

## Species of *Pilobolus* and *Pilaira* from India

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The first elaborate account of the genus *Pilobolus* and *Pilaira* was presented by Buller (1934) in his Researches on Fungi (Vol. VI) which included Grove's monographic treatment of these two genera. Since then Mc Vickar (1942) has reported three additional species of *Pilobolus*, namely *Pilobolus simplex*, *P. proliferens*, and *P. ramosus*, and Boedijn (1958) reported a new species from Indonesia, viz., *Pilobolus hyalosporus*. In all, nearly twenty one species of *Pilobolus* are known. Grove (1934) has described five species of *Pilaira* in his monograph and since then the number of species has not increased. Out of these five species, only *Pilaira anomala* Schröt. seems to be more common since it has been reported by a number of workers dealing with soil fungi.

Previous reports from India are: *Pilobolus crystallinus* Tode and *P. longipes* van Tiegh. by Mahju (1933) from Punjab, *Philobolus kleinii* van Tiegh. by G in a i (1936) from Punjab, and *Pilobolus roridus* van Tiegh. and *P. nanus* van Tiegh. by R u g m i n i (1956) from Sagar. Therefore in all five species of *Pilobolus* and none of *Pilaira* have been reported from India.

No concerted attempt seems to have been made to find out the species of *Pilobolus* and *Pilaira* present in India. The present investigation is the first attempt in this direction. Ten species of *Pilobolus* and one of *Pilaira* have been studied. Out of these six are new reports from India.

### Key to the species of *Pilobolus* (Known in India)

- |  |                        |
|--|------------------------|
| A. Sporangiohores long (usually above 4 cm), trophocysts very long         | <i>P. longipes</i>     |
| AA. Sporangiohores short (usually less than 4 cm), trophocysts or napiform | B                      |
| B. Sporangiohores disposed in bundles, sporangia yellow                    | <i>P. nanus</i>        |
| BB. Sporangiohores usually single, sporangia not yellow                    | C                      |
| C. Sporangiospores globose or subglobose                                   | D                      |
| CC. Sporangiospores ellipsoidal and elliptic only                          | E                      |
| D. Sporangiospores double-walled   | <i>P. oedipus</i>      |
| DD. Sporangiospores single-walled  | F                      |
| E. Sporangiospores heterosporus  | <i>P. heterosporus</i> |
| EE. Sporangiospores not heterosporus                                       | G                      |
| F. Sporangiospores with deep yellow contents, 8—15 $\mu$ in                | <i>P. borzianus</i>    |

- FF. Sporangiospores colourless, yellowish in mass, 6.5—12.5  $\mu$   
in diameter *P. sphaerosporus*
- G. Sporangium umbonate in shape *P. umbonatus*
- GG. Sporangium rounded above H
- H. Sporangiospores mostly larger than 10  $\mu$  *P. kleinii*
- HH. Sporangiospores less than 10  $\mu$  I
- I. Sporangiospores 5.0—11.5  $\times$  2.5—5.0  $\mu$   
(mostly 7.5  $\times$  5.0  $\mu$ ) *P. crystallinus*
- II. Sporangiospores 3.—7.5  $\times$  2.0—3.5  $\mu$  (mostly 5  $\times$  3.3  $\mu$ ) *P. roridus*

*Pilobolus longipes* Van Tieghem Trois. Mém. in Ann. Sci. Nat.  
ser. 6, vol. iv, pp. 338—340, pl. 10, f. 11—15, 1876. Figs. 25—33.

Mycelium submerged; trophocysts usually external to the substratum, elongated horizontally, 100—500  $\mu$  long, cylindrical and tapered at one end, giving rise to a sporangiophore at the other end; sporangiophores 2—5 cm in length, occasionally 4—8 cm, cylindrical, smooth, erect, unbranched, phototrophic; subsporangial swelling oval, 200—800  $\mu$  broad, 300—850  $\mu$  long; sporangium globose, black, cutinised, 100—600  $\mu$  in diameter, wet, many-spored; columella broadly conical, bluish black, 100—250  $\mu$  long, 120—182  $\mu$  broad; sporangiospores smooth, globose or ovoid, thick walled, contents yellow orange, 8—12  $\mu$  in diameter (oval ones 6—10  $\times$  4.5—6  $\mu$ ). Zygospores and chlamydo-spores not seen.

The description of the present isolate has been based on the culture isolated from horse dung at Allahabad. Slide preparation has been deposited in BSM Culture Collection, Botany Department, University of Allahabad, India under No. Mx. 90. This species is easily differentiated by large globose spores, its elongated trophocysts and very long sporangiophores.

