

A new species of *Embellisia*, associated with skin disease of hyacinths

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Abstract

A new species of the genus *Embellisia* (Hyphomycetes, Dematiaceae) was isolated from bulbs and leaves of various cultivars of *Hyacinthus*, *Scilla* and *Freesia*. It is characterized by dark, multiseptate conidia which are somewhat pointed at the apex and variable in shape and size. In contrast to other species of the genus it rarely forms chlamydospores in pure culture. The fungus was found on several locations in the Netherlands, and is also known in the USA and Germany. Inoculation experiments on several cultivars of *Hyacinthus orientalis* resulted in a high percentage of affected plants.

Introduction

In hyacinths the outer bulb scales are often damaged and discoloured by fungal attack. Amongst bulb growers these symptoms are known as 'skin * disease' ('huidziek'). A particular kind of skin disease, characterized by small necrotic patches with reddish brown edges has been known for a long time. However, it was not until the autumn of 1970 that we isolated a dematiaceous fungus from the affected bulbs. In the spring of 1971 we isolated the same fungus from leaf spots of *Hyacinthus orientalis* L. and in 1972 from *Freesia refracta* (Jacq.) Klatt and *Scilla sibirica* Andrews.

Identification of the fungus

The fungus initially was identified as a species of *Ulocladium*. It differs, however, from the species of this genus by more elongate and basally less apiculate conidia and the transverse septa, which are mostly rather thick and dark. Recently Simmons (1971) described the genus *Embellisia*, characterized by elongate conidia with often very thick transverse septa. The genus comprised two species, hitherto classified in *Helminthosporium* and *Pseudostemphylium*. The present fungus has several characteristics in common with the species of *Embellisia*, and is thought to be a further species of this genus. Dr E. G. Simmons kindly confirmed this identification.

Embellisia hyacinthi de Hoog & Muller, sp. nov.—Fig. 1

? *Cladosporium fasciculare* Fr. sensu Massink in Arb. pflanzenphysiol. Versuchsstat. k. pomol. Inst. Proskau 4: 18. 1876.

* The term 'skin' is used by bulb growers for the outer dying off scales of bulbs, which desiccate later. The colour of undamaged skins varies in hyacinth cultivars from deep purple red to white.

Fig. 1. *Embellisia hyacinthi* after 8 days grown on oatmeal agar at room temperature. Conidia, $\times 1200$.

