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Genus *Panaeolus*: New records from India

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ABSTRACT

Collection tours for exploration and collection of agarics from different localties of the state of Punjab were undertaken between 2009 to 2011. As a result, a large number of agarics were collected. Of these, three species of *Panaeolus* (Fr.) Quél. viz. *P. sphinctrinus* var. *minor* (Fr.) Singer, *P. castaneifolius* (Murrill) A.H. Smith and *P. tropicalis* Oláh are taxonomically described and are new records for India.

Key Words: Cheilocystidia, cellular pileus cuticle, germpore.

INTRODUCTION

While surveying the state of Punjab for the collection of agarics during the monsoon season a number of gilled mushrooms were collected. In the present paper three species of genus *Panaeolus* (Fr.) Quél. viz. *P. sphinctrinus* var. *minor* (Fr.) Singer, *P. castaneifolius* (Murrill) A.H. Smith and *P. tropicalis* Oláh are taxonomically described supported with field photographs, microphotographs and line drawings. The genus *Panaeolus* (Fr.) Quél. is known by 15 species world over Kirk et al., (2008) and only 14 species of this genus have been recorded from India. The genus *Panaeolus* (Fr.) Quél. belongs family *Psathyrellaceae* Vilgalys. The genus differ from the rest of the members of this family by its small carpophores, black spore print, metulloidal Pleurocystidia which are chrysocystioid and dark coloured lemon shaped spores with a distinct germpore, these are larger than 10 μm in most known species. The carpophore context not bluing. During survey three species of *Panaeolus* (Fr.) Quél. viz. *P. sphinctrinus* var. *minor* (Fr.) Singer, *P. castaneifolius* (Murrill) A.H. Smith and *P. tropicalis* Oláh were identified on the basis of gross morphology and microscopic observations using relevant literature. The taxonomic observations supported with Camera Lucida drawings and field photographs are described.

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MATERIALS AND METHODS

The macroscopic and microscopic observations were worked out according to the methodology given by Atri et al. (2005). The classification, terminology and generic concepts as given in the 'Dictionary of Fungi' by Kirk et al. (2008) and Mycobank were followed. The colours of the various parts of the carpophores were noted as per Kornerup and Wanscher (1978). Many chemical colour reactions, stains and dyes were employed for taxonomic observations, segregation at generic as well as species level. The identified specimens have been deposited in the Herbarium, Department of Botany, Punjabi University, Patiala (Punjab), India under the Accession No. PUN.

TAXONOMIC OBSERVATIONS

Panaeolus sphinctrinus var. ***minor*** (Fr.) Singer, *Lilloa,* 30: 119, 1960. **Fig.1, 2 & 7-A-I**

Carpophores 2.7-5.3 cm in height. Pileus 0.4-1 cm broad, hemispherical, broadly umbonate; surface moist; greyish white with brownish orange ($6C_4$) in centre and offwhite periphery; smooth; margin irregular; cuticle not peeling; taste sour; odour spicy; flesh upto 0.1 cm thick, membranous, creamish, unchanging. Pileal veil scaly, white. Lamellae broadly adnate; unequal, 3 lengths; subdistant;

narrow (upto 0.2 cm broad); greyish black; gill edges lacerate, white; normal. Stipe central, 2.6-5.1 cm long, 0.1-0.2 cm, cylindrical, tubular with an expanded to somewhat bulbous base covered with white mycelia; shiny, orange white ($6A_2$) with lighter base, pale violet ($16A_3$) near attachment to the cap, solid; exannulate.

