

Some new or interesting *Physoderma* Species from India. - III.

By M. J. Thirumalachar & M. S. Pavgi.
(Pimpri, Poona and Banaras Hindu University, India.)
With plates I—II.

In continuation of the previous studies on *Physoderma* species by the writers (1954 and 1954 a*), further collections made in different places have been investigated. In the present paper an account of five *Physoderma* species which are new to Science is presented. Germination studies of the resting sporangia have been carried out in case of two species. Type material of the new species are deposited in Herb. Crypt. Ind. Orient., New Delhi, Herb. C. M. I., Kew England and in the Mycology Division, U.S.D.A., Beltsville, Maryland, U.S.A.

1. Black leaf stripe disease of *Chrysopogon* species.

On the leaves of *Chrysopogon* species (*gryllus?*) growing in rocky beds of low lying lands, a *Physoderma* species was collected in the month of July soon after the rains in a locality near Poona, Bombay. Infection on top leaves appeared as leaden grey spots, 3 to 4 mm. long, while on the lower leaves the infection was severe, appearing as long black stripes 2 to 3 cms. long (Fig. 1). Microscopic examination of sectioned material showed that in the region of black stripe of the sori, the epidermis showed a black epithecium-like layer. The rhizomycelium was tenuous, intracellular and branched. The resting sporangia were chiefly distributed in the epidermal cells as a continuous layer, and very rarely were distributed in the mesophyll cells (Fig. 2). The resting sporangia were 1 to 2 in each cell, pale yellow in colour and embedded in a brownish matrix within the host cell. No appendages or haustorial processes of any kind have been observed in young resting sporangia. Mature sporangia measure $15-32 \approx 10-12 \mu$.

Germination studies were carried out by placing teased sporangia on slides. At room temperature of 24° C. germination was observed after 3 days incubation. Germination took place by the protrusion of the endosporangium and pushing aside of the operculum. 30 to 40 zoospores are differentiated and these escape out by the rupture of endosporangium. Zoospores are ovate to subspherical, with a long flagellum and an excentric refractive globule. Comparative

*) Part. I. Bull. Torrey Bot. club. 1954. — Part. II. Sydowia 8: 90—95, 1954.

studies have indicated that the fungus represents an undescribed species, and the name *Physoderma chrysopogonicola* is proposed for its accomodation.

***Physoderma chrysopogonicola* Thirum. & Pavgi sp. nov.**

Inciting formation of leaden grey dull smooth spots, 1 to 3 mm. long, coalescing with each other to form long black stripes 2 to 3 cms. long, sori covered by a blackish-grey epithecium-like layer. Rhizomycelium intracellular, tenuous, branched. Resting sporangia chiefly in the epidermis, in a continuous layer, occasionally in the mesophyll, 1 to 2 in each cell, pale yellow, smooth, globose to sub-spherical, medium thick-walled, embedded in a brownish matrix of the host, $15-32 \approx 10-27 \mu$. Resting sporangium germinating by the protrusion of the endosporangium and pushing apart of the operculum. Zoospores uniflagellate, measuring $4 \approx 5 \mu$.

Hab. On leaves of *Chrysopogon* species, Pimpri, Poona, 29-6-1954, leg. M. J. Thirumalachar (Type).

Maculae lineares, 1-3 mm. longae, griseo-brunneae, saepe confluentes et striiformes, 2-3 cm. longae, epithecio tectae. Rhizomycelium tenue, intracelulare. Sporangia plerumque in epidermide, raro in mesophylli cellulis evoluta, 1-2 in quaque cellula, pallide lutea, levia, globosa vel subsphaerica, crassiuscule tunicata, matrixi brunneo-decoloratae immersa. Sporangia $15-32 \approx 10-27 \mu$. Sporangia perdurantia operculo dehiscentia et endosporio protruso germinantia. Zoosporae unciliatae $4 \approx 5 \mu$.

2. *Physoderma*-disease of *Bothriochloa pertusa* (L.) A. Camus.

On the leaves of *Bothriochloa pertusa* an important forage grass, a *Physoderma* species was collected soon after the rains in July. In some of the low lying areas in the fields where water had stagnated for few days and partially submerged the plants, the leaves showed heavy infection. While in the initial stages infection appears as deep purple violet spots 1 to 2 mm. long, they coalesce and form long streaks up to 1 cm. long. In due course, infection becomes systemic and the affected plants become dwarfened with shorter internodes. Infection becomes culmicolous, and in the new tillers regenerating the leaves appear slightly paler, and the sori appear as reddish-brown streaks over the entire plant surface (Fig. 5).