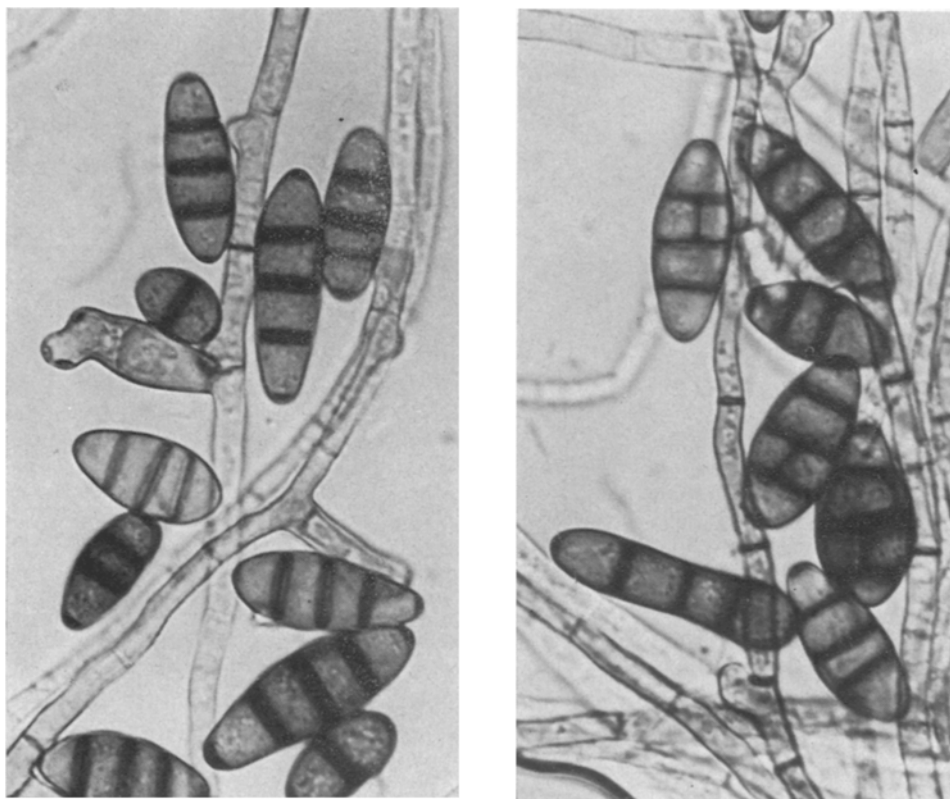


Fig. 1. *Embellisia hyacinthi* na 8 dagen gekweekt op haverhout agar bij kamertemperatuur. Conidia, $1200\times$.

Coloniae in agaro avenaceo 20°C post 8 dies 55–60 mm diametro, lanosae vel floccosae; primum obscure virides, deinde olivaceo-nigrae; reversum olivaceo-nigrum. Hyphae vegetativae fere hyalinae vel pallide olivaceae, $2\text{--}4\text{ }\mu\text{m}$ crassae. Conidiophora simplicia vel irregulariter ramosa, septata, brunnea, $4\text{--}5\text{ }\mu\text{m}$ crassa, parte conidiogena sympodialiter elongata, deinde irregulariter geniculata, mono- vel polyblastica. Conidia olivaceo-brunnea vel atro-brunnea, ellipsoidea, ovoidea vel subcylindrica, novella basi rotundata vel modice apiculata, cellula apicali fere triangulari, $32\text{--}38 \times 9\text{--}12\text{ }\mu\text{m}$, 3–6 septis transversalibus crassis, saepe etiam obliquis divisa; vulgo 1–3 septa longitudinalia adsunt. Nonnumquam singulae ad quattuor cellulae obscurae crassitunicatae intercalares agglomeratae adsunt. Status perfectus ignotus.

Typus CBS 416.71, isolatus ex epidermide bulbi Hyacinthi orientalis, Lisse, Oct. 1970.

Colonies on oatmeal agar at 20°C growing rapidly, attaining a diameter of 55–60 mm in 8 days, appearing lanose to floccose, up to 3 mm high; at first dull green (25''m)*, when older, olivaceous black (29'''m); reverse olivaceous black (21'''m). Exudate and odour absent. Submerged *hyphae* hyaline or subhyaline, smooth-walled, (1.5–) 2–3 (–5) µm wide. Vegetative aerial hyphae subhyaline to pale olive, smooth-walled, (3–) 4–5 (–6) µm. *Conidiophores* lateral or terminal, simple or irregularly branched, pale brown to dark olive brown, smooth-walled, (3.5–) 4–5 (–5.5) µm wide, mostly wider than the supporting hypha, septate; sterile part somewhat flexuous, up to 60 µm long; conidiogenous portion mostly slightly swollen, elongating sympodially, becoming irregularly geniculate, frequently somewhat nodose, soon becoming septate, with conidial scars about 1 µm wide, sometimes with sterile intercalary cells of variable length. *Conidia* when young, hyaline, ellipsoidal with a rounded or somewhat pointed base, soon becoming pale olivaceous and forming a median transverse septum. Mature conidia brownish olive, dark brown (in that case base and apex somewhat lighter), occasionally blackish brown throughout, smooth-walled, subcylindrical, clavate, fusiform, obclavate or ovoidal, rarely subglobose, slightly curved, with a more or less rounded base, the apical cell somewhat triangular; conidia measuring (17–) 32–38 (–51) × (8–) 9–12 (–13) µm, provided with (1–) 3–6 (–9) transverse septa, often also with oblique and 1–2 (–5) longitudinal septa; conidia mostly slightly constricted at the septa. The transverse septa may become very thick, in the edges with a ring of blackish brown pigmented material.

Occasionally small clusters of 1–4 (–5) dark brown, intercalary, thick-walled cells occur, which often become somewhat rough-walled. Perfect state unknown.

