

ADDITIONS TO FUNGI OF MADRAS—II*

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(4) *Puccinia solani-giganteæ* sp. nov.

THIS rust is found on the leaves of *Solanum giganteum* Jacq. at Naduvattam, Nilgiris. Its presence can be recognized by the groups of orange-yellow sori in the midst of the thick white tomentum on the lower surface of the leaves. Corresponding to these, small rusty brown spots are seen on the upper surface of the leaves.

Pycnia are developed towards the upper surface. They are subepidermal globose, 100–180 μ , and yellowish-brown in colour. Paraphyses and spores are present in the pycnia.

Aecia are hypophyllous, cup-like, formed in groups one to three millimetres in diameter, each cluster having a variable number of sori. The æcium is sunk in the tissue of the leaf and is provided with a distinct peridium of one layer of thick-walled warty cells (Fig. 1 b). The mean size of the æcium is 215 μ wide and 210 μ deep (range 200–270 \times 180–225 μ). Aeciospores are formed in chains from a basal hymenial layer of elongated cells as in other species of *Puccinia*. They are spherical or elliptic, 17.8 μ (12–25 μ) in diameter, very lightly coloured. The spore wall is hyaline with a finely warty surface.

Telia are hypophyllous and are formed mixed with the æcia as hard-rimmed, brown, circular, open cups, 222 \times 202 μ (190–250 \times 180–215 μ) in diameter and depth respectively. There is no distinct peridium as in the æcium, but the cup has a lining of two to three layers of small fungal cells. Teliospores are produced from the bottom of the cup (Fig. 1 c) on long hyaline pedicels which get easily separated from the spores. Teliospores are two-celled subspherical, rounded at the ends, slightly constricted in the middle, deep golden brown in colour and measure 37.9 \times 24.8 μ

* The first paper in this series appeared in *Proceedings of the Indian Academy of Sciences*, Section B, Vol. XXV, No. 1. In this and succeeding papers it is proposed to describe the new fungi collected from various parts of the Presidency. New records of fungi will also find a place in these papers.

(28–52 × 20–28 μ). The wall is smooth and uniformly thick. Some of the spores exhibit abnormalities having three to four cells by the formation of vertical or oblique cross walls in each cell (Fig. 1 c).

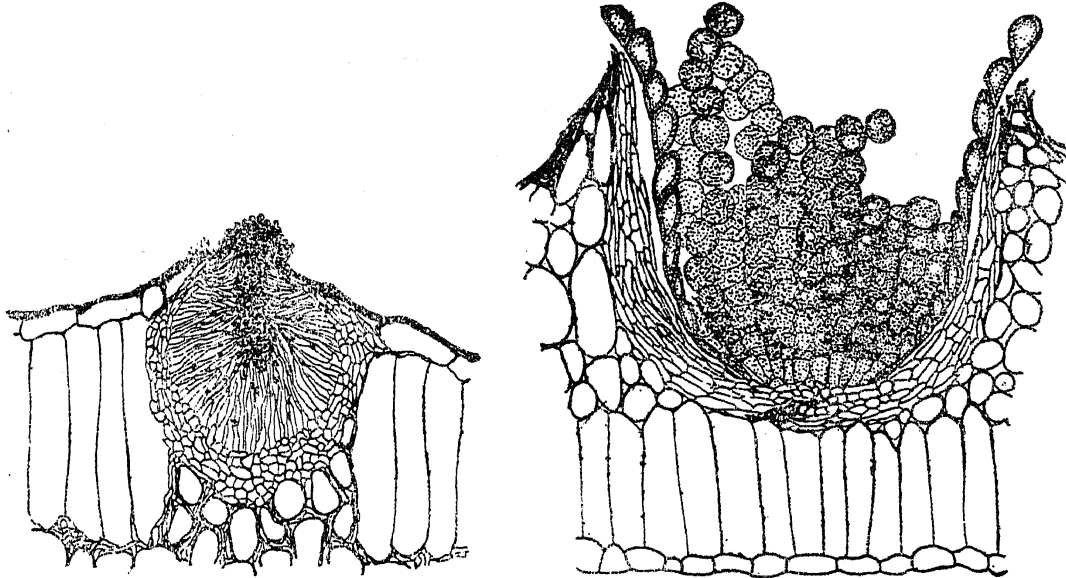
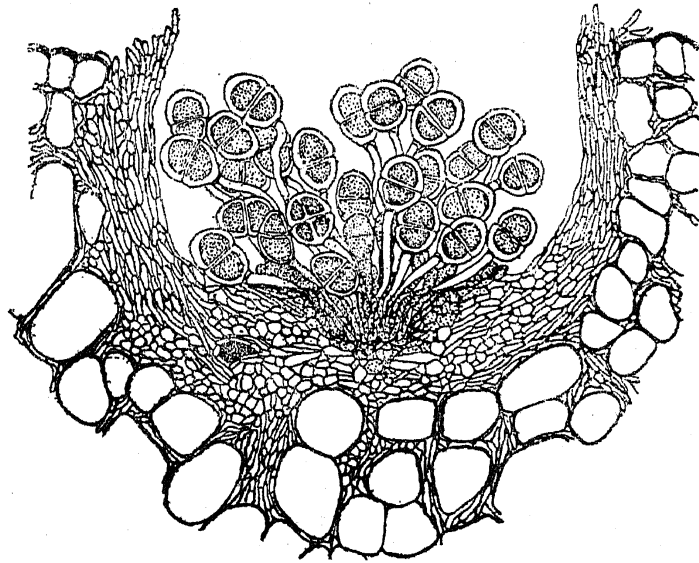