Basidiospores 13.52-18.59 x 9.29-11.83 µm (excluding apiculus), (Q=1.5) limoniform to subhexagonal, elliptic in side view; double walled; blackish brown, granular; truncated with a somewhat excentric germ pore; apiculate, apiculus 0.84-1.69 µm long. Basidia 20.28-33.8 x 11.83-13.52 µm, clavate, granular, bi to tetrasporic, bi sporic are rare; sterigmata 3.38-5.07 µm long, swollen. Pleurocystidia absent. Cheilocystidia 16.9-30.42 x 8.45-10.14 µm, versiform, urn shaped with tubular necks with blunt rounded, thickly granular tips, oil like globules and thick granulations present in tips, abundant; gill edges sterile. Carpophore context homoiomerous. Pileus cuticle cellular, gelatinized, made up of spherical to elongated, columnar cells measuring 11.83-21.97 x 9.29-11.83 µm, scattered pileocystidia present over the surface. Pileocystidia 18.59-32.11 x 5.91-7.6 µm, lageniform, granular apices; pileus context cells closely placed, 20.28-27.04 x 15.21-20.28 µm, double walled. Hymenophoral trama regular, hyphal. Stipe cuticle hyphal, made up of longitudinally tangled, 3.94-9.85 µm broad, septate hyphae with projecting caulocystidia. Caulocystidia 15.21-33.8 x 5.91-7.6 µm, claviform to fusoid, weakly granular, rare. Pileal veil hyphal, made up of 3.38-5.07 µm broad, septate, granular hyphae, with few cellular elements. Clamp connections present in stipe.

Chemical color reaction– Basidiospores do not fade in conc. H_2SO_4.

Collection examined– Punjab: Faridkot (196 m), Village Bajakhana, growing scattered on humicolous, grassy soil mixed with horse dung and decaying leaf litter, Harwinder Kaur, PUN 5973, August 08, 2011.

Distribution and ecology– Gibson (2003) reported *P. sphinctrinus* var. *minor* species from Pacific Northwest. Present collection was found scattered on horse dung in early August.

Remarks– The present collection was compared with *Panaeolus alcidis* and *P. sphinctrinus* but, due to the lack of pileal veil and subhexagonal basidispores in *P. alcidis* which are prominently present in the present collection also the spore size is quite different i.e. in *P. alcidis* the basidiospores are (16.3) 18-19 (21) x (8) 9.5-10.5 (12) µm whereas in the present collection the basidiospores are smaller 13.52-18.59 x 9.29-11.83 µm, it did not match with this species. Further, in its gross morphology and microscopic details it matches well with *P. sphinctrinus* var. *minor* (Fr.) Singer as described by Gibson (2003). Gerhardt (1996) proposed to include *P. sphinctrinus, P. campanulatus and P. retirugis* as synonyms of *P. papilionaceous* but, these species being quite different from each other are treated as separate by Pegler (1977), Watling and Gregory (1987) and Gibson (2003). *P. sphinctrinus* var. *sphinctrinus* is earlier reported from South India by Natarajan and Raman (1984). It has been reported from North India (Punjab) by Kaur (2012). *P. sphinctrinus* var. *minor* is not earlier known from India.

Panaeolus castaneifolius (Murrill) A.H. Smith, *Mycologia* 40 (6): 685, 1948. **Fig.3, 4 & 8-A-H**

Carpophores 3.5-7.5 cm in height. Pileus 0.6-3.8 cm broad, hemispherical to convex; surface moist, offwhite with pale orange ($5A_3$) to greyish orange ($5B_3$) centre, greyish brown ($5D_3$) to grey ($5B_1$) at maturity, smooth, wrinkled on drying with irregularly angular cracks; margin regular to irregular, may or may not splitting at maturity; cuticle fully peeling; flesh 0.1-0.2 cm thick, creamish brown, bluing on handling or unchanging; taste sour; odour mild. Pileal veil absent. Lamellae broadly adnate; unequal, in 3 lengths; subdistant; moderately broad (upto 0.4 cm broad); grey ($7D_1$ to $8D_1$) when young, greyish brown ($9F_3$) to black grey at maturity; gill edges finely smooth to serrate, white; normal. Spore deposit black. Stipe central, 3-7.3 cm long, 0.2-0.6 cm broad, tubular, equal in diameter, with a bulbous base covered with thick white mycelial mat; silvery, white to brownish, slightly pink near the base, blackish brown on drying; hollow to solid; scaly, scales white, pruniosefibrillose scattered all over the stipe; exannulate.

