Fusarium species from Marion and Prince Edward Islands: sub-Antarctic

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Fusarium species were isolated from plant debris in 27 soil samples representing the major habitat and vegetation types of Marion and Prince Edward Islands. The survey provided qualitative and quantitative information on the occurrence, distribution and ecology of Fusarium spp. in these subantarctic soils and is to our knowledge the first report of Fusarium spp. from the subantarctic. Altogether 432 Fusarium isolates were recovered after plating plant debris on a selective medium. The most prevalent Fusarium sp., which comprised 73% of the isolates obtained from Marion Island and 82% of the isolates from Prince Edward Island, was F. merismoides Corda. Two other species (F. acuminatum Ell. & Ev. and F. reticulatum Mont.) occurred at similar frequencies to each other and were more prevalent in areas that were influenced by animal and bird activity. A number of F. reticulatum isolates were obtained from isolations made from necrotic leaf tissue of Pringlea antiscorbutica R. Br.

Fusarium-spesies is geïsoleer uit plantreste in 27 grondmonsters verteenwoordigend van die hoofhabitat en plantgroeitipes van Marion- en Prince Edwardeilande. Die opname het kwalitatiewe en kwantitatiewe gegevens oor die voorkoms, verspreiding en ekologie van Fusarium spp. in hierdie subantarktiese gronde verskaf, en is na ons wete die eerste melding van Fusarium spp. in die subantarktieke. Altesame 432 Fusarium-isolate is verkry vanaf isolasies wat uit nekrotiese plantreste op 'n selektiewe medium. Die mees algemene Fusarium-spesie wat 73% van die isolate vanaf Marion Island en 82% van die isolate vanaf Prince Edward Island uitgemaak het, was F. merismoides Corda. Twee ander spesies (F. acuminatum Ell. & Ev. en F. reticulatum Mont.) het soortgelyke frekwensies in vergelyking met mekaar gehad en het 'n hoër voorkoms in areas wat deur dier- en voël-aktiwiteite beïnvloed was, gehad. 'n Aantal F. reticulatum-isolate is verkry vanaf isolasies wat uit nekrotiese blaarweefsel van Pringlea antiscorbutica R. Br. gemaak is.

Keywords: Fusarium, plant debris, soil, subantarctic islands, vegetation

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Introduction

Marion Island (46° 54'S, 37° 45'E) and its smaller neighbour Prince Edward Island (46° 38'S, 37° 57'E), 22 km to the north-east, are situated in the subantarctic region 2 300 km south-east of Cape Town.

Marion Island (and similarly Prince Edward Island) experiences low temperatures (annual mean 5.1°C), high rainfall (>2 500 mm per annum) and a high incidence of galeforce winds (Schulze 1971). Both islands consist of two distinct lava types, a grey preglacial and a black postglacial eruption. The influence of geology on vegetation is through variation in microclimate and soil drainage, rather than through chemical differences in the lava types (Huntley 1971). A comprehensive review of the the chemical composition of the soils and the plant ecology of Marion Island is given by Smith (1977, 1978). Manuring by birds and seals markedly enhances soil microbial populations by adding nutrients and possibly energy sources to the soils (Steyn & Smith 1981; Grobler et al. 1987).

Fusarium spp. have been recorded in the subarctic region from tundra and glaciated soils in Alaska (Stoner 1981), and from soils and plant roots in Iceland (Kommedahl et al. 1975). In the subantarctic, however, only brief reference is made to fungi in general on Marion and Prince Edward Islands (Joubert 1971; Steyn & Smith 1981). Mercantini et al. (1989) studied the distribution of keratinophilic and other fungi on the Antarctic Continent, but found no Fusarium spp. According to Corte & Daglio (1963), Tubaki is the only person to refer to a Fusarium sp. isolated from the Antarctic. To our knowledge, Fusarium spp. have not previously been recorded in the subantarctic region.

This paper reports on the first intensive survey of Fusarium spp. on these subantarctic islands. The frequency of Fusarium spp. was determined in plant debris associated with various biotically and non-biotically influenced soil environments. Isolations were also made from necrotic leaves of Pringlea antiscorbutica R. Br.

Materials and Methods

Soil sampling sites and procedures

During April–May of 1985 and 1986 soil samples (± 500 g/sample) were collected from Marion (Figure 1) and Prince Edward (Figure 2) Islands. A description of each sampling site is summarized in Table 1. Each location indicated represents four separate subsamples (several
metres apart, depending on the terrain and vegetation) taken from the top 10 cm of soil and then bulked. Plant residues and rocks were removed from the soil surface before the subsamples were collected with a hand trowel. The samples were placed in polyethylene bags and taken to the station on Marion Island.

**Extraction of plant debris from soil**

Soil samples were treated as described by Nelson *et al.* (1983) for the extraction of plant debris. The resultant debris samples were allowed to dry in a heated (18–25°C) room, sealed in polyethylene bags and returned to the laboratories of the University of the Orange Free State for analysis.

**Isolation and identification of *Fusarium* species**

The collected debris was plated on a selective *Fusarium* isolation medium (SFA) (van Wyk *et al*. 1986). One
hundred pieces of debris from each soil sample were plated out (10 debris pieces/petri dish) and incubated at 10°C for 7 days and then at 25°C for another 7 days. The fungal colonies that developed were transferred to plates of potato-dextrose agar to which 30 mg dm⁻³ streptomycin had been added (PDAS). Cultures of Fusarium spp. isolated on PDAS were single-spored, transferred to potato-dextrose agar (PDA) and carnation leaf agar (CLA) (Fisher et al. 1982) and identified according to Nelson et al. (1983). Representative isolates were deposited in the culture collection of the Medical Research Council (MRC), Tygerberg.

