

Diversity and distribution of macrofungi of Himachal Pradesh

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ABSTRACT

Taxonomy of wild macro fungi needs much importance as these are basic foundations of conserving and sustainable management of natural resource. Many fungi are at the edge of extinction due to loss of habitat destruction. The present study deals with diversity of 10 different species belonging to 10 genera in different eco-sites of Himachal Pradesh. Field surveys of wild mushrooms were conducted during the 2018-2020. All the specimens namely *Ophiocordyceps gracilis*, *Clavaria argillacea*, *Hygrophorus fuscopapillatus*, *Pisolithus tinctorius*, *Gymnopus peronatus*, *Amanita phalloides*, *Leotia lubrica*, *Cyptotrama asprata*, *Auriscalpium vulgare* and *Tylopilus balloui* have been studied for taxonomic features and illustrated over here.

Keywords: Ascomycetes, Basidiomycetes, fungal diversity, wild mushrooms

Himachal Pradesh is a state that lies in Western Himalayan region of India representing mountainous terrain with an altitude variation from 300-7000 mt. Due to marked topographic variations, its possess rich flora and also provide a congenial environment for various types of macrofungi especially mushrooms. As a part of research, we surveyed fungal diversity in different localities of Himachal Pradesh to explore region for new records. A brief account of ten wild mushrooms viz., *Ophiocordyceps gracilis*, *Clavaria argillacea*, *Hygrophorus fuscopapillatus*, *Pisolithus tinctorius*, *Gymnopus peronatus*, *Amanita phalloides*, *Leotia lubrica*, *Cyptotrama asprata*, *Auriscalpium vulgare* and *Tylopilus balloui* is described for their morphological and microscopic details. Among these 3 species namely *Clavaria argillacea*, *Hygrophorus fuscopapillatus* and *Tylopilus balloui* are new records for India.

MATERIALS AND METHODS

Standard terminology with adequate methods for collection, conservation and characterization of wild mushrooms was adopted (Atri *et al.*, 2005). Colour notations used is that of Methuen Handbook of colour (Korner up and Wanscher, 1978). Photographs of all the specimens were obtained by using digital camera. Identification of specimens was done by critical observations through relevant literature (Arora, 1986; Breitenbach and Kranzlin, 1984; Nooedeloos *et al.*, 1999). The photographs and microscopic details were given in figures 1-10.

RESULTS AND DISCUSSION

Taxonomic Details

1. *Ophiocordyceps gracilis* (Grev.) G.H. Sung, J.M. Sung, Hywel-Jones et Spatafora, 2007.



Fig.1. *Ophiocordyceps gracilis* (A-E): A-Stromata in natural habitat, B-Perithecia, C-Fragmented/part Ascospores, D-E Asci with multiseptate ascospores

Description

Stromata usually solitary or gregarious, capitate, straight or curved 5-7 cm long. Fertile portion apical, head globose, 2 cm in diameter, pale orange with raised dark dots of perithecia pore. Stipe up to 5-6 cm long, 1 cm broad, upper part whitish or lower portion pale

orange, smooth, solid. Perithecia immersed, elongate fusiform, 200-250 x 500-700 µm. Asci 250-500 µm long, 5-8 µm in width, cylindrical, with cap 4-5 x 5-10 µm. Ascospores filiform, up to 1-1.5 µm in width, multiseptate, soon breaking in to one celled fragment, 5-8 x 1-1.5 µm.

Collection examined - Narkanda, Shimla, India, VP Sharma and Ajeet Kumar (2500 mt MSL) Collection No. DMR136-19. Growing solitary to scattered among grass under conifers.

2. *Clavaria argillacea* Pers

Description

Fruiting bodies up to 10 cm long, 2 cm broad. Club shaped, initially pointed tipped then gradually turns to rounded or swollen head, surface dull pale yellow,

flesh soft, hard to detached, and stuffed to solid, stipe reduced. Taste and odour indistinctive. Basidiospores 9-12 x 4.5-5 μ m, ellipsoid to cylindrical, inamyloid. Basidia 19-32 x 8-10 μ m, Clavate, tetrasporic. Hyphal system monomitic. Hyphae up to 15 μ m in width. Clamp connections present.

Collection examined - Narkanda, Shimla Himachal India, VP Sharma and Ajeet Kumar (2500 mt MSL). Collection No. DMR 85-20. Growing scattered to gregarious on soil among grasses in sub-temperate region.

