NOTES ON SOME INDIAN USTILAGINAE VIII.*

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With plates I and II.

This is a continuation of the previous studies by the authors on the ustilagineae collected from several places in India. The types of the new species reported in this paper have been deposited in the Herb. Crypt. Ind. Orient., New Delhi, Herb. C. M. I., Kew England and in the Mycological Division, Plant Industry Station, Beltsville, Maryland, U.S.A.

1. **Tilletia themedae-anatherae** sp. nov.

Sori in the ovaries, affecting only a few spikelets in the inflorescence, 1—1.5 cms. long, 1.5 to 2 mm broad, protruding beyond the glumes, covered by a false membrane enclosing black spore mass. Mature spores subglobose to spherical, brownish-black to opaque, 18.6—24.3 μ in diameter with a mean of 21.8 μ. Epispore thick, pale-brown, covered by truncate scale-like processes. Sterile cells numerous, thick-walled, hyaline, 12.9 to 17.2 μ in diameter.

Hab. in ovaries of *Themeda anathera* Hack., Mussorie, Uttar Pradesh, 24-10-1953, leg. M. S. Pavgi. (Figs. 1 to 4).

Sori nonnulla tantum ovaria inflorescentiae inficientes, 1—1.5 cm longi, 1.5—2 mm lati, e glumis prominuli, membrana falsa obtecti, sporarum massa nigra repleti; sporae maturae subglobosae vel sphericae brunneo-atrae vel opacae, 18.6—24.3 μ plerumque 21.8 μ diam. metientes. Episporium crassum, pallide brunneum, verruculis truncatis ornatum. Cellulae steriles numerosae, crassis parietibus praeditae, hyalinae, 12.9—17.2 μ in diam.

The fungus somewhat resembles in the spore character *Tilletia themedicola* Mishra & Thirumalachar (Sydowia **7**: 82, 1953) on *Themeda quadrivalvis* Kuntz. recorded from Parasnath, Bihar. The spores of this latter fungus are larger in size 22.5—30.5 μ and the scale-like processes covering the episspore are of different shape than in the species under study. In *T. themedae-anatherae* sori superficially resembles that of a *Sphacelotheca* in having a long slender structure covered by a false membrane.

2. **Tilletia panici-humilis** sp. nov.

Sori in the ovaries, infection scattered in the inflorescence, inconspicuous, concealed by the enveloping glumes, becoming evident on

*) Part VII in Sydowia VII: 98—102, 1953.

rupture of the sorus revealing black spore mass. Mature spores subglobose to spherical, olive-brown, to opaque, 15.8—21.5 μ in diameter with a mean of 18.9 μ. Epispore thick, with 5 to 6 angled reticulations. Sterile cells numerous, hyaline, subglobose to angular, thick-walled, 13—17 μ in diameter.

Hab. in ovaries of *Panicum humile* Nees, Banaras, Uttar Pradesh, 24-9-1953, leg. M. S. Pavgi. (Figs. 5 to 7).

Sori in ovariis per totam inflorescentiam dispersi, inconspicui, glumis obtecti, tandem sporis ejectis manifeste visibiles. Sporae maturae subglobosae vel sphaericae, olivaceo-brunneae vel opacae, 15.8—21.5 μ, plerumque 18.9 μ diam.; episporio crasso, reticulato, areolis 5—6-angulosis; sporae steriles numerosae, hyalinae, subglobosae vel angulares, crassis parietibus praeditae, 13—17 μ in diam.

Tilletia panici-humilis is closely related to *T. courtetiana* Har. & Pat. (Bull. Mus. Hist. Nat. (Paris) 2: 197, 1909) which parasitises *Panicum proliferum* Lam. in Belgian Congo and French Congo in Africa. The spores of this are also olive-brown, with epispore which is reticulate having 5—6 angled alveoli. Examination of the type material indicated that the spores are 18.4 to 24 μ in diameter with a mean of 21.5 μ where as in *T. panici-humilis* the spores are smaller in size, 15.8—21.5 μ with a mean of 18.9 μ. Two other species of *Tilletia* on species of *Panicum* with reticulate epispore are *T. tumefaciens* H. & P. Syd. on *P. antidotale* and *T. narasimhanii* Thirumalachar & Safee, on *Panicum trypheron,* both occurring in India. *T. tumefaciens* incites a large hood-shaped gall on the leaves and culms with spores 17—24 μ with a mean of 20.5 μ. *T. narasimhanii* is a different species with pale cinnamon-brown coloured spores which are 20—27 μ in diameter with a mean of 23 μ.

