Two new genera of Ustilaginales: *Nannfeldtiomyces* and *Pseudodoassansia*, and a survey of allied genera

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Abstract. — Two new genera: *Nannfeldtiomyces* and *Pseudodoassansia* are described; given is also a key and the characterisations of these and allied smut genera as *Burrillia*, *Doassansia*, *Doassansiopsis*, *Narasimhania* and *Tracya*. The following new combinations are made: *Nannfeldtiomyces sparganii* (based on *Melanotaenium sparganii* LGH.), *Nannfeldtiomyces anomalus* (based on *Burrillia anomala* CROWELL), *Doassansia kamatii* (based on *Burrillia kamatii* THAKUR), *Doassansiopsis furva* (based on *Doassansia furva* J. J. DAVIS), *Doassansiopsis intermedia* (based on *Doassansia intermedia* SETCH.) and *Pseudodoassansia obscura* (based on *Doassansia obscura* SETCH.). *Burrillia acori* DEARNESS was found to be synonymous with *Nannfeldtiomyces sparganii*.

Introduction

There is a natural group of Ustilaginales which parasitises on aquatic or paludal plants and usually produces only hardly visible symptoms. The spores form light-coloured spore balls, embedded in the host tissue. The spore balls may be composed of spores, sterile cells and/or mycelia in different arrangement and proportion. The structure of the spore balls, the pattern of the arrangement of these components may serve as the base for the generic concept. Since W. A. SETCHELL (1891, 1892), who monographically studied this group of smut fungi, many species have been described but no attempt has been made to revise their classification. The difficulties lie also in the fact that for a satisfactory study of the spore-ball-structure slides of high quality are needed.

During the studies of European Ustilaginales, I found that the controversial *Entyloma sparganii* (LGH.) LGH., in the leaves of *Sparganium erectum* L., does not form single spores but spore balls. The spore balls, however, disjoin easily into separate spores when slides are made. However, they remain intact when the epidermis of the host plant is carefully removed (Fig. 1 A). A detailed study of them is possible only, when they are embedded and sectioned by microtome. Their structure is different from that of all known related smut genera and hence *Entyloma sparganii* is made the type of a new genus *Nannfeldtiomyces*, which I name after my teacher Prof. J. A. NANNFELDT (Uppsala, Sweden). The spore ball structure of *Burrillia anomala* CROWELL, on *Sparganium chlorocarpum* RYDB. is the same and is

transferred to the genus *Nannfeldtiomyces*. The examination of the type of *Burrillia acori* DEARNESS, on *Sparganium ?eurycarpum* ENGELM. (given as *Acorus calamus* L.), showed that it is identical with *Nannfeldtiomyces sparganii*. On this occasion I have studied also other members of this group of smuts and found that the spore ball structure of *Burrillia kamatii* THAKUR, on *Hygrophila serpyllum* ANDERS., is of the *Doassansia*-type and therefore it was transferred to this genus. For the same reason both *Doassansia intermedia* SETCH., on *Sagittaria latifolia* WILLD., and *Doassansia furva* J. J. DAVIS, on *Sagittaria rigida* PURCH., are transferred to *Doassansiopsis*. Studies of *Doassansia obscura* SETCHELL, the sole representative of SETCHELL's subgenus *Pseudodoassansia*, showed that it is justified to rise *Pseudodoassansia* to generic rank.

Material and methods

Dried herbarium material containing spore balls was first softened in diluted NH_4OH for some hours. After washing three times in distilled water it was transferred into 2.5% (v/v) glutaraldehyde in 0.1 M Na-cacodylate buffer at pH 7.2, for a few days, postfixed for 1 h in 2% (w/v) aqueous $KMnO_4$, dehydrated in a graded ethanol series, embedded in Epon and sectioned with LKB Ultrotome 1 using glass knife. This method, however, takes much time and it is inadequate for checking rich material. For this reason I have adopted a quick method with very good results. Instead of making transvers sections of leaves or stems, I made tangential sections. I "shaved" the sori with a slightly bent razor blade under a dissecting microscope, thereby sectioning the "naturally" embedded spore balls by repeated tangential movements. The sections were then studied in lactophenol in the usual way after being heated a few times to the boiling point to drive out the air bublets from the sterile cells, and rehydrate the spores. Sometimes it is difficult to identify the components of a spore ball, as the difference between spores and sterile cells may be very small. Sometimes the sterile cells, especially those of the cortex, are darker than the spores and can be mistaken as spores. Using cotton blue in lactophenol may help. Nevertheless, as a rule, the mature sterile cells are always empty, whereas the spores contain protoplasma. In old specimens, however, the protoplasma is often dried up. It is notable that the inner side of the wall of the sterile cortical cells usually is ornamented: they are very finely and more or less densely punctate, verruculose or echinate.

The abbreviations of herbaria follow Index Herbariorum (HOLMGREN & KEUKEN 1974). HUV = Herb. Ustilag. VÁNKY, the author's private collection.

Burrillia, *Doassansia*, *Doassansiopsis*, *Nannfeldtiomyces*, *Narasimhania*, *Pseudodoassansia* and *Tracya* form a natural group of smut fungi. They parasitize aquatic or paludal plants and are characterised by many-spored spore balls, rather permanently embedded in the host tissue. The spore balls are formed extracellularly, composed of spores, sterile cells and/or modified mycelial filaments, in different arrangements and proportions. This arrangement of the spores, sterile cells and/or hyphae is the base for the generic classification. The spore balls are rather permanent (with exception of *Nannfeldtiomyces*)

and usually have an outer layer of more or less evident andl firmy adherent sterile cells or spores, called also cortex (except *Burrillia* and *Nannfeldtiomyces*). Germination, where it is known, after *Tilletia* scheme.