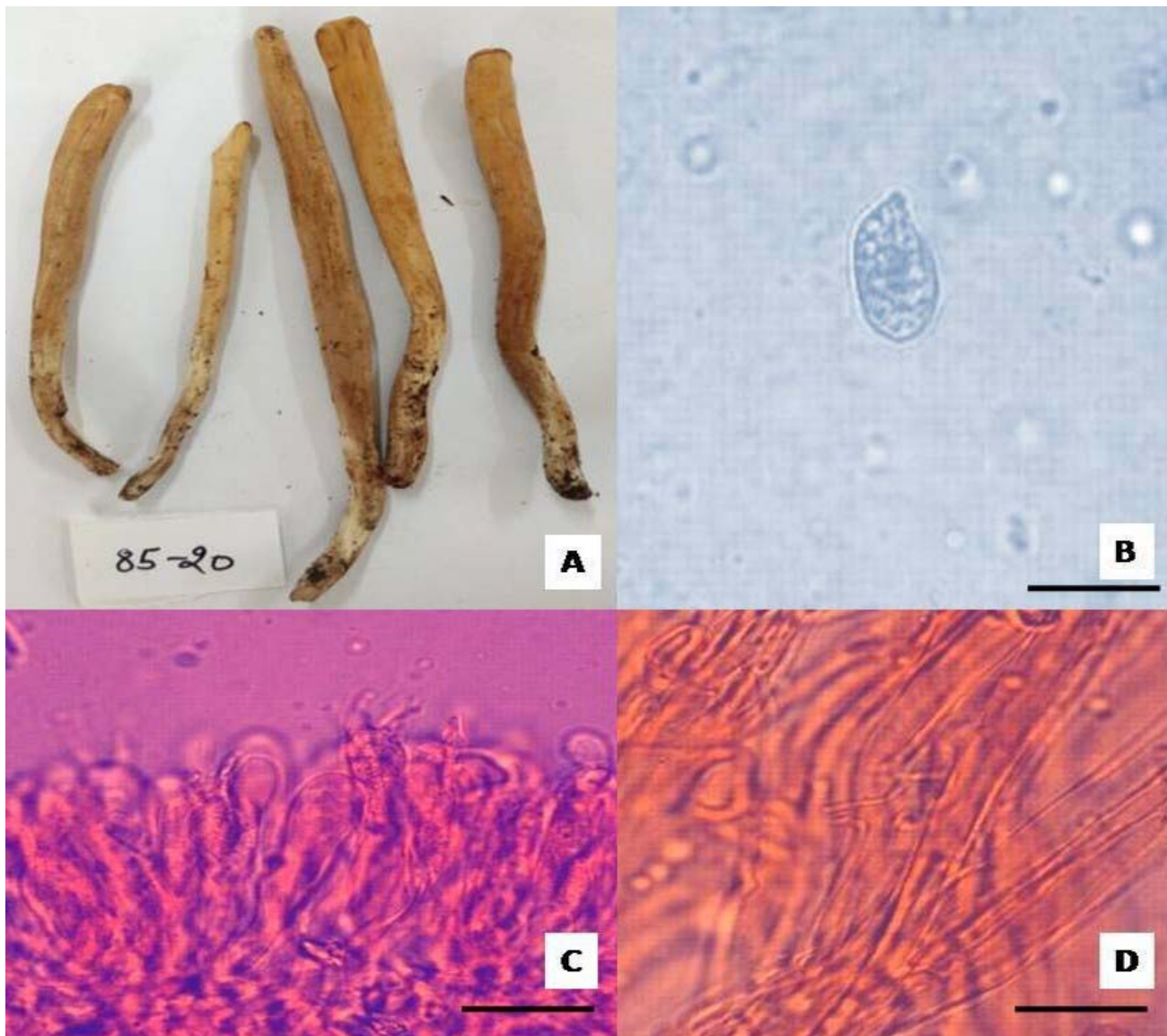


Fig.2. *Clavaria argillacea* (A-D): A-Carpophores, B- Basidiospores, C- Basidia, D-Hyphae

3. *Hygrophorus fuscopapillatus* C.Q. Wang & TH Li. 2020.

Description

Pileus up to 5 cm in diameter, convex to broadly campanulate, surface greyish white with small dark brown umbo, covered with brownish scales, stretching out fibres sticky initially. Lamellae adnexed to shortly decurrent, whitish, close, 0.4 cm broad, smooth. Stipe up to 10 cm long, 1 cm broad, white, covered with

small brown glandular dotted scales. Basidiospores 7-9 x 4.5-5 μm smooth, ellipsoid, inamyloid. Basidia 18-23.5 x 7-10 μm , clavate, tetrasporic, sterigmata up to 3 μm long. Cystidia absent. Hymenophoral trama divergent. Pileipellis a ixocutis of septate cylindrical elements. Clamp connections present.

Collection examined- Shimla, Himachal Pradesh, India. VP Sharma and Ajeet Kumar (2200 mt MSL). Collection No. DMR 104-19. Growing scattered or in groups in mycorrhizal association with conifers.

