

Some new or interesting *Physoderma* Species from India. II.

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With plate IV—V.

In a recent paper (1954) the writers described some of the interesting species of *Physoderma* collected from different parts of India, including two new species, *Ph. dichanthicum* and *Ph. brachiariae*. The study of *Physoderma* species have evoked considerable interest, primarily because it is a member of the chytriaceous group, and secondly of their rarity and interesting life-cycle. Their rarity may to some extent be due to the fact that many of the species incite very inconspicuous symptoms and are easily overlooked in the field. Few others such as *Ph. alfalfae*, *Ph. aeschynomene* and *Ph. limnanthemii* though incite conspicuous gall formations, are either subterranean or produce galls in submerged parts of the plant, so that it is by accident that one comes across with these forms.

All collections of materials for the present study have been made in the neighbourhood of the Banaras Hindu University. As was pointed out in previous paper, species of *Physoderma* are most commonly met with in particular habitats. They are mostly found in low lying patches in the fields which become water-logged during the rainy season between July to September. The plants that are submerged become exposed during September-October when the small puddles begin to dry up. In species such as *Ph. aeschynomene* the region of infection on plant become specifically demarcated to the submerged parts only. In the present study accounts of seven species of *Physoderma* are presented. They all produce inconspicuous spots on the hosts and none of them incite systemic infection. The type specimens of the new species have been deposited in the Herb. Crypt. Ind. Orient., New Delhi, Herb. C. M. I., Kew, England and Mycological Division, U.S.D.A., Beltsville, Maryland, U.S.A.

(1) A *Physoderma* leaf spot disease of *Cynodon dactylon* Pers.

After the first few showers of rain during July, a brown leaf spot disease of *Cynodon dactylon* was observed in a low lying patch in a field. The spots were minute, 2 to 3 mm. in diameter and more numerous on the lower leaves than on the upper ones. In cases of severe infection there was premature drying of the leaves. Micro-

scopic examination of the infection spots revealed the rhizomycelial strands and the numerous intracellular resting sporangia of *Physoderma* species. There were one to two resting sporangia within the infected cells. Comparative studies have indicated that the species is undescribed.

***Physoderma cynodontis* Pavgi & Thirumalachar sp. nov.**

Inciting the formation of roundish to elongate pale brown spots, 1 to 3 mm. long, 0.5 to 1.5 mm. broad, often coalescing with each other, slightly raised and surrounded by a yellow halo. Rhizomycelium tenuous, intracellular; resting sporangia in slightly hypertrophied mesophyll cells surrounding vascular bundles, 1 to 2 in each cell, yellowish-brown, ovate to subglobose, flattened on one side, smooth, thin-walled, measuring $15.7\text{--}38.5 \pm 11.5\text{--}28.5 \mu$ with a mean of $22.2 \pm 17 \mu$. Germination not observed. (Figs. 1 and 2).

Hab. On living leaves of *Cynodon dactylon* Pers., Banaras, U.P., leg. M. S. Pavgi, 15. VIII. 1953.

Maculae pallide brunneae, orbiculares vel ellipticae, $1\text{--}3 \pm 0.5\text{--}1.5$ mm, saepe confluentes, anguste flavo-marginatae. Rhizomycelium tenue, intracellulare; sporangia in cellulis mesophylli parum hypertrophice deformatis evoluta, fasciculos vasorum circumdantia, $1\text{--}2$ in quaque cellula, flavo-brunnea, ovoidea vel globosa, in uno latere applanata, levia, tenuiter tunicata, $15.7\text{--}38.5 \pm 11.5\text{--}28.5 \mu$, plerumque $22.2 \pm 17 \mu$; germinatio non observata.

Physoderma graminis (Busgen) de Wilde was previously described by the writers (1954) on the same host in Banaras. This species however, incites a systemic infection causing shortening of internodes and leaves and presenting a witches broom appearance. The resting sporangia of *Ph. graminis* are larger ($20\text{--}55 \pm 20\text{--}40 \mu$) than those of *Ph. cynodontis* ($15.7\text{--}38.5 \pm 11.5\text{--}28.5 \mu$). *Ph. gerhardtii* Schroeter parasitic on species of *Phalaris*, *Glyceria* and *Alopecurus* in Germany has slightly smaller spore measurements than *Ph. cynodontis*, an further, the resting sporangia of *Ph. gerhardtii* are spherical to lobate, following the same shape of the host cell.