FIG. 1. (a) Pycnium of *P. solani-gigantea* (×360). (b) Aecium of *P. Solani-gigantea* (×360).



(c) Telium of *P. solani-gigantea* (× 360).

Identity of the rust.—Several rusts have been described on *Solanum*. Most of these are from the Americas or West Indies. *Puccinia solanacearum* Sacc. et Syd. has been recorded from the Sutlej valley in India. This produces 0, I, and III stages on *Solanum* sp., but unlike the rust under discussion the telia are formed only on the stem, causing malformations.

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P. araucana Diet. et Neg. forms I and III and even here the telia are formed only on the stem. *P. adducta* Arth. has been recorded by Arthur (1918) on *S. racemosum* as having 0, II and III but not æcia. *P. tubulosa* Arth. (*Aecidium tubulosum* Pat et Gaill) has been observed in India on *S. melongena* but the telial stage is found to develop on *Paspalum* sp. The other species of *Puccinia* on *Solanum* have been known to form only telia. *S. giganteum* has not been known to be infected by *Puccinia* till now. The peculiar cup-like telia are also characteristic and unlike those of other species on *Solanum*. Therefore it is concluded that this rust is different and is named *P. solani-giganteæ*. Dr. G. R. Bisby to whom the specimens and the diagnosis were kindly forwarded by Dr. B. B. Mundkur, is also of the opinion that this is an unrecorded species of *Puccinia*.

Puccinia solani-giganteæ sp. nov.—*Pycnia* epiphyllous, subepidermal, globoid; æcia in clusters, hypophyllous, cup-shaped, $210 \times 215 \mu$ with a distinct peridium of thick-walled warty cells; æciospores in chains, spherical or elliptical, 17.8μ ($12-25 \mu$); telia hypophyllous, mixed with the æcia, cup-shaped $220 \times 202 \mu$; teliospores 2-celled, deep golden brown, subspherical, smooth, $37.9 \times 24.8 \mu$ ($28-52 \times 20-28$) stalked, stalks long hyaline, deciduous.

On living leaves of *Solanum giganteum* Jacq. Naduvattam (Nilgiris) 15-3-1946, Coll. C. L. Subramanian and K. Ramakrishnan. (Type) Type specimen deposited in the herbarium of the Government Mycologist, Coimbatore, and Herb. Crypt. Ind. Orient, New Delhi.

Puccinia solani-giganteæ sp. nov.—*Pycnia* epiphylla, subepidermia, globosa; æcia aggregata, hypophylla, cupulata, $210 \times 215 \mu$, peridio distincto cellarum crasso-muratarum; æcio-sporidia catenulata, globosa vel elliptica 17.8μ ($12-25 \mu$). Telia hypophylla æcii mixta, cupulata $220 \times 202 \mu$, teliosporidia duo-cellata, aurati intense brunnei colores, subglobosa, lævia, $37.9 \times 24.8 \mu$ ($28-52 \times 20-28 \mu$), pedicellata; pedicelli longi, hyalini, decidui.

In vivis foliis *Solani giganteæ* Naduvattam (Nilgiris), 15-III-1946, Leg. C. L. Subramanian and et K. Ramakrishnan. Typi specimina deposita in Herbario Government Mycologist Coimbatore et Herb. Crypt. Ind. Orient, New Delhi.

