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A NEW SPECIES OF *ENDOPHRAGMIELLA* FROM TAIWAN

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Endophragmiella was proposed by Sutton (**1973**) to accommodate two species, *E. pallescens* Sutton, and *E. canadensis* (Ell. & Ev.) Sutton. Separation of *Endophragmiella* from the morphologically similar genus *Endophragmia* was based on several features. For example, *Endophragmiella* was characterized by thin-walled conidiophores and conidiogenous cells, conidiophores simple or irregularly branched, without producing flared cup-shaped collarettes, and conidia bearing a distinct frill (Sutton, **1973**). Hughes (**1979**) indicated that many species included in *Endophragmia* were untenable, because they seceded conidia rhexolytically and showed percurrent proliferation arising from the penultimate cells of the conidiophores. The mechanism of conidiogenesis and conidiophore proliferation actually did not comply with the definition of *Endophragmia* proposed by Duvernoy and Maire (**1920**). Many previously described species of *Endophragmia* (Ellis, **1971**, **1976**), therefore, were transferred to *Endophragmiella* after its generic concept was redefined (Hughes, **1979**). Accepting the concept of Hughes (**1979**), Kirk published a series of papers describing many new species of *Endophragmiella* (Kirk, **1981a**, **b**, **1982a**, **b**, **c**), and provided a key to the 46 described species (Kirk, **1985**). During investigations of the hyphomycetes of Taiwan associated with decaying leaves and stems, a conidial fungus was isolated, conidia of which secede rhexolytically and had a frill at their base. The terminal cell of the conidiophore proliferated percurrently to form a new conidiogenous cell. These characteristics suggested a relationship to *Endophragmiella.* Nevertheless, the shape, size, septation and pigmentation of conidia and conidiophores distinguish this fungus from other described *Endophragmiella* species (Ellis, **1971**, **1976**; Hughes, **1979**; Kirk, **1981a**, **b**, **1982a**, **b**, **c**, **1985**), and warrant accommodation in a new species. For the diagnosis, Kornerup and Wanscher (**1978**) was used as a color standard.

Endophragmiella achromatica *sp. nov.* Figs. 1–3

Coloniae on CMA (*Zea mays* L. farinosis agaribus) effusae, aurantiacae albae ad pallidam aurantiacam; reversae obscure aurantiacae albae ad obscure aurantiacas umbras. Mycelium fere immersum in substrato, constituta laeve, ramosum, septatum; hyphae hyalinae. Conidiophorum macronematoideum, mononematoideum, oriens singulatim vel 3–5 in caterva ab mycelio vel intercalaris moniliformis cellulae, gracile, strictum vel leviter flexuosum, laeve, septatum, hyalinum ad laete pallidum brunneum, 70–160 μm altum, cylindricum ad subulatum, contractum ad finem, cum crasso-pariete inflata base, 4.3–11 μm latum, simplex vel raro ramosum, cum usque ad 10 percurrens proliferum. Cellulae conidiogenae, monoblastic, integrae, terminales, percurrentes, contractae ad apicem. Conidia solitaria, exsiccata, acroportata, ovoidea, vel late oblongata, ferens angustus, cylindraceus protuberans abscissus hilum ad basim, 0.4–1.6 μm longam et 2 μm latam, 3-septata, paries conidicus usque ad 1.6 μm crassum, et septa usque ad 1.3 μm crass, laeves, hyalinae, 12.2–21.3 × 5.8–9.2 μm.