Material examined

CBS 416.71 (type) isolated by P. J. Muller from the outer scale of bulbs of *Hyacinthus orientalis*, Lisse, October 1970, and many other strains from several locations, among which CBS strains 498.71, 835.71, 449.72, 824.72, and CBS 823.72 sent by Dr Roswitha Schneider.

Embellisia allii (Campanile) Simmons differs from *E. hyacinthi* mainly by its regular subcylindrical conidia, mostly 27–36 × 10–12 µm, rounded at both ends, with 3–9 (mostly 5) transverse septa and sometimes 1 longitudinal or oblique septum. *Embellisia chlamydospora* (Hoes et al.) Simmons is more similar to *E. hyacinthi*. The species, however, can be distinguished by conidia of rather constant shape, mostly 23–28 × 7–9 µm, subcylindrical, rounded at both ends, provided with 3–7 (mostly 5) transverse septa, and sometimes with 1, rarely 2 longitudinal or oblique septa. In pure culture, in both species mentioned by Simmons (1971), chlamydospores, composed of many cells are present.

A species similar to *Embellisia hyacinthi* was described and depicted by Massink (1876) and by Sorauer (1878) as *Cladosporium fasciculare* Fr., which was listed by Hughes (1958) as a synonym of *Coelosporium fruticulosum* Link. Possibly no material of the latter species has been preserved; from its vague description its identity can not

* Colour names and symbols refer to Rayner (1970).

be ascertained. Probably Massink did not preserve any material of his fungus either. According to the figures given by Massink (1876) the percentage of dictyoconidia was rather low, only one conidium with a longitudinal septum was depicted; the presence of longitudinal or oblique septa was not mentioned. His description does not agree with that given by Link (1824) and subsequent authors as listed by Hughes (1958).

In our strains two types of chlamydospore-like structures occur. An atypical form in poorly sporulating cultures consists of slightly swollen subcylindrical cells, arising terminally on undifferentiated hyphae, or occasionally on the conidiogenous portions of conidiophores. They are regularly fusiform or subcylindrical, not or scarcely constricted at the septa, brown, smooth-walled. The second type comprises irregular clusters of dark brown, rounded cells. Their occurrence is erratic and not correlated to the sporulation of the strains. Sometimes they develop conidiophores producing blastoconidia.

When *Embellisia hyacinthi* is cultivated on different media and colonies of different age are examined, the blastoconidia may vary considerably in colour, shape and septation. Rich sporulation is obtained on V-8 juice agar and on oatmeal agar. After 5 days the conidia obtained from any place of the colony are generally brown, ellipsoidal to subcylindrical with 4 or more transverse septa, only occasionally with longitudinal septa (Fig. 2a). Near the centre of older colonies a higher percentage of short conidia with less than 4 septa is observed (Fig. 2b). On Czapek agar sporulation is

Fig. 2. *Embellisia hyacinthi*, conidia in pure culture, $\times 400$. a, oatmeal agar after 8 days; b, oatmeal agar after 40 days; c, Czapek agar after 8 days; d, Czapek agar after 40 days.

