Zundelula, a new genus of smuts.

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With plate VII.

An ovaricolous smut on *Fimbristylis* sp. was collected by the writers which on examination proved to be very interesting. The infection was scattered, only few ovaries in the inflorescence showing infection. The infected ovaries were enlarged, 1.5 to 3 mm. in diameter, spherical and could be easily distinguished from the healthy ones (Fig. A.). The sorus at maturity ruptured at the apex releasing dark glomeruli or the spore balls which varied from 15 to 25 in number. Microscopic and cultural studies of the smut revealed that it belonged to an undescribed genus herein described.

Sections through a developing sorus revealed that the entire ovary was replaced by the fungus except for the thalamus and the pedicel. The thalamus protruded into the sorus as a short abortive columella (Fig B.). In the mature sorus protruding out of the spikelet, the wall of the sorus consisted of a pseudoperidial layer composed of interwoven hyphal strands.

The spores were massed together in the form of permanent spore balls. These were developed basipetally around the abortive columella. From the dense strands of hyphae, sphaerical masses of hyphae which are the initials of the spore balls were differentiated. Since the spore balls were formed in basipetal succession, the younger ones were situated towards the base and the older ones were pushed towards the periphery (Fig. B.). By the rupture of the sorus at the apex the spore balls got dispersed. Mature spore balls were subglobose to polygonal, dark and opaque and measured 450—570 ⇌ 300—450 μ.

The structure and development of the spore balls were studied in sections and the details revealed characters not reported in any of the members of the *Ustilaginales* so far. The large spore ball had an outer sheath of sterile spores which were 2 to 3 layers deep and an inner core of fertile spores (Fig. E.). The sterile spores were large, deep chestnut brown, without any cell contents and very fragile. Even with little pressure the spore-cells crumbled into pieces (Fig. C.). The walls were reticulately thickened and measured 10 to 19 μ in diameter.

The sterile sheath of spores became differentiated even at very early stage of spore ball development. In sections through the young spore balls in which the sporiferous hyphae in the centre were in the process of rounding off, following gelatinisation of their cell walls, the sterile spore sheath had already been well differentiated forming a protective layer (Fig. D.).

The fertile spores formed the inner core in the centre of the spore ball. The entire region of the fertile spores was traversed by yellowish-brown sterile pseudoparenchymata which completely enveloped the spores and interconnected them (Fig. G.). Consequently when the spores were teased out and examined they appeared reticulate on account of the outer enveloping sheath of the pseudoparenchymata. The broken ends of the pseudoparenchymata extended beyond the exospore (Fig. F.). The spores have been described in the present paper as being reticulate eventhough the underlying exospore was smooth. Mature spores were pale cinnamon-yellow, spherical and measured 7.5 to 10.5 μ in diameter with a mean of 9 μ.

The fertile spores were teased out of the spore balls on slides and were germinated and stained by the method described by Thirumalachar & Narasimhan (1952). Observations of the germination stages made during the month of May revealed that the promycelium was uniseptate, elongating to considerable length without showing sporidial development (Fig. H.). It was therefore uncertain at first whether to include the smut in the *Ustilaginaceae* or the *Tilletiaceae*. On the basis of the previous experience with other smut species that high temperature conditions prevailing during the month of May (90 to 105 F.) might have been responsible for this abnormal type of germination, the slides with the spores were transferred into an incubator at 70 F. immediately after the first sign of germination of the chlamydospore became visible. Observations made after 8 hours incubation at this temperature showed that the promycelium in all cases had become 3-septate, bearing lateral and terminal sporidia characteristic of the Ustilaginaceae (Fig. I.). The sporidia were ovate-ellipsoid, thin-walled and measured 4—6 ⇌ 2.5 μ.

Regarding the identity of the fungus, the following facts may be considered. The smut under study has no relationship with genera like *Doassansia* Cornu and others, which possess sterile outer cortex and fertile core of spores in the centre. In the possession of a pseudoperidial layer of hyphoid tissue enveloping the sorus, the smut under study resembled *Planetella lironis* Savile and *Dermatosorus eleocharidis* Sawada which also occur on cypericolus hosts.

Examination of the co-type material of *Planetella lironis* however showed that the spores were not united into spore balls.

