot in jack fruit in Sri Lanka. A die-back caused by *L. theobromae* is also known in jack trees (Adikaram, unpublished data). In such trees, the inoculum is likely to come from the die-back affected branches or twigs to infect ripe fruits and develop rots.

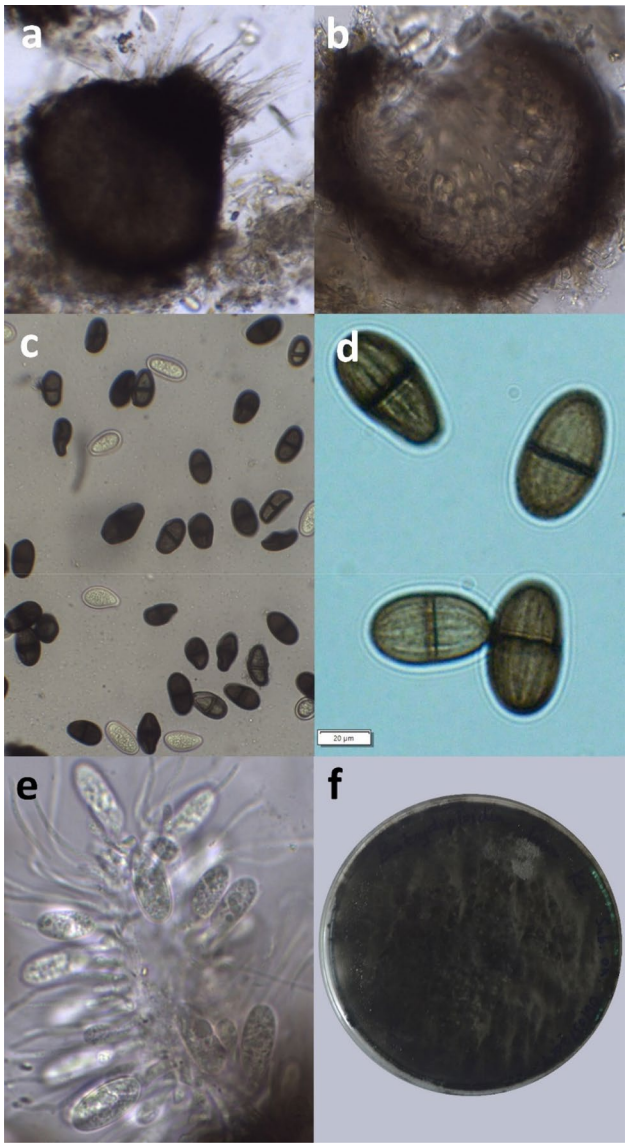

Fig. 2 **a** A pycnidium with protective setae around the osteole, **b** Mature pycnidium with conidia being released through the osteole, **c** Young, hyaline and dark mature conidia, **d** Mature conidia enlarged showing septum and longitudinally striate, **e**. Cylindrical conidiophores, paraphyses and developing conidia, and **f** 4-week old colony of *L. theobromae* grown on PDA

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