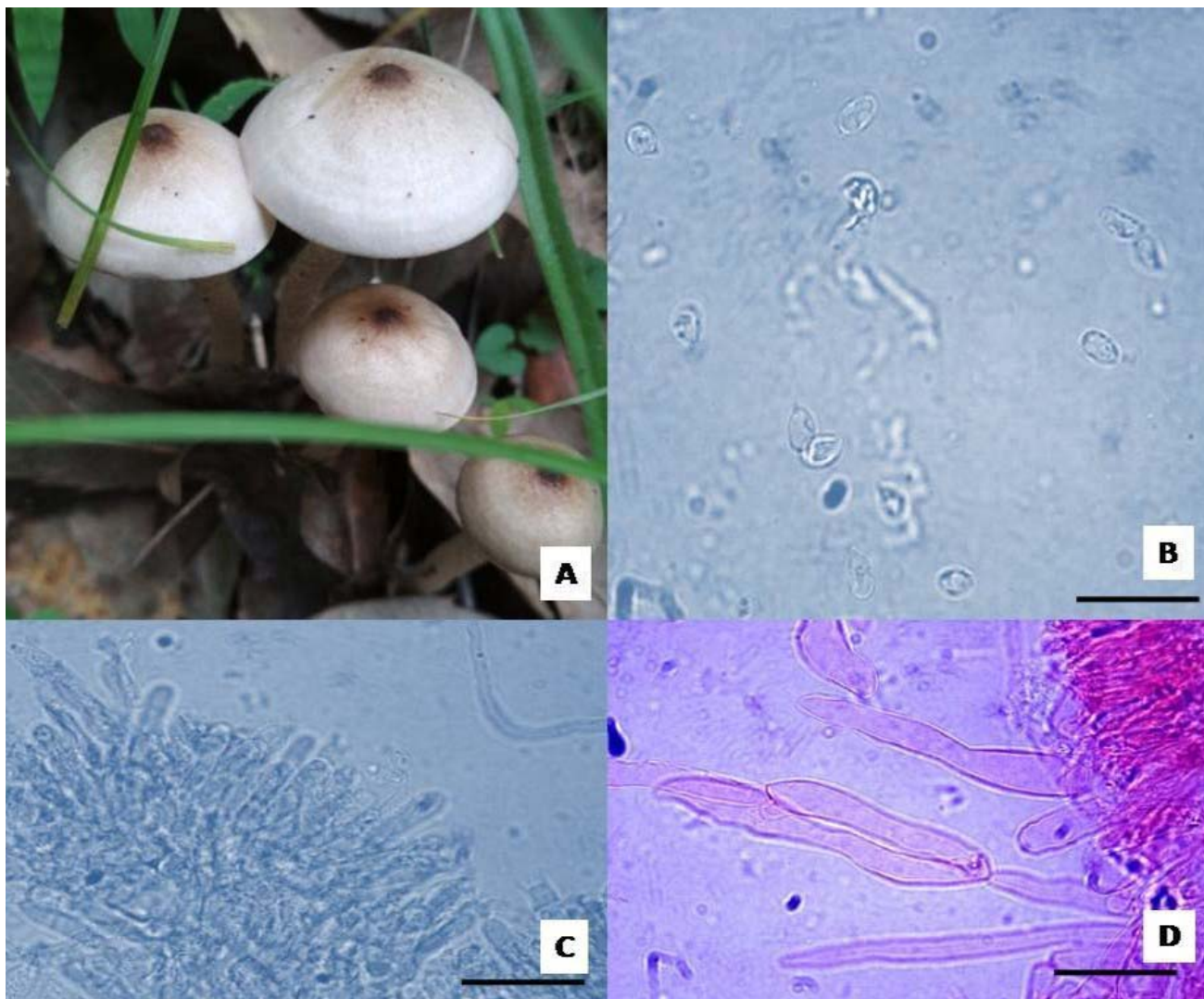


Fig.3. *Hygrophorus fuscopapillatus* (A-D): A-Carpophores in natural habitat, B- Basidiospores, C- Basidia, D- Tramal hypae

4. *Pisolithus tinctorius* (Pers.) Coker and Couch

Description

Fruiting bodies up to 8 cm across, ball to pear shaped brownish to yellowish, which exposed interior portion showing compactly arranged, pea sized yellowish, whitish brownish balls in blackish gelatinized matrix which gradually turns in to powdery spore mass. Basidiospores $7.12 \times 8.12 \mu\text{m}$, globose, thick

walled, dark brown, warty, isolated spines, up to $2 \mu\text{m}$ long, dense. Basidia not seen. Hyphae septate, multiple branched, clamped. Clamp connections present.

Collection examined- Basal, Solan HP, India. Anupam Barh (1600 mt MSL). Collection No. DMR 181-19. Growing solitary to scattered, in small groups rarely gregarious on ground, lawns, ditches, gravel, sandy soil, etc. in mixed forest.

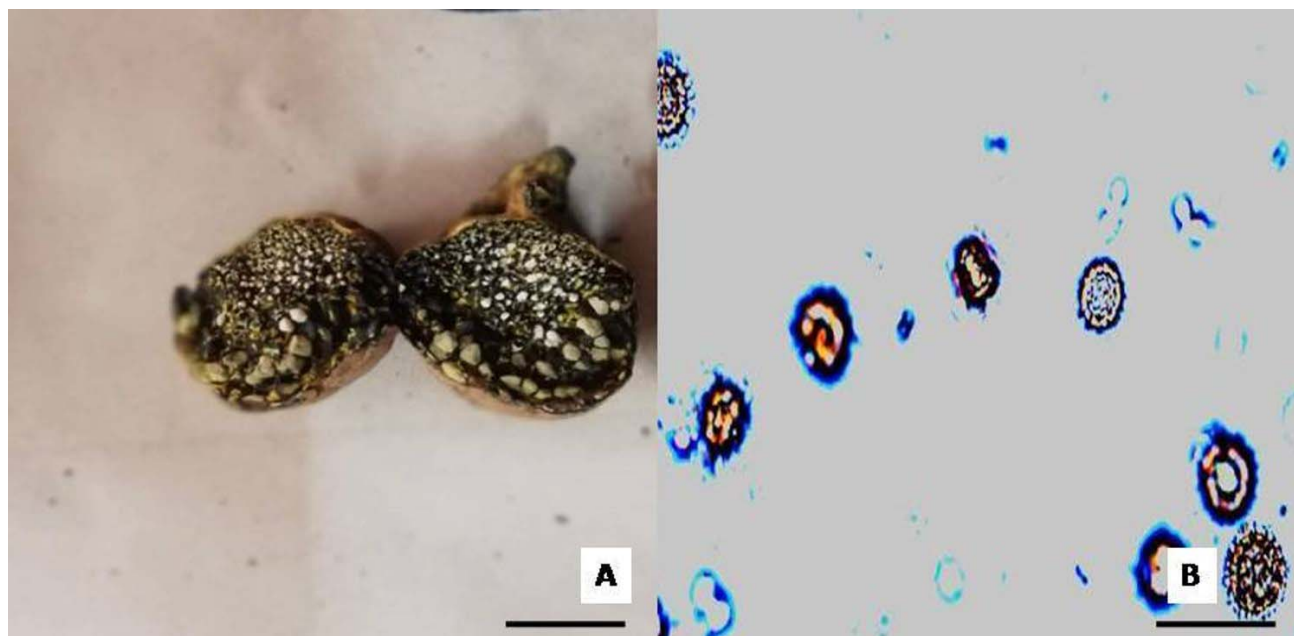


Fig. 4. *Pisolithus tinctorius* (A-B) A-Carpophores B- Basidiospores

5. *Gymnopus peronatus* (Bolton) Gray

Description

Pileus up to 6 cm in diameter, convex to plane at maturity, with small broad umbo, surface yellowish brown to pinkish brown. Wrinkled or shrunken cap surface on maturity. Lamellae free to adnexed, white to pinkish, closed, 0.4 cm broad. Stipe up to 8 cm long, 0.6 cm broad, whitish, covered with small whitish

scales, solid, equal. Basidiospores $8-10 \times 2.5-3.5 \mu\text{m}$, ellipsoid. Basidia $10-18 \times 5-7 \mu\text{m}$, clavate, tetrasporic, sterigmata up to $3 \mu\text{m}$ long. Cheilocystida numerous long clavate, tubular to pointed tipped, Irregular, $15-34 \times 7-12 \mu\text{m}$ in width. Clamp connections present.