Basidiospores 11.83-16.9 x 9.29-10.14 (11) µm (excluding apiculus), (Q=1.5) limoniform to hexagonal, double walled, granular, dark brown, smooth, truncated with an apical germ pore, not bleaching in H_2SO_4; apiculate, apiculus 0.84-1.69 µm long. Basidia 15.3-29 x 6.8-15.21 µm, broadly cylindrical to claviform, bi to tetrasporic, thin walled, granular; sterigmata 2.53-5.07 µm long, thick, swollen. Pleurocystidia absent. Cheilocystidia 18.59-55.77 x 5.91-13.52 µm, claviform, generally with rounded apices, wavy tailed, some with tubular apices, granular at the apex, abundant in bunches; gill edges sterile. Carpophore context homoiomerous. Pileus cuticle cellular, made up of 13.52-27.04 x 11.82-25.35 µm, spherical to hemispherical cells interspersed with pileocystidia. Pileocystidia 20.28-

Fig1. ***P. sphinctrinus*** var**.** ***minor*** **(Fr.) Singer.** Carpophores growing on leaf litter.

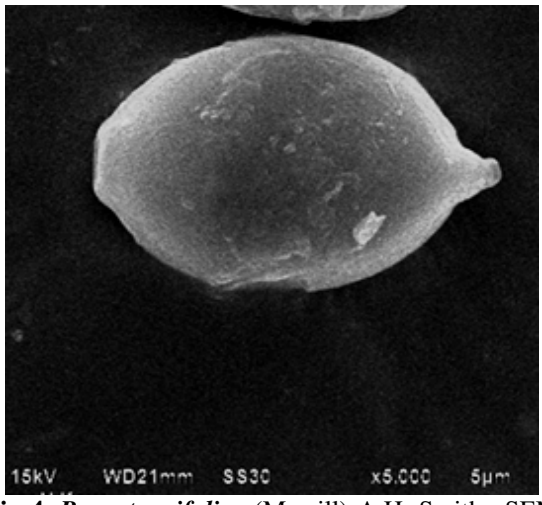


Fig 4. ***P. castaneifolius*** (Murrill) A.H. Smith– SEM of Basidiospores.

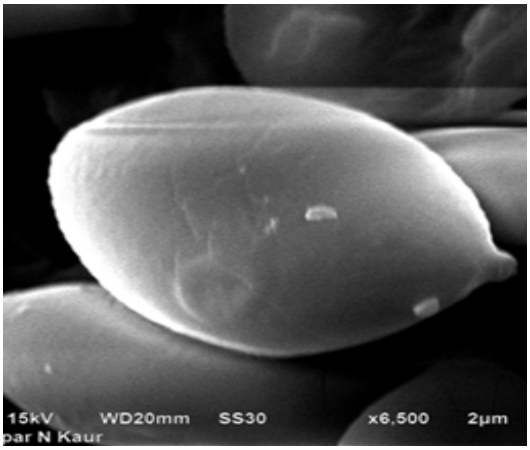


Fig 2. ***P. sphinctrinus*** var**.** ***minor*** **(Fr.) Singer**. SEM of Basidiospores.