(2) Leaf spot and shot hole disease of *Eriochloa procera* Hubb.

Infection on this host was manifest on the lower leaves which were submerged for short periods under water during the rainy season. The fungus incite severe spotting which were ovate to linear or irregular, 1 to 1.5 mm. long. often coalescent to form long streaks. In early stages the spots were surrounded by a yellow halo which became less distinct in later stages. The infection spots occasionally extended into leaf sheath also and hastened premature drying of the leaves. Shortly after drying of the leaves, the infected portion dropped

off leaving shot holes on the blades. Microscopic examination of the infection spots revealed the rhizomycelia and the resting sporangia of *Physoderma*. The resting sporangia were distributed within the entire mesophyll cells in the infection spot region, pale brown in colour, and smooth. The species differs from the other graminicolous species of *Physoderma* including *Ph. echinoclaoe*, *Ph. maydis*, *Ph. paspali*, *Ph. gerhardtii* and the imperfectly known *Ph. agrostidis*. The name *Physoderma eriochloae* is proposed.

***Physoderma eriochloae* Pavgi & Thirumalachar sp. nov.**

Infection spots circular to linear, 1 to 1.5 mm. long, reddish-brown, often coalescent, surrounded by a yellowish halo, infected portions dropping off and leaving a shot hole. Rhizomycelium tenuous, intracellular. Resting sporangia intraepidermal and within mesophyll cells, pale brown, globose to ovate, flattened on one side, medium thick-walled, smooth, measuring $14.5-23 \pm 11.5-17 \mu$, with a mean of $17.5 \pm 13.4 \mu$. Germination not observed. (Figs. 3 and 4).

Hab. On living leaves of *Eriochloa procera* Hubb. Banaras, U. P., leg. M. S. Pavgi, 18. VIII. 1953.

Maculae orbiculares vel lineares, 1—1.5 mm longae, rubro-brunneae, saepe confluentes, flavo-marginatae, postea collabascens, denique excidentis et foramina minuta relinquentes; rhizomycelium tenue, intracellulare; sporangia in epidermidis et in mesophylli cellulis evoluta, pallide brunnea, globosa vel ovoidea, in uno latere applanata, crassiuscule tunicata, levia, $14.5-23 \pm 11.5-17 \mu$, plerumque $17.5 \pm 13.4 \mu$; germinatio non observata.

(3) Tar spot disease of *Cyperus compressus* L.

On *Cyperus compressus*, an inhabitant of marshy places, a leaf spot disease was observed in September soon after the shallow pools to dry up. The infection spots were black, slightly raised, distributed mostly on leaves and rarely on peduncles, 1 to 1.5 mm. in diameter. Microscopic examination of the infected spots revealed the rhizomycelia and resting sporangia characteristic of *Physoderma*. They were embedded in a tannin-like matrix similar to those previously recorded for *Ph. dichanthicolum*. The description of the fungus is as follows:

Infection spots 1 to 1.5 mm. in diameter on the upper leaf surface and occasionally on peduncles, purple black, subglobose to polygonal, slightly raised when fresh, often coalescent with one another when in close proximity. Rhizomycelium tenuous; resting sporangia chiefly intraepidermal and also in mesophyll cells, one to two in each cell, embedded within purple pigmented matrix in the host cell. Mature sporangia ovate to spherical, yellowish-brown, flattened on

one side, smooth, $21.5-38.5 \Rightarrow 14.3-28.5 \mu$, with a mean of $26.9 \Rightarrow 18.6 \mu$.

Hab. on living leaves of *Cyperus compressus* L. Banares, U. P. leg. M. S. P a v g i. 1953. (Figs. 7 and 8).

The fungus closely resembles in description *Ph. schroeteri* Krieger first recorded on *Scirpus maritimus* in Germany, with resting sporangia measuring $23-36 \mu$ in diameter. Sydow and Butler (1907) recorded this fungus in India on *Scirpus supinus*. It is also reported from Hungary on *Heleocharis palustris* (Karling 1950). The fungus under study is now referred to *Ph. schroeteri*, and *Cyperus compressus* is a new host record.

(4) Brown leaf sheath spot of *Setaria glauca* Beauv.