Sections through the sori reveal the rhizomycelium bearing numerous resting sporangia. The resting sporangia are distributed both in the epidermis and mesophyll (Figs. 3 and 5) and are heterosporous. They often assume the same shape as the host cells, especially in the trichomes of the epidermis and in the small irregularly shaped parenchymata (Fig. 6). In this respect it resembles *P. gerhardtii* Schroet. Mature resting sporangia are dark reddish-brown, irregular in shape,

and embedded in a brownish matrix within the host cell. The position of the operculum is obscure. The large-sized sporangia measure $20-37 \rightleftharpoons 17-29 \mu$ (mean $28 \rightleftharpoons 21 \mu$) and the small sized sporangia measure $13-20 \rightleftharpoons 10-17 \mu$ (mean $16.7 \rightleftharpoons 13 \mu$). Germination of the resting sponrangia has not been carried out.

Physoderma bothriochloae, Thirum. & Pavgi sp. nov.

Inciting formation of deep purple spots, fusoid, 2 mm. long, coalescent with each other and forming streaks up to 1 cm. Rhizomycelium tenuous, intracellular. Resting sporangia chiefly in the epidermal cells and mesophyll, often 1 to 3 in each cell, heterosporous, having same shape as host cell, embedded in brownish matrix within the host cell, dark reddish-brown, smooth. Larger sporangia measuring $30-37 \rightleftharpoons 17-29 \mu$ (mean $28 \rightleftharpoons 21 \mu$) and smaller sporangia $13-20 \rightleftharpoons 10-17 \mu$ (mean $16.7 \rightleftharpoons 15 \mu$).

Hab. On leaves of *Bothriochloa pertusa* (L.) A. Camus, Poona 8-9-1954, leg. M. J. Thirumalachar (Type). (Figs. 3 to 6).

Maculae purpureae, fusoid-striiformes 2 mm. longae, saepe confluentes, et tunc 1 cm. longae. Rhizomycelium intracellulare, tenue. Sporangia in epidermidis et in mesophylli cellulis evoluta, 1-3 in quaque cellula heterospora, interdum irregularia, rubro-brunnea, levia, matrici brunneo-decoloratae immersa. Sporangia majora $20-37 \rightleftharpoons 17-29 \mu$ (plerumque $28 \rightleftharpoons 21 \mu$), sporangia minora $13-20 \rightleftharpoons 10-17 \mu$ (plerumque $16.7 \rightleftharpoons 13 \mu$). Germinatio ignota.

3. A new *Physoderma* disease of *Iseilema laxum* Hack.

Iseilema laxum is a common pasture grass growing in moist situations, often forming a dense carpet. Soon after the rainy season and during the months of July to October, a *Physoderma* disease inciting abundant leaf spotting is commonly found in Poona. The infected leaves show numerous rose coloured flecks which are more abundant in the lower leaves than on the top ones. Diseased leaves dry up prematurely. In sections through the leaf spots, the rhizomycelium and the numerous resting sporangia may be observed. The latter are chiefly distributed in the epidermis and rarely in the mesophyll cells. Mature sporangia are spherical, golden yellow, smooth, measuring $21-34 \rightleftharpoons 17-36 \mu$ (mean $31.2 \rightleftharpoons 25 \mu$). The position of the operculum is obscure. Comparative studies have indicated that the fungus is undescribed, and the name *Physoderma dicksoni* is proposed, named in honour of Dr. James G. Dickson, Professor of Plant Pathology, University of Wisconsin, U.S.A.

Physoderma dicksoni Thirum. & Pavgi sp. nov.

Infection spots linear to fusoid, rose coloured flecks, minute, numerous, often covering the entire leaf surface, later turning olive

brown to grey, 2 mm. long. Rhizomycelium tenuous, intracellular. Resting sporangia chiefly in the epidermis, rarely in the mesophyll, 1—2 in each cell, pale golden yellow, ovate to subspherical, smooth, medium thick-walled, measuring $21-37 \Rightarrow 17-36 \mu$ (mean $31.2 \Rightarrow 25 \mu$).