Collection examined: Narkanda, Shimla HP. VP Sharma and Ajeet Kumar (2500 mt MSL). Collection No. DMR 140-19. Growing scattered or in groups, on conifer litter in mixed or coniferous forest.

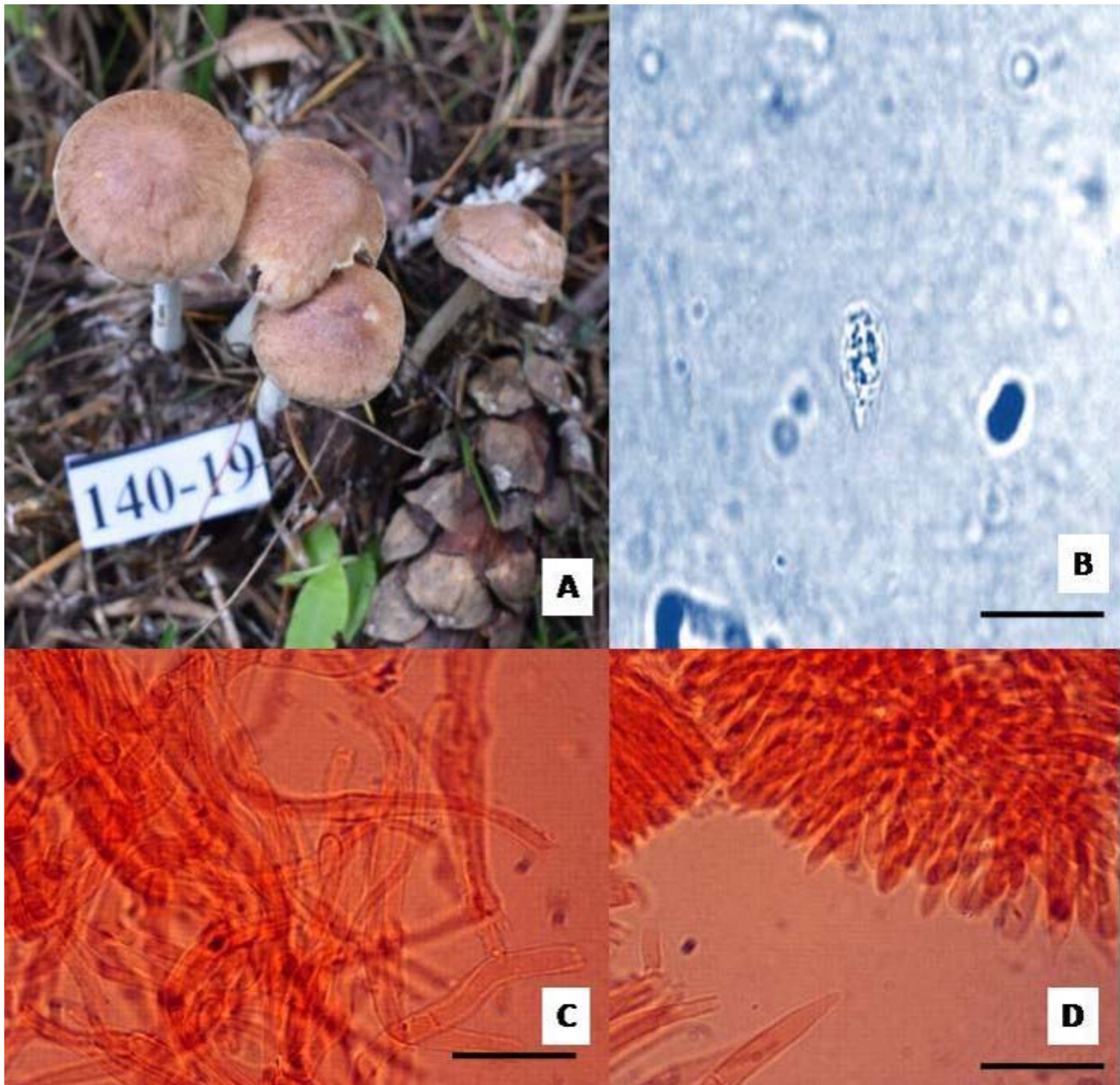


Fig. 5. *Gymnopus peronatus* (A-D): A-Carpophores in their natural habitat, B-Basidiospores, C-Hyphal system, D-Cystidia

6. *Amanita phalloides* (Vaill. Ex Fr.) Link (1833)

Description

Pileus up to 15 cm in diameter, initially egg shaped, convex to finally applanate, yellowish brown to olive green to yellow, surface sticky, glabrous, streaky appearance. Lamellae free, crowded, yellowish white, fleshy, 1.5 cm broad, smooth. Stipe central, cylindrical

up to 20 cm long 2 cm broad, equal, yellowish white, covered with minute yellowish fibrils, pendulate annulus, annulus skirt type, with basal saccate white volva. Basidiospores 7.5-12 x 5.5-8 μ m, ellipsoid to subglobose, amyloid. Basidia 33-49 x 8-13 μ m, clavate, tetrasporic, sterigmata up to 4 μ m long. Pileipellis an ixocutis of gelatinized cylindrical hyphae. Clamp connections absent.