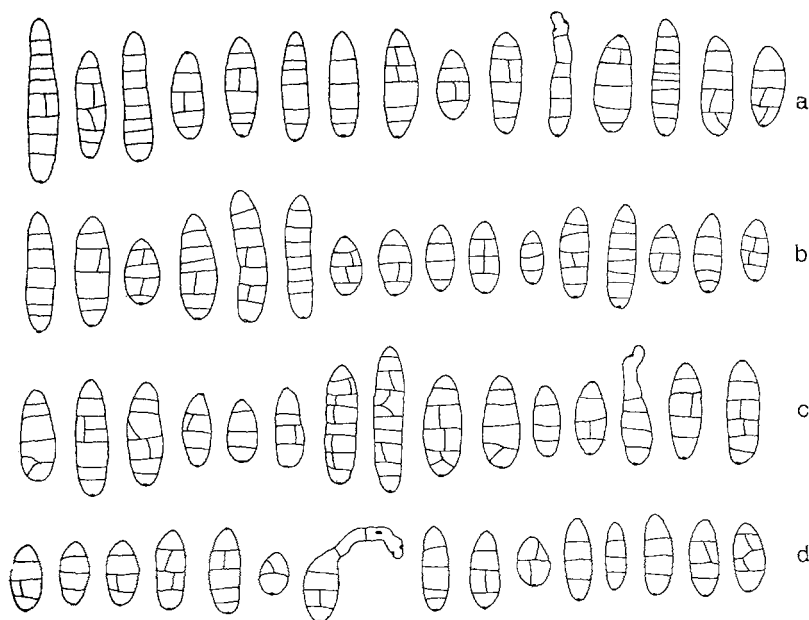


Fig. 2. *Embellisia hyacinthi*, conidia in reincultuur, $400\times$. a, haverhout agar na 8 dagen; b, haverhout agar na 40 dagen; c, czapek agar na 8 dagen; d, czapek agar na 40 dagen.

rather poor; after 40 days on this medium most of the conidia are dark to blackish brown, ellipsoidal, mostly only $19-26 \times 7-9 \mu\text{m}$ (Fig. 2d). Subcylindrical conidia can hardly be found. Under the latter circumstances the fungus strongly resembles some *Ulocladium* species.

Symptoms and occurrence of the disease

Embellisia hyacinthi can attack bulbs and leaves of hyacinths. The bulb skin attack is characterized by the occurrence of necrotic patches on the outer bulb scale at the moment of lifting (Fig. 3 left). The colour varies from light to dark brown with usually a reddish brown edge, the diameter varies from 1–10 mm. The patches occur scattered or in groups in the median parts of the bulb surface, and sometimes coalesce. The same discolourations may occur near the top of the bulb in a garlandshaped area. The pigmentation of the skin around the spots differs from that of healthy parts. In case of purplish coloured skin the adjacent tissue of the spots is often cream coloured, on white skin it may be reddish. The pathogen may attack as much as 90% of the bulbs. Some cultivars, such as 'Ostara', 'Bismarck', 'Carnegie' and 'la Victoire', are particularly sensitive to the disease.

Fig. 3. Bulbs of *Hyacinthus orientalis* cultivar 'Ostara'. Left, attacked by *Embellisia hyacinthi*. Right, healthy bulb. 3/4 natural size.

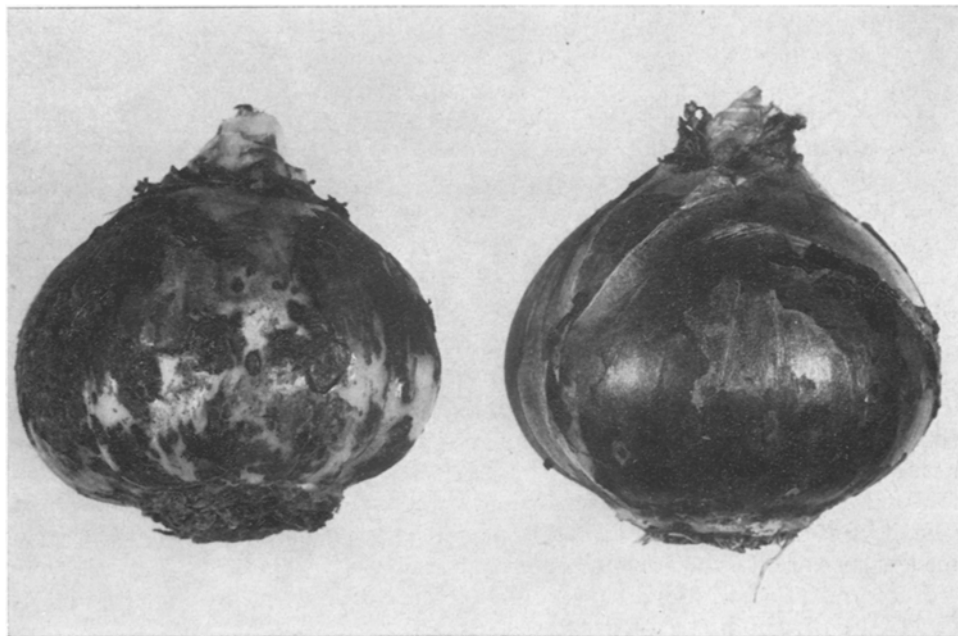


Fig. 3. Bollen van *Hyacinthus orientalis* cultivar 'Ostara'. Links, besmet met *Embellisia hyacinthi*. Rechts, gezonde bol, 3/4 natuurlijke grootte.