It was first reported in India by Mahju (1933) on dung of buffalo, horse and sambhar, and G in a i (1936) has reported from dung of cow, donkey and buffalo.

*Pilobolus nanus* Van Tieghem Trois. Mém. in Ann. Sci. Nat.  
ser. 6, vol. iv, pp. 340—342, pl. 10, f. 16—22, 1876. Figs. 46—48.

Mycelium submerged, fruiting primordium at first yellow; trophocysts submerged, intercalary; sporangiophores erect, cylindrical, 0.5 mm—1.0 mm high, sometimes arising singly or in groups of two or three, non-septate, unbranched, smooth, phototrophic; subsporangial swelling subglobose, hyaline, 90—350  $\mu$  in length, 100—400  $\mu$  in width; sporangia globose, with the membrane of the upper part cutinised and yellow, 100—200  $\mu$  in diameter; columella “depressed-convex”; sporangiospores globose or ovoid, hyaline, yellow in mass, 3.75—6.0  $\mu$  in diameter. Zygospores and chlamydo-spores not seen.

Description based on the isolate from rat dung at Allahabad. Preparation of the slides have been deposited in BSM Culture Collection, Botany Department, University of Allahabad, India under No. Mx-92.

It was first reported from India by G i n a i (1936) on dung of nilghai and donkey.

*Pilobolus oedipus* Mont. Mémoire sur le genre *Pilobolus* in Ann. Soc. Linn. de Lyon, pp. 1—7, f. a—i, 1823. (Figs. 14—17).

Mycelium submerged; trophocyst roundish or napiform, filled with yellow protoplasmic contents, submerged; sporangiophores reddish, form a thick turf above the substratum, usually short, nonseptate, smooth, variable in length, unbranched, 0.5—2.0 mm (or even 3—6 mm in length); subsporangial swelling ovoid or hemispherical, black, 200—040  $\mu$  in width, 400—600  $\mu$  in length, thin walled, smooth, hyaline, faint yellow or orange at the base; sporangia hemispherical. Occasionally in the form of a hexagonal archlike structure, large, almost as wide as the subsporangial vesicle, black, heavily cutinised, 100—500  $\mu$  in width, 110—300  $\mu$  in length; columella conical or subcylindrical, slightly narrowed in the middle, sometimes so high that it reaches almost to the top of the sporangium; 100—150  $\mu$  in width, 80—110  $\mu$  in length, smooth, thin-walled; sporangiospores globose, yellowish-red, 7.8—15.0  $\mu$  in diameter, with a wall composed of two distinct layers, of which the epispore is thick and often bluish while inner is thin and yellowish in colour.

Description based on a isolate from human excreta at Allahabad. Preparation of slides have been deposited in BSM Culture Collection, Botany Department, University of Allahabad under No. Mx-86. — It is being reported here for the first time from India.

*Pilobolus heterosporus* Palla, Zur Kenntniss der Pilobolus-Arten, in Oesterr. Bot. Zeitschr. vol. 50, p. 349, pl. 10, f. 1—5, 1900. (Figs. 49—52).

Submerged mycelium distended; trophocyst usually submerged in substratum, ellipsoid, rarely globose, yellow, thick walled; sporangiophores cylindric, erect, phototrophic, smooth, nonseptate, unbranched, variable in length, yellow in colour; subsporangial swelling ovoid or ellipsoid, 200—600  $\mu$  high, 100—350  $\mu$  broad, provided at the insertion of the columella with a thin narrow annular zone; sporangia broad, deep-black, heavily cutinised, 100—350  $\mu$  broad; columella more or less deeply constricted in the middle, rounded at the apex, reaching nearly to the top of the sporaigium; sporangiospores yellow or orange-red, thin-walled, ellipsoid, oval, 6.5—12.5  $\mu$  in length, 3.75—9.5  $\mu$  inwidth. Zytospores and chlamyospores not been.

Despription based on the isolates collected from the dung of rat, cow and pea-cock at Allahabad. Preparation of the slides have been deposited in BSM Culture Collection, Botany Department University of Allahabad, India, under No. Mx-93.

It is being reported here for the first time from India.

*Pilobolus borzianus* Morini, Mem. Accad. Sci. It. Bologna, ser. 6, vol. III, p. 126, f. 3—10 (1906).