Colonies on corn meal agar effused, orange white to pale orange; reverse dull orange-white to dull orange shades. Mycelium mostly immersed in the substratum, composed of smooth, branched, septate, hyaline hyphae. Conidiophores macronematous, mononematous, arising singly or 3–5 in a group from mycelium or intercalary moniliform cells, slender, straight or slightly flexuous, smooth, septate, hyaline to light pale brown, 70–160 μm high, cylindrical to subulate, tapered toward the end, with thick-walled swollen base, 4.3–11 μm wide, simple or rarely branched. Conidiogenous cells monoblastic, integrated, terminal, tapered toward apex, with up to 10 percurrent proliferations. Conidia solitary, dry, acrogenous, ovoid or broadly oblong, 12.2–21.3 × 5.8–9.2 μm bearing a basal narrow, cylindrical protuberant abscission scar, 0.4–1.6 μm long and 2 μm wide; conidial wall up to 1.6 μm thick, smooth, hyaline, 3-septate; septa up to 1.3 μm thick.

Habitat. On rotten stems collected from Wulai, Taipei, Taiwan, on 4.III.1987. HOLOTYPUS: PPH4 (dried culture) and ex-typus PPH4E, deposited in the De-

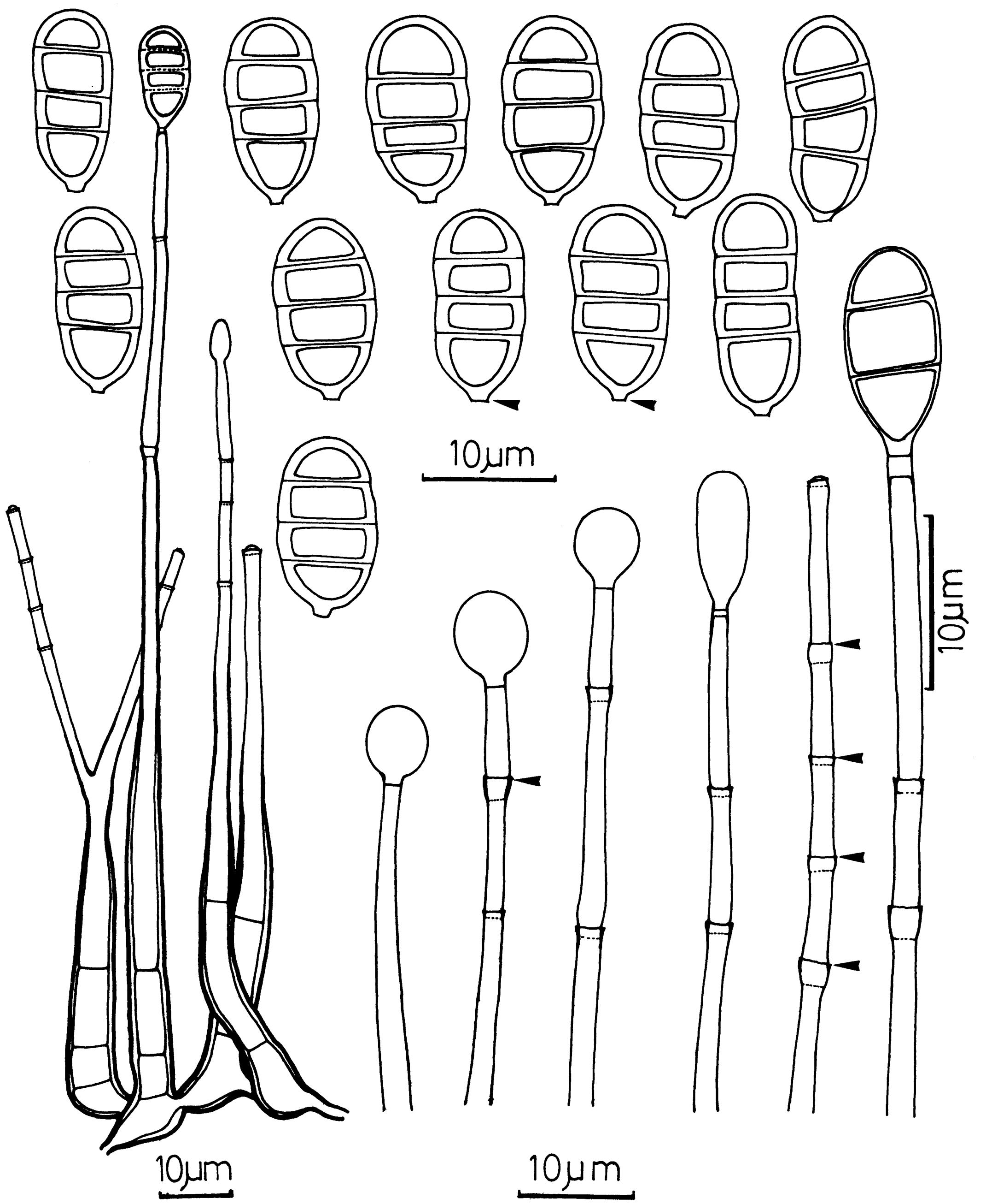

FIG. 1. Conidiophores, conidiogenous cells, conidia, and conidiogenesis of *Endophragmiella achromatica*. Arrows indicate the conidium basal frill, collarette, and percurrent proliferation of conidiogenous cells.

partment of Plant Pathology and Entomology, National Taiwan University, Taipei, Taiwan; ex-typus deposited in the Culture Collection and Research Center (CCRC), Hsinchu, Taiwan. ISOTYPUS: PPH4-1 (dried culture) also deposited in New York Botanical Garden; ISOTYPUS: PPH4-2 (dried culture), and ex-typus in Commonwealth Mycological Institute.

Hughes (**1979**) redefined *Endophragmiella* to include only species in which conidia secede