Hab. On leaves of *Iseilema laxum* Hack., Pimpri, Poona, 8-9-1954, leg. M. J. Thirumalachar (Type). (Figs 7 and 8).

Maculae lineares utrinque saepe plus minusve attenuatae 2 mm. longae, minutae, roseae, numerosae. Rhizomycelium tenue, intracellulare. Sporangia plerumque in epidermide, raro in mesophyllo evoluta, 1—3 in quaque cellula, pallide aureo-lutea, ovata vel subsphaerica, crassiuscule tunicata, levia, $21-37 \Rightarrow 17-36 \mu$ (plerumque $31.2 \Rightarrow 35 \mu$).

4. A *Physoderma* leaf spot disease of *Paspalidium geminatum* Stapf.

On the leaves of *Paspalidium geminatum* a member of the *Panicoideae*, a *Physoderma* leaf spot disease was collected and examined during the month of September. As in the other species of *Physoderma* infection was restricted to the lower portions of the culms which was in close contact with water during the rains. The infection spots appear at first as linear yellowish-brown flecks, and gradually turn leaden grey in colour. When sectioned, the numerous resting sporangia are seen readily separating due to the disintegration of the host cells in which they are formed. Consequently when a mature sorus is scraped, the powdery mass of spores separating away from the host cells are seen. Mature resting sporangia are yellowish-brown, ovate to subglobose flattened on one side and indicating the position of the operculum, smooth and measuring $18.5-30 \Rightarrow 24-27 \mu$ (mean $24.8 \Rightarrow 20 \mu$). Comparison with other species on closely related hosts including *P. echinochloae* Thirum. & Whitehead indicated that the species is undescribed.

***Physoderma paspalidii* Thirm. & Pavgi sp. nov.**

Inciting formation of linear minute sori, yellowish-brown at first, later turning leaden-grey, sori often covering the entire plant, often crowded and coalescent, rupturing the surrounding mesophyll cells and releasing the spores free Rhizomycelium intracellular, tenuous. Resting sporangia 1—3 in each cell, distributed in the mesophyll and the epidermis, yellowish-brown, ovate to subglobose, thick-walled, measuring $18.5-30 \Rightarrow 14-27 \mu$ (mean $24.8 \Rightarrow 20 \mu$).

Hab. On leaves of *Paspalidium geminatum* Stapf., Pimpri, Poona, 8-9-1954, leg. M. J. Thirumalachar (Type) (Figs. 9 and 10).

Maculae lineares, minutae, primum flavo-brunneae, demum griseo-brunneae, saepe confluentes, sori pustulati. Rhizomycelium tenue, intracellulare. Sporangia in mesophyllo evoluta, 1—3 in quaque cel-

lula flavo-brunnea, ovata vel subglobosa, crassiuscule tunicata, 18.5—30 \Rightarrow 14—27 μ (plerumque 24.8 \Rightarrow 20 μ).