(5) *Entyloma bidentis* P. Henn.

Saccardo-Syll. Fung. XIV, 495, 1888.

On living leaves of *Bidens pilosa* L. Coimbatore and Kallar (Coimbatore District) October 1946 (K. Ramakrishnan).

In October 1946, this smut was noticed in an epiphytotic form on the leaves of *Bidens pilosa*, a weed, in Coimbatore and Kallar. The lower leaves were first affected and later the infection spread to the upper also. Amphigenous, whitish to yellow, circular spots develop on the leaves. The spots are small in the initial stages but enlarge later becoming 0.5 to 1 cm. in diameter. They are isolated or sometimes coalescent. The upper surface of the spot becomes convex and the lower surface correspondingly concave. The colour deepens to yellow on the upper surface and finally turns brown.

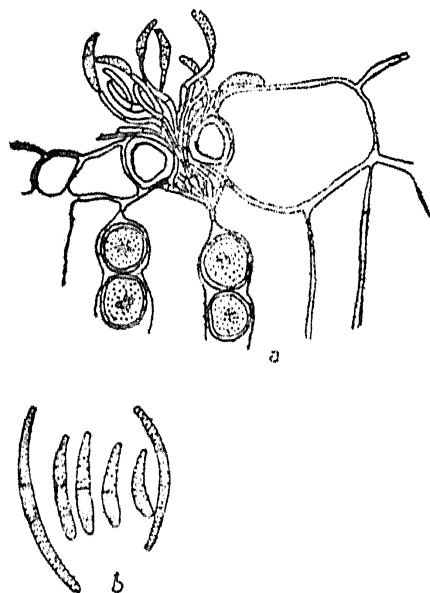


FIG. 2. (a) Section of leaf showing smut spores and conidia of *E. bidentis*. (b) conidia ($\times 300$).

The conidia of the smut are produced when the spots have attained their full size. These are formed on both sides of the spot, but first appear on the lower surface, producing a white-dotted appearance which may deepen into greenish yellow with age. The conidia are fusiform or filiform, hyaline, straight or bent, with one to three septa. The conidiophores emerge through the stomata in fasciculate masses and bear the conidia at their apices. The conidia measure $7-8 \times 1.3 \mu$ ($6-10 \times 1-2 \mu$). The conidial fructification is like *Entylomella* V. Hohn (Ciferri, 1928).

Inoculations were carried out on healthy plants of *Bidens pilosa* with these conidia. A suspension of the conidia was made in sterilised distilled water and this was brushed over the surface of the leaves after which the plants were kept covered with a bell-jar for 48 hours. On the fifth day small white spots developed on the inoculated leaves. These enlarged and in the course of fifteen days reached their maximum diameter. The colour of the spots deepened and brown streaks became evident in twenty days. At this stage conidial formation had commenced on the lower surface of

the spots and the smut spores also had developed within the leaf. Thus the relationship between the conidia and the smut was established.

The smut spores are spherical, ellipsoidal or angular and measure on an average $15 \times 13 \mu$ ($11-22 \times 8-16 \mu$). The epispore is smooth but sometimes a small hyaline appendage may be seen projecting from one angle. This is only the remnant of a hypha. The spores develop intercellularly in the palisade tissue forming chains, but in the spongy tissue of the mesophyll the spores are grouped together resulting in the displacement of the cells.

Conidia have been observed in a number of species of *Entyloma*, but they have not been described in the case of *E. bidentis*.

Saccardo has listed *E. bidentis* P. Henn. as occurring on *Bidens pilosa* in East Africa. The measurements of this smut as given by Saccardo are $10-15 \times 9-14 \mu$ with an epispore $1-1\frac{1}{2} \mu$ thick. *E. guaraniticum* Speg. has also been recorded on *Bidens pilosa* by Ciferri (1928). But the spores of this smut as described by Clinton (1904) are hyaline to light yellow with a prominent gelatinous envelope. The spores of the smut now recorded are brown and do not possess a gelatinous envelope. Owing to the difference in colour and the absence of the gelatinous envelope it is identified as *E. bidentis* P. Henn.

(6) *Entyloma dahliae* Syd.

Sydow, H. and P. .. *Ann. Mycol.* Berlin, X, 36, 1912.