(3) Chamydospore germination in *Tilletia eleusines* Syd.

The ovaricolous smut on *Dactyloctenium aegypticum* Richt. (*Eleusine aegyptica* Desf.) first described by Sydow (Ann. Mycol. **32**: 287, 1934) occurs in several parts of India. The chlamydospores are dark-brown with reticulate epispore. The chlamydospores were germinated on slides at room temperature (22—24 C.) by the method outlined by the writers (Indian Phytopathology **3**: 177—178, 1950). Freshly collected spores germinated after an incubation period of 4 days by the development of a stout promycelium. The single large fusion nucleus from the spore migrated into the promycelium. By further development, a terminal whorl of 6 to 8 sporidia were formed which conjugated immediately. The conjugating tubes are formed laterally and the sporidia at this stage appear as forked structures (Figs. 16 to 18). The type of germination and formation of conjugating branches are exactly similar to that of *T. tumefaciens* Syd. (Thiruma-

lachar Lloydia **13**: 165—167, 1950) and of *T. narayanaraoana* (Thirumalachar & Mundkur Mycol. Pap. 40, C. M. I., England, p. 6—7, 1951). Soon after conjugation, the entire crown of sporidia detatched from the promycelium. Infection hyphae are formed directly, and no secondary sporidial formation has been observed.

(4) *Ustilago ornata* Tracy & Earle. Bull. Torrey Bot. Club. **22**: 175, 1905.

Sori ovaricolous, only few spikelets in the panicle infected, minute inconspicuous. Infected ovary slightly enlarged in early stages, appearing as greyish-green ovate bodies, 0.25—0.5 mm long, 0.2 to 0.3 mm broad, rupturing at maturity and exposing the dark powdery mass of spores. Mature spores reddish-brown, subglobose to spherical, 11.5 to 16.5 μ in diameter with a mean of 13.8 μ. Epispore thick and covered with sharp echinulations.

Hab. in ovaries of *Leptochloa filiformis* (Lam.) Beauv., Allahabad, Uttarpradesh, 10-10-1952, leg. M. S. Pavgi. (Figs. 9 to 11).

The fungus is identical with *U. ornata* on *Leptochloa uninervia* and *L. filiformis* reported from the United States, with echinulate spores measuring 10—17 μ in diameter.

(5) *Entyloma nymphaeae* (Cunningh.) Setchell var. **macrospora** Thirumal. Pavgi & Safee. var. nov.

Ressembling *Entyloma nymphaeae* in the type of symptoms produced and colour and shape of the spores, but spores are larger in size 12.5—19 ⇌ 8—14 μ as compared with 8—14 ⇌ 8—11 μ in *E. nymphaeae.*

Hab. on leaves of *Nymphaea* sp. Banaras, Uttar Pradesh, 10-9-1952, leg. M. S. Pavgi (Figs. 12 to 15).

Entyloma nymphaeae similis, sporae 12.5—19 ⇌ 8—14 μ.

(6) *Schroeteria delastrina* (Tul.) Winter in Rabenh. Krypt. Fl. **1**: 117, 1881. Hab. in ovariis of *Veronica verna* L., Naugaum, Kashmir, 4-6-1953, leg. M. S. Pavgi. (Figs. 19—21).

This interesting genus so widely distributed on number of species of *Veronica* all over Europe, and as yet unkown in America, is being recorded for the first time in India. The infection is very severe, and owing to its systemic nature all the capsules of the plant are destroyed. The type of the species was collected on *Veronica praecox* in France. On the present host species *V. verna,* the fungus has been previously recorded from Czechoslovakia, Finland and Ukraine (Russia).

(7) *Sphacelotheca schweinfurthiana* (Thum.) Sacc. var. *minor* Zundel in Mycologia **35**: 168, 1943.

Sori in the ovaries, destroying all in the panicle and transforming them into long cylindrical pinkish-gray bodies, protruding beyond the

glumes, 8 to 12 mm long and 1.5 to 2 mm broad, rupturing irregularly at maturity exposing the dusty black spore mass, with a long simple columella in the centre. Mature spores cinamon-brown, subglobose to spherical, 6 to 10 μ in diameter with a mean of 8.4 μ; epispore thick, smooth to very faintly punctate. Cells of the false membrane hyaline to slightly cinnamon-yellow, smooth, grouped together in clusters, 10—15 μ in diameter.