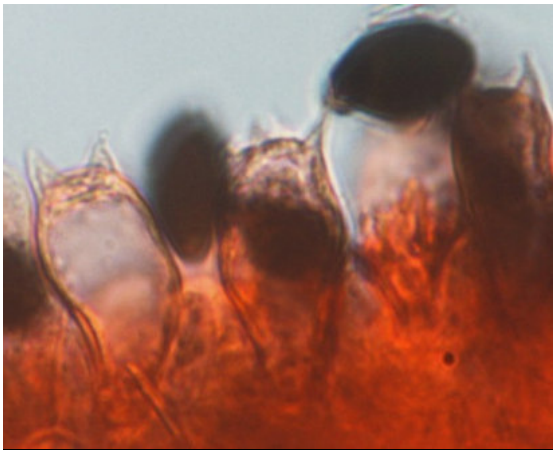
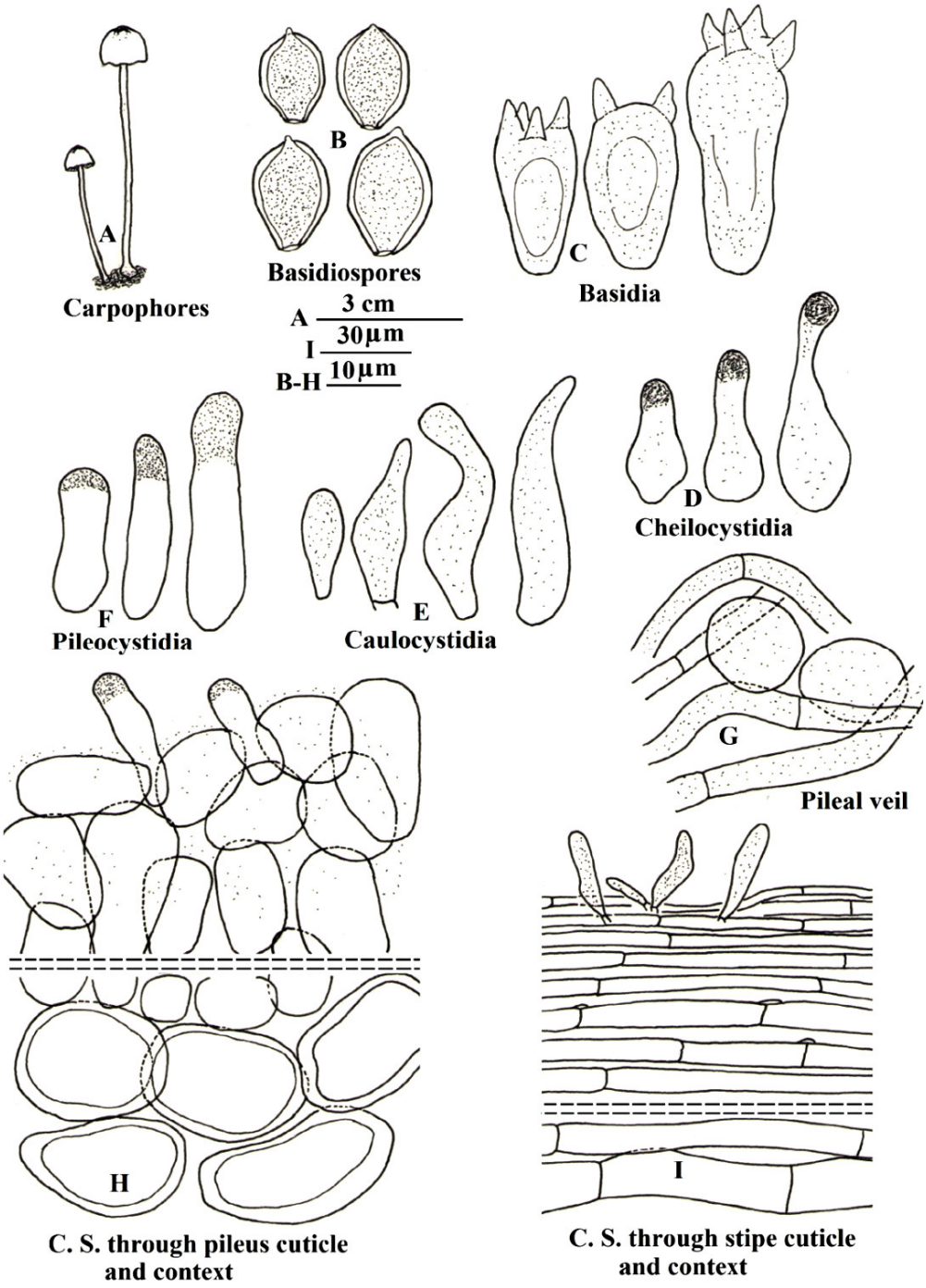