Fig. 4. Leaf spots of *Hyacinthus orientalis* caused by *Embellisia hyacinthi*, natural infection. Left, natural size. Right, detail.

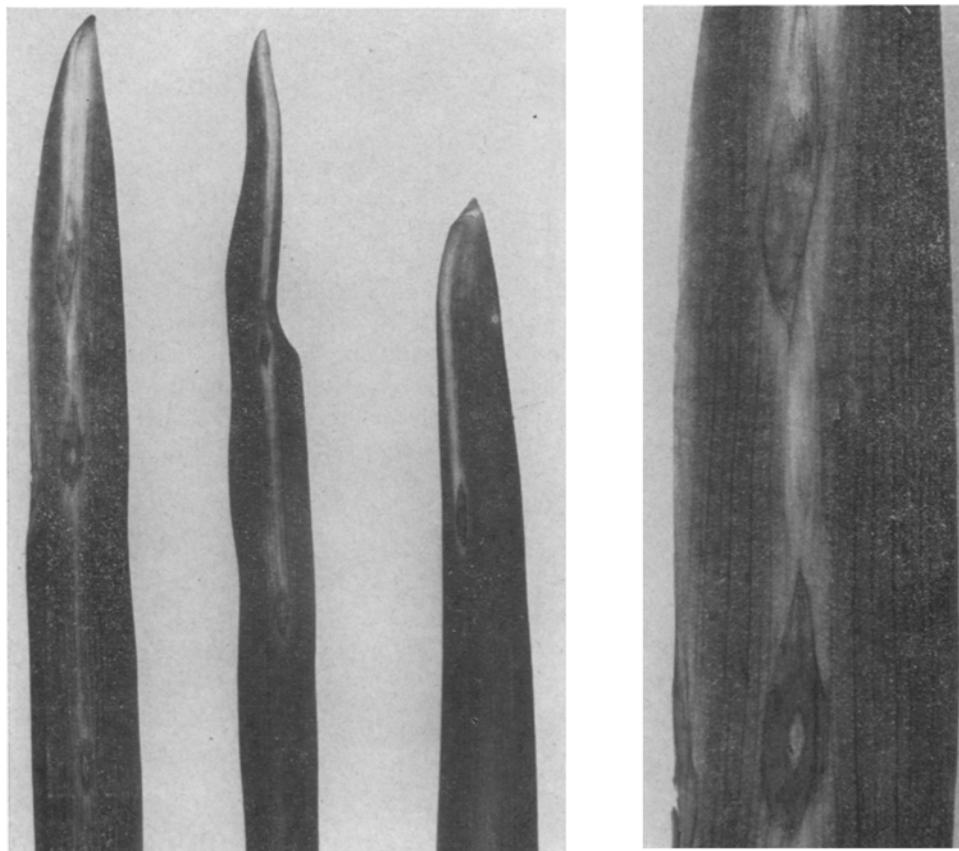


Fig. 4. Bladvlekken van *Hyacinthus orientalis* veroorzaakt door *Embellisia hyacinthi*, natuurlijke infectie. Links, natuurlijke grootte. Rechts, detail.

Leaf spots are found occasionally on outdoor-grown plants in spring. The spots are $2-8 \times 2-25$ mm in size and elliptical to lenticular in shape. Part of the leaf, above the spot, yellows and finally becomes brown (Fig. 4). The spots are mainly found on some of the outer leaves and vary in number from 1-8 per leaf. Attacked plants usually occur scattered in the field.

When sporulating on the leaves or bulbs the fungus can be recognized with the naked eye as a black coating, consisting of conidia and conidiophores in the centre of the leaf spot or on or between the outer bulb scales.

No correlation was found between the presence of leaf spots in the field and the occurrence of skin disease of bulbs after harvest.

