Malaysian Journal of Microbiology, Vol 6(1) 2010, pp. 102-105

Fusarium species isolated from peat soil of Pondok Tanjung and Sungai Beriah, Perak

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Received 29 June 2009; received in revised form 5 September 2009; accepted 17 September 2009

ABSTRACT

Isolates of *Fusarium* from peat soil samples were recovered using three methods namely, soil dilution, direct isolation and debris isolation techniques. Based on identification using morphological characteristics, four species of *Fusarium* species were identified. The most common species isolated was *F. solani* (70.4%) followed by *F. oxysporum* (14.8%), *F. semitectum* (11.1%) and *F. proliferatum* (3.7%).

Keywords: *Fusarium*, peat soil

INTRODUCTION

Peatland accumulate peat which is an organic material develops as a results of incomplete decomposition of vegetation in the ecosystem (Shier, 1985). Peat is formed by accumulation of partially decaying plant debris such as leaves, roots, branches and twigs as well as insect and animal remains in waterlogged environments which lead to anaerobic conditions, low oxygen levels and highly acidic conditions (Whitmore, 1984; Howes, 1998). These extreme conditions prevent microorganisms from rapidly decomposing the plant debris and animal remains.

Among the microorganisms, it has been suggested that fungi are the main decomposer in many peatland ecosystems and therefore assume a more dominant role than bacteria (Latter *et al*., 1967; Williams and Crawford, 1983). As a decomposer, fungi have an extensive hyphal network with faster growth rate and the ability to translocate nutrients through the hyphal network to vast areas in the peatland ecosystem (Thormann, 2006).

Diverse assemblages of fungi have been recovered from peatland soils worldwide such as anamorphic ascomycete, teleomorphic ascomycete, Zygomycota and Basidiomycota (Thormann, 2006). These groups of fungi play an important role in carbon cycle and interact with plants through exchange of organic and inorganic compounds (Kamal and Varma, 2008).

From compilation of Thormann and Rice (2007) on fungi from peatlands, the genus *Fusarium* was one of the fungal genera isolated from different types of peatland soils. However, information on species of *Fusarium* from tropical peatland is lacking. Therefore, this preliminary study was conducted to determine the occurrence of species of *Fusarium* in peat soils from peatswamp area in Pondok Tanjung and Sungai Beriah, Perak.

MATERIALS

Soil sample

A total of five soil samples were collected from peatland area at Pondok Tanjung and Sungai Beriah, Perak. The soil samples were taken from a depth of about 1–15 cm, stored in paper bag, and brought to the lab for drying process. The soil samples were air-dried for 48 h at 27 ± 1 ℃. After drying, the soils were grinded to fine powder and sieved through a 0.05 mm sieve to remove plant debris and small stones. The grinded soils and plant debris were stored separately and kept in 4 ℃ to be used for isolation of *Fusarium* isolates and soil analysis.

Isolation and identification of *Fusarium* isolates

Three isolation methods namely, soil dilution plate, debris isolation and direct isolation methods were used to recover isolates of *Fusarium* from the peat soil samples. The three isolation methods were based on the method described in The *Fusarium* Laboratory Manual by Leslie and Summerell (2006) for isolation of *Fusarium* from soils.

Isolates of *Fusarium* successfully isolated were identified using primary and secondary morphological characteristics according to the description and classification in The *Fusarium* Laboratory Manual (Leslie and Summerell, 2006). The media used for isolation and identification were also adapted from the manual.

Soil analysis

The peat soil samples were also analysed for the texture, pH and moisture. Soil texture was determined using feel method (Brady and Weil, 1999) and soil texture was classified based on Biondo and Lee (1997).

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Soil pH was measured by weighing 20 g of the soil and put in a 100 mL beaker. A 50 mL of distilled water were added and mixed well. The mixture was incubated for 24 h and the pH was recorded using a pH meter (Jenway).

The percentage of moisture was calculated by weighing 10 g of the soils in a Petri dish and incubated at 105 ℃ for 24 h. Then, the soils were weighted again. The percentage of moisture was calculated based on the following formula:

$$\text{soil moisture (\%)} = \frac{\text{(weight of petri dish + soil before incubation) g} - \text{(weight of petri dish + soil after incubation) g}}{\text{(Weight of soil sample) g}}$$

RESULTS

A total of 27 isolates of *Fusarium* were obtained from five peat soil samples. Based on morphological characteristics, four species of *Fusarium* were identified (Table 1). The most common species isolated was *F. solani* (70.4%) followed by *F. oxysporum* (14.8%), *F. semitectum* (11.1%) and *F. proliferatum* (3.7%). The *Fusarium* species successfully recovered, the soil texture, pH and moisture are shown in Table 2. The peat soil samples had loamy texture with different categories namely, silty clay loam, sandy clay loam and clay loam. The isolates of *Fusarium* were recovered from acidic environment with pH ranging from 2.95–3.52 and the moisture content of 0.58%–1.51%.

From the three isolation methods, debris isolation method had the most isolates recovered i.e. 13 isolates followed by direct isolation and soil dilution methods with 11 and three isolates, respectively (Table 3).

DISCUSSION

The four species of *Fusarium* recovered from the peat soil samples are common species found in the soils world wide. The isolates were obtained in soils with acidic conditions which are the pH range of peat soils. Lower moisture content could be due to the dried and warm weather during sampling. Moreover, peatland areas are subjected to periods of varying water levels.