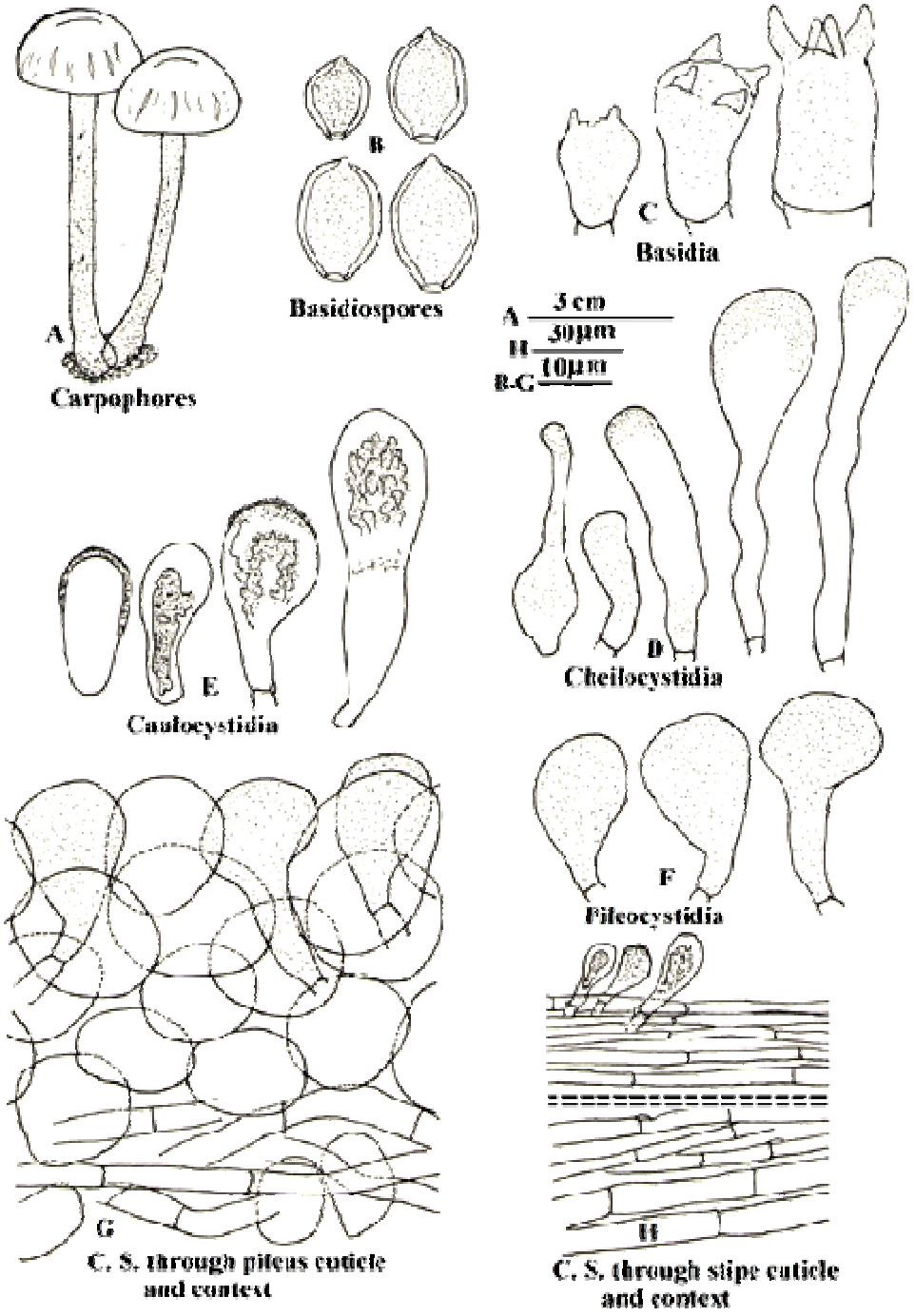
Fig 5. ***P. tropicalis*** Oláh–Microphotograph of Basidia.

Fig 3. ***P. castaneifolius*** (Murrill) A.H. Smith– Carpophores growing on humicolous grassy soil.