Mycelium submerged; trophocysts ovoid, sporangiophores arising in group of two to four, cylindrical, phototrophic, smooth, nonseptate, unbranched, variable in length, 1.0—6 mm high; 100—250  $\mu$  in width; subsporangial swelling globose, subglobose or shortly ovoid, 100—350  $\mu$  high, 80—300  $\mu$  broad, almost colourless or quite hyaline; sporangium globose, much flattened from above, 100—300  $\mu$  in diameter, bluish-black, heavily cutinised, wet, many spored; columella hemispherical or conical, 60—100  $\mu$  high, 80—240  $\mu$  broad near the base; sporangiospores spherical, deep yellow, 8—15  $\mu$  in diameter. Zygospores and chlamydo-spores not seen.

Description based on an isolate collected from the soil at Allahabad. Slide preparations have been deposited in BSM Culture Collection Botany Department, University of Allahabad, under No. Mx-87. — It is being reported here for the first time from India.

*Pilobolus sphaerosporus* Palla, Zur Kenntnis der Pilobolus-Arten in Österr. Bot. Zeitschr. vol. 50, p. 400, pl. 10, 1900.  
(Figs. 24—26).

Mycelium submerged; trophocyst napiform in shape, buried in the substratum, dark brown, smooth walled, intercalary; sporangiophores arising singly from the trophocysts, cylindrical, smooth, phototrophic, erect, nonseptate, unbranched, variable in length, light brown in colour, 1.08 mm—2.0 mm in length, 80—100  $\mu$  in width, sub-sporangial swelling ellipsoid, 400—500  $\times$  350—450  $\mu$ , smooth, upper half with yellowish content; sporangia globose, subglobose, at maturity black in colour with colourless base, heavily cutinised, wet, many-spored, 30—400  $\times$  240—350  $\mu$ ; columella conical, smooth, at first colourless later yellowish in colour; 100—160  $\mu$  long, 80—180  $\mu$  wide; sporangiospores subglobose to globose, thin-walled, smooth, yellow or orange, variable in size, 6.5—12.5  $\mu$  in diameter. Zygospores and chlamydo-spores not seen.

Description of the above species is based on the isolates from various dung of cat, pea-cock and cow at Allahabad. Slide preparations have been deposited in BSM Culture Collection, Botany Department, University of Allahabad under No. Mx-89. — It is being reported here for the first time from India.

*Pilobolus umbonatus* Buller, Researches on Fungi, London, vol. VI, pp. 169—178, 1934.  
(Figs. 9—13).

Mycelium submerged; trophocyst oval to napiform, terminal or intercalary; sporangiophores single, 1.5—5.0 mm in length, 80—250  $\mu$  in width, smooth, cylindrical, light brown in colour, variable in length,

nonseptate, unbranched, phototrophic; sub-sporangial swelling ellipsoid, sometimes ovoid, 90—500  $\mu$  in length, 80—400  $\mu$  in width, with pale to orange-red band of protoplasm at the junction of the sporangiophore and the subsporangial swelling; sporangia umbonate in shape and more-or-less conical, 160—320  $\mu$  in length, 100—200  $\mu$  in width or about one-half the diameter of subsporangial swelling, shrinking on drying after discharge and becoming acutely pointed, black, heavily cutinised; columella very bluntly conical or rounded, grayish, distinctly darker than the subsporangial swelling; sporangiospores ellipsoid, oval, hyaline, yellow in mass, smooth,  $5.0\text{--}8.0 \times 3.7\text{--}4.4 \mu$ . Zygospores and chlamyospores not seen.

The above description is based on an isolate collected from cow dung at Allahabad. Slide preparations of the isolate have been deposited in BSM Culture Collection, Botany-Department, University of Allahabad, under No. Mx-85.

It is being reported here for the first time from India.

The present isolate differs from the description of this species given by Buller (1934) in spore size which is slightly more.

*Pilobolus kleinii* van Tieghem. Trois. Mém. in Ann. Sci. Nat. ser. 6, vol. iv, pp. 337—8, pl. 10, fig. 6—10, 1876. (Figs. 34—45).

Mycelium submerged; trophocyst ovate-cylindrical, filled with orange red granular contents; sporangiophores cylindric, erect, phototrophic, smooth, nonseptate, unbranched, 1—6 (10) mm in length, 60—100  $\mu$  in width; subsporangial swelling ovoid or subellipsoid, 400—600  $\mu$  in length, 300—500  $\mu$  in width; sporangia dark black, heavily cutinised, subglobose to globose, more or less depressed, about two-third as wide as the length to nearly as wide; columella faint blackish, generally hyaline, broadly conical, but occasionally narrowed in the middle so that the apex resembles like a papilla; 150—180  $\mu$  long, 140—180  $\mu$  broad at the base; sporangiospores hyaline, in mass varying shades of orange-yellow, ellipsoid, smooth, thin-walled,  $8\text{--}15 \times 4\text{--}8 \mu$ . Zygospores and chlamyospores not seen.