Key to genera

1. Spore balls friable, consisting of branched hyphae with scattered spores which are easily disjoined; no cortex. . (4) *Nannfeldtiomyces*
1*. Spore balls rather permanent, composed of fertile spores and sterile cells and/or hyphae; cortex present (except *Burrillia*) . . . 2
2. Spore balls often lobed and contain cavities and lacunes clad by sterile cells. Spores scattered in a pseudoparenchymatous tissue . . . . . (5) *Narasimhania*
2*. Spore balls not lobed, without cavities and lacunes 3
3. Central part of the balls composed of hyphal network 4
3*. Central part of the balls composed of spores or sterile cells or both 5
4. Balls composed of a central network of branched, septate, firm hyphae and a peripheral layer of hardly united spores. . . . . (7) *Tracya*
4*. Balls composed of a central network of fine hyphae surrounded by the spores and a dinstinct cortex of sterile cells . . . . . (6) *Pseudodoassansia*
5. Central part of the balls composed of a mass of spores surrounded by a more or less distinct cortical layer of sterile cells . . . . . (2) *Doassansia*
5*. Central part not so 6
6. Balls composed of a central mass of pseudoparenchymatous sterile cells surrounded by the spores and a (usually thin) cortex of sterile cells . . . . . (3) *Doassansiopsis*
6*. Balls composed entirely of a pseudoparenchymatous tissue of sterile cells in which the spores are scattered; no cortical layer . . . . . (1) *Burrillia*

1. *Burrillia* Setchell, Proc. Amer. Acad. Arts 26: 18, 1891.

Sori as punctated spots in the leaves, petioles and stems. Spore balls (Fig. 2A; 3A) rather permanent, composed of a pseudoparenchymatous tissue of sterile cells in which the spores are scattered more or less uniformly or concentrated towards the periphery. Cortical layer absent.

Type species: *B. pustulata* Setch. on *Sagittaria latifolia* Willd. (= *S. variabilis* Engelm.), U.S.A., Illinois, Dixon, 31. VII. 1889, T. J. Burrill.

The number of the known species is about 6—7.

2. *Doassansia* CORNU, Ann. Sci. Nat. Bot. Sér. 6, 15: 285, 1883.

Sori mostly in the leaves, petioles and stems as pale green, yellowish or brownish areas with numerous, in the host tissue embedded spore balls as very minute brown dots. Spore balls (Fig. 2B; 3B; 3C) rather permanent, composed of a central mass of spores surrounded by a more or less evident cortex of sterile cells.

Type species: *D. alismatis* (NEES v. ESENB.) CORNU on *Alisma "natans"* (= misnamed *A. plantago-aquatica*, teste LIRO 1938: 252), Germany, NEES v. ESENBECK.

The number of species known is about 25.

Doassansia kamatii (THAKUR) VÁNKY comb. nov.

Bas.: *Burrillia kamatii* THAKUR, Curr. Sci. 44: 482, 1975. *Type* on *Hygrophila serpyllum* T. ANDERS. (Acanthaceae), India, Maharasthra State, Kandala near Bombay, 26. VI. 1972, THAKUR (AMH 1905, !).

A study of the type specimen shows that the structure of the spore balls (Fig. 3C) agrees with *Doassansia* type instead of that of *Burrillia*. The spore balls lack pseudoparenchymatous tissue; they are composed of a central mass of spores surrounded by a thin cortical layer of sterile cells. Germination of *Tilletia* type (THAKUR, 1975: 482; 1976: 167).

Note. *Doassansia hygrophilae* THIRUMALACHAR (1946: 29) on *Hygrophila* sp., also from India, differs from *D. kamatii* among other things by spore balls having distinct cortex of radially elongate cells which measure 9—15 × 16.5—25 μm in diameter.

3. *Doassansiopsis* (SETCHELL) DIETEL, in ENGLER & PRANTL, Die Natürl. Pflanzenfam. 1(1**): 21, 1898.

Sori in the leaves, petioles, stems or ovaries as spots or swellings with the spore balls embedded in the host tissue. Spore balls (Fig. 2C; 3D; 3E) rather permanent, composed of a central mass of pseudoparenchymatous sterile cells, surrounded by the firmly adhered spores and an usually thin cortical layer of sterile cells.

Type species: *D. hydrophyla* (A. DIETRICH) LAVROV (= *D. martianoffiana* (THÜMEN) DIETEL) on *Potamogeton sp.*, U.S.S.R., „Ostseeprovinzen", in DIETR., Crypt. exs. IX: 65.

There are known about 8 species of *Doassansiopsis*.

Doassansiopsis furva (DAVIS) VÁNKY comb. nov.

Bas.: *Doassansia furva* DAVIS, Trans. Wisconsin Acad. Sci. 19: 904, 1919. *Type* on *Sagittaria heterophylla* PURSCH., U.S.A., Wisconsin, Trempeleau Co., Arcadia, 31. VII. 1916, DAVIS (BPI 0178355, !).

The description of this species agrees well with that of *Doassansiopsis* type, a fact which is confirmed by the examination of the type material.