5. An undescribed *Physoderma* species on *Dactyloctenium aegypticum*.

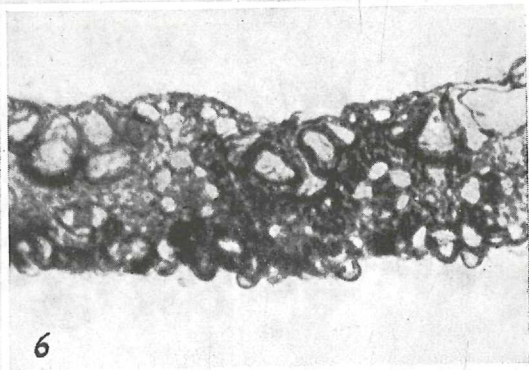
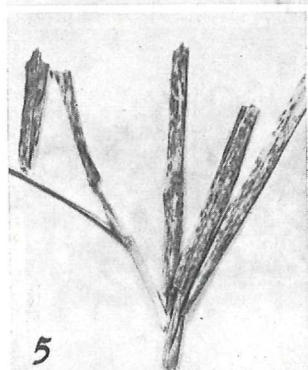
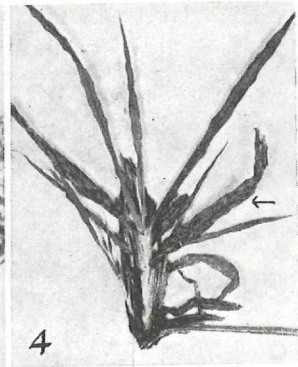
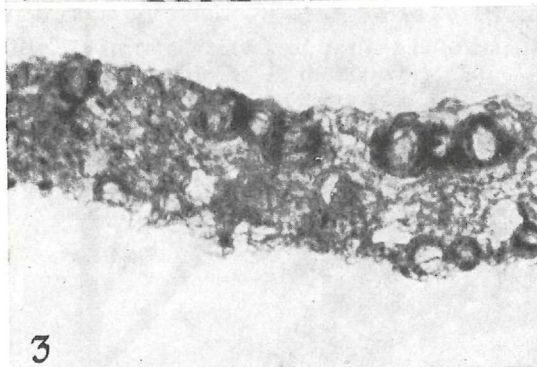
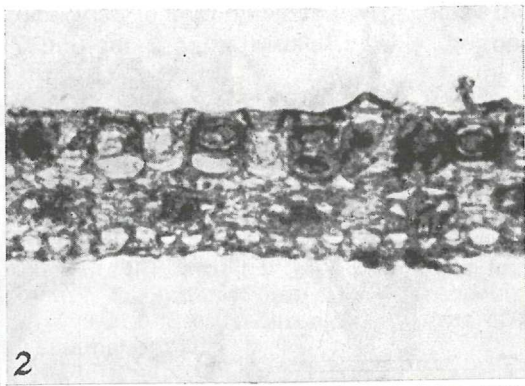
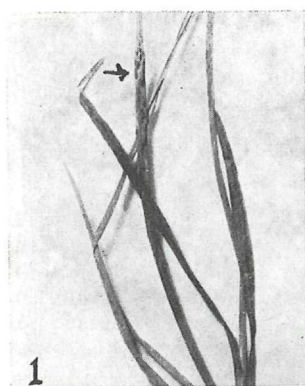
In a large patch of *Dactyloctenium aegypticum* Richt. plants in a low lying area in Pimpri, Poona, a *Physoderma* species was collected during the months of September and October. The diseased plants could be seen only with much difficulty since infection symptoms were very inconspicuous. On the leaves and the sheathing leaf base, linear minute reddish-brown streaks are seen which are 1 to 2 mm. long and slightly raised. Often the infection spots coalesced to form long streaks. The diseased leaves usually turned brown and wilted away prematurely. Sections through the leaves showed the tenuous rhizomycelium and numerous resting sporangia distributed in the epidermis and mesophyll cells. In the epidermal cells, the resting sporangia often assumed the same shape as the host cell, but within the mesophyll cells, they were subglobose to spherical, flattened on one side and revealing the position of the operculum. Mature sporangia are yellowish-brown, thick-walled, smooth, and measured 19—33 \Rightarrow 16—24 μ (mean 25.5 \Rightarrow 19.5 μ). The resting sporangia teased out of the sori were placed for germination on slides and incubated in moist chambers for periods of 3 to 5 days. About 20% of the resting sporangia were seen germinating after 4 days at incubation temperature of 24° C. by the formation of circumcissile lid of dehiscence and the protrusion of the endospore. From 16 to 32 zoospores were observed. Comparative studies indicate that the fungus represents an undescribed species, and the name *Physoderma narasimhanii*, named in honour of Dr. M. J. Narasimhan, Mycologist, Mysore, is proposed.