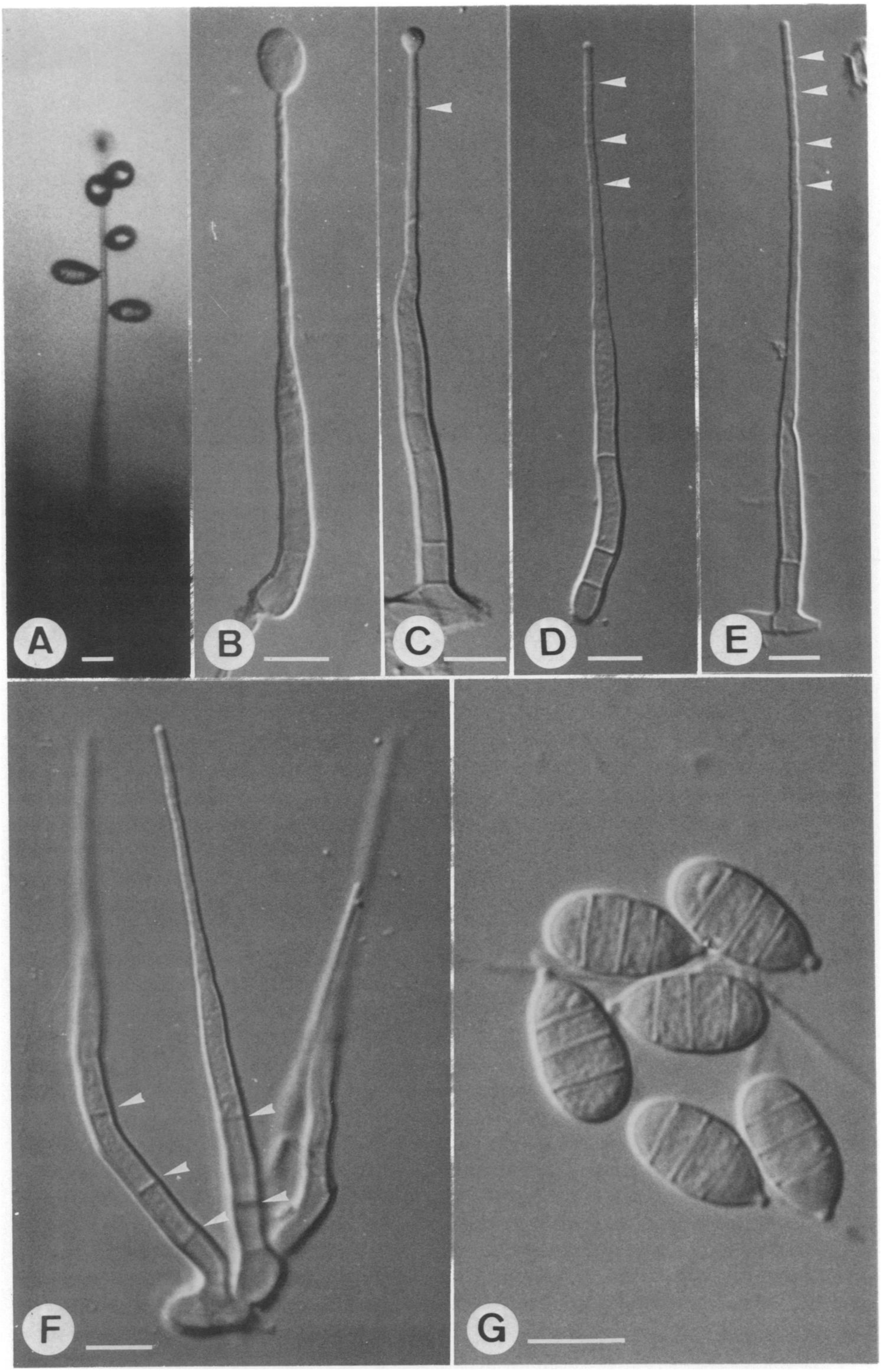

FIG. 2. Morphological characteristics of *Endophragmiella achromatica*. A. Habit, without disturbance, under humid condition. The seceded conidia push aside, but still remain adherent on the conidiophore. B. First conidial initial on the conidiophore, judging by the lack of any collarette. C. Percurrent proliferation of a second conidium. The first conidium has seceded, and the collarette remains (arrow). D, E. Third and fourth collarettes (arrows), implying that 2–3 conidia have been formed and seceded. F. Conidiophores in a group of four arising from the foot-like cells showing permanent septa (arrows). G. Conidia broadly ovoid, some with prominent abscission hilum. Bar = 10 μm.