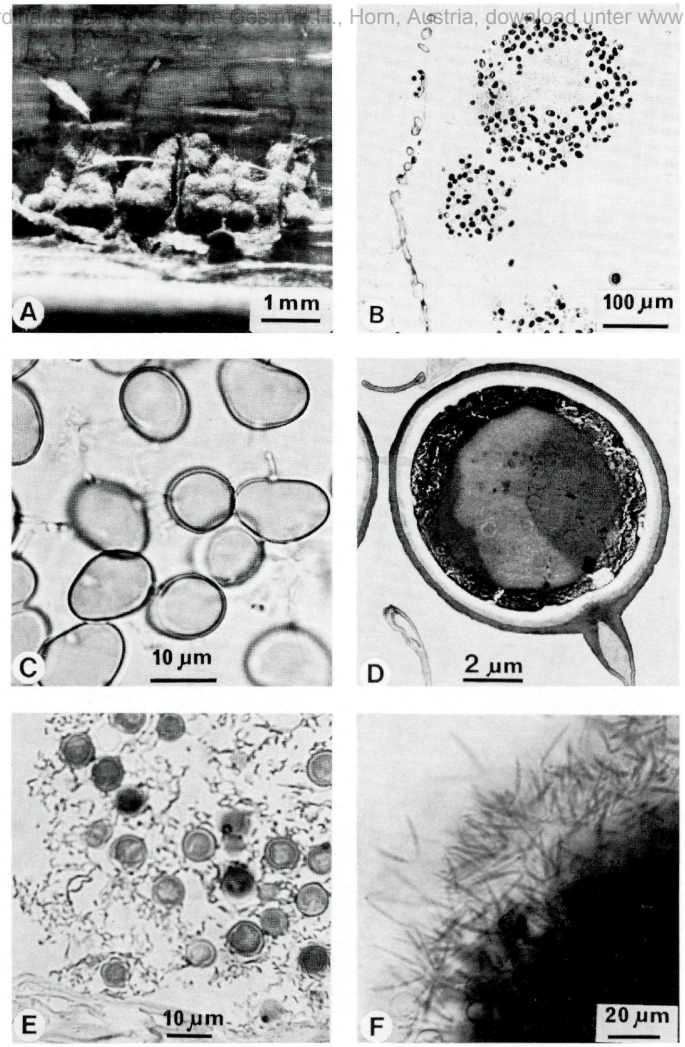

Fig. 1: A. Portion of a leaf of *Sparganium erectum* L. with removed epidermis showing the spore balls of *Nannfeldtiomyces sparganii* (Lgh.) Vánky (Huv 8699). — B. Sectioned spore balls of *Nannfeldtiomyces sparganii* (Lgh.) Vánky in a leaf of *Sparganium erectum* L. (Huv 8699). — C. Spores of *Nannfeldtiomyces sparganii* (Lgh.) Vánky in solution of lactophenol (Huv 8699). — D. Spore of *Nannfeldtiomyces sparganii* (Lgh.) Vánky (Huv 8699) by Tem. — Photo A. v. Hofsten & I. Forsberg. — E. Part of a spore ball of *Nannfeldtiomyces anomalus* (Crowell) Vánky (Type). — F. Spore germination of *Nannfeldtiomyces anomalus* on *Sparganium minimum* (Huv 9542) in lake water, at room temperature, after 5 days, showing a great number of copulated basidiospores, in cottonblue-lactophenol solution

Specimens examined. — On *Sagittaria rigida* PURSH. (= *S. heterophylla* PURSH.):

U.S.A.: Wisconsin, Arcadia, 31. VII. 1916, DAVIS, Type (BPI); —, Chetec, 11. IX. 1918, DAVIS (BPI); —, Chetec, 22. IX. 1922, DAVIS (HUV), in Fgi. Wisc. Exs. 118 (BPI) —, New London, 16. IX. 1921, DAVIS (BPI).

Doassansiopsis intermedia (SETCHELL) VÁNKY comb. nov.

Bas.: *Doassansia intermedia* SETCH., Bot. Gaz. (Crawfordsville) 19: 185, 1894. *Type*: on *Sagittaria variabilis* ENGELM., U.S.A., New Hampshire, Shelburne, VIII—X. 1893, FARLOW (S, !).

Doassansia affinis ELLIS & DEARNESS, Bull. Torrey Bot. Club 22: 364, 1895. Type on *Sagittaria variabilis* ENGELM., Canada, London, VII. 1895, DEARNESS (2269).

Already, when describing this species, SETCHELL (1894: 186) ranged it in his subgenus *Doassansiopsis* and wrote: "In structure of the sorus (= spore ball) it comes very near to the species of the subgenus *Doassansiopsis*; but instead of the spores being situated in a single regular layer underneath the cortex as they are in *D. occulta, D. martianoffiana,* and *D. deformans,* in *D. intermedia* they are in several (2—5) irregular layers. Consequently it seems best to emend the character of the subgenus ..." (Fig. 3E).

Specimens examined. — On *Sagittaria latifolia* WILLD. (= *S. variabilis* ENGELM.):

Canada: Ontario, London, VII. 1895, J. DEARNESS, in ELL. & EV., N. Amer. fgi. 3341 (HUV, M); —, W London, Dickies, 1. VIII. 1912, DEARNESS (BPI); —, Hyde Park, 22. VIII. 1912, DEARNESS, in Syd. Ust. 463 (BPI, HUV, S).

U.S.A.: New Hampshire, Shelburne, VIII—X. 1893, FARLOW, Type (S); Wisconsin, Vilas Co., Racine, 16. VII. 1901, DAVIS (BPI).

