

## Root Rot of Moth Orchid Caused by *Fusarium* spp.

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Moth orchid plants with yellowing blight and root rot symptoms were collected, and a total of 54 isolates of *Fusarium* spp. was obtained from roots and leaf bases of the diseased plants. The isolates were identified based on their morphological characteristics. Out of the 54 isolates of *Fusarium* spp., 42 isolates were identified as *F. solani*, 5 isolates as *F. oxysporum*, and 7 as *F. proliferatum*. Isolates of the three *Fusarium* spp. were tested for pathogenicity to moth orchid plants by artificial inoculation. All the *Fusarium* spp. induced root rot of the host plants. The symptoms progressed up to the basal part of the leaves, which later caused yellowing blight. The symptoms induced on the plants by artificial inoculation with the *Fusarium* spp. isolates were similar to those observed in greenhouses. The present study reveals that *F. oxysporum*, *F. proliferatum*, and *F. solani* cause root rot of moth orchid, and that *F. solani* is the main pathogen of the disease.

**Keywords :** *Fusarium oxysporum*, *Fusarium proliferatum*, *Fusarium solani*, moth orchid, *Phalaenopsis* spp., root rot.

Moth orchid (*Phalaenopsis* spp.) is cultivated extensively as a popular flowering plant in Asian countries. In Korea, hybrids Red, White, and Pink of the plant are mostly grown in pots under semi-shaded greenhouse conditions. Yellowing blight and root rot symptoms were frequently observed during a disease survey of moth orchids in Gyeonggi province in Korea from 1997 to 2000. Disease incidence reached up to 30% infected plants in some greenhouses. The symptoms were characterized by dark-brown to black discoloration of roots (Fig. 1A and B). The infected roots became rotten in dry condition. Lower leaves of severely diseased plants turned yellow and blighted later.

A total of 54 isolates of *Fusarium* spp. was obtained from roots and leaf bases of diseased moth orchids. These were identified based on their morphological characteristics (Fig.

1C-G and Table 1). The morphological characteristics of the three *Fusarium* spp. examined by the authors were consistent with those described by previous workers (Booth, 1971; Nelson et al., 1983). Out of the 54 isolates of *Fusarium* spp., 42 isolates were identified as *F. solani* (Mart.) Sacc., 5 isolates as *F. oxysporum* Schlecht.:Fr., and 7 isolates as *F. proliferatum* (Matsushima) Nirenberg.

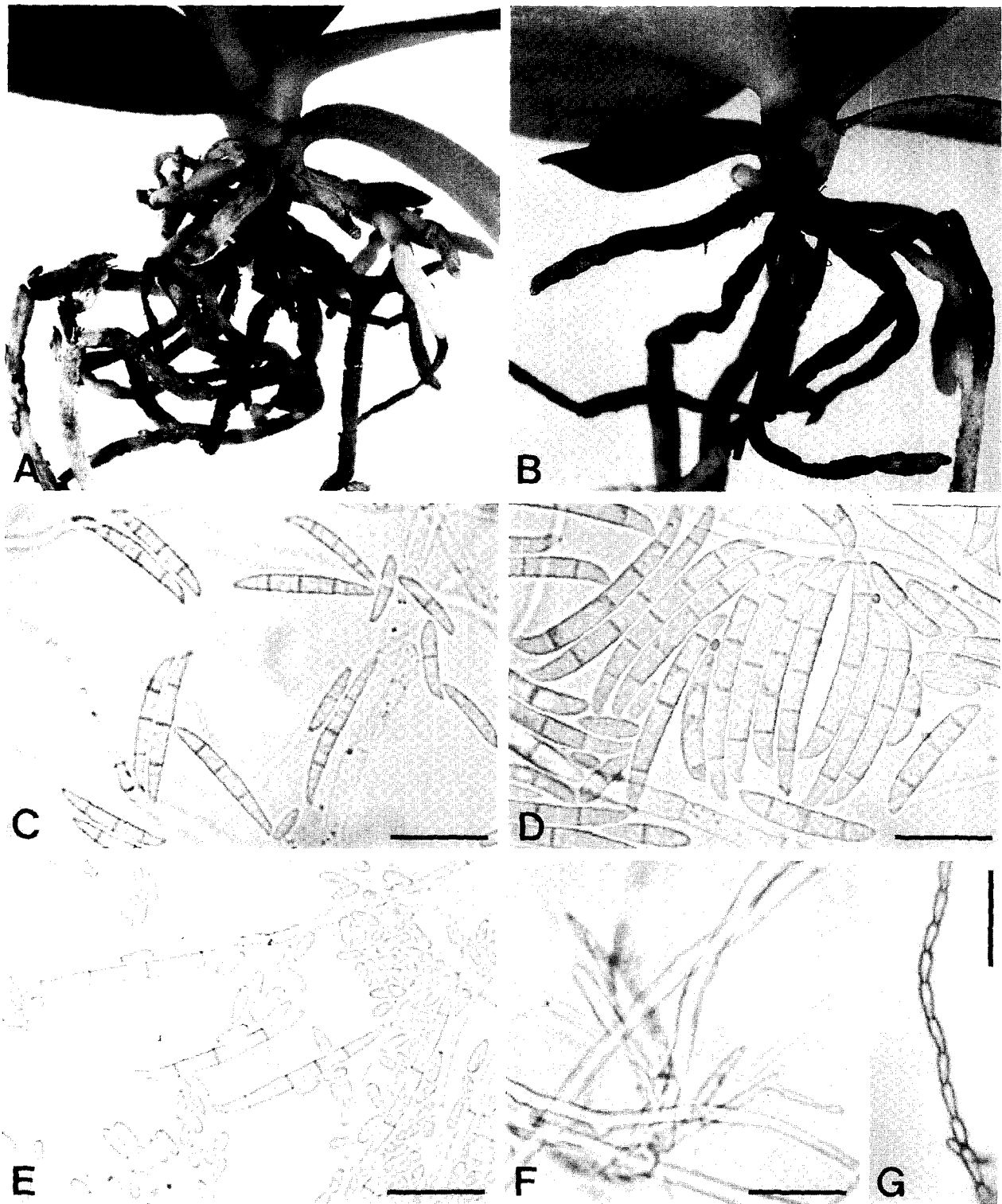
Two to four isolates of the three *Fusarium* spp. were tested for their pathogenicity to 6-month- to 1-year-old healthy plants of moth orchids (hybrids Red and White) by artificial inoculation with inoculum prepared using cornmeal-sand medium (Lee et al., 2002). The same quantity of cornmeal-sand medium was used for the control plant. The inoculation experiment was performed in three replicates. All the isolates of *F. oxysporum* and *F. proliferatum* tested were strongly pathogenic to roots of the host (Table 2). Two isolates of *F. solani* were strongly pathogenic to the roots, while the other two isolates of the fungus were weakly pathogenic. The root rot symptoms induced by *Fusarium* spp. progressed up to the basal part of the leaves, which later caused yellowing blight. No symptom was observed on the control plants. The symptoms induced on the plants by artificial inoculation with the *Fusarium* spp. isolates were similar to those observed in the growers' greenhouses. The isolates which induced symptoms on the host plants were re-isolated from the lesions.