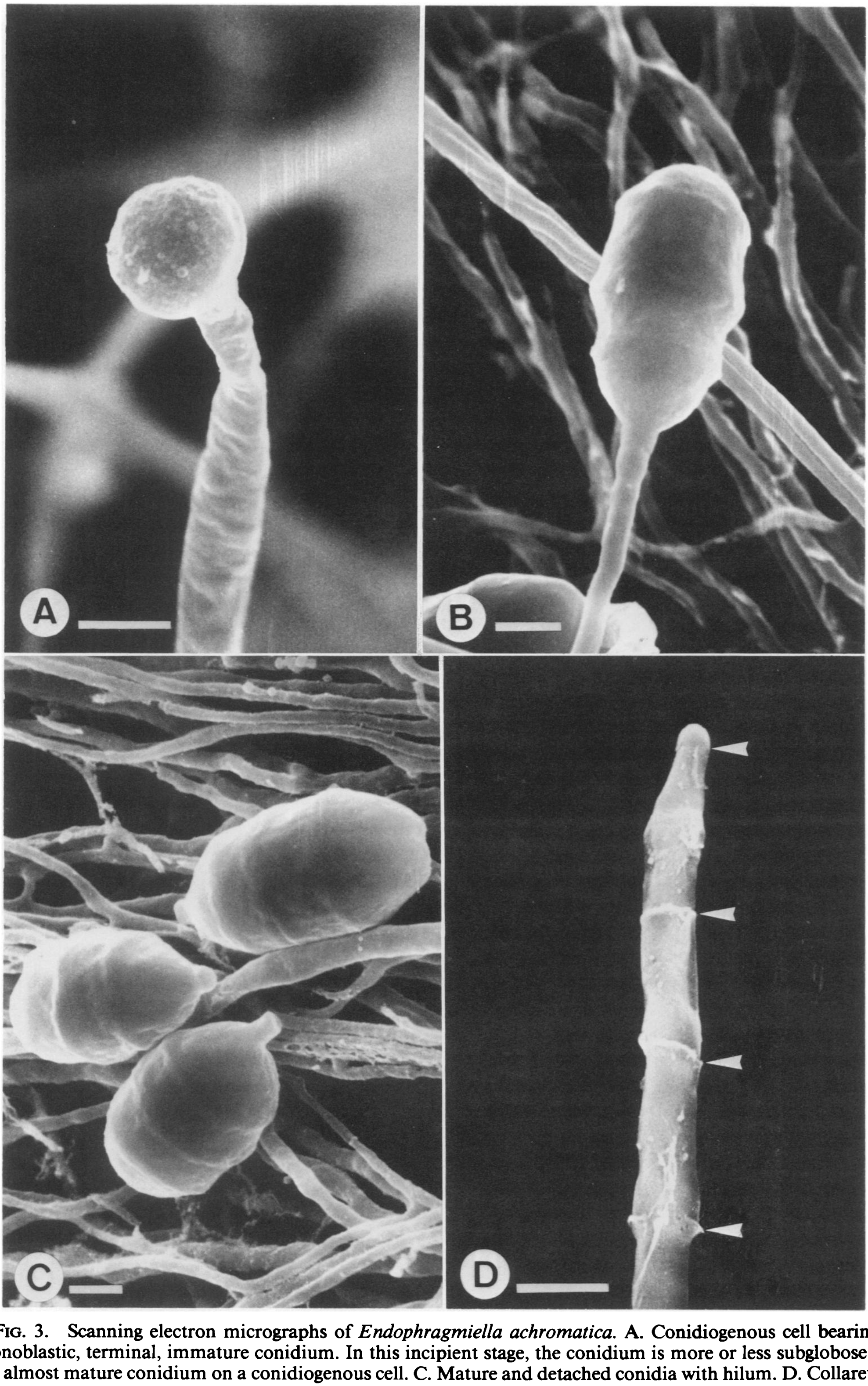

FIG. 3. Scanning electron micrographs of *Endophragmiella achromatica*. A. Conidiogenous cell bearing a monoblastic, terminal, immature conidium. In this incipient stage, the conidium is more or less subglobose. B. An almost mature conidium on a conidiogenous cell. C. Mature and detached conidia with hilum. D. Collarettes left over on the conidiophore (arrows) after conidia have seceded. Bar = 2 μm.

TABLE I

MORPHOLOGICAL CHARACTERISTICS OF *ENDOPHRAGMIELLA* SPECIES

Species	Conidia			
	Shape	Septation	Pigmentation	Size (μm)
E. bisbyi	obovoid to pyriform, distal cell largest	predominantly 3-septate	brown above, pale below, distal septum partly obscured by dark band	12.5–16 × 6.3–7.6
E. eboracensis	narrowly ellipsoidal, cylindrical, narrowly obvoid	(1-)3-septate	evenly brown to dark with basal or apical cell paler	17–21.5 × 5.4–6.6
E. theobromae	obovoid, central cell shortest	predominantly 2-septate	very pale brown, basal cell subhyaline	18–27 × 9–11.7
E. tripartita	ellipsoid, broadly obovoid	predominantly 2-septate	brown to dark brown	18–21.5 × 8–9.5
E. achromatica	ovoid to broadly oblong	predominantly 3-septate	hyaline	12.2–21.3 × 5.8–9.2