4. *Nannfeldtiomyces* VÁNKY gen. nov.

Sori in foliis vel caulibus plantarum aquaticarum vel palustrium maculas flavobrunneas margine indistinctas efformantes. Glomeruli sporarum extracellulares, in contextu matricis inclusi, pluricellulares, e reticulo hyphae tenuis ramosisque et sporis in ipso dispersis constructi, fragiles, facile in sporas singulas dissoluti, sine strato corticali. Sporae colore pallidae, laxe cohaerentes, plerumque cum residuis hyphalis. Germinatio ut in *Tilletia*. Typus generis: *Nannfeldtiomyces sparganii* (LAGERHEIM) VÁNKY.

Sori in the leaves and stems of aquatic or paludal plants as yellowish-brown spots with indistinct margins. Spore balls extracellularly, embedded in the host tissue, many-spored, composed of a network of thin, branched hyphae in which the spores are scattered, friable and easily disjoined into separate spores; no cortical layer. Spores light coloured, often with hyphal rests. Germination of *Tilletia* type. Type species: *Nannfeldtiomyces sparganii* (LAGERHEIM) VÁNKY.

Only two species of *Nannfeldtiomyces* are known.

Nannfeldtiomyces sparganii (LAGERHEIM) VÁNKY comb. nov. — Fig. 1A—D; 3G.

Bas.: *Melanotaenium? sparganii* LGH., Bull. Soc. Mycol. France 15: 98, 1899. — *Entyloma sparganii* (LGH.) LGH., in PALM, Svensk Bot. Tidskr. 4 (1):

(3), 1910. — *Entyloma sparganii* (Lgh.) Ciferri, Atti Ist. Bot. Univ. Pavia, Ser. 3, 1: 94, 1924. — *Type* on *Sparganium* sp., France, Dépt. Hérault, Lattes, VI. 1889, Lagerheim.

Burrillia acori Dearness, in Zundel, Additions and corrections to Ustilaginales. North American Flora 7: 1026, 1939. — *Type* on *Sparganium ?eurycarpum* Engelm. (given as "*Acorus calamus* L."), Canada, Ontario, 3 miles N of Puslinch Lake, near Guelph, in a small lakelet, 2. VIII. 1913, Dearness (Macdonald College Herb. in Daom, !).

Sori in the leaves forming ovoid, fusiform or linear spots from 2—3 mm × 1 mm to 5—15 cm × 0.5—1 cm in diameter, or more by fusion, at first inconspicuous, yellowish-green, later light yellowish-brown to light brown, with indistinct margins, never black or brown-black. Spore balls (Fig. 1A) many-spored, situated extracellularly in the lacunae of the leaf parenchyma, at first as white, agglomerated mycelia, looking like minute cotton balls, in which the spores are differentiated. The mature spore balls are light brown, solitary or two or more confluent, globose to irregularly elongated, 100—500 µm long, composed of a network of thin, branched mycelia, or remnants of mycelia, in which the spores are scattered (Fig. 1B, 3G). The central part of the spore ball often free from spores. No cortical layer of spores, sterile cells or mycelia. Spores (Fig. 1C) subglobose, ovoid, usually slightly irregular, moderately elongated and flattened in one side, sometimes slightly curved, 9—11 × 10—16(—18) µm in diameter, light yellowish-brown. Spore wall smooth, about 0.7 µm thick, usually with two, short mycelial appendages on the opposite sides; by TEM (Fig. 1D) two-layered, outer layer somewhat rough, 0.2—0.3 µm thick, inner layer 0.5—0.6 µm. Germination unknown.

On Sparganiaceae: *Sparganium* spp., Europe, N. America.

Specimens examined. — On *Sparganium erectum* L. (= *S. ramosum* Huds.).

Danmark: Sjaelland, Kongens Lyngby near København, Frederiksdal, Hjortholm near lake Furesø, alt. c. 30 m, 22. VII. & 19. VIII. 1979, Klug-Andersen, Rabenborg & Vánky (Huv).

Hungary: Bács-Kiskun dïstr., near Lakitelek, Natural Reservation "Tőserdő", 9. VIII. 1979, Gönczöl (in Vánky, Ust. 350).

Sweden: Råsunda near Stockholm, IX. 1909, Lagerheim (Pc). Drottningholm near Stockholm, IX, 1910, Lagerheim (S), in Vestergren, Microm. rar. sel. 1592 (Huv, M, S, Ups); —, 1925, Lagerheim (S); —, 31. VIII. & 2. X. 1975, T., U. & K. Vánky (Huv, Ups), Skåne, the river Kävlingeån, N of Furulund, 1. VIII. 1932, Christoffersson (Bucm, Huv, L). Skåne, Lund, Knästorp, 21. VII. 1933, Christoffersson (Huv, L).

On *Sparganium ?eurycarpum* Engelm. (host plant identified by Savile (1957: 279) and Parmelee (in litt.).

Canada: Ontario, 3 miles N of Puslinch Lake, near Guelph, nearest railway station Hespeler, in a small lakelet, 2. VIII. 1913, Dearness (as "*Burrillia acori* Dearn., 6306, Type, on *Acorus calamus* L.") (Bpi, Macdonald College Herb. in Daom); —, 14. VIII. 1914, Dearness (Bpi).