Bulb and root rot of *Phalaenopsis* sp. caused by *F. oxysporum* Schlecht.:Fr. f. sp. *cattleyae* Foster was recorded in USA (Farr et al., 1989). In Japan, Morita et al. (1992) reported Nectria blight of *Phalaenopsis* spp. caused by *Nectria haematococca* Berk. & Br., the teleomorph of *F. solani*. The present study revealed that *F. proliferatum* as well as *F. oxysporum* and *F. solani* causes root rot of *Phalaenopsis* spp. although further study is needed to identify a forma specialis of the *F. oxysporum* isolates. There were no differences among the symptoms on moth orchid plants caused by the three *Fusarium* spp., and the most common symptom appeared as root rot. Hence, 'root rot' seemed to be the most appropriate name of the moth orchid disease caused by *Fusarium* spp.

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**Fig. 1.** Root rot symptoms of moth orchids grown in pots and morphological features of the causal *Fusarium* spp. isolated from the lesions. (A and B) weakly or severely rotted roots of moth orchids, respectively; (C) microconidia and macroconidia of *F. oxysporum*; (D) microconidia and macroconidia of *F. solani*; (E-G) microconidia, macroconidia, mono- and polyphialides, and a conidial chain of *F. proliferatum*. Each scale bar = 20  $\mu$ m.

**Table 1.** Morphological characteristics of *Fusarium* spp. isolated from diseased roots and leaf bases of moth orchids<sup>a</sup>

Structure	Division	<i>F. oxysporum</i>	<i>F. solani</i>	<i>F. proliferatum</i>
Conidiophores	Shape	Monophialide	Monophialide	Monophialide, polyphialide
	Size (µm)	5-24×2-3	12-125×2-5	16-42×2-4
Microconidia	Shape	Oval to cylindrical	Oval to ellipsoidal	Fusiform to clavate
	Septum	0-2	0-2	0-1
	Size (µm)	3-24×2-4	5-22×2-6	4-12×2-3
Macroconidia	Shape	Fusoid, falcate	Inequilaterally fusoid	Fusoid, delicate
	Septum	3-5	3-5	2-5
	Size (µm)	19-52×2-4	28-53×4-6	25-60×3-4
Chlamydospores	Shape	Globose to ellipsoidal	Globose to oval	—
	Septum	0	0	—
	Size (µm)	4-16×4-12	5-10×5-10	—

<sup>a</sup> Measurement was made after 20-30 days of cultivation on carnation leaf agar. — = no formation.

**Table 2.** Pathogenicity of *Fusarium* spp. isolates to moth orchid plants by artificial inoculation

<i>Fusarium</i> spp.	Isolate No.	Virulence of isolates
<i>F. oxysporum</i>	F6303-2	++ <sup>a</sup>
	F6412-1	++
<i>F. proliferatum</i>	F6458-1	++
	F6463-1	++
<i>F. solani</i>	F6306-2	++
	F6358-1	++
	F6440-1	+
	F6457-1	+
Control		—

<sup>a</sup> Disease rating was made 30 days after inoculation. ++ = severe root rot; + = weak root rot; — = no symptom.

Recently, Lee et al. (2002) reported that *F. oxysporum*, *F. proliferatum*, and *F. solani* cause dry rot of *Cymbidium* orchids, and that *F. oxysporum* is the main pathogen of the disease. Therefore, it is believed that the three *Fusarium* spp. could attack a variety of orchid plants. Among the *Fusarium* spp., *F. solani* was the most frequently isolated from the root rot lesions of moth orchid plants, while

isolation frequency of *F. oxysporum* and *F. proliferatum* from the lesions was very low. The results suggest that *F. solani* is the main pathogen of the disease.

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