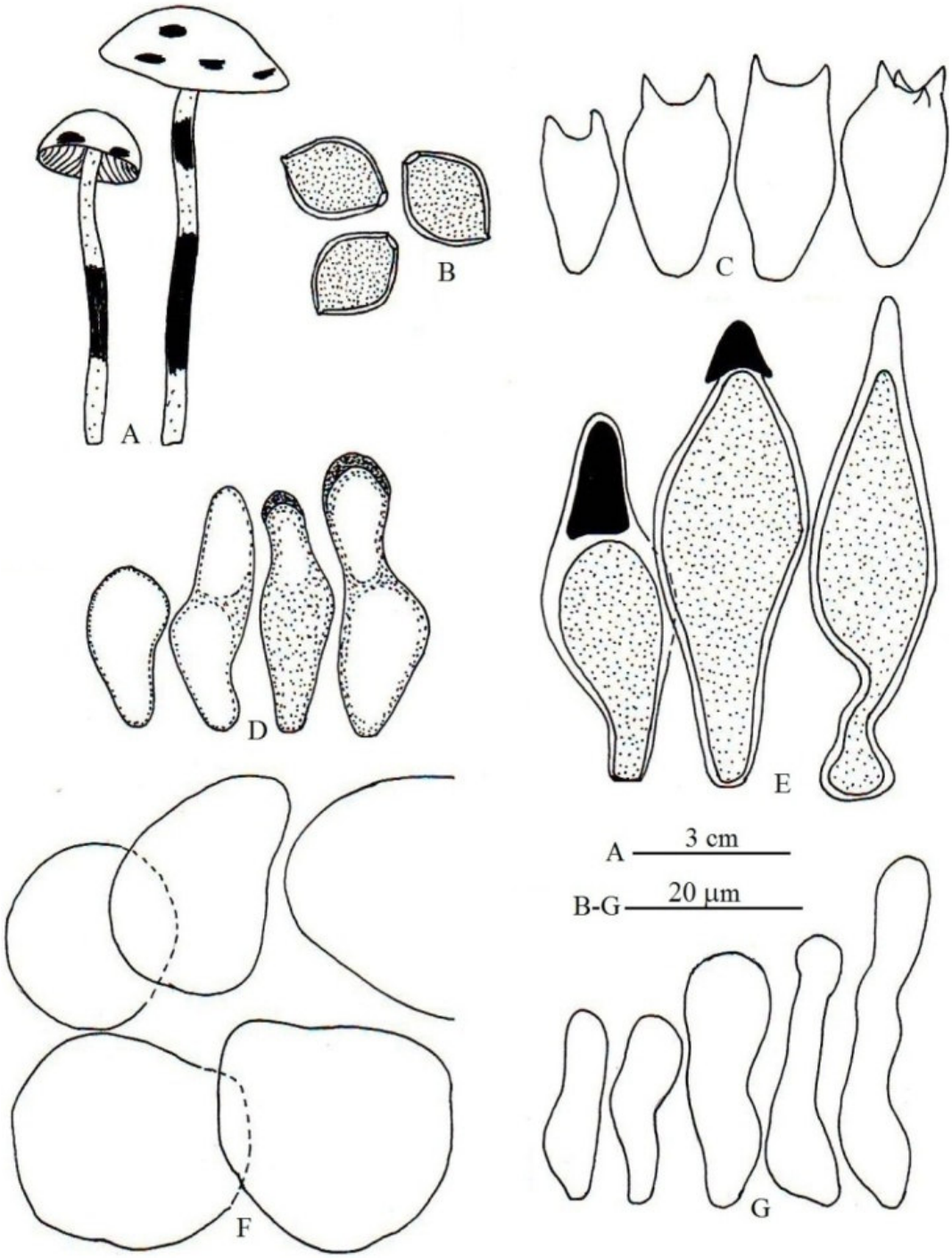
Fig 6. ***P. tropicalis*** Oláh –Microphotograph of Chrysocystidium & basidiospores.



Figs 7. A–I. ***Panaeolus sphinctrinus*** var. ***minor*** (Fr.) Singer. **A.** Carpophores **B.** Basidiospores **C.** Basidia **D.** Cheilocystidia **E.** Caulocystidia **F.** Pileocystidia **G.** Pileal veil **H.** C.S through Pileus cuticle elements and context **I.** C.S through stipe cuticle and context.



Figs 8. A–H. ***Panaeolus castaneifolius*** (Murrill) A.H. Smith. **A.** Carpophores **B.** Basidiospores **C.** Basidia **D.** Cheilocystidia **E.** Caulocystidia **F**. Piloocystidia **G**. C.S through Pileus cuticle and context **H**. C.S through stipe cuticle and context.



Figs 9. A–G. ***Panaeolus tropicalis*** **Oláh. A.** Carpophores **B.** Basidiospores **C.** Basidia **D.** Cheilocystidia **E.** Chrysocystidia **F.** Pileus cuticle elements **G**. Caulocystidia.