Comperative studies indicated that the smut under study is closely related to *Dermatosorus* Sawada described recently by Ling (1949). Here the spore balls are composed of an inner core of loosely grouped fertile spores covered by a permanent cortex of pseudoparenchymatous tissue 15—75 μ thick, consisting of reddish-brown cells 3 to 6.5 μ in diameter. In the smut under study, however, the outer cortex is of the nature of sterile spores and therefore distinct, though similar in function as the pseudoparenchymata of *Dermatosorus*. The chief difference between the two genera lies in the fact that in the smut under study, the pseudoparenchymata traverse the fertile region of the sorus, interconnecting the spores and forming a sheath round them. In contrast, the fertile mass of spores in *Dermatosorus* are not interconnected by dermata, but loosely grouped as in *Sorosporium*. Examination of slide of type material of *Dermatosorus eleocharidis* kindly sent by Dr. Lee Ling has confirmed the above features. The smut under study therefore represents an undescribed genus, closely related to *Dermatosorus*, for which the name *Zundelula* is proposed, named in honour of late Dr. G. L. Zundel of Pennsylvania State College, a devoted student of world *Ustilaginales*.

ZUNDELULA Thirumalachar & Narasimhan gen. nov.

Sori in the ovaries, enveloped by a thick pseudoperidium of interwoven hyphal strands, enclosing large spore balls which are permanent and black. Mature spore balls composed of an outer 2 to 3 layers of sterile spores which are dark-brown, without cell contents, fragile, and an inner core of fertile spores which are interconnected by webbing in the form of yellowish-brown pseudoparenchymata or dermata. Mature spores are yellowish-brown, germinate by septate promycelia bearing lateral and terminal sporidia as in *Ustilaginaceae*.

Type species *Zundelula fimbristylidis* Thirumal. & Narasimhan.

Sori in ovariis oriundi, pseudoperidio crasso, permanente, ex hyphis intertextis formato involuti, sporarum glomerulis majusculis atris repleti; sporarum maturarum glomeruli extus e stratis 2—3 sporarum sterilium, obscure brunnearum, fragilium, intus e sporis fertilibus, retiformiter connatis et quasi contextum pseudoparenchymaticum, luteo-brunneum formantibus compositi; sporae luteo-brunneae, promycelio septato, sporidiis lateralibus et terminalibus ut in *Ustilaginaceis* praedito germinantes.

Species typica *Zundelula fimbristylidis*.

Zundelula fimbristylidis Thirumal. & Narasimhan sp. nov.

Sori in the ovaries, only a few in the inflorescence affected, infected ovaries appearing as spherical bullate bodies, 1.5 to 3 mm. in diameter, enveloped by a thick pseudoperidium of densely interwoven hyphal strands, rupturing at maturity and releasing 15 to 25 large spore balls which measure 450—570 ≒ 300—450 μ. Spore balls permanent, black in mass, produced in basipetal succession from the hyphal plexus at the base of the sorus, composed of an outer sheath of 2 to 3 layer of sterile spores and in inner core of fertile spores; sterile spores large, chestnut-brown, fragile and breaking into fragments even under gentle pressure, thick-walled, with reticulate thickenings, measuring 10 to 19 μ in diameter. Fertile spores subglobose to spherical, yellowish-brown, measuring 7.5 to 10.5 μ with a mean of 9 μ, exospore with reticulate thickenings. Fertile spores interconnected by webbing in the form of yellowish-brown pseudoparenchymata or dermata, germinating by septate promycelia bearing lateral and terminal sporidia; sporidia ovate-ellipsoid, thin-walled, measuring 4—6 = 2.5 μ.

Hab. in the ovaries of *Fimbristylis* sp., Mithapur, Patna, 12—12—1951, leg. M. J. Narasimhan (Type). Type deposited in the Herb. Crypt. Ind. Orient, New Delhi, Herb. C. M. I., Kew, England, and Mycological Division, Bureau of Plant Industry, Beltsville, Maryland, USA.

Ovaria infecta bullato-sphaerica; sori in ovariis, raro in inflorescentia evoluti, 1.5—3 mm diam.; pseudoperidio crasso, permanente, ex hyphis intertextis formato involuti, glomerulis sporarum 15—25 majusculis, 450—570 = 300—450 μ metientibus repleti, in maturitate disrumpentes; sporarum glomeruli permanentes, atri, ad basin sori e contextu hyphoideo in successione basipetali oriundi, extus e stratis 2—3 sporarum sterilium, intus e nucleo sporarum fertilium compositi; sporae steriles majusculae, castaneo-brunneae, caducae, pariete retiformiter incrassato, facile in frustula minuta dilabentes, 10—19 μ diam.; sporae fertiles globosae, luteo-brunneae, exosporio retiformiter incrassato, 7.5—10.5 μ, plerumque 9 μ diam.; sporidia in promycelio septato lateralia et terminalia, ovato-ellipsoidea, episporio tenui praedita, 4—6 = 2.5 μ.

In conclusion the writers wish to acknowledge their deep indebtedness to Dr. F. Petrak for kindly translating the descriptions of the genus and species into Latin.