Hab. in ovaries of *Saccharum munja* Roxb., Banaras, Uttar Pradesh, 18-4-1953, leg. M. S. Pavgi. (Figs. 22—25).

Sphacelotheca schweinfurthiana first described on the host *Imperata cylindrica* (L.) Beauv. from Sudan, has been recorded in India on *Saccharum munja* Roxb. The spores of this smut measures 10 to 12 μ with a mean of 11 μ. An almost similar smut with slightly smaller spores on *Saccharum arundinaceum* Retz. in China, was referred to as a new variety of *S. schweinfurthiana* by Zundel, with spore measurements 7—10 μ in diameter. The smut studied by us on *Saccharum munja* has also smaller spore measurements than *S. schweinfurthiana* recorded on the same host, and is therefore referred to var. *minor* designated by Zundel. We had no opportunity to examine the type material of *S. schweinfurthiana* var. *minor*.

(8) *Cintractia clintonii* Ciferri in Ann. Mycol. **26**: 29, 1928.

Sori ovaricolous, 1.5 to 2 mm in diameter, elongate, semiagglutinated, greyish-black and covered at first by a pinkish pseudomembrane which flakes away at maturity revealing the spore mass. Spores reddish-brown, subglobose to spherical, 12 to 15 μ in diameter with a mean of 12 μ. Epispore medium thick and densely verrucose. Sterile cells hyaline, thick-walled, smooth, 6 to 9.5 μ in diameter.

Hab. in ovaries of *Fimbristylis diphylla* Vahl. var *annua* C. B. Clarke. Banaras, Uttar Pradesh, 17-9-1952, leg. M. S. Pavgi. (Figs. 26—27).

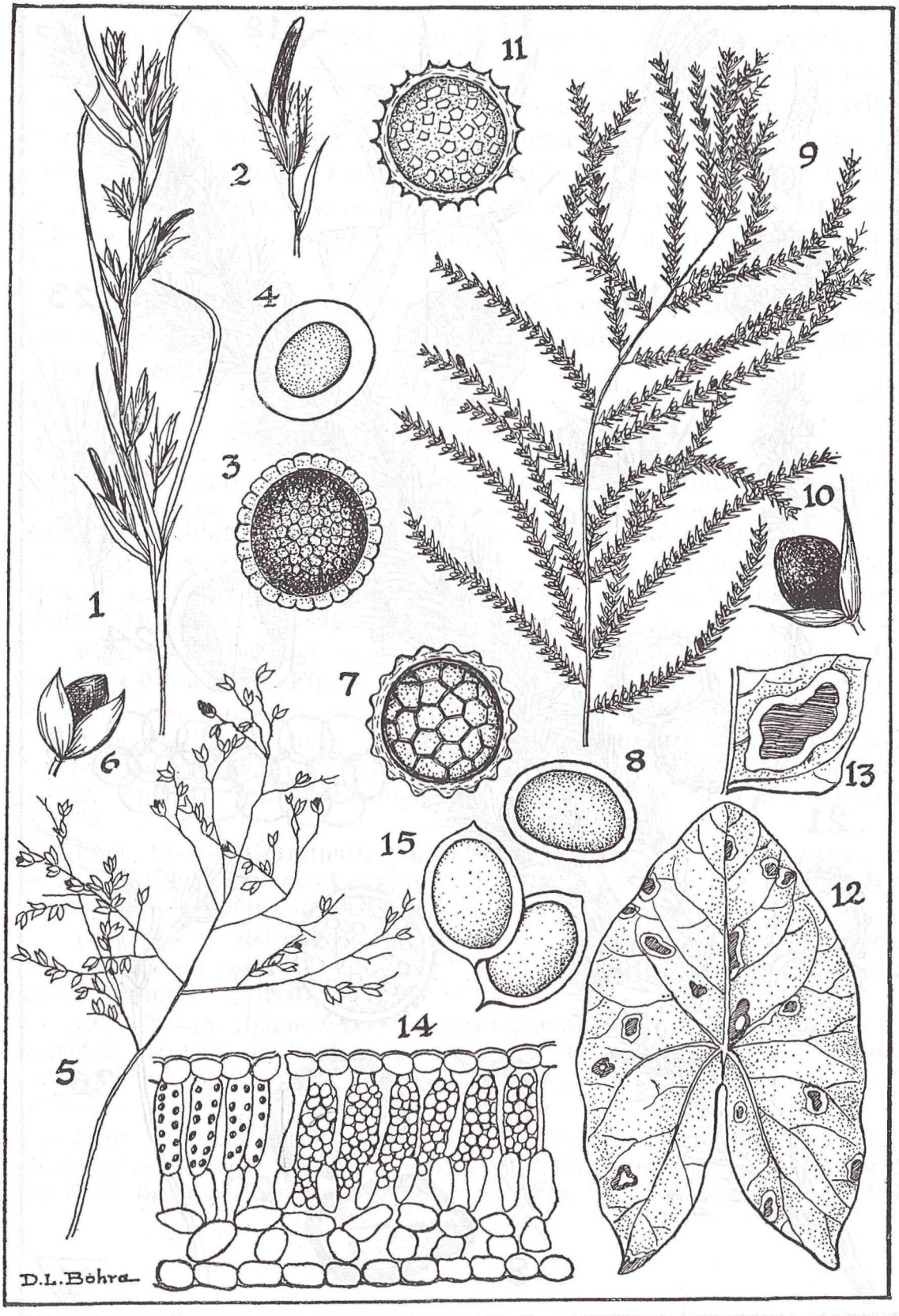
Cintractia clintonii with its characteristic verrucose spores which distinguishes it from *C. axicola* was first recorded from Mexico on *Fimbristylis holwayana*. The fungus has not previously been reported from India, and *F. diphylla* var. *annua* is also a new host.