Minute dark cinnamon-brown linear streaks were observed on sheaths of lower leaves of *Setaria glauca* plants growing in low-lying areas where rain water had accumulated and stagnated for some time. The infection symptoms very much resembled those incited by *Helminthosporium* or *Piricularia* species. The streaks are often masked by the premature drying up of the leaves and may be easily overlooked in the field. When fresh, the infection spots are slightly raised and may be felt with hand. The rhizomycelium is tenuous intracellular and may be observed in the early stages of infection. The resting sporangia are 2 to 3 in each cell, and pale yellowish-brown in colour. The fungus represents an undescribed species of *Physoderma*.

Physoderma setaricola Pavgi & Thirumalachar sp. nov.

Inciting dark olive-green to brownish streaks on leaf sheaths and stems, 1 to 1.5 mm. long, coalescent with each other, slightly raised. Rhizomycelium tenuous, intracellular. Resting sporangia intracellular, 2 to 3 in each cell, globose to ovate, pale yellowish-brown, flattened on one side, smooth, measuring $17.2-33 \Rightarrow 14.3-24.3 \mu$ with a mean of $22.6 \Rightarrow 18.7 \mu$. Germination not observed.

Hab. On leaves of *Setaria glauca* Beauv., Banaras, U. P., leg. M. S. P a v g i, 20. IX. 1953. (Figs. 5 and 6).

Maculae obscure olivaceae vel brunneolae, striiformes, 1—1.5 mm longae, saepe confluentes, indistincte tumescentes; rhizomycelium tenue, intracellulare; sporangia 2—3 in quaque cellula, globosa vel ovoidea, pallide flavo-brunnea, in uno latere applanata, $17.2-33 \Rightarrow 14.3-24.3 \mu$, plerumque $22.6 \Rightarrow 18.7 \mu$; germinatio non observata.

(5) *Physoderma* leaf spot disease of *Digitaria royleana* Prain.

A small patch of sickly looking plants of *Digitaria royleana* collected along the margin of a drying pool revealed the infection due

to *Physoderma* species. The spots were minute, pale brown, roundish to fusoid, 1 to 2 mm. in diameter. The resting sporangia were uniformly distributed in the mesophyll cells, yellowish-brown and smooth. The infected leaves showed premature yellowing and drying up.

***Physoderma digitariae* Pavgi & Thirumalachar sp. nov.**

Infection spots minute, brown, 1 to 1.5 mm. in diameter, slightly raised, often coalescent. Rhizomycelium intracellular, tenuous. Resting sporangia intracellular, ovate, globose to reniform, occasionally irregular, yellowish-brown, smooth, thin-walled, with a lateral depression, measuring $15.7-26 \rightleftharpoons 11.5-24.3 \mu$ with a mean of $20.8 \rightleftharpoons 17 \mu$.

Hab. On leaves of *Digitaria royleana* Prain, Banaras, U. P., leg. M. S. Pavgi, 22. IX. 1953. (Figs. 9 and 10).

Maculae brunneae, 1—1.5 mm diam., saepe confluentes, indistincte limitatae; rhizomycelium intracellulare tenue; sporangia intracellularea, ovoidea, globosa vel reniformia, interdum irregularia, flavo-brunnea, levia, tenuiter tunicata, e latere compressa, $15.7-26 \rightleftharpoons 11.5-24.3 \mu$, plerumque $20.8-17 \mu$.

(6) *Physoderma* leaf spot disease of *Aneilema nodiflorum* R. Br.