Isolation from Pringlea leaves

Leaves of the indigenous plant Pringlea antiscorbutica (Brassicaceae), which had dark necrotic lesions, were collected near the meteorological station. These leaves were dried in a heated (18–25°C) room, sealed in a polyethylene bag and returned to South Africa. Small sections of the necrotic leaves were plated on SFA (25 leaf pieces) and also on water agar (25 leaf pieces) to which 30 mg dm⁻³ streptomycin had been added. These plates were incubated at 10°C for 7 days and then at 25°C for another 7 days. The colonies that developed were treated similarly to those from the debris plates.

Results

Fusarium species isolated from plant debris

The frequency of isolation of each Fusarium sp. from each plant debris sample is given in Table 2. Only three species of Fusarium were isolated from the islands’ soils and are listed with their respective sections as in Nelson et al. (1983): F. merismoides Corda in the section Eupionnotes, F. acuminatum Ell. & Ev. in the section Gibbosum, and F. reticulatum Mont. in the section Discolor. A total of 432 Fusarium isolates were recovered from the 27 plant debris samples. The most frequently isolated species from soils from both islands was F. merismoides, comprising 73% of the total isolates from Marion Island and 82% from Prince Edward Island. The species totals for F. acuminatum and F. reticulatum are relatively low for both islands and both were isolated with similar frequencies, F. acuminatum being slightly more prevalent than F. reticulatum.

Isolations from necrotic Pringlea leaves

The only fungus isolated from the Pringlea leaf pieces was F. reticulatum. This species was isolated from 12 of the 50 plated necrotic leaf pieces.

Discussion

All three Fusarium species isolated from plant debris during the present survey are soil-inhabiting fungi that exist either as saprophytes and/or as non-aggressive plant pathogens. F. merismoides [syn. F. episphaeria (Tode) Synd. & Hans. pro parte] (Nelson et al. 1983) is common in soil and in polluted water or sludge (Booth 1971), but was not recorded during a recent survey of South African soils (Marasas et al. 1988). It was found to be common in Icelandic soils (Kommedahl et al. 1975).
stages of ecological succession and community development.

It appears that the presence of animal and bird activity enhances the prevalence of the abovementioned three *Fusarium* species, which supports the findings of Steyn & Smith (1981) with respect to microbial populations in Marion Island soils. The prevalence of *F. acuminatum* and *F. reticulatum* was highest at a burrowing bird habitat (F4), while *F. merismoides* was also isolated at high frequencies at this location. On a grass slope frequented by nesting albatross (F8), the incidence of *F. merismoides* and *F. acuminatum* was relatively high. The incidence of *F. merismoides* was at its highest at a seal wallow area (F10). Two well-vegetated locations in close proximity to animal or bird activity (F24, F26) also had high *Fusarium* populations. Conversely, those environments that were not biotically influenced and were sparsely vegetated (fjøeldmark) had some of the lowest *Fusarium* frequencies recorded. This is supported by the low *Fusarium* counts from a *Blechnum*-slope (F3) and an inland mire (F5), both with no animal activity. The *Fusarium* population at F5 could also, however, have been influenced by the waterlogged soil conditions.

The possibility exists that *F. reticulatum* caused the necrotic lesions on the *Pringlea* leaves, but this has not been proven by pathogenicity tests.

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**Table 2** Frequency and identity of *Fusarium* species isolated from plant debris found in soil on Marion and Prince Edward Islands

| *Fusarium* species | Marion Island sampling sites | Species total |
|--------------------|-----------------------------|--------------|
|                    | F1  | F2  | F3  | F4  | F5  | F6  | F7  | F8  | F9  | F10 | F11 | F12 | F13 | F14 | F15 | F16 | F17 | F18 | F19 | F20 |
| *F. merismoides*   | 6   | 4   | 5   | 44  | 2   | 0   | 15  | 0   | 70  | 4   | 2   | 2   | 0   | 53  | 0   | 2   | 5   | 2   | 0   | 221 |
| *F. acuminatum*   | 2   | 1   | 1   | 25  | 0   | 0   | 0   | 11  | 0   | 2   | 1   | 1   | 0   | 0   | 0   | 0   | 0   | 1   | 1   | 0   | 46  |
| *F. reticulatum*  | 4   | 0   | 0   | 25  | 0   | 0   | 0   | 2   | 0   | 2   | 0   | 1   | 0   | 0   | 0   | 2   | 1   | 0   | 0   | 37  |
| Site total         | 12  | 5   | 6   | 94  | 2   | 5   | 0   | 28  | 0   | 74  | 5   | 4   | 2   | 0   | 53  | 0   | 4   | 7   | 3   | 0   | 304 |
| *Fusarium* species | Prince Edward Island sampling sites | Species total |
|                    | F21 | F22 | F23 | F24 | F25 | F26 | F27 | | | | | | | | | | | | | | |
| *F. merismoides*   | 0   | 17  | 7   | 52  | 3   | 15  | 11  | 0   | 105 |
| *F. acuminatum*   | 0   | 0   | 1   | 2   | 0   | 9   | 1   | 13  |
| *F. reticulatum*  | 0   | 0   | 0   | 3   | 1   | 5   | 1   | 10  |
| Site total         | 0   | 17  | 8   | 57  | 4   | 29  | 13  | 128 |
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