Comments. — This species has been much discussed. Lager-

HEIM (1899: 98) described it as "*Melanotaenium* ?" but later (1910: 3) changed its generic position to *Entyloma*. LIRO (1938: 500) misunderstood this species (as LINDEBERG showed 1959: 49) considering *Entyloma sparganii* as synonymous with *Cladochytrium sparganii-ramosi* BÜSGEN. This last species often grows together with *Nannfeldtiomyces sparganii*, causing much more evident, dark-brown to black spots. SCHWARZMAN's report (1960: 263) of *Entyloma sparganii* on *Sparganium stoloniferum* from Kazakhstan, having spores of 13—18.7×15—22.5 μm in diameter, refers also with all probability to *Physoderma sparganii-ramosi* (BÜSGEN) DE WILDEMAN (= *Cladochytrium sparganii-ramosi*).

DEARNESS (1939: 1026) was the first to observe the spore balls but due to the misidentified host plant, he described this fungus as a new species: *Burrillia acori* DEARN. CROWELL (1942: 327) wrote: "In his description of the genus *Burrillia* SETCHELL states 'Sorus (= spore ball) compact, not separating into its elements on being crushed ...' This condition seems to be true for all but two species of the genus, namely *B. acori* DEARNESS and *B. anomala*, both of which are reported only from Ontario. Spore-balls of these species are unusual in that the spores are very loosely held together. Dry spore-balls may be described as friable, since the spores are readily disjoined, becoming powdery under slight pressure." In spite of these very good observations CROWELL designed these two species to the genus *Burrillia* without searching the cause of these observations which lies in the peculiar structure of the spore balls.

Burrillia anomala CROWELL has the same spore ball structure as *Nannfeldtiomyces sparganii* and therefore it is transferred into the genus *Nannfeldtiomyces*.

Nannfeldtiomyces anomalus (CROWELL) VÁNKY comb. nov. — Fig. 1E, F.

Bas.: *Burrillia anomala* CROWELL, Canad. J. Res. Sect. C, Bot. Sci. 20: 327, 1942. *Type* on *Sparganium diversifolium* GRAEBNER var. *acaule* (BEEBY) FERNALD & EAMES, Canada, Ontario, Bear Island, Lake Timagami, Denton's Bay, 12. IX. 1929, JACKSON, WHETZELL & THOMPSON. (!).

Sori as inconspicuous spots in the leaves, light yellowish-green to light yellowish-brown, oval to elongated, 0.5—6 cm long, or larger by confluence, margins indefinite. Spore balls (Fig. 1E) rather permanently embedded in the host tissue, extracellularly in the lacunae, solitary or sometimes confluent, globose, ovoid to elongated, 50—160(—230) μm long, beige coloured, composed of a network of branched, fine hyphae in which the readily disjoined spores are scattered; no cortical layer. Spores rather uniform, globose or subglobose, sometimes slightly ovoid, 8—9.5×8.5—11 μm, subhyaline to light yellowish-brown. Spore wall smooth, thin, about 0.5 μm in diameter, often with short hyphal appendages. Germination

(Fig. 1F) of *Tilletia* type. On Sparganiaceae: *Sparganium chlorocarpum* RYDB. (N. America) and *S. minimum* (HARTM.) FR. (Europe).

Specimens examined. — On *Sparganium chlorocarpum* RYDB. (= *S. diversifolium* GRAEBNER) var. *acuale* (BEEBY) FERNALD & EAMES.

CANADA: Ontario, Bear Island, Lake Timagami, Denton's Bay, 12. IX., 1929, JACKSON, WHETZELL & THOMPSON (Macdonald College Herb. in DAOM. Type); —, Lake Timagami, 16. VIII. 1930, CONNERS (DAOM).

On *Sparganium chlorocarpum* RYDB.

U.S.A.: Connecticut, Thompson, 14. IX. 1930, C. A. & U. F. WEATHERBY, in UPS copy of Plantae Exsicc. Grayannae 408 (HUV, UPS).

On *Sparganium minimum* (HARTM.) FR.

Sweden: Dalarna, 13 km ESE of Gagnef, mt. Gimklack, 1 km SE of Lake Mörtsjön, alt. 195 m, 21. IX. 1980, VÁNKY (in VÁNKY, Ust. 349).

5. *Narasimhania* THIRUMALACHAR & PAVGI, Sydowia 6: 390, 1952.

Sori in the leaves as spots with embedded spore balls, visible as minute, dark brown, punctate elevations. Spore balls (Fig. 2D; 3F) rather permanent, often lobed and contain cavities clad by sterile cells. The spores are scattered in a pseudoparenchymatous tissue of sterile cells. A rather indistinct cortical layer of sterile cells are present. Type species: *N. alismatis* PAVGI & THIRUMALACHAR on *Alisma* sp., India, Banaras (= Varanasi), U. P., 12. IX. 1951, PAVGI.

Monotypic genus.

6. *Pseudodoassansia* (SETCHELL) VÁNKY gen. et stat. nov.

Bas.: *Doassansia* subgen. *Pseudodoassansia* SETCHELL, Proc. Amer. Acad. Arts 26: 16, 1891.

Sori inconspicuous. Spore balls (Fig. 2E; 3H) in large intercellular spaces, rather permanent, composed of a central network of fine, branched hyphae, surrounded by loosely arranged spores and a dinstinct cortical layer of sterile cells. Type species: *P. obscura* (SETCHELL) VÁNKY. Germination after *Tilletia* scheme.

Monotypic genus.