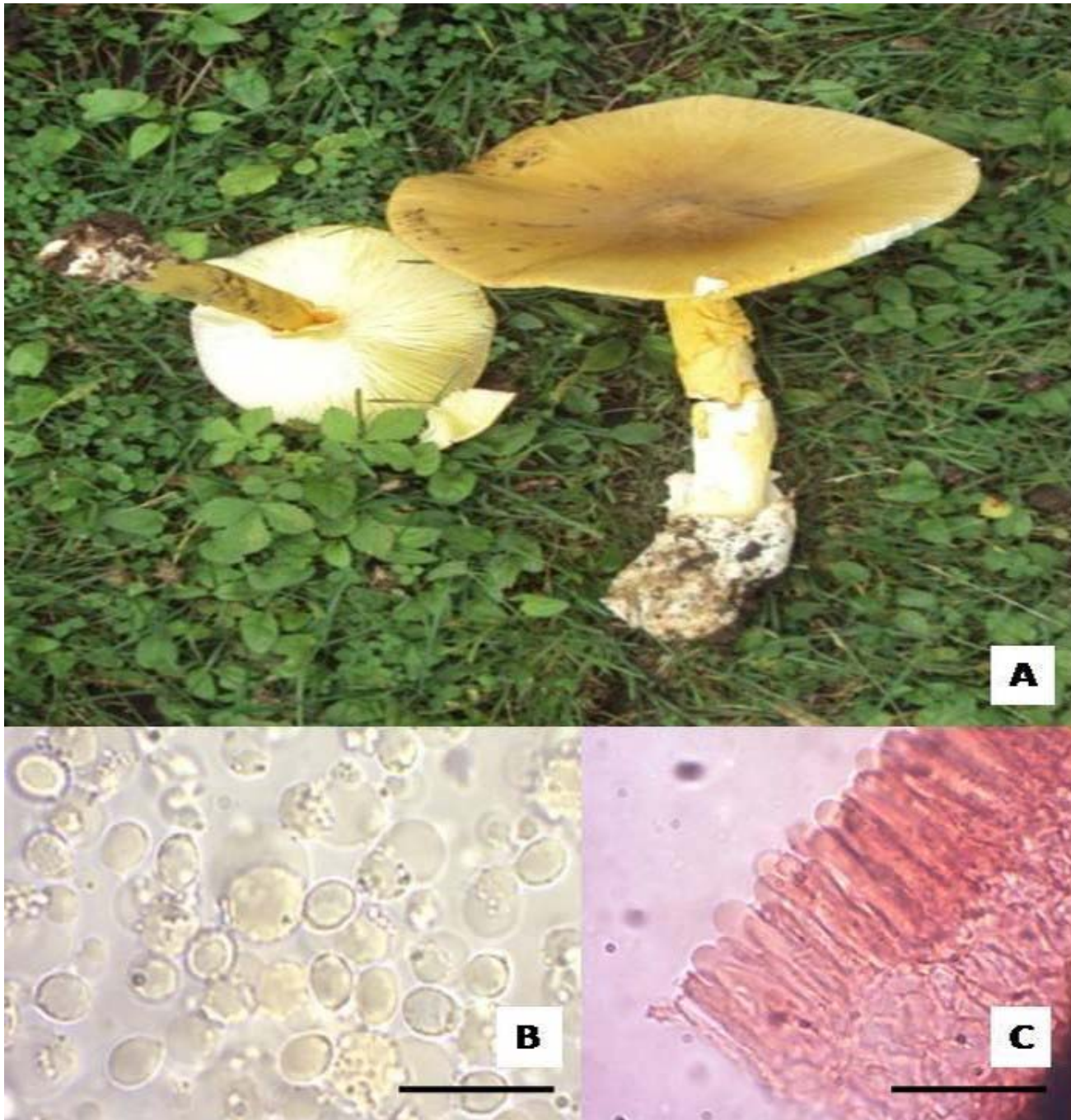


Fig.6. *Amanita phalloides* (A-C): A-Carpophores in their natural habitat, B-Basidiospores, C-Basidia

Collection examined: Narkanda, Shimla H.P.(2500 mt MSL).VP Sharma and Ajeet Kumar . Collection No. DMR 131-18. Growing solitary to scattered or even gregariously on soil among grasses and on leaf litter under coniferous trees.

7. *Leotia lubrica* (Scop.) Pers. 1797.

Description

Pileus up to 3 cm across, convex to convoluted irregular lobed head, clammy, smooth, sticky,

