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Calcutta University, Kolkata 700 019, India

Taxonomic study of smut fungi from eastern and north-eastern India

M.K. BAG[1] AND D.K. AGARWAL[2]

Rice Research Station, Chinsurah, West Bengal[1], Division of Plant Pathology, Indian Agricultural Research Institute, Pusa, New Delhi[2]

During the survey (1997-1999) of parts of Eastern and North-Eastern India various smut fungi were collected and identified. In present study, the following fungi namely, *Cintractia axicola*, *C. fimbristylis-miliaceae*, *C. limitata*, *Sporisorium formosanum* and *S. mishrae* were taken for detailed taxonomic studies to review their true morphological and taxonomical identity. These details were compared with the species earlier described in relevant literature as well as based on the study of type specimens if available. Scanning Electron Micrograph (SEM) of above specimens revealed some new characters in reference to surface wall ornamentation, which were not reported earlier. Amendments in the descriptions were also made on the basis of variable characters. All the specimens were submitted to H.C.I.O., New Delhi. All the above fungi were reported first time from these regions.

Key words : Smut fungi, taxonomy.

INTRODUCTION

Insufficient taxonomic study of the smut fungi from eastern and north-eastern India has been made. Detailed characterizations of the morphological, anatomical and scanning electron microscopic surface features of these fungi are lacking. The present paper is an attempt to study some of the smut fungi of eastern and north-eastern India collected by us.

MATERIALS AND METHODS

Microscopic slides of smut spores taken from infected plant parts were prepared in Shear's solution (Chupp, 1940). Characters of sori and spores were examined under Olympus monocular and Stereobinocular microscope to record there shape, size, colour and measurement. After calibration of microscope (Olympus monocular) on an average 100 measurements were taken for each sample. Ridgway's (1912) *Color standard and Color Nomenclature* were used for colour identification. For Scanning Electron Micrograph (SEM) study of the specimens standard method was followed (Va'nky, 1985). Taxonomic determination was confirmed with the help of type specimens and available literature.

RESULTS AND DISCUSSION

***CINTRACTIA AXICOLA* (Berk.) Cornu, *Ann. Sci. Nat. Bot.* Ser. 6, XV, p.279, 1883; Saccardo, *Syll. Fung.*, VII, p. 480, 1888.**

= *Ustilago axicola* Berk., *Ann. Mag. Nat. Hist.*, Ser. 2, **IX,** p. 200, 1852.

= *U. fimbristylis* Thuemen, *Bull. Torrey Bot. Cl.*, **VI,** p.95, 1876.

= *C. Mundkuri* Chowdhury, *Ind. J. Agric. Sci.*, **XIV,** p. 231, 1944.

Sori usually born at the base of peduncles or pedicels sometimes in spikelets, globular (2-7 mm in diameter) to irregular in shape. Spore mass dusty, dark black in colour, agglutinated, enclosed by pseudomembrane which soon flake away. Spores cadmium yellow (Ridgway Plate III, middle-3), ovoid to rounded, laterally compressed, 11.0-15.3 µm (Avg. 14.7 µm in size). Epispore thick, dark reddish under ×1600 magnificaton. Spores germinate in water resulting in four celled promycellia from which sporidia are budded off.

SEM observations revealed presence of very fine and densely verrucose spore wall representing low warts partly confluent, forming short, irregular, sometimes ramified striae. Majority of spores show typical verrucose wall. This is a new record from North-Eastern India.

Specimens examined : On clums and spikelets of *Cyperus scariosus* L., Coochbehar, W.B., March, 1996, Coll. D.K. Agarwal, H.C.I.O. 42946; On *Fimbristylis dichotoma* (L.) Vahl., Guwahati, Assam, Coll. M. K. Bag, April, 1998, H.C.I.O. 43154; Costarica, March, 14, 1991, Coll. T. et K. Va'nky, HUV. 809; Sina, China, Sept. 19, 1985, Coll. L. Guo & K. Va'nky, HUV. 505; On *F.aestivalis* Vahl., Amritsor, Punjab, Oct. 12, 1907, Coll. A.H. Khan, H.C.I.O. 1437.