Ciferri, R. de .. *Ibid.*, XXVI, 56, 1928.

Mundkur, B. B. .. *Trans. Brit. Mycol. Soc.*, XXIV, 332, 1940.

On leaves of *Dahlia variabilis* Desf. (garden variety), Ootacamund, Nilgiris, 30-9-1946 (T. S. Ramakrishnan).

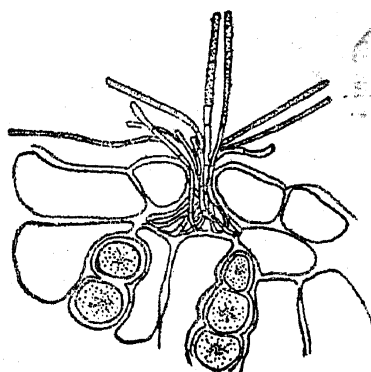


FIG. 3. Section of *Dahlia* leaf showing conidia of *E. dahliae* ($\times 300$).

This smut is prevalent all over the upper elevations of the Nilgiris. Mundkur has stated that conidia were not found, nor has Sydow included

them in his original description. In the specimen collected from Coimbatore, stomacund conidia were observed in large numbers. These were filiform, hyaline, straight or bent. They were produced on conidiophores in fascicles emerging through the stomata on the upper surface (Fig. 1, 2). The spots on which the conidia are formed exhibit a white rosy, reticulate appearance on the surface.

(7) *Melanotænium brachiaræ* Viegas.

Syn. *Tolyposporella brachiaræ* Mundkur and Thirumalachar, Mycological Papers, No. 16, *Imp. Myc. Inst.*, London, p. 5, 1946.

This smut has been observed in different parts of the Coimbatore District on the leaves and leaf-sheaths of *Brachiaria distachya* (L.) Stapf. (*Panicum distachyum* L.).

Viegas has described *M. brachiaræ* on the leaves of *B. plantaginea* from Brazil. Mundkur and Thirumalachar have recorded *Tolyposporella brachiaræ* from Bangalore and New Delhi. Dr. Mundkur was kind enough to let us have fragments of the type specimens of these two fungi for comparison with the specimen collected at Coimbatore. There was close agreement between the three specimens. Microtome sections of the sori (Plate XVI, Fig. b) revealed that the spores occur in groups in the mesophyll tissue outside the ring of cells surrounding the vascular bundles. The spore germinates producing a promycelium from the apex of which a whorl of sporidia arise (Plate XVI, Fig. a).

A comparison of the type specimens of *M. brachiaræ* and *T. brachiaræ* with the local specimen showed that the external symptoms, the disposition of the sori and spores and the germination of the spores were alike in all the three. The measurements of the spores were as follows:

Specimen	Range of dimensions of the spores in μ	Means size μ
<i>M. brachiaræ</i> ..	8-14 × 6-14	11 × 8.1
<i>T. brachiaræ</i> ..	8-16 × 7-12	11 × 8.0
Local smut ..	8-15 × 6-11	11.5 × 9.0

It is clear from the above that the same fungus is involved in all these. It has to be decided whether it is an *Entyloma* or *Melanotænium*. The difference between these genera is very slight and rests mainly on the colour of the sori and the spores. A number of species described originally as *Entyloma* have been transferred to *Melanotænium* on this basis. Following this trend it is desirable to include this smut under *Melanotænium* on account

of the sori and dark olive-brown spores. Dr. Mundkur's attention was drawn to the fact that the smut on *B. distachya* is not a *Tolyposporella* but a *Melanotanium* and he concurred with us in this.

(8) *Phyllachora cymbispora* sp. nov.

Spots forming yellowish-green rings 1-2 mm. wide surrounding the stroma, visible on both sides of the leaf, isolated or aggregated in groups of 2-4; stromata solitary in each spot, clypeate, black, shining, and raised almost equally on both sides of the leaf, 0.3-1.5 mm., with one locus, dense black just beneath the epidermal layers; locus broadly-flask-shaped and flattened, ostiolate, 225-396 μ broad and 162-228 μ deep, bounded by a cellular border; asci thin-walled, cylindric-spindle-shaped, narrowed at the base, with a small foot, 120 \times 16 μ (102-150 \times 10-20 μ); paraphyses present filiform; ascospores 8, light-olivaceous, cymbiform, partly distichous, 30 \times 6.6 μ (22-38 \times 3-9 μ); pycnia often present by the side of the perithecia, subepidermal, deeply sunk, dark-coloured, 123 μ broad and 180 μ deep, ostiolate, containing filiform, hyaline conidia (Plate XVI, Fig. c).