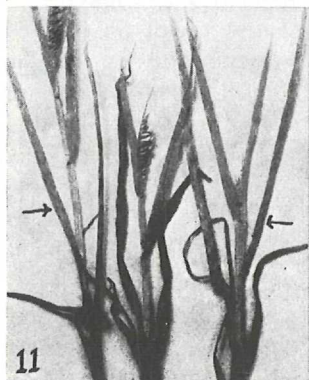
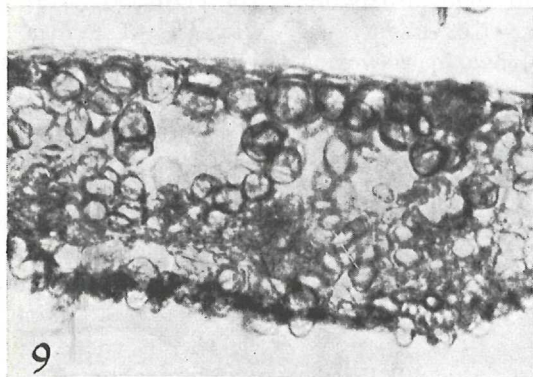
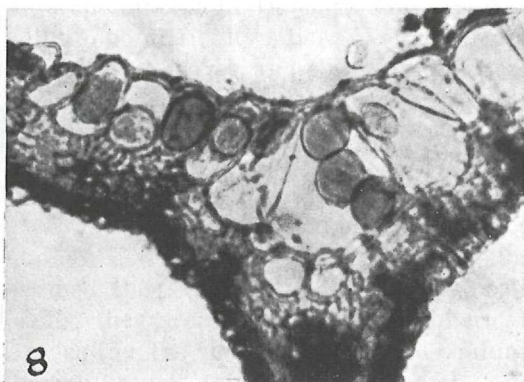
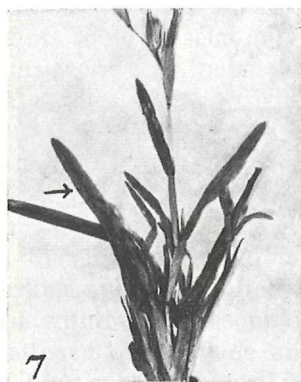
***Physoderma narasimhanii* Thirum. & Pavgi sp. nov.**

Sori on lower leaves, linear, 1 to 2 mm. long, numerous, often coalescing with each other, reddish-brown, slightly raised. Rhizomycelium intracellular, tenuous. Resting sporangia, distributed in epidermis and mesophyll, one in each cell, yellowish-brown, ovate to subglobose, flattened on one side, smooth, thick-walled, 19—33 \Rightarrow 16—24 μ (mean 25.5 \Rightarrow 19.5 μ). Resting sporangia germinating by the protrusion of endosporangium and pushing apart of the operculum. Zoospores uniflagellate measuring 5 μ in diameter.

Hab. On leaves of *Dactyloctenium aegypticum* Richt., Pimpri, Poona, 28-7-1954, leg. M. J. Thirumalachar (Type). (Figs. 11 and 12.)

Maculae lineares, 1—2 mm. longae, rubro-brunneae, numerosae, saepe coalescentes. Rhizomycelium tenue, intracellulare. Sporangia in epidermidis et mesophylli cellulis evoluta, in quaque cellula so-





litaria, flavo-brunnea, ovoidea vel subglobosa, levia, crassiuscule tunicata, $19-33 \approx 16-24 \mu$ (plerumque $25.5 \approx 19.5 \mu$). Sporangia perdurantia operculo dehiscentia et endosporangia protruso germinantia. Zoosporae uniciliatae, 5μ diam.

Hab. In foliis *Dactylotaeniae aegypticae* Richt., Pimpri, Poona, 28-7-1954, leg. M. J. Thirumalachar.

In conclusion the writers wish to acknowledge their indebtedness to Dr. Franz Petrak, Wien, for kindly translating the diagnoses of the new species into latin.

Explanation of Figs.

Plate I.

Fig. 1. Showing sori of *Physoderma chrysopogonicola* nat. size. — Fig. 2. Resting sporangia of the same, $\times 250$. — Fig. 3. Resting sporangia of *P. bothriochloae*, $\times 250$. — Fig. 4. Showing infection on lower leaves of *Bothriochloa pertusa*. — Fig. 5. Systemic infection on shoots on *B. pertusa* in the 2nd. year. — Fig. 6. Section through the sorus of the same. $\times 250$.

Plate II.

Fig. 7. Infected leaves of *Iseilema laxum*, nat. size. — Fig. 8. Showing resting sporangia of *P. dicksonii*, $\times 250$. — Fig. 9. Section through the sori of *P. paspalidii*, $\times 250$. — Fig. 10. Infection spots on *Paspalidium geminatum* leaves. — Fig. 11. Infected plants of *Dactylotaenium aegypticum*, nat. size. — Fig. 12. Resting sporangia of *P. narasimhanii* in the leaf tissue, $\times 250$.

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Autor(en)/Author(s): Thirumalachar M. J., Pavgi M. S.

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