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DISEASE NOTES OR NEW RECORDS

Incidence and pathogenicity of *Phytophthora palmivora* and *Pythium vexans* associated with durian decline in far northern Queensland

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Abstract. In recent years, dieback of durian has become a major problem in mature orchards in the northern Queensland wet tropics region. A survey of 13 durian orchards was conducted during the dry season (July–September 2001) and following wet season (February–April 2002), with roots and soil from the root zone of affected trees being sampled. *Phytophthora palmivora* was recovered from the roots of affected trees on 12 of the 13 farms in the dry season, and all farms in the wet season. *Pythium vexans* was recovered from all 13 farms in both seasons. *P. palmivora* and *P. vexans* were recovered from diseased roots of 3-month-old durian seedlings cv. Monthong artificially inoculated with these organisms.

Additional keywords: Root rot, trunk canker, dieback, oomycetes.

Durian (*Durio zibethinus*) is a fruit of high economic value and is deemed the 'King of Fruits' in many south-east Asian countries. In recent years, there has been increasing interest in the development of an Australian durian industry. *Phytophthora palmivora* is known to cause the most destructive and economically significant diseases of durian in south-east Asia (Lim 1990) and, in recent years, decline has become a major problem in mature durian orchards in the wet tropics region of far northern Queensland. Symptoms of durian decline in Queensland are rapid dieback of branches, necrosis in the cortex of feeder roots and eventual tree death. These symptoms are similar to those found in trees infected with *P. palmivora*, except for the absence of the characteristic trunk canker (Lim 1990).

As early as 1934, Thompson recorded the death of durian trees in Penang and *P. palmivora* was recovered from canker-like symptoms on the main trunk of affected trees (Thompson 1934). Thompson (1938) also reported the dieback of durian without the symptoms of trunk canker in a small fruit estate in Singapore. *Pythium vexans* (synonym *Pythium complectens*) (Drechsler 1938) was found to be associated with the death of these trees. Since then, *P. palmivora* has been the pathogen most commonly associated with the decline and death of durian in various parts of south-east Asia (Navaratnam 1966; Lim 1990; Sivapalan *et al.* 1997). Both *P. palmivora* and *P. vexans* have been previously recorded on durian in far northern Queensland (L. Vawdrey, unpublished data), but there has been no systematic survey of durian with decline symptoms or pathogenicity studies completed.

This paper reports the incidence of *P. palmivora* and *P. vexans* recovered in a survey of 13 durian orchards in the wet tropics region of far northern Queensland during 2001/2002. The aggressiveness of *P. palmivora* and *P. vexans* recovered from roots of durian was compared under glasshouse conditions.

A survey of 13 durian farms was conducted during the dry season (July–September 2001, 141 mm recorded at South Johnstone Research Station) and wet season (February–April 2002, 1102 mm recorded). Roots and soil taken from each farm were sampled to a depth of 20 cm from four separate sites at the drip zone under each of six durian trees of fruit-bearing age expressing early symptoms of dieback. Where possible, the same trees on a particular farm were sampled during the dry season and wet season surveys. If this was not possible due to a tree death, then a nearby tree of similar age and at a similar stage of decline as others in the survey was chosen.

Soil samples from each tree were bulked to give a sample of ~500 mL of soil. Two 50 mL sub-samples of each soil were placed in 250 mL plastic cups and the cup filled with distilled water to within 1 cm of the top and capped with plastic lids with pre-punched holes. Root samples were treated similarly, with ~10 g of roots placed in the plastic cups. Pre-germinated lupin seedlings (*Lupinus angustifolius*)