Species of *Fusarium* in peat soils are probably saprobes which involved in decomposition of organic matter. Deacon (1997) grouped the genus *Fusarium* in group 3 behavioral grouping of decomposer fungi which degrade simple polymer. Although the information on the occurrence of *Fusarium* in tropical peatland soils is lacking, species of *Fusarium* is one of the dominant anamorphic ascomycetes recovered from boreal peatlands (Thormann, 2006), *F. avenaceam* and *F. culmorum* have been recovered from bog and fen peatland soils (Dickinson and Dooley, 1969).

Fusarium solani was the most common species recovered from the peat soil samples which are not surprising as *F. solani* is one of the most common species inhabit different types of soil and has been isolated from numerous soils in sub-tropical, semi-arid and grassland soils (Burgess and Summerell, 1992), cultivated soils (Lim and Chew, 1972; Latiffah *et al*., 2007), forested area (Latiffah *et al*., 2009) and from sandy soils (Sanquis and Borba, 1997).

Similar with *F. solani*, *F. oxysporum* was also common

Table 1: Morphological characteristics of *Fusarium* species isolated from peat soil

Characteristic	*Fusarium* species			
	F. solani	***F. oxysporum***	***F. semitectum***	***F. proliferatum***
Microconidia	Abundant in aerial mycelial, reniform and ellipsoid with1–2 septa,	Abundant in aerial mycelial, oval to reniform with 0 septa,	Scarce in aerial mycelium and rabbit ear appearance (*in situ*), pyriform to obovate with 1 septa mesoconidia fusoid with 3–5 septa	Microconidia in chain (*in situ*), club shaped and 0 septa.
Macroconidia	Abundant in sporodochia, stout, wide, straight and stout with 4–7 septa, rounded basal cell, blunt and rounded apical cell	Abundant in sporodochia, straight to slightly curved, with 3 septa, foot shaped basal cell, slightly hook apical cell	Slender and slightly curved with 3–5 septa, foot shaped basal cell, curved apical cell	Slender and relatively straight with 3–5 septa, not well developed basal cell, curved apical cell
Conidiophore	Long monophialides	short monophialides	Monophialides and polyphialides	Monophialides and polyphialides
Chlamydospore	Present - in pairs and singly	Present - singly and in pairs	Present – singly and in pairs	Absent
Pigmentation	Cream, blue, green-blue	Pale violet to dark violet	Beige, brown, yellowish	Purple
Growth rate	3.0–3.8 cm	3.4–4.0 cm	3.5–4.6 cm	3.4–4.0 cm

Table 2: Texture, pH value, moisture and *Fusarium* species isolated from peat soil samples

Soil sample	Texture	pH	% moisture	*Fusarium* species
Pondok Tanjung (forested area)	Sandy clay loam	3.52	1.36%	*F. semitectum* *F. solani* *F. oxysporum*
Sg. Beriah Kanan 1	Clay loam	2.95	1.00%	*F. oxysporum* *F. solani*
Sg. Beriah Kanan 2	Clay loam	2.98	1.51%	*F. oxysporum* *F. solani*
Sg. Beriah Kiri 1	Silty clay loam	2.98	0.70%	*F. semitectum* *F. solani*
Sg. Beriah Kiri 2	Silty clay loam	3.41	0.58%	*F. solani* *F. oxysporum* *F. proliferatum*

Table 3: Number of *Fusarium* isolates obtained based on soil dilution, direct isolation and debris isolation techniques

Isolation technique	Number of isolates	*Fusarium* species
Soil dilution	3	*F. solani* *F. oxysporum*
Direct isolation	11	*F. solani* *F. oxysporum* *F.semitectum* *F. proliferatum*
Debris plating	13	*F. solani* *F. oxysporum* *F.semitectum*
Total	27	

soil fungi recovered from various types of soil from agricultural soils (Onyike and Nelson, 1993; Skorgaard *et al*., 2000; Latiffah *et al*., 2007) to non-agricultural soils (Joffe and Palti, 1977; Sarquis and Borba, 1977 and balmas, 1999). From peatland soils, *F. oxysporum* was one of the soil fungi isolated from fen peatland (Stenton, 1953) and *F. oxysporum* has also been isolated from rhizosphere and roots of *Spartina alterniflora* in Dongtan wetland in China (Luo *et al*., 2007).

Fusarium semitectum is widely distributed as saprophyte in soils and most probably exists as soil inhabitants (Burgess *et al*., 1988, Leslie *et al*., 1990). *Fusarium semitectum* was also one of the species of *Fusarium*, recovered in Dongtan wetland, China (Luo *et al*., 2007).

F. proliferatum also occur in wide variety of agricultural soils and has been isolated sporadically in non-agricultural soils in Australia (Burgess and Summerell, 1992; Summerell *et al*., 1993) and found to be abundant in rhizosphere of *Livistona mariae* palms (Gott *et al*., 1994).

In conclusion, four species of *Fusarium* were isolated from peat soil samples from Pondok Tanjung and Sungai Beriah, Perak. The species were *F. solani*, *F. oxysporum*, *F. semitectum* and *F. proliferatum*.

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