rhexolytically and in which conidiogenous cells proliferate percurrently from the penultimate cell of conidiophores. Conidium secession and percurrent proliferations could be divided into three major models. First, like *E. pallescens,* the break in the wall of the conidiogenous cell is well below the apex, resulting in a conspicuous frill around the conidium scar. Second, as in *E. boewei* (Crane) Hughes, the mature conidium secedes by a clean, rhexolytic break at a visible line of dehiscence just below the base of the conidium. The conidium, therefore, is not ornamented with a prominent basal frill. Third, in some *Endophragmiella* species a septum may fail to develop during proliferation, so that no new conidiogenous cell is delimited. Thus, the conidiogenous cells continue to elongate after completion of conidiogenesis and bear longer linear fragments (Hughes, **1979**). In *E. achromatica,* more or less similar to *E. albiziae* (Ellis) Hughes, *E. boewei,* or *E. eboracensis* Sutton, at first the apex of the conidiophore expands into a conidial initial (FIGS. 1, 3A). The initial developed and became ovoid or broadly oblong in shape, and laid down three transverse septa (FIG. 1, 3B). Subsequently, a thin septum is then formed at a very short distance (0.5–2 μm) below the thickened base of the conidium. The conidium matures and a newly differentiated terminal cell of the conidiophore is vacuolated or presumably emptied of its contents, judging by lack of staining by 0.1% cotton blue in lactophenol. The mature conidium then secedes by a rhexolytic break along a dehisced line just below the thickened but narrow hilar basal abscission scar, and bears a barely visible frill. When the conidium matures and secedes, a collarette is left over; the septum (adventitious or temporary) which becomes elastic, then proliferates percurrently. After *ca* 5–10 percurrent proliferations, occasional additional secondary (permanent) septa are then usually laid down at irregular intervals in acropetal succession.

The length and width of the conidium scar in *E. achromatica* is comparable to *E. albiziae* (Hughes, **1979**). The holoblastic, integrated, terminal and percurrent conidiogenesis exhibited by *E. achromatica* is further verified by scanning electron microscopy (FIG. 3A–D). The conidiogenous cell bulges out to form a conidial initial which eventually matures and becomes broadly oblong, smooth but with slight constriction.

In light of the key to *Endophragmiella* species provided by Kirk (**1985**), *E. achromatica* shows morphological similarities to *E. bisbyi* (Sutton) Hughes, *E. eboracensis, E. theobromae* Ellis and *E. tripartita* Hughes. On the other hand, based on distinctions of shape, size, septation, pigmentation, basal frill of the conidia, conidiophore and conidiogenous cell (Hughes, **1979**; Kirk, **1985**), separation of these four species is maintained (TABLE I).

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Key Words: *Endophragmiella*, hyphomycetes, taxonomy

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INFECTION OF WOODLAND GRASSES BY FUNGAL ENDOPHYTES

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Many grasses are known to harbor systemic clavicipitaceous endophytes within leaves, stems, and seeds. The fungi are classified in the tribe Balansieae (Clavicipitaceae) including the form genus *Acremonium* sect. *Albo–lanosa* Morgan-Jones & Gams which accommodates the anamorphs of *Epichloë* (Fr.) Tul. (Diehl, **1950**; Morgan-Jones and Gams, **1982**). Previous work has shown that this association is often mutualistic with host plants exhibiting increased growth and resistance to insect herbivores compared to uninfected plants (Clay, **1988**). Most research has focused on two economically important forage and turf grasses, *Festuca arundinacea* Schreb. and *Lolium perenne* L., infected by *A. coenophialum* Morgan-Jones & Gams and *A. lolii* Latch *et al.*, respectively (Funk *et al.*, **1983**; Latch *et al.*, **1985**; Clay, **1986**; Bacon and Siegel, **1988**).

Little is known about community level patterns of infection frequency; for example, are there differences between infection frequency of grasses from early *vs* late successional habitats, woodland *vs* grassland habitats, or tropical *vs* temperate communities? While there have been several surveys of endophyte-infected grasses based on herbarium sheets and seed collections (White, **1987**; Latch *et al.*, **1987**), they have been at a large scale and not focused on all the grass species within a particular community. There have also been several field surveys of endophyte-infected