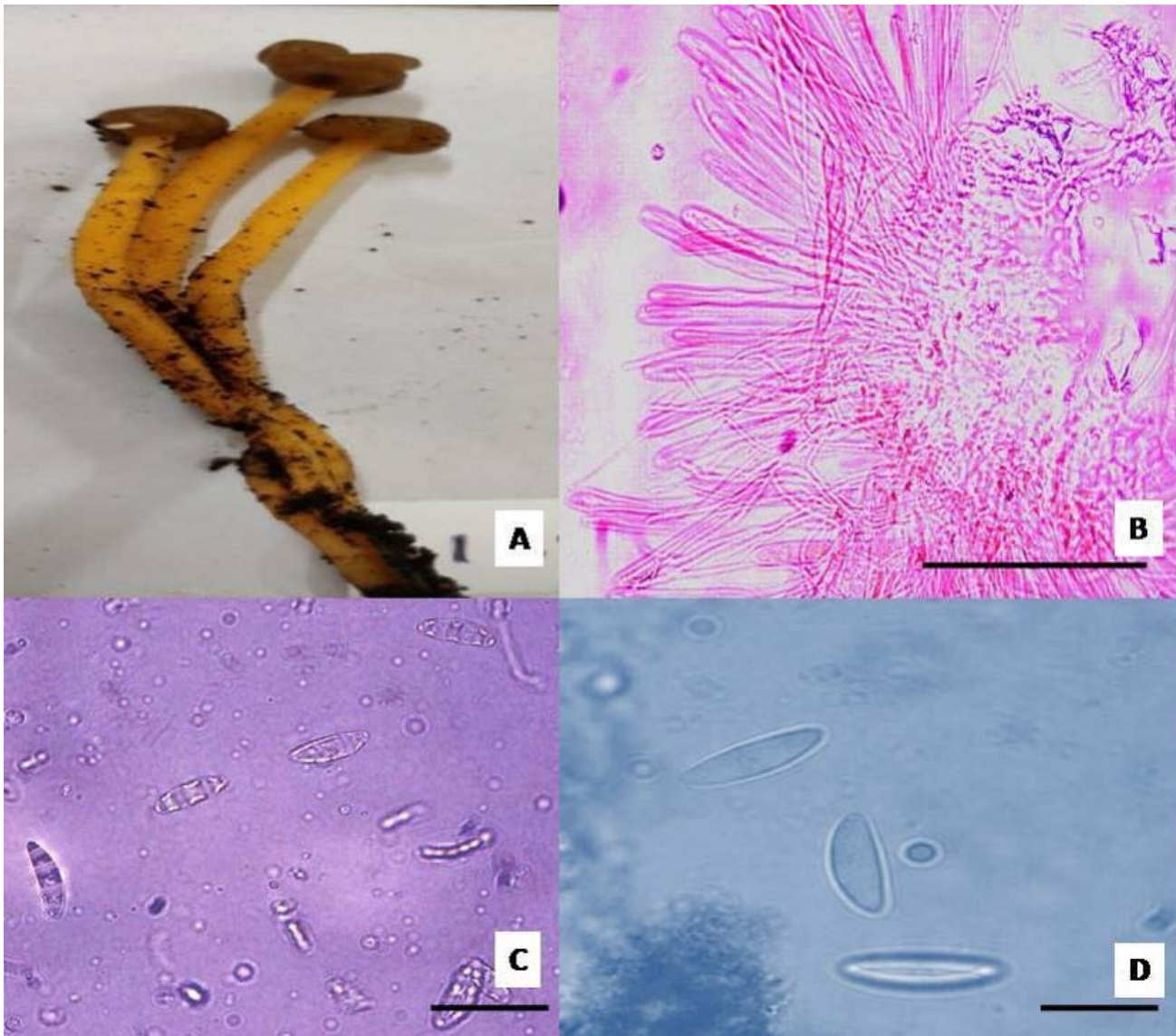


Fig. 7. *Leotia lubrica* (A-D): A-Carpophores, B-Asci and Paraphysis, C-D Ascospores

gelatinous, slippery, wrinkled, olive green to yellowish brown. Stipe up to 10 cm long, 1 cm broad, central, equal, yellowish brown with small pale granules, slimy, gelatinous, greenish on bruising, hollow, stuffed with gelatinous material. Ascospores 14-23 x 4-6 μm , subfusiform, curved, smooth, inamyloid, 3-7 septation on maturity giving banded appearance. Paraphysis cylindrical to narrowly clavate, branched up to 2 μm wide.

Collection examined- Chail , Solan HP. (2200 mt MSL). VP Sharma and Ajeet Kumar. Collection No.

DMR 189-20. Growing scattered and in gregarious clumps on soil among mosses in coniferous forest.

8. *Cyptotrama asprata* (Berk.) Redhead & Ginns (1980)

Description

Pileus up to 4 cm in diameter, convex to nearly plane on maturity, scaly, surface covered with prominent scales, granular, bright orange to yellow, sometimes with brownish tinge. Lamellae adnexed,

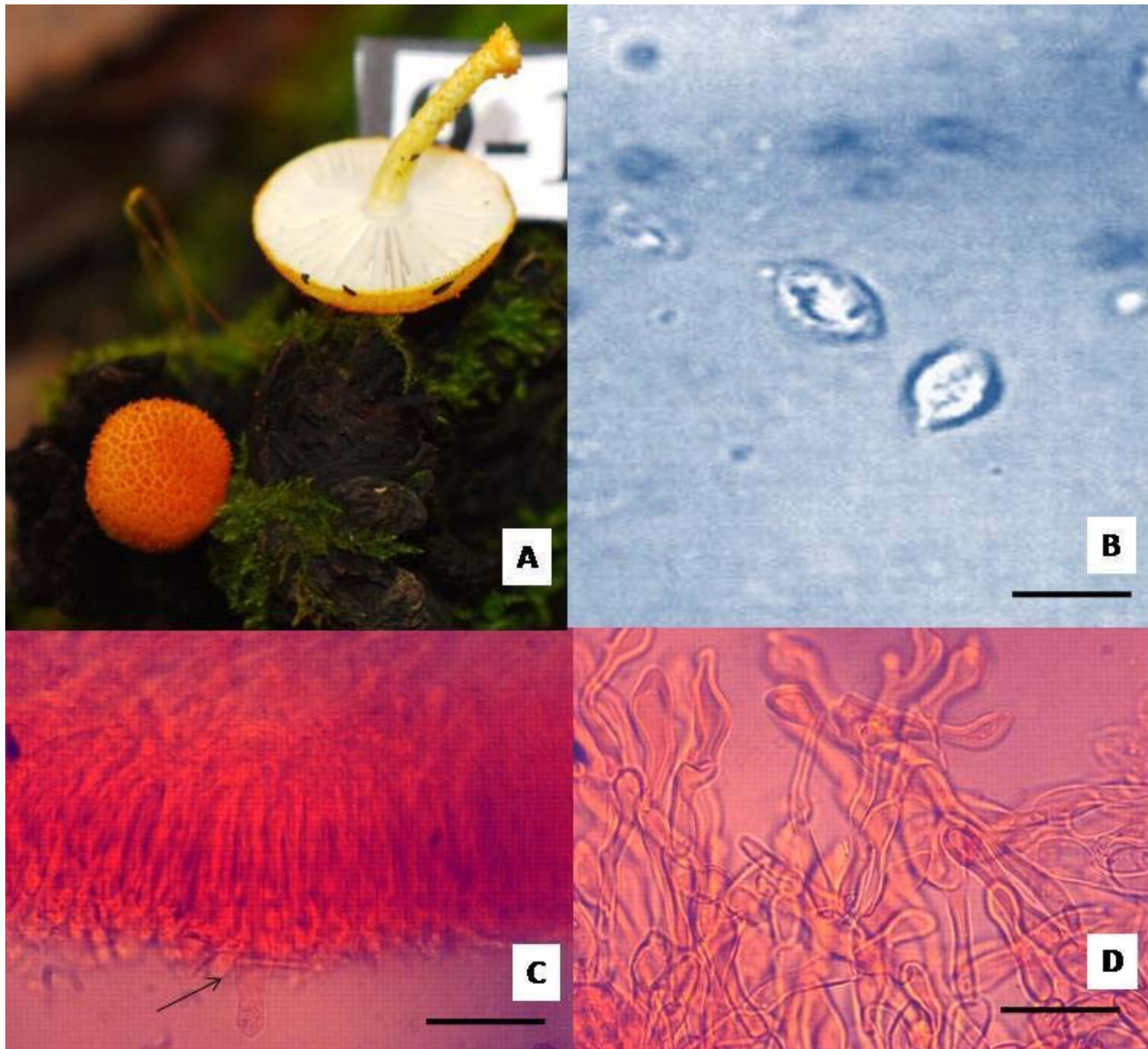


Fig. 8. *Cyptotrama asprata* (A-D): Carpophores in their natural habitat, B Basidiospores, C-Pleurocystidia, D- Pileal elements