SETCHELL (1891, 1892) classified this group of smuts as follows:
Genus I. *Doassansia* CORNU
Subgenus 1. *Eudoassansia* SETCH.
Subgenus 2. *Pseudodoassansia* SETCH.
Subgenus 3. *Doassansiopsis* SETCH.
Genus II. *Burrillia* SETCH.
Genus III. *Cornuella* SETCH.

Later H. & P. SYDOW (1910: (3)) showed that this last name was already preoccupied (*Cornuella* PIERRE, 1891, Fam. Sapotaceae) and changed it into *Tracya*. The subgenus *Doassansiopsis* was soon treated by DIETEL (1898: 21) as a genus. Most modern authors have more or

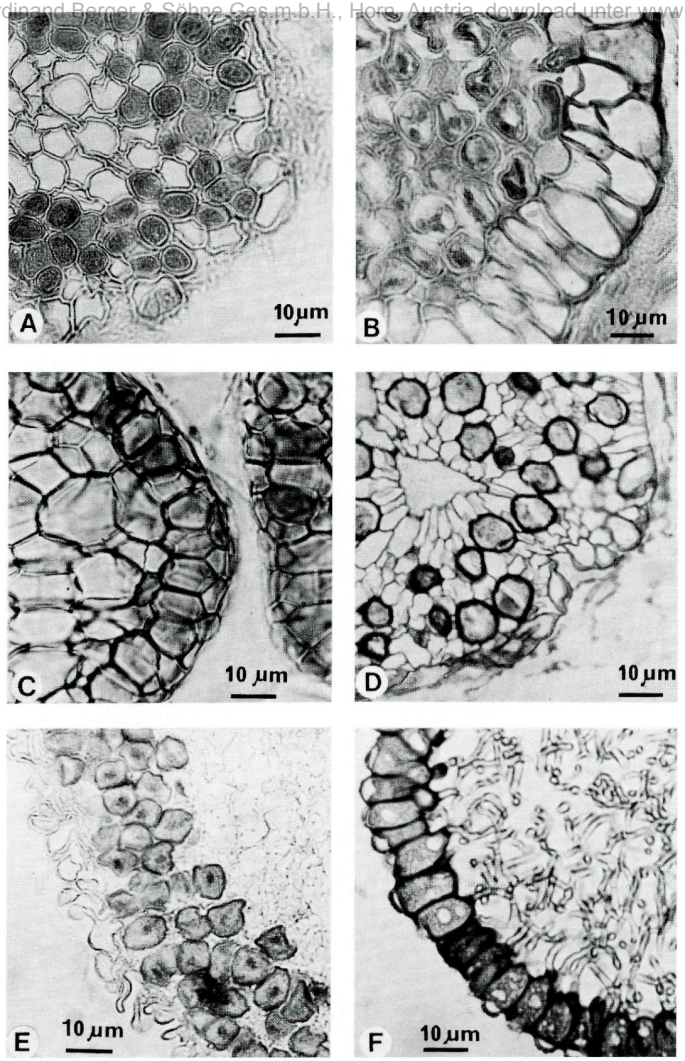

Fig. 2: A. Part of a spore ball of *Burrillia pustulata* SETCHELL on *Sagittaria latifolia* WILLD. (Type). — B. Part of a spore ball of *Doassansia alismatis* (NEES v. ESENB.) CORNU, on *Alisma lanceolatum* WITH. (HUV 436). — C. Parts of spore balls of *Doassansiopsis occulta* (HOFM.) DIETEL in a seed of *Potamogeton* sp. (PETRAK, Fl. Bohem. et Morav. exs. 2473). — D. Part of a spore ball of *Narasimhania alismatis* PAVGI & THIRUM. on *Alisma* sp. (Type). — E. Part of a spore ball of *Pseudodoassansia obscura* (SETCH.) VÁNKY on *Sagittaria latifolia* WILLD. (Type). — F. Part of a spore ball of *Tracya lemnae* (SETCH.) H. &. P. SYDOW on *Spirodela polyrrhiza* (L.) SCHLEID. (HUV 7798)

less got away from SETCHELL's classification. The idea of dividing the genus *Doassansia* into subgenera was apparently not attractive longer. Moreover, some authors (ZUNDEL, 1953; LINDEBERG, 1959) have treated the genus *Doassansiopsis* as *Doassansia*. The subgenus *Pseudodoassansia*, with its sole representative *Doassansia obscura* SETCH. was totally neglected although already SETCHELL (1891: 16) remarked that this smut "is abundantly distinct from all the other species of the genus. The central hyphae, the loosely compacted spores, the obconical lobed cells of the cortex and the method of germination of the spores are all characteristic. It seems to differ so much from the species which cluster about *Doassansia alismatis* as to demand a special subgenus for its reception." Studies of authentic material have convinced me that this species differs so much from all known genera that it is justified to treat it as separate genus.

Pseudodoassansia obscura (SETCHELL) VÁNKY comb. nov. — Fig. 2E; 3H.

Bas.: *Doassansia obscura* SETCHELL, Proc. Amer. Acad. Arts 26: 16, 1891. *Type* on *Sagittaria variabilis* ENGELM., U.S.A. Massachusetts, Cambridge, IX. 1890, SETCHELL (BPI 0178468, !, selected here).