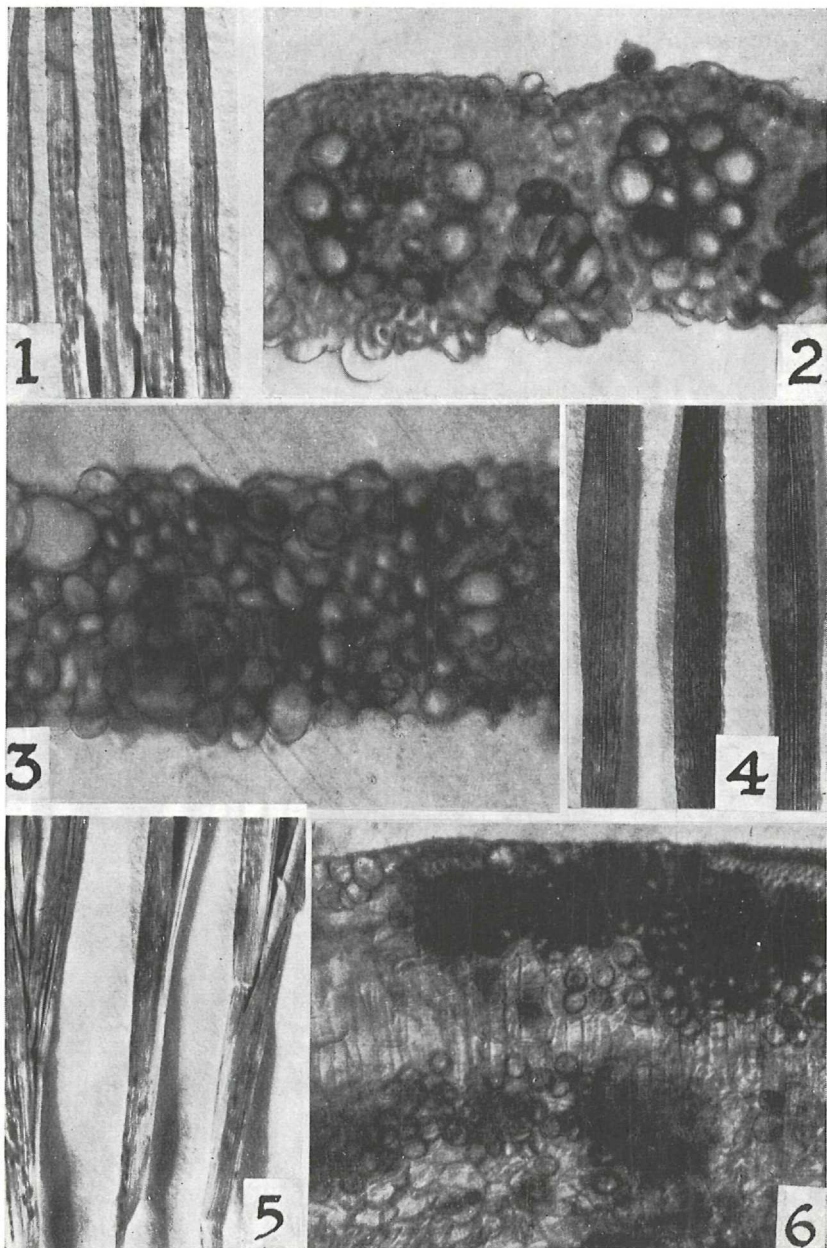
During the later part of September, some of the plants of *Aneilema nodiflorum* growing in marshy place showed greyish-black linear patches on leaves, 3 to 6 mm. long. Most of the leaves in the plants showed such spotting. Microscopic examination of the infection spots revealed the rhizomycelium and the resting sporangia of *Physoderma* species. Comparative studies indicated that it differed from other *Physoderma* so far known. No species of *Physoderma* has been recorded up-till now on any of the members of the *Comelinaceae* (Karling 1950).