***CINTRACTIA FIMBRISTYLIS-MILIACEAE* (Henn.) Ito, In *Trans. Sapparo Nat. His. Soc.* 14: 42, 1935.**

= *Ustilago fimbristylis-miliaceae* Henn., *Bot. Jahrb. Sys.*, **37:** 156, 1906.

= *Cintractia clintonii* Cliff. *Ann. Mycol.* **26:** 30, 1928.

Sori born at the base of peduncle, mostly in the ovaries, spikelets covered by whitish peridium, 1-3 mm in size. On rupturing reveal agglutinated, black spore mass. Spores deep chrome in colour (Ridgway Plate III, b-3), oval, ellipsoidal, 8.5-13.6 µm (Avg. 11.8 µm) in size. In LM spore wall appears as very finely and densely punctate to verrucose. SEM revealed verrucose to echinulate wall forming confluent columns of warts.

C. fimbristylicola Mundkur and Pavgi having characteristics similar to present specimen, except in the spore size 7.0-11.0 µm (Avg. 9.0 µm). *C. minor* (Clin.) Jack. tallied in spore size but its thick epispore, minutely punctate to smooth wall differed from present specimen. C. mitchelli Va'nky (1997) recorded spore size as 9.5-13.5 × 11-14.5 µm. SEM studies revealed verrucose-reticulate spore wall morphology which differed from present studies. This is first time recorded from North-Eastern India.

Specimens examined : On the peduncles, spikelets and ovaries of *Fimbristylis miliaceae* (L.) Vahl., Hooghly, W.B., Sept. 1998, Coll. M.K. Bag, H.C.I.O. 43155; Kolhapur, M.S., Sept., 17, 1994, Coll. M.S. Patil, H.C.I.O. 42806.

***CINTRACTIA LIMITATA* Clinton, *Proc. Bost. Nat. Hist.*, 31: 399, 1940.**

= *C. axicola* var. *minor* Clinton, J. Myc., **8:** 143, 1902.

= *C. minor* Jacks. *Mycologia*, **12:** 153, 1920.

= *Ustilago mariscana* Zundel, *Mycologia*, **35:** 165, 1943.

Sori at the base of peduncles or pedicels, rarely in parts of spikelets. Spore mass are semiagglutinated to granular and finally becoming powdery black. Spore apricot yellow in colour (Ridgway Plate IV, b-1), round, ovoid to polyangular, 8.8-13.2 µm (Avg. 10.7 µm). Under LM spore wall appeared finely verrucose with thick epispore. SEM studies revealed spore surface ornamentation as verrucose where dense, minute, low warts are present in regular pattern. Present studies tallied with the report of Fischer (1953) and Zambettakis (1970). *C. limitata* is being reported for the first time in India on *Cyperus rotundus* L. which constitutes as a new host record.

SEM studies revealed that all the three species of *Cintractia* possess verrucose to verruculose spore wall ornamentation. In case of *C. axicola* very fine to dense low warts, confluent in nature and forming short, irregular, sometimes ramified striae were observed whereas in *C. limitata*, simple dense, minute to low warts were observed. But *C. fimbristylis-miliaceae* showed typical verruculose to echinulate spore wall layer forming confluent and columnar warts.

Specimens examined : On the culms, peduncles and spikelets of *Cyperus rotundus* L., Howrah, W.B., Sept., 1998, Coll. M.K. Bag, H.C.I.O. 43156; On *C. ligularis* L., Venezuela, Dec., 13, 1993, Coll. C. and K. Va'nky, H.C.I.O. 41726 (Type).

***SPORISORIUM FORMOSANUM* (Sawada) Va'nky, *Publ. Herb. Univ. Uppsala*, 11: 12, 1983.**

= *Sorosporium formosanum* (Saw.) Sawada, *Rep. Dept. Agric. Govt. Res. Inst. Formosa*, **XXXV**, p.29, 1928.

= *Ustilago formosana* Saw., In Tanaka, *Mycologia*, **14:** 89, 1922.