Sori on the basal part of the petioles as inconspicuous, light yellowish-green spots or only thin, brown striae on the white portions, with the spore balls embedded in the host tissue. Spore balls (Fig. 2E; 3H) extracellularly in the lacunae, globose, ovoid or slightly irregular, 180—220×200—300 μm in diameter, light brown coloured, composed of a central network of finely branched hyphae surrounded by a few layers of loosely arranged spores and a compact cortical layer of sterile cells. Spores globose or subglobose, 8—12 μm in diameter, subhyaline to light yellowish-brown, with smooth, about 0.5 μm thick wall. Cortical cells irregular, obversely conical, more or less deeply lobed at the outer, broad end, light brown coloured. Germination after *Tilletia* scheme. Promycelium cylindrical, about 20 μm long. Basidiospores (sporidia) in a whorl of 5—7, 1.5—2×16—17 μm, producing secondary sporidia without conjugation (SETCHELL 1892: 43). On Alismataceae: *Sagittaria latifolia* WILLD. (N. America).

Specimens examined. — On *Sagittaria latifolia* WILLD. (= *S. variabilis* ENGELM.).

U.S.A.: Massachusetts, Cambridge, IX. 1890, SETCHELL, Type (BPI); — Cambridge, Glacialis, 3. X. 1900, CLINTON (Macdonald College Herb. in DAOM).

7. *Tracya* H. & P. SYDOW, Hedwigia Beibl. 40: (3), 1901. (= *Cornuella* SETCH., 1891 May, non *Cornuella* PIERRE, 1891 January).

Sori as finely punctate, rather indefinite spots on the vegetative parts of the host plants. Spore balls (Fig. 2F; 3I) rather perma-

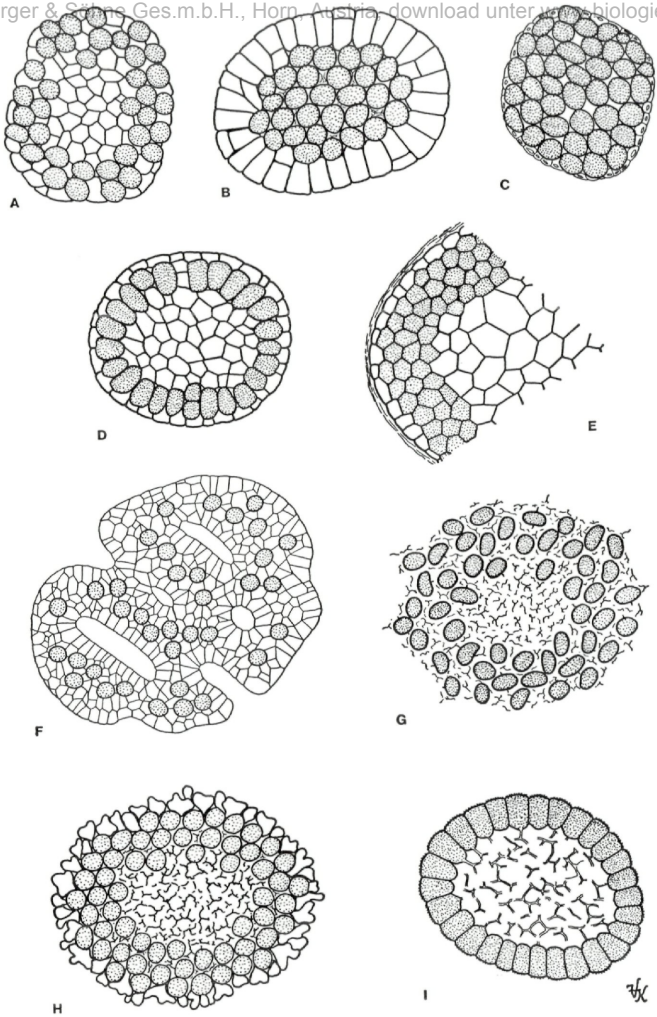

Fig. 3: A. Spore ball of *Burrillia pustulata* SETCH. (Type; schematised). — B. Spore ball of *Doassansia alismatis* (NEES v. ESENB.) CORNU on *Alisma lanceolatum* (HUV 436; schematised). — C. Spore ball of *Doassansia kamatii* (THAKUR) VÁNKY (Type; schematised). — D. Spore ball of *Doassansiopsis hydrophila* (DIETRICH) LAVROV on *Potamogeton natans* (VÁNKY, Ust. 16, schematised). — E. Part of a spore ball of *Doassansiopsis intermedia* (SETCH.) VÁNKY on *Sagittaria latifolia* (Type; schematised). — F. Spore ball of *Narasimhania alismatis* PAVGI & THIRUM. (Type; schematised). — G. Spore ball of *Nannfeldtiomyces sparganii* (LGH.) VÁNKY on *Sparganium erectum* (HUV 8699; schematised). — H. Spore ball of *Pseudodoassansia obscura* (SETCH.) VÁNKY (Type; schematised). — I. Spore ball of *Tracya hydrocharidis* LGH. on *Hydrocharis morsus-ranae* (VÁNKY, Ust. 32; schematised)

nent, composed of a central network of branched, septate, hardened mycelia and a peripheral layer of firmly adhered spores. Type species: *T. lemnae* (SETCH.) H. & P. SYDOW on *Spirodela polyrrhiza* (L.) SCHLEID. (= *Lemna polyrrhiza* L.), U.S.A., Massachusetts, Cambridge, Glacialis Pond, SETCHELL (sel. by ZUNDEL 1953: 304).

Only two species of *Tracya* are known.

The characterisation of these genera was based in most of the cases on the studies of the types or authentic specimens, but also on studies of so many species as possible within each genus.