On living leaves of *Eurya japonica* Thunb., Lovedale (Nilgiris) 15-3-'46 K. Ramakrishnan and C. L. Subramanian, type. Type specimen deposited in the Herbarium of the Government Mycologist, Coimbatore and Herb. Crypt. Ind. Orient., New Delhi.

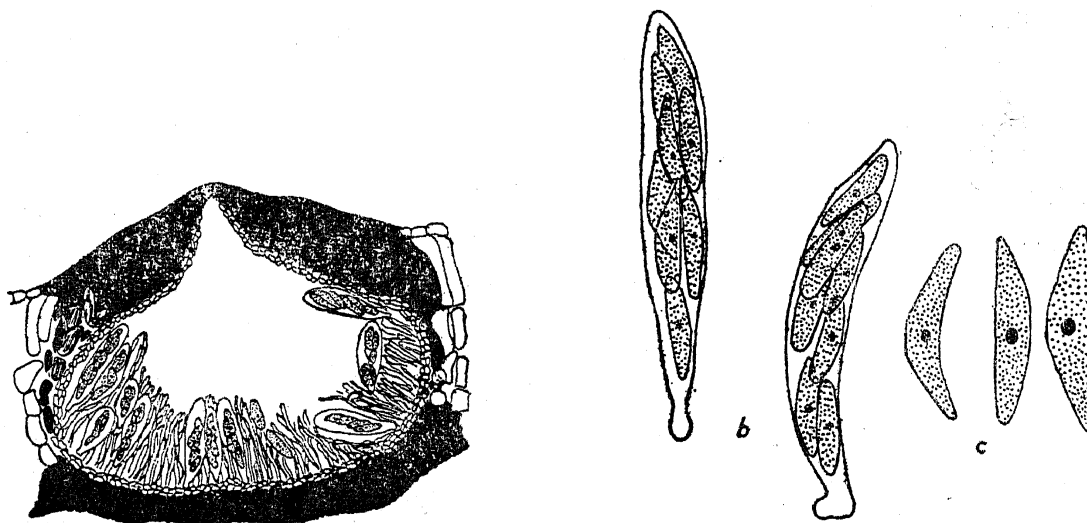


FIG. 4. (a) Section of perithecium of *Phyllachora cymbispora* ($\times 100$).
(b) Asci ($\times 360$). (c) Ascospores ($\times 510$).

Phyllachora cymbispora sp. nov. Maculae formantes anulum flavidem viredem 1-2 mm. lat., circumdantes stroma, utrimque visibiles, solitariae vel 2-4 aggregatae, stroma unum in quaque macula, clypeatum, nigrum,

micans, elevatum fere pariter utrimque folii, 0.3–1.5 mm. lat., uniloculatum, ostiolatum, stroma valde nigro infra epidermium; locusculus latiusculus, lageniformis, et compressus, 225–396 μ lat. 162–228 μ alt, cellis limbatus asci tenuimuniti, cylindranei fusiformes, unguistati in basi, parvo pede, 120 \times 16 μ (102–150 \times 10–20.5) paraphyses adsunt, filiformes; ascosporidia 8, lavis olivacei colores, cymbiformes, partum disticha, 30 \times 6.6 μ (22–38 \times 3–9 μ); pycnia saepe adsunt, prope perithecia, fuscicolores 123 μ lat et 180 μ alt, ostiolata continentia filiformia, conidia hyalina.

In vivis foliis *Euryæ japonicæ* Thunb., Lovedale (Nilgiris) Leg. K. Ramakrishnan et C. L. Subramanian, typus. Typi specimina deposita in Herbario Government Mycologist, Coimbatore et Herb. Crypt. Ind. Orient, New Delhi.

Catacauma euryæ (Racib) Theis. et Syd. has been recorded on *Eurya acuminata* Dc. from Java and *Phyllachora transiens* Syd. et But. on the same host from Kumaon, India. In both these fungi the stromata are hypophyllous. Further the asci and ascospores are smaller than those of *P. cymbispora*. Comparative measurements are given below.