distant, whitish, up to 2 mm broad, smooth. Stipe up to 5 cm long, 0.3 cm broad, equal with slightly swollen base, granular, scaly, yellowish to orange. Basidiospores 6.5-10 x 5.5.-7 µm, limoniform to lacrymoid, inamyloid, hyaline. Basidia 12-22 x 8-10 µm, narrowly clavate, tetrasporic, sterigmata up to 3 µm, long. Pleurocystidia and Cheilocystidia are similar, numerous, scattered, clavate to fusiform. Pileipellis a hymeniform of golden brown, clavate to pyriform thick layered elements, up to 15 µm in width.

Collection examined- Growing scattered to gregariously on decayed wooden logs, sticks of conifers. Shilly Forest Solan (1600 mt MSL). Babita Kumari and Anupam Barh.

9. *Auriscalpium vulgare* Gray 1821.

Description

Pileus up to 3 cm in diameter, semicircular, convex to kidney shaped, surface reddish brown to

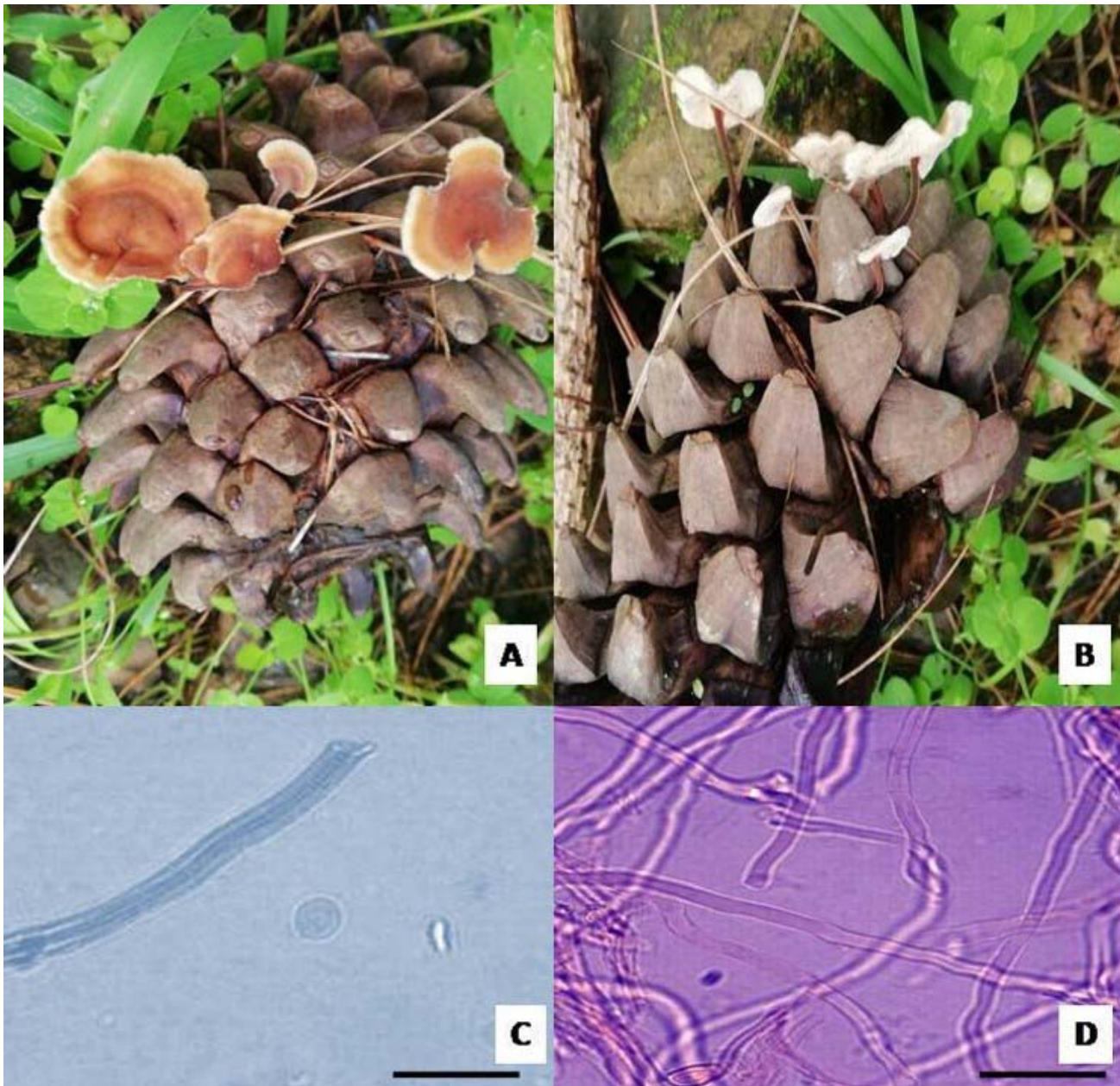


Fig. 9. *Auriscalpium vulgare* Gray (A-D): A-B Carpophores in their natural, C-Basidiospores, D-Skeletal and Binding hyphae

yellowish brown, covered with small hairs. Under surface whitish spiny, spines up to 3 mm long, crowded. Stipe up to 4 cm long, 0.2 cm in diameter, orangish brown, equal, cylindrical, hairy. Basidiospores 4-5.5 x 4-5 μm , ovoid to subglobose, ornamented, roughened, amyloid. Basidia 15-25 x 4-6 μm , clavate, with clamps at base. Cystidia numerous 20-36 x 5-8 μm , cylindrical with pointed to conical apex. Clamp connections present. Pileal hairs septate, cylindrical,

septate hyphae up to 7 μm in diameter. Clamp connections present.