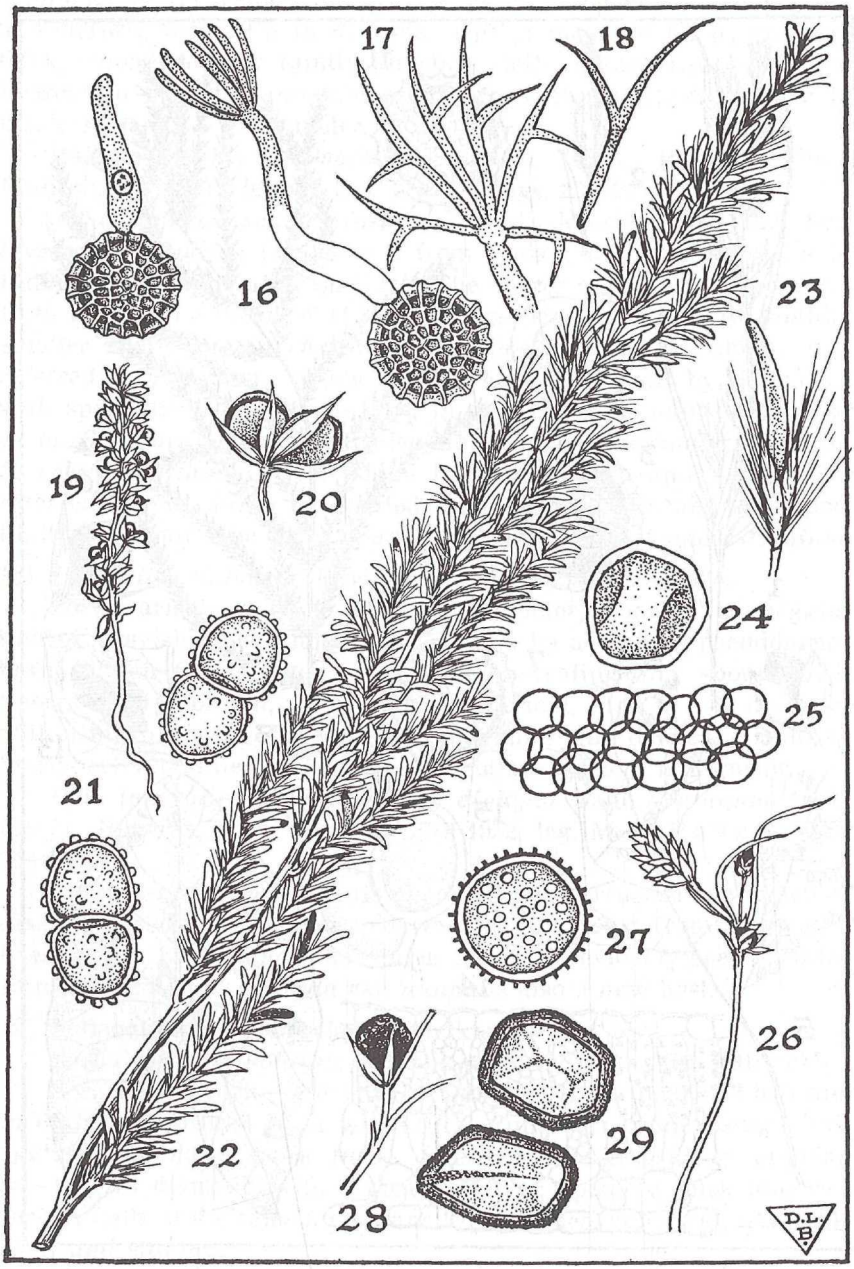
(9) **Sphacelotheca kobresiae** (Mundkur) comb. nov.