	Asci	Ascospores
<i>C. euryæ</i> ...	80–90 \times 14–16 μ	14–16 \times 6–8 μ , hyaline, oval
<i>P. transiens</i> ..	50–70 \times 10–11 μ	20–22 \times 5–7 μ , hyaline, oblong
<i>P. cymbispora</i> ..	102–150 \times 10–20 μ	22–38 \times 3–9 μ , light olivaceous cymbiform

It is manifest that the fungus under study is quite different from those mentioned above and is therefore named *Phyllachora cymbispora* (deriving the name from the shape of the spores).

(9) *Colletotrichum ciliatum* sp. nov.

Spots amphigenous, isolated, oval, 4–9 \times 2–6 mm., or confluent forming irregular big patches, brownish grey with darker coloured margins; *acervuli* minute, numerous, black, amphigenous, separate, or confluent into linear striae, erumpent; stromata of dark brown cells filling the epidermis and one or two layers of subepidermal cells, erumpent, setae numerous, 86–135 \times 5–10 μ , blackish brown, pointed, 2–3 septate; *conidia* hyaline, unicellular, falcate, 29 \times 4.7 μ (19–25 \times 3–5 μ), with one terminal cilium, 5–19 μ long.

On living leaves of *Cymbopogon polyneuros* Stapf. Nanjanad (Nilgiris) 29–9–1946 (T. S. Ramakrishnan) Type.