Literature cited.

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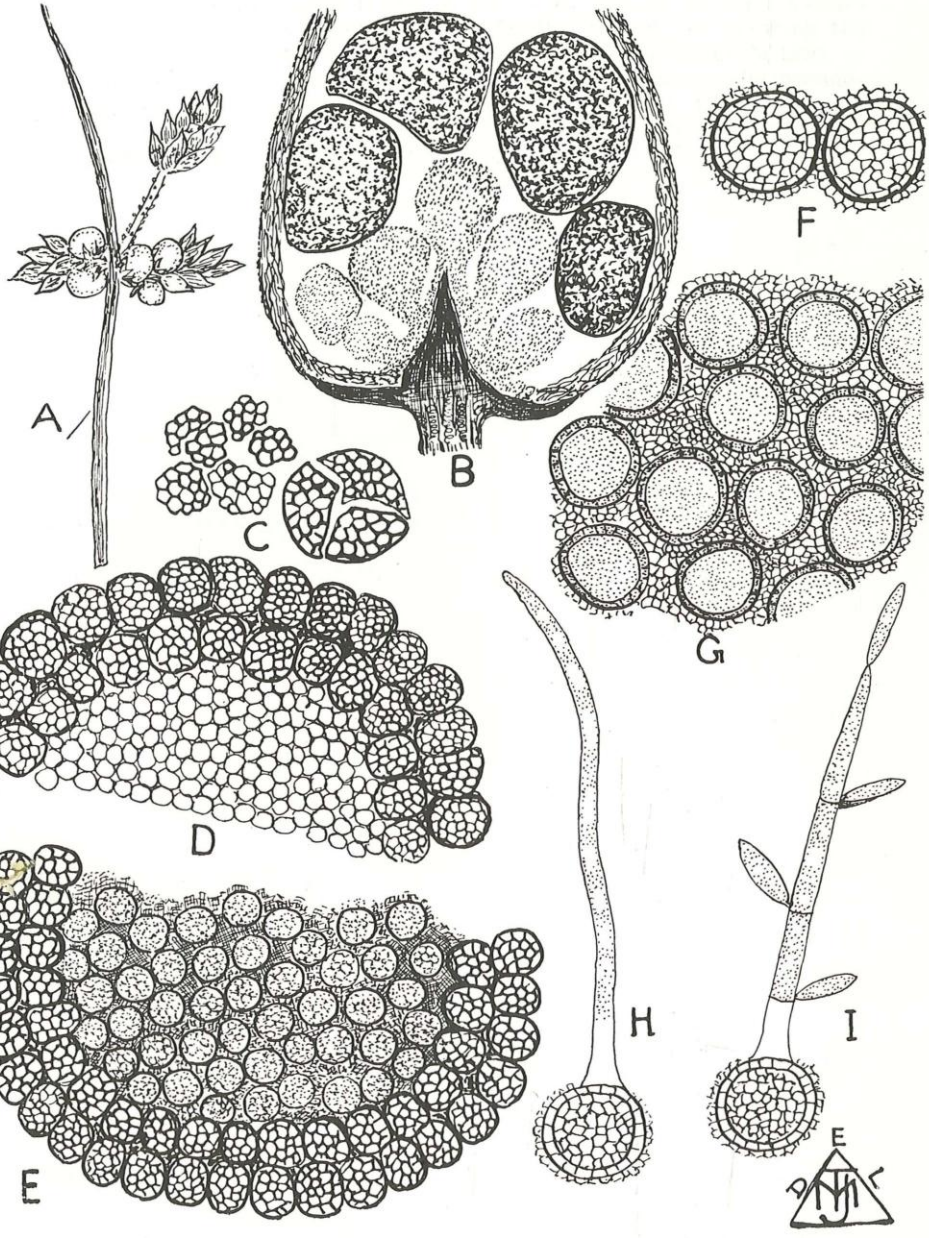

Explanation of plate VI.

A. Showing the smutted ovaries of *Fimbristylis* sp. × 2 nat. size. — B. Section through the sorus showing the thalamus, abortive columella, pseudoperidia and spore balls × 50. — C. Showing the fragile nature of the sterile spores × 1000. — D. Section through a young spore ball showing the sterile and fertile spore layers × 750. — E. Section through mature sporeball × 750. — F. Chlamydospores (fertile) teased out showing the extension of the pseudoparenchymata beyond the exospores × 1250. — G. Section through the fertile region of spore ball showing the pseudoparenchymata interconnecting the spores × 1000. — H. Chlamydospore germination under high temperature conditions × 1250. — I. Normal spore germination by lateral and terminal sporidia × 1250.