The components of the spore balls may vary considerable from the one species to another within the same genus. The cortex, for instance, within the genus *Doassansia* may be thin, one-layered, small-celled (e. g. *D. limosellae* (J. KUNZE) SCHRÖTER, *D. kamatii* (THAKUR) VÁNKY), may be moderately thick, many-layered, small-celled (e. g. *D. epilobii* FARL.) or well developed, thick, consist of large cells in one or two layers (e. g. *D. alismatis* (NEES v. ESENB.) CORNU, *D. alismatis-oligococci* VÁNKY, *D. hottoniae* (ROSTR.) de TONI, *D. niesslii* de TONI). The spores in the spore balls of *Doassansia* usually are packed compact. Sometimes, however, the spores are loosely situated with mycelial remains between the spores (e. g. *D. alismatis-oligococci*). Nevertheless, we can find mycelial rests between the spores even in other species (e. g. *D. alismatis*, *D. niesslii*; VÁNKY 1975: 48). The spores in the spore balls of *Doassansiopsis* usually are one-layered (e. g. *D. furva* (DAVIS) VÁNKY, *D. horiana* (HENN.) SHEN, *D. hydrophila* (DIETR.). LAVROV or *D. occulta* (HOFFM.) DIETEL but in *D. intermedia* (SETCH.) VÁNKY they are many-layered. The spores may be dispersed more or less uniformly in the pseudoparenchymatous tissue in some *Burrillia* species (e. g. *B. ajrekari* THIRUM. (THIRUMALACHAR, 1947: 607) or concentrated towards the periphery of the spore ball (e. g. *B. pustulata* SETCH.). The same phenomenon can be seen in *Nannfeldtiomyces anomalus* (CROWELL) VÁNKY and in *N. sparganii* (LGH.) VÁNKY respectively.

The most important feature for the delimitation of these genera is the pattern of the structure of the spore balls, i. e. the arrangement of the spore ball components. In *Doassansia* pattern the spores are more or less compactly packed in a central mass, surrounded by a more or less evident cortex of sterile cells; in the *Doassansiopsis* pattern a central mass of pseudoparenchymatous tissue is surrounded by the firmly adhered spores and the cortex of sterile cells. In some cases, however, a species may possess an unusual element, which is typical for another genus. Thus, small groups of minute sterile cells between the spores, characteristic for *Burrillia*, *Doassansiopsis* or *Narasimhania* may occure in *Doassansia epilobii* FARL., altough the pattern of the whole spore ball is still typical for *Doassansia*. However, these variations of the pattern, together with other morphological

characteristics, such as the size of the spores or the sterile cells, and others, are useful characters for species delimitation only.

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Literature

Crowell, I. H. (1942). Two new Canadian Smuts. — Canad. J. Res. Sect. C, Bot. Sci. 20: 327—328.

Dearness, J. (1939). In Zundel, G. L.: Additions and corrections to Ustilaginales. — North American Flora 7: 1026.

Dietel, P. (1898). Hemibasidii. In Engler, A. & Prantl, K.: Die Natürlichen Pflanzenfamilien. Ed. I. 1 (1**): 2—24.

Holmgren, P. K. & Keuken, W. (1974). — Index herbariorum. Part I. Utrecht. 1—397.

Lagerheim, G. (1899). Contribution à la flore mycologique des environs de Montpellier. — Bull. Soc. Mycol. France 15: 95—103.

— (1910). In Palm, B.: Nya bidrag till Stockholmstraktens svampflora. — Svensk Bot. Tidskr. 4 (1): (1)—(8).

Lindeberg, B. (1959). Ustilaginales of Sweden. — Symb. Bot. Upsal. 16 (2): 1—175.

Liro, J. I. (1938). Die Ustilagineen Finnlands 2. — Ann. Acad. Sci. Fenn. Ser. A 42 (1): 1—720.

Savile, D. B. O. (1957). Notes on boreal Ustilaginales II. — Canad. J. Bot. 35: 279—286.

Schwarzman, S. R. (1960). Golovnevye griby. In Fl. spor. rast. Kazachst. 2: 1—369.

Setchell, W. A. (1891). Preliminary notes on the species of *Doassansia* Cornu. — Proc. Amer. Acad. Arts. 26: 13—19.

— (1892). An examination of the species of the genus *Doassansia* Cornu. — Ann. Bot. (London) 6: 1—48.

— (1894). Notes on Ustilagineae. — Bot. Gaz. (Crawfordsville) 19: 185—190.

Sydow, H. & P. (1901). Mycologische Mitteilungen. — Hedwigia Beibl. 40 (1): (1)—(3).

Thakur, S. B. (1975). A new species of *Burrillia* from India. — Curr. Sci. 44: 482—483.

— (1976). Report of *Burrillia* (Ustilaginales) in pure culture. — Mycologia 68: 166—167.

Thirumalachar, M. J. (1946). Nuclear cycle and life history of a new species of *Doassansia* (Ustilaginales). — Lloydia 9: 24—30.

— (1947). Species of the genera *Doassansia*, *Dossansiopsis*, and *Burrillia* in India. — Mycologia 39: 602—611.

Vánky, K. (1975). *Doassansia alismatis-oligococci* Vánky sp. nov. — Svensk Bot. Tidskr. 69: 45—48.

Zundel, G. L. (1953). The Ustilaginales of the World. — Pennsylvania State Coll., Dept. Bot., Contrib. 176: 1—410.