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and petals of *Impatiens wallerana* were used to bait soil and roots. Five germinated lupin seedlings with radicles 2 cm in length were inserted through the holes in each lid and into the soil-water/root-water suspension. A single flower of *Impatiens* was floated on the surface of each soil-water/root-water suspension. Lupin radicles were checked daily and those showing brown, discoloured lesions (within 2–7 days) were thoroughly washed under running tap-water for 10 min, rinsed with sterile distilled water and blotted dry with sterile paper before being plated directly onto P_{10}ARP selective medium and potato-dextrose agar + streptomycin sulfate (PDAS) culture medium. Petals of *Impatiens* showing signs of rot (usually within 48 h) were rinsed with sterile distilled water and plated onto both P_{10}ARP and PDAS. In addition to baiting soils and roots, sections of diseased durian roots were surface sterilised in 70% ethanol for 1 min, rinsed in sterile distilled water and blotted dry using sterile paper then transferred to P_{10}ARP and PDAS. All culture plates were incubated in the dark at 26°C. Cultures were examined microscopically and the fungi recovered identified on morphological characteristics.

The aggressiveness of *P. palmivora* and *P. vexans* recovered from root tissue of durian was assessed using 3-month-old durian seedlings cv. Monthong growing in 2 L plastic bags infested with either *P. palmivora* (root isolate BRIP 42475), *P. vexans* (root isolate BRIP 43503) or a mixture of both isolates. Inoculum of *P. palmivora* (chlamydospores) and *P. vexans* (oospores) was prepared using the submerged culture method described by Tsao (1971). Plants were inoculated with 1 mL of a 10^5 spore suspension applied to each pot. Four replicate plants were used per treatment. A non-inoculated treatment was included for comparison. Two weeks after the inoculum was applied the pots were placed in plastic trays filled with water to a depth of 25 mm to saturate the soil by capillary action. After 3 days the pots were removed from the trays and the soil allowed to drain. Thereafter, plants were hand-watered as required. Plant roots were examined for root rot after a further 6 weeks. Sections of diseased roots were surface sterilised in 70% ethanol for 1 min, rinsed in sterile distilled water, blotted dry using sterile paper and then transferred to P_{10}ARP. The plates were observed for the growth of *P. palmivora* and *P. vexans* from the roots after incubation in the dark at 26°C.

In the survey *P. palmivora* was recovered from the roots of affected trees on 12 of the 13 farms in the dry season, and all farms in the wet season. *P. vexans* was recovered from all 13 farms in both seasons. *P. vexans* was isolated with greater frequency than *P. palmivora* in the dry season, 68% compared with 24%, respectively, of all trees sampled. In the wet season, *P. vexans* was recovered at lower levels (45%), but still with greater frequency than *P. palmivora* (35%).

The study into the pathogenicity of *P. palmivora* and *P. vexans* on durian seedlings showed that plants infested with *P. palmivora* exhibited obvious rotting of feeder roots and a reduction in the number of roots. However, the feeder roots of plants infested with *P. vexans* appeared only slightly necrotic compared with non-infested plants and there was no obvious reduction in the number of roots. A combination of *P. palmivora* and *P. vexans* appeared not to increase the severity of root rot compared with *P. palmivora* alone. *P. palmivora and P. vexans* were re-isolated from roots of the inoculated plants.

Although *P. vexans* was recovered from durian roots and soil with greater frequency than *P. palmivora*, glasshouse inoculation tests indicated that *P. palmivora* was the more pathogenic of the two organisms causing more severe and extensive root rot symptoms. However, the damage to roots caused by *P. vexans* was still significant and could lead to a reduction in the efficiency of affected feeder roots.

Excessive soil moisture is often associated with root diseases caused by *Pythium* spp. and the development of disease can be reduced by the drying out of soil (Thompson 1938). However, *P. vexans*-related disease of durian can develop under relatively dry conditions (Thompson 1938), although disease severity increases under excessive moisture. This supports our findings of a higher recovery of the species during the dry season.

In 1990, Lim reported the virtual annihilation of a durian orchard in Malacca due to the combined effect of drought and *Phytophthora*-related disease. In his view, drought lowered tree vigour, pre-disposing them to disease. Similar observations have been made in durian orchards in north Queensland (L. Vawdrey, unpublished data). Irrigation management will assist in reducing major fluctuations in soil moisture and is seen as an important component in the integrated management of durian decline.

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