Syn. *Cintractia kobresiae* Mundkur in Mycologia **36**: 291, 1944.

Sori in the ovaries, appearing as greyish-black bodies, 3 to 4 mm in diameter, covered by a whitish false membrane enclosing semi-agglutinated dark spore mass. Spores ovate-globoid to angular, 12—18 μ in diameter with a mean of 15 μ; epispore thick and verrucose. Cells of the false membrane thick-walled, spherical, columella short and stumpy.

Hab. in ovaries of *Kobresia laxa* Boeck. Satpura Nulla, Kashmir, leg. R. R. Stewart (Type). (Figs. 28—29).





A detailed examination of the sorus structure from the type material revealed that the fungus is a *Sphacelotheca* and not *Cintractia*. Except for the differences in the size of the spore, the fungus under study is identical with *Sphacelotheca eleocharidis* Thirumal. & Pavgi (Sydowia **7**: 99—100, 1953). Usually smut species with agglutinated spore mass are freely placed under *Cintractia* if they occur on members of the *Cyperaceae* and under *Sphacelotheca* if they parasitise graminaceous hosts. The sorus characters of the two genera are however very distinct. The development of spores from the base of the sorus vertically, and without radial strands of sterile hyphae in the smut on *Kobresia laxa* indicated that it is a species of *Sphacelotheca*.

In conclusion the writers wish to acknowledge their deep gratitude to Dr. F. Petrak, Vienna, for kindly translating the descriptions of new species into Latin.

Explanation of Plates I and II.

Figs. 1—4. *Tilletia themedae-anatherae*. Fig. 1. Habit, showing infection on *Themeda anathera* × 0.8 nat. size. Fig. 2. Sorus enlarged × 1.5 nat. size. Fig. 3. Chlamydospore × 1000. Fig. 4. Sterile cell × 1000.

Figs. 5—8. *Tilletia panici-humilis*. — Fig. 5. Infection on *Panicum humile*. × 0.8 nat. size. Fig. 6. Sorus enlarged × 4. Fig. 7. Chlamydospore × 1000. Fig. 8. Sterile cell × 1000.

Figs. 9—11. *Ustilago ornata*. — Fig. 9. Infection on *Leptochloa filiformis* × 0.8 nat. size. Fig. 10. Sorus enlarged × 4.8. Fig. 11. Chlamydospore × 1300.

Figs. 12—15. *Entyloma nymphaeae* var. *macrospora*. — Fig. 12. Infected leaf of *Nymphaea* × 0.8 nat. size. Fig. 13. Showing infection patch × 3.2. Fig. 14. Section through sorus × 120. Fig. 15. Chlamydospore × 1000.

Figs. 16—18. Germination of chlamydospores in *Tilletia eleusines*. — Fig. 16. Development of promycelium and sporidia × 800. Figs. 17 & 18. Formation of conjugation branches × 1000.

Figs. 19—21. *Schroeteria delastrina*. — Fig. 19. Systemically infected *Veronica verna* plant × nat. size. Fig. 20. Sorus in ovary. × 3.2. Fig. 21. Chlamydospore. × 1000.

Figs. 22—25. *Sphacelotheca schweinfurthiana* var. *minor*. — Fig. 22. Infected panicle of *Sacharum munja* × 1½ nat. size. Fig. 23. Sorus enlarged. × 3.2. Fig. 24. Chlamydospore. × 2000. Fig. 25. Sterile cells × 800.

Figs. 26—28. *Cintractia clintonii*. — Fig. 26. Habit on *Fimbristylis diphylla* var. *annua*. × 1½ nat. size. Fig. 27. Chlamydospore. × 1000. Fig. 28. Sorus of Sphacelotheca kobresiae. × 2.4. Fig. 29. Chlamydospore. × 1200.