Sori mostly destroying the panicle, cylindrical, initially covered by leaf sheath and by a grayish-white pseudomembrane which later flakes away exposing black spore mass. Columella present, later shredded at apex to form a penicillate structure. Spore ball subglobose or ellipsoidal, 20.4-51.0 × 59.0-102.0 µm in size and opaque. Spores globose to subglobose, chestnut-brown in colour (Ridgway Plate XIV, m-3), 5.1-6.8 µm (Avg. 6.3 µm), epispore moderately thick. SEM revealed that spore walls are sparsely or minutely echinulate in nature.

In the present studies *S. formosanum* was found to have spore size 5.1-6.8 µm (Avg. 6.3 µm) with echinulate spore wall as revealed by SEM studies. These findings differed slightly from Tanaka's (1922) report of spore size 5.5-6.0 µm

having mostly smooth to finely echinulate Spore wall. Mundkar and Thirumalachar (1952) reported spore size 4.5-7.5 µm (Avg. 6.0 µm) with sparsely verrucose spore wall based on Light microscopy. Based on these findings the descriptions of the fungus have been amended. This constitutes new record from North-Eastern India.

Specimens examined : In the inflorescence of *Panicum repens* L., Kalimpong, W.B., April, 1999, Coll. M.K. Bag, H.C.I.O. 43160; Kerala, Jan., 31, 1980, Coll. Va'nky, H.C.I.O. 36215; Ceylon, March, 20, 1975, Coll. K. Va'nky, H.C.I.O. 32377 (Type).

***SPORISORIUM MISHRAE* K. Va'nky, *Mycotaxon*, 65: 133-158, 1997.**

= *Sorosporium aphudae* J.N. Mishra, *Mycologia*, **48:** 875, 1956.

Sori born in the spikelets grouped in to form witches broom like appearance. The floral envelops of infected spikelets turn leafy and elongated. Sori long, with acute tip, 5.0-15.0 mm, covered by leathery brown peridium which ruptures irregularly from the sides disclosing the agglutinated to powdery, blackish-brown mass of spore balls and spores surrounding a simple, long, central columalla. Spore balls loose to compact, multispored, subglobose to elongated or irregular, 54.5-60.0 × 88.0-110.5 µm, and reddish brown. Spores globose, ellipsoidal, subpolyhedral to irregular, thin walled (0.5-0.8 µm), 8.5-10.2 × 9.4-13.2 µm (Avg. 9.9 µm), amber-yellow in colour (Ridgway Plate XVI, b-3). Sterile cells not observed.

SEM showed spore wall ornamentation as verrucose having moderate to dense, minute warts in irregular fashion. Wall in between warts is rough. *S. mishrae* collected on *Aphuda mutica* L. was found to be similar as described in the literature by Mundkur and Thirumalachar (1952) and Va'nky (1997). Hence the fungus is retained as such in its true taxonomic position. It is being recorded for the first time from North- Eastern India.

Specimens examined : In the inflorescence of *Aphuda mutica* L., Howrah, W.B., Sept., 1998, Coll. M.K. Bag, H.C.I.O. 43162; Netarhat, Bihar, Nov., 30, 1955, Coll. J. N. Mishra, H.C.I.O. 25282 (Type); Karnataka, Nov., 16, 1995, Coll. N. D. Sharma, H.C.I.O. 42617.

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REFERENCES

Chupp, C. (1940). Further notes on double cover glass mounts. *Mycologia*, **32:** 269-270.

Fischer, G.W., 1953. *Manual of the North American Smut Fungi*. Ronald Press Co., New York, 343 pp.

Mundkur, B.B.and Thirumalachar, M.J., 1952. *Ustiaginales of India*. Commonwealth Mycol. Inst., Kew, Surrey, England, 84 pp.

Ridgway, R., 1912. *Color Standard and Color Nomenclature*. Little Brown and Company, U.S.A., 129 pp.

Tanaka, T., 1922. New Japanese Fungi. *Mycologia*, **14:** 81-89.

Va'nky, K., 1985. *Carpathian Ustilaginales*. Symbolae Botanicae Upsalienses, **24:** 1-309.

Va'nky, K., 1997. Fulvisporium, a new genus of Ustilaginales. *Mycotaxon*, 64: 57-66.

Zambettakis, C., 1970. Recherches sur les Ustilaginales D'Afrique. *Bull. De La Soc. Mycol. de France*, **LXXXVI**, 388 pp.

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