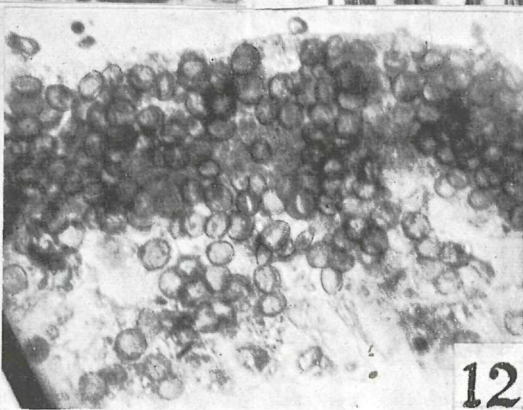
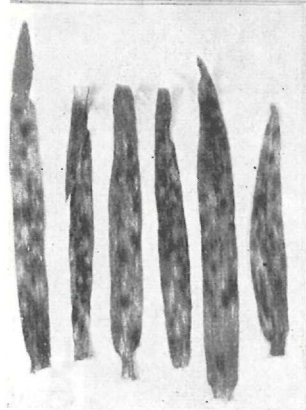
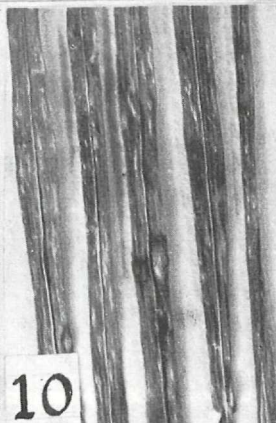
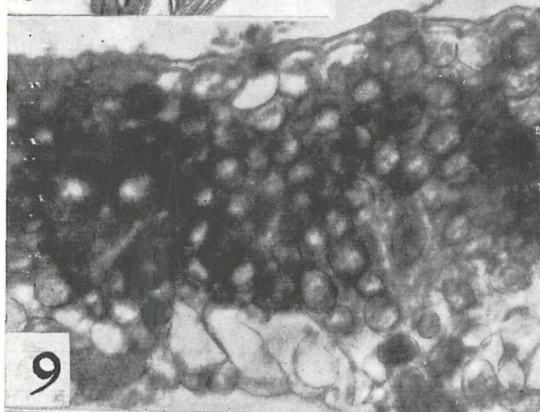
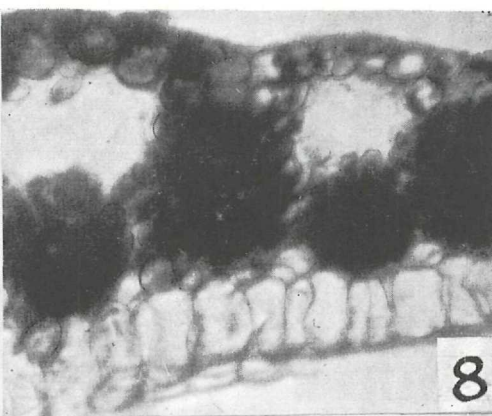
***Physoderma anellemae* Pavgi & Thirumalachar sp. nov.**

Infection spots greyish-brown, oblong linear, 3 to 8 mm. long, 1 to 2 mm. broad, slightly raised. Rhizomycelium intracellular, tenuous. Resting sporangia intracellular, ovate-globose, cinnamon-brown, smooth, thin-walled, $25.7-33 \rightleftharpoons 21.5-30 \mu$ with a mean of $29.4 \rightleftharpoons 26.5 \mu$. Germination not observed. (Figs. 11 and 12).

Hab. On living leaves of *Aneilema nodiflorum* R. Br., Banaras, U. P., leg. M. S. Pavgi, 10. IX. 1953.

Maculae griseo-brunneae, oblongo-lineares, 3—8 $\rightleftharpoons$ 1—2 mm, indistincte limitatae; rhizomycelium intracellulare, tenue; sporangia intracellularea, ovoideo-globosa, cinnamonea, levia, tenuiter tunicata, $25.7-33 \rightleftharpoons 21.5-30 \mu$, plerumque $29.4 \rightleftharpoons 26.5 \mu$. Germinatio ignota.





(7) *Physoderma echinochloae* Thirumalachar & Whitehead. Science 1953.

This species first reported from Patna, Bihar, appears to be well distributed in other parts of north India. At Banaras the infection on *Echinochloa crusgalli* was very severe and no plants seemed to be free from it. The diseased plants dry up prematurely.

In conclusion the writers wish to acknowledge their deep gratitude to Dr. Franz Petrak for kindly translating the diagnose of the new species into Latin.

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Explanation of plate IV—V.

Fig. 1. Infection spots on leaves of *Cynodon dactylon* $\times 1,25$ nat. size. — Fig. 2. T. S. of the leaf through sorus $\times 300$. — Fig. 3. Showing the resting sporangia of *Phys. eriochloae* $\times 300$. — Fig. 4. Infected leaf of *Eriochloa procera* $\times 0,75$. — Fig. 5. Infected leaf sheaths of *Setaria glauca* $\times 1,25$ nat. size. — Fig. 6. Showing the resting sporangia of *Phys. setaricola* $\times 200$. — Fig. 7. Infection spots on leaves of *Cyperus compressus* $\times$ nat. size. — Fig. 8. T. S. showing resting sporangia $\times 250$. — Fig. 9. Showing the resting sporangia of *Phys. digitariae* $\times 250$. — Fig. 10. Infection leaves of *Digitaria royleana* $\times 1,8$ nat. size. — Fig. 11. *Physoderma* spotting on leaves of *Aneilema nodiflorum* $0,85$ nat. size. — Fig. 12. T. S. showing resting sporangium $\times 180$.

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Zeitschrift/Journal: [Sydowia](#)

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

Artikel/Article: [Some new or interesting Physoderma Species from India. II. 90-95](#)