Description based on the isolate collected from the dung of horse, donkey and goat at Allahabad. Slide preparations have been deposited in BSM Culture Collection, Botany Department, University of Allahabad, under No. Mx-91.

It was first reported from India by G in a i (1936) from dung of nilghai.

*Pilobolus crystallinus* Tode Schr. Natfo. Fr. Berlin, 5, S. 96, 1784. (Figs. 1—8)

Mycelium submerged; trophocysts ovate, often concealed in the substratum, terminal, sometimes intercalary; sporangiophores arising from trophocyst, smooth, cylindric, nonseptate, unbranched, phototrophic, pale

yellow in colour, 1.0—3.8 cm in length, mostly 2.5 cm, 200—250  $\mu$  in width; subsporangial swelling ovoid or elliptic ovoid, 150—450  $\mu$  in width, pale, orange-red; sporangia convex, from half as wide to nearly as wide as the subsporangial swelling; 220—450  $\mu$  in width, 40—300  $\mu$  long, at maturity fully black, wet, heavily cutisined, many-spored; columella conical, faintly blackish blue, 20—200  $\mu$  high, 150—300  $\mu$  broad; sporangiospores ellipsoid, yellowish or quite hyaline, 5.0—11.5  $\mu$  long, 2.5—5.0  $\mu$  broad, mostly 7.5—5.0  $\mu$ , thin-walled. Zygospores chlamydo-spores not seen.

Description of the present isolate based on the culture isolated from cow, buffalo and camel dung at Allahabad. Slide preparation of the isolate deposited in BSM Culture Collection, Botany Department, University of Allahabad, under No. Mx-84.

It was first reported in India by Mahju (1933) from dung of horse and buffalo and by G in a i (1936) from donkey and buffalo dung.

*Pilobolus roridus* (Bolt) Pers. Syn. meth. p. 118, 1801. (Figs. 18—21).

Mycelium submerged; trophocysts intercalary between two mycelial swellings, submerged, filled with granular contents, ovate in shape, orange in colour; sporangiophores arising from trophocysts, 1—1.5 cm in length, 80—150  $\mu$  in width, nearly colourless, cylindric, erect, phototrophic, non-septate, unbranched, smooth; subsporangial swelling oval or almost globose, upto 300—600  $\mu$  in diameter; sporangium nearly globose, black, heavily cutisined, terminal, 90—200  $\mu$  in length, 90—300  $\mu$  in width, wet, many-spored; columella convex, sometimes conical, bluish black, 80—120  $\mu$  high, 100—200  $\mu$  broad; sporangiospores ellipsoid, hyaline, 3.5—7.5  $\times$  2.0—3.5  $\mu$

Description based on the isolate collected from the dung of goat, rabbit and pea-cock. Preparation of slides have been deposited in BSM Culture Collection, Botany Department, University of Allahabad, No. Mx-88.

It was first reported from India by R u g m i n i (1956) from horse dung.

*Pilaira anomala* (Ces.) Schröter, Pilze, in Cohn's Kryptogamen-Flora von Schlesien, vol. iii, p. 211, 1889. (Figs. 53—56).

Mycelium submerged; sporangiophore single thread-like, nonseptate, 1—5 cm high, and 30—100  $\mu$  thick, very soon collapsing and forming a high loose, hyaline felt on which black sporangia appear as black points, long cylindric, without basal and subsporangial swellings, hyaline; sporangia terminal, globular thin, at first white then yellow, at maturity black with colourless base, wet, 60—300  $\mu$  in diameter, many-spored; columella large, disc like, flat or knob-shaped, persistent, smooth, colour-

less, 80—160  $\mu$  in width, 40—80  $\mu$  in length; sporangiospores elliptical, oval, hyaline, smooth, thin-walled, 6—10  $\times$  4—6  $\mu$ . Zygospores and clamydospores not seen.

Description based on the isolate collected from the dung of rat, cow and pea-cock at Allahabad. Preparation of the slides have been deposited in BSM Culture Collection, Botany Department, University of Allahabad, India under No. Mx-94. — It is being reported here for the first time from India.

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