Collection examined- Shilly Forest, Solan, Himachal Pradesh India (1600 mt MSL). Babita Kumari and Anupam Barh. Collection No. DMR. 80-20. Growing solitary to scattered on conifers cones or conifers litter which buried or partially in soil in tropical to sub-temperate region.

10. *Tylophilus balloui* PK (Singer)

Description

Pileus up to 10 cm in diameter, convex to plano convex, surface bright orange, dry, velvety, cracked,

finely areolate. Flesh white to yellowish white. Taste and odour mild. Under surface poroid, adnexed, pores angular to broadly angular, tubes up to 2 mm broad. Pale yellowish to brown on maturity. Stipe up to 6 cm long, 2 cm broad, equal to slightly tapering stipe, Pale yellow to orange, pruinose, powdery, stuffed to

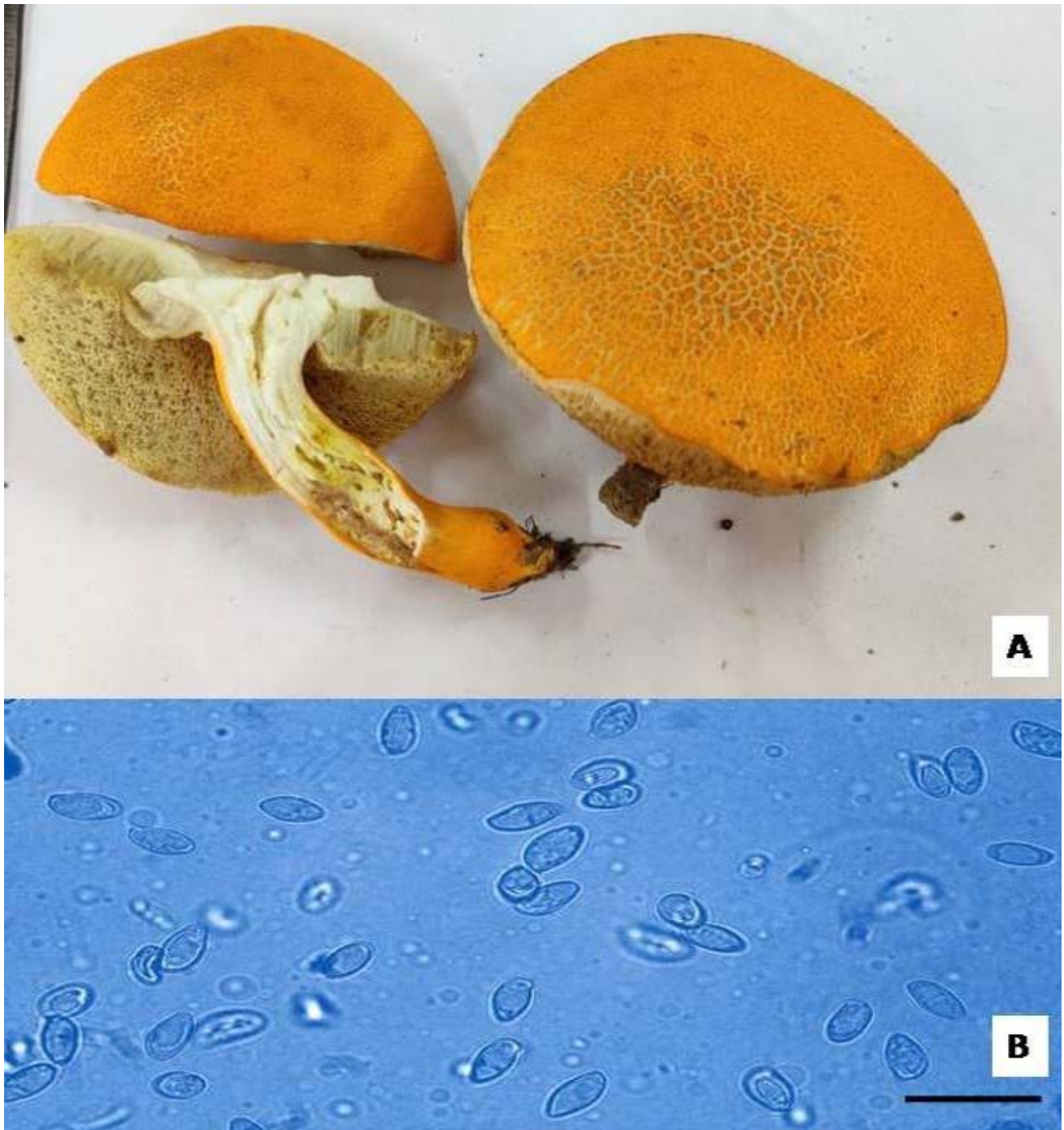


Fig.10. *Tylophilus balloui* (A-B): A- Carpophores, B-Basidiospores

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solid, slowly turned in to brownish on exposure. Basidiospores 5.5-8.5 x 3.5-5 µm, ellipsoid, inamyloid, monoguttulate. Basidia 15-23 x 8-11 µm, clavate, tetrasporic, sterigmata up to 2 µm long. Pleurocystidia 30-66 x 5-15 µm, lageniform with mucronate end or pointed tip. Pileipellis a gelatinized cutis of golden brown, cylindrical elements up to 8 µm in width.

Collection examined- Narkanda, Shimla, Himachal Pradesh India (2800 mt MSL). VP Sharma and Ajeet Kumar. Collection No. DMR. 60-20. Growing solitary to scattered on soil in coniferous forest in temperate region.

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