Embellisia hyacinthi was frequently isolated from dark brown tips and spots of outer leaves of hyacinths, which were planted for early flowering in plunging beds or

Fig. 5. Leaves of forced *Hyacinthus orientalis* cv. 'l'Innocence' with dark brown tips and spots, bordered with a yellow margin.

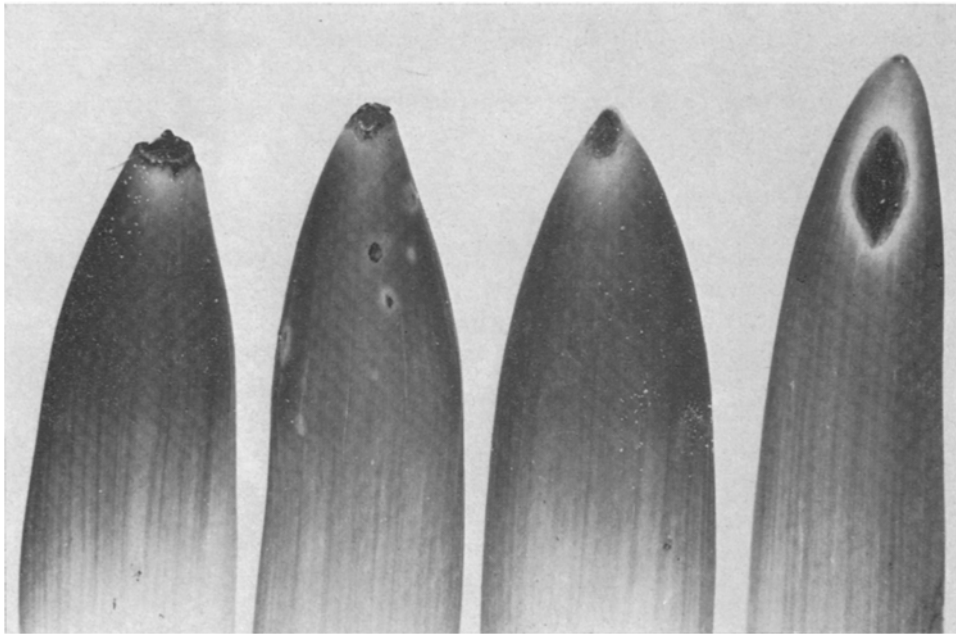


Fig. 5. Bladeren van geforceerde planten van *Hyacinthus orientalis* cv. 'l'Innocence', met donkerbruine topjes en vlekken, begrensd door gele zone.

rooting chambers (Fig. 5). Dr E. Leiber, Frankfurt am Main, proved the pathogenicity of the fungus for these symptoms (Schneider, personal communication). On the bulbs of *Scilla sibirica* identical symptoms are found as on hyacinth. On *Freesia* the fungus was isolated from dying plants in the open, with dark brown underground leaf parts.

Inoculation experiments

In the spring of 1971 two fields, each containing 50 plants of the two hyacinth cultivars 'la Victoire' and 'Carnegie', were used for an inoculation experiment with *E. hyacinthi*. On May 27, oatgrains densely colonized by the fungus were brought in contact with the bulbs. For this purpose the soil around the plants was removed down to bulb depth, and put back after inoculation. When lifted on July 9, the bulbs in the inoculated plots appeared to show a much higher incidence of the same kind of skin disease than those in the control plots. The rate of attack was, for 'la Victoire' contaminated 91 %, and control 52 %, and for 'Carnegie' 63 % and 28 % respectively. The fact that the bulbs in the control plots did show the disease indicates that the fungus was already present naturally. The plants in the field of 'la Victoire', which had been machine planted, showed in the contaminated plot the most severe symptoms on the side of the bulbs to which the inoculum was applied. The greater part of the plants of the same

cultivar showed die-back symptoms in the contaminated plots, whereas all plants in the neighbouring untreated plot remained green. On the underground leaf parts dark brown elongated streaklike spots were observed from which the inoculated fungus and *Rhizoctonia solani* Kühn were isolated. The inoculated fungus was also isolated from the spots on the bulbs. Affected bulbs of 'Carnegie', which had been planted upright by hand, showed symptoms all over the surface of the upper parts of the bulbs.