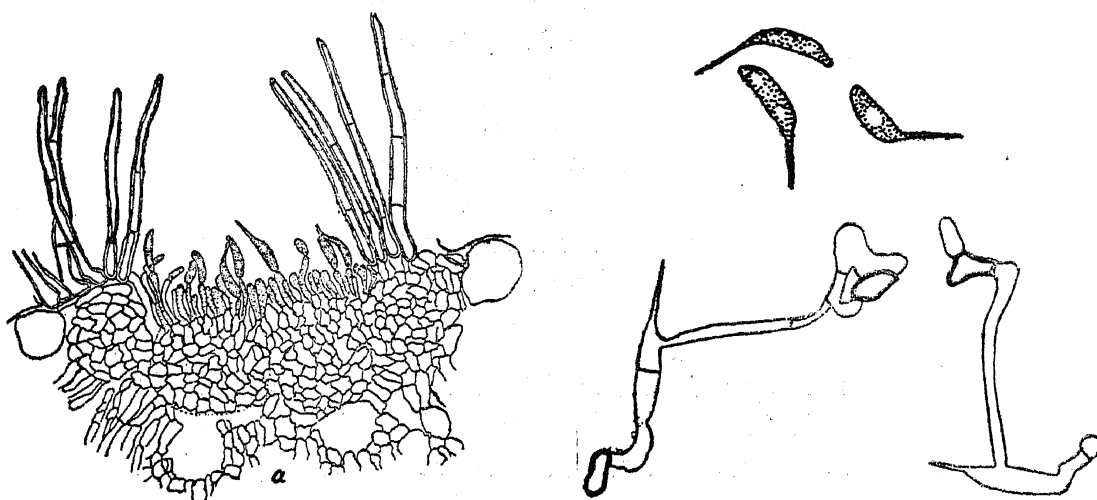


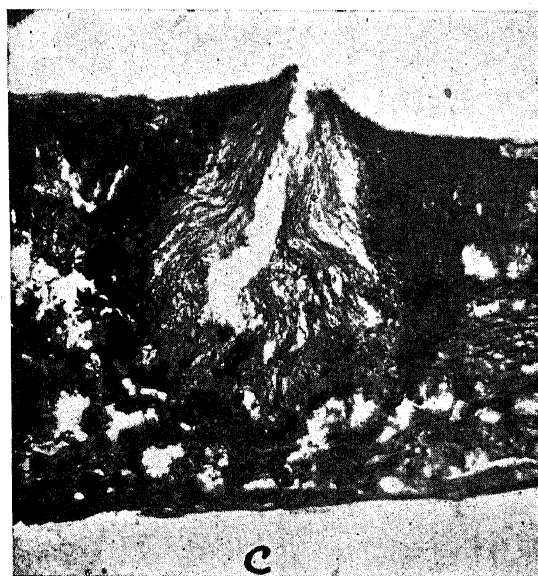
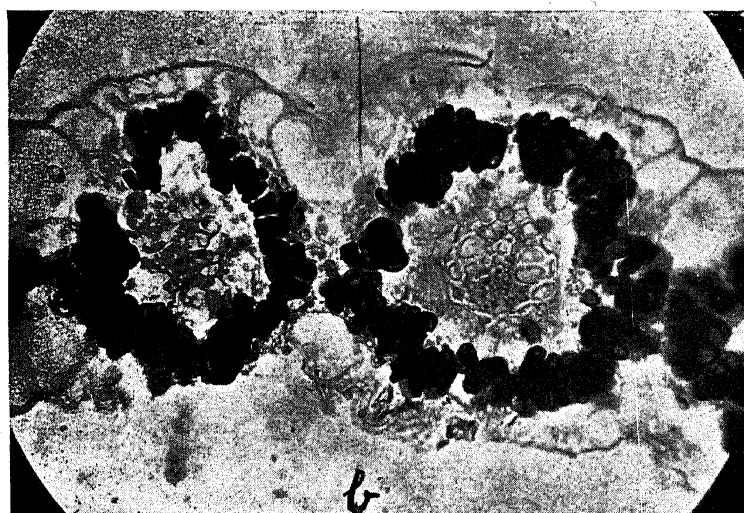
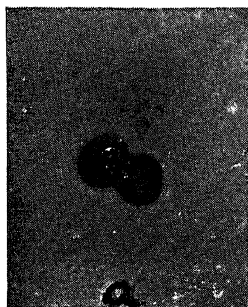
FIG. 5. (a) Section through an acervulus of *C. ciliatum*. ($\times 240$). (b) Conidia ($\times 510$).
(c) Germinating conidia ($\times 510$).

Colletotrichum ciliatum sp. nov.—Maculae amphigeniae, solitariae, ovales, $4-9 \times 2-6$ mm., vel confluentes, formant, magna, irregularia, panna, brunneolae, marginus fusciores; acervuli minutissimi, numerosi, fusci, amphigeni, solitariae, vel confluentus cum liniari striis, erumpentis; stromata fuscarum brunnearum, cellarum, implentia, epidermidum et unum vel duo strata cellarum subepidermidum, erumpentia, setae numerosae, $86-135 \times 5-10 \mu$, fusci brunnei colores, aculeatae, 2-3 septatae, conidia hyalina, unicellaria, falcata, $29 \times 4.7 \mu$ ($19-25 \times 3-5 \mu$) cum uno cilio terminali.

In vivis foliis *Cymbopogon polyneuros* Stapf. Nanjanad (Nilgiris) 29-9-1946, Leg. T. S. Ramakrishnan, typus.

This species is unique in having a cilium at the apex of the conidium. It is in the form of a sharp process and is either straight or curved. The cilium is developed as the spore matures and is not evident in the earlier stages of spore development. The germination of the conidium is as in other species of *Colletotrichum*. One or more germ tubes are produced by the conidium and appressoria develop on these. A septum is seen in some of the germinating spores. The cilium is not shed during germination nor does a germ tube develop from it. The acervuli are first seen on the upper surface of the spots. They are formed on the lower surface only in the later stages. The infected leaves soon dry up owing to the formation of large lesions. On these dry leaves acervuli may be seen all over the surface.

The characteristics of the fungus show, that it is a *Colletotrichum*. But the conidia are ciliate—a feature not noticed in the genus. However, the resemblance to *Colletotrichum* is so close that it is thought fit to include



- (a) Germinating spores of *Melanotanium brachiariae* ($\times 600$)
(b) Section through the sorus of *Melanotanium brachiariae* ($\times 600$)
(c) Section through the pycnidium of *Phyllachora cymbispora* ($\times 400$)

it in that genus, but as a new species. *C. graminicolum* (Ces.) Wils. has been observed on *Cymbopogon* sp., but the conidia of this species are not ciliate. Therefore the present fungus is named *C. ciliatum*.

ACKNOWLEDGMENT

We wish to express our deep debt of gratitude to Dr. B. B. Mundkur of the Indian Agricultural Research Institute, New Delhi, for his ungrudging help in lending type specimens, helping with references to literature, and for critically going through the manuscript. We are grateful to Dr. Bisby of the Imperial Mycological Institute, Kew, for his help in the identification of the rust on *Solanum*, and to Rev. Fr. Singarayar of the St. Joseph's Seminary, Coimbatore, for rendering the diagnoses into Latin. Our grateful thanks are due to Mr. K. M. Thomas, Government Mycologist, for his constant help and encouragement. Mr. M. S. Balakrishnan, Research Fellow, was kind enough to prepare the drawings.

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