Significance of the fungus

The skin disease caused by *E. hyacinthi* is generally found in bulb stocks. Severely attacked bulbs appear to be less sound than infected ones, which reduce their value for dry selling. No reduction in growth or flowering of infected bulbs could be observed in the fields. Only if disease incidence is raised artificially, die-back symptoms may occur. On forced hyacinths, however, the presence of the fungus may result in dark-brown discolouration of the leaf tips. On bulbs of *Scilla* the disease is frequently found, but on *Freesia* it was observed only once.

Samenvatting

Een nieuwe soort van Embellisia, optredend bij huidziekte van hyacint

Een nieuwe soort van het genus *Embellisia* (Hyphomycetes, Dematiaceae), *E. hyacinthi*, werd geïsoleerd uit de buitenste bolrokken van cultivars van *Hyacinthus orientalis*. De schimmel is gekarakteriseerd door bruine, apicaal iets spitse conidiën met een wisselend aantal transversale, en dikwijls ook enkele longitudinale septa (Fig. 1), en de afwezigheid van duidelijk gedifferentieerde groepjes van chlamydo-sporen.

Een sterk hierop gelijkende soort werd in 1876 beschreven door Massink als *Cladosporium fasciculare* Fr. Het opvallende voorkomen van longitudinale septa werd in zijn studie echter niet expliciet genoemd.

Wanneer *Embellisia hyacinthi* wordt gekweekt op havermoutagar zijn na 5 dagen de meeste conidiën vrij lang, cilindrisch, met 3 of meer septa (Fig. 2a). Na langere tijd echter worden kleinere conidiën gevormd, zodat de variabiliteit der conidiën op dezelfde plaats groter wordt (Fig. 2b). Dit verschijnsel uit zich nog sterker op Czapek-agar (Fig. 2c-d).

Embellisia hyacinthi veroorzaakt kleine bruine plekje op de buitenste bolrok van hyacint. Deze vorm van huidziekte is reeds lang bekend; de schimmel is ook in de USA en Duitsland gekonstateerd, en werd tevens geïsoleerd van *Freesia refracta* en *Scilla sibirica*. Soms ook komen langwerpige bladvlekken op de buitenste bladeren van hyacint voor. Een inoculatieproef werd gedaan met de cultivars 'la Victoire' en 'Carnegie'. De met *Embellisia hyacinthi* geïnoculeerde planten vertoonden een aanzienlijk hoger aantastingspercentage dan die op het controleveld.

Acknowledgments

The authors are indebted to Dr E. G. Simmons for confirmation of the identification and to Dr Roswitha Schneider for her kind cooperation. We are much obliged to Dr W. Gams for the help in preparing the manuscript. Mr H. A. van Kesteren is acknowledged for sending the material of freesia plants, and Dr K. M. Old for correcting the English text.

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Book review

Baker, K. F. (ed.): *Annual Review of Phytopathology*. Vol. 10. Annual Review Inc., Palo Alto, California, USA, 1972. IX + 557 pp. Price \$ 10.50.

The *Annual Review of Phytopathology* really needs no recommendation to phytopathologists. During the ten years of its existence it has become one of the leading phytopathological journals. In the preface we read that 257 authors from 21 countries (48.5% from USA) contributed 188 reviews to the first 10 volumes. K. F. Baker has now taken over the task of chief editor from J. G. Horsfall.

The present volume continues the established tradition. It contains 23 articles which cover the entire field of phytopathology. The prefatory chapter is by S. D. Garrett, whose story on how he developed into a plant pathologist makes very stimulating reading especially for young and aspiring phytopathologists. Very timely is the article by A. J. Ullstrup on the impact of the Southern corn leaf blight epidemics in 1970-71. There are two Dutch contributions, one by A. van Kammen, giving a clear account of the phenomenon of viruses consisting of more than one component, and the other by J. C. Zadoks on the methodology of epidemiological research.

To discuss or even mention all the articles would be impossible. However, phytopathologists will undoubtedly find articles of interest, relevant to their particular field. They may also profit by browsing through the added list of titles of 'some related articles in other annual reviews'.

Th. Limonard