54 x 3.4-13.52 µm, claviform to lageniform, thin walled, fully granular, rare; pileus context made up of cellular and hyphal elements, cellular elements measuring 17.73-43.34 x 19.77-45.31 µm, granular, hyphae 6.8-18.7µm broad. Hymenophoral trama regular composed of thin walled, 5-15.3 µm broad hyphae. Subhymenium pseudoparenchymatous. Stipe cuticle hyphal, made up of longitudinally, parallel arranged, 3.94-15.76 µm broad, closely septate hyphae, with projecting caulocystidia. Caulocystidia 20.28-45.31 x 7.6-13.52 µm, segmented, fusiform. Clamp connections present throughout.

Chemical color reaction– Basidiospores do not decolor in conc. H_2SO_4.

Collection examined- Punjab: Faridkot (196 m), Village Dal Singh Wala, growing in caespitose clusters or in groups on dung, Harwinder Kaur, PUN 5968, September 10, 2009; Village Dod, growing solitary on dung among grasses, Harwinder Kaur, PUN 5969, September 10, 2010; Punjab: Sangrur(231m), Sikanderpura, growing on mixed cattle dung, Amandeep Kaur, PUN 4358, June 29, 2011; Patiala (251m): Ghanaur, growing solitary on buffalo dung, Amandeep Kaur, PUN 4357, July 19, 2011.

Distribution and ecology– *P. castaneifolius* is reported to be growing scattered to gregariously in grassy areas from North and South America (Stamets, 1996). From India, it has been presently collected from various localities growing either solitary or in caespitose groups on dung throughout the monsoon season.

Remarks– The morphology and microscopic details of the above examined collection are in full conformity with the details given for *Panaeolus castaneifolius* (Murrill) A.H. Smith by Stamets (1996) for this species. However, in the presently examined collections, pleurocystidia are absent while Stamets (1996) has described these as similar in size as that of basidia. The species is recorded for the first time from India.

Panaeolus tropicalis Oláh, *Rev. Mycol.* 4- 289, 1969.
Fig.5, 6 & 9-A-G

Carpophores 4.8-12.5 cm in height. Pileus 1.4-4 cm broad, 1.5-1.8 cm high, convex to applanate; surface pale cream with bluish gray tinge, dry, smooth; pileal veil absent; margin regular, not splitting at maturity, non-striate; cuticle fully peeling; flesh upto 0.1 cm thin, bluing when handled, non-deliquescent; taste and odor not distinctive. Lamellae adnate to decurrent; unequal, 3-sized; subdistant; narrow up to 0.25 cm broad, fragile, bluish gray; gill edges smooth. Spore print black. Stipe central to slightly eccentric, 6.4-12.4 cm long, 0.2-0.4 cm broad; tubular; equal in diameter throughout; solid, surface pale cream, changing to bluish gray on bruising, pruinose, exannulate.

Basidiospores 8-12 x 7-10 µm (Q = 1.23), lenticular, limoniform in face view, broadly ellipsoidal in side view, slightly angular at the centre, with acute base and a truncate germ pore at the apex, thick-walled, smooth, blackish brown, not bleaching in concentrated H_2SO_4. Basidia 12.8-21 x 7-11.4 µm, clavate, bi to tetrasporic, mostly bi-sporic, thin-walled, hyaline; sterigmata 2-3.8 µm long. Cheilocystidia 15.5-25.5 x 5.5-10.47 µm, abundant, polymorphic, cylindrical, clavate or lageniform, thin-walled, hyaline to granular, some with subcapitate densely granular tips. Gill edges sterile. Pleurocystidia chrysocystidioid, 28-54 x 8-17 µm, metulloidal, ventricose fusoid, thick walled, apical encrustations granular, golden brown, reddish brown in NH_4OH. Pileus cuticle, cellular epithelium, cells 21-35 x 11-35.5 µm, globose, subglobose or piriform, thin-walled, hyaline; pileocystidia absent; pileus context made up of interwoven 5.7-20 µm broad hyphae. Hymenophoral trama regular composed of thin-walled 5.7-18.5 µm broad hyphae. Subhymenium pseudoparenchymatous. Stipe cuticle hyphal, with caulocystidia present in groups; stipe context hyphae interwoven, thin-walled, hyaline 2.8-25.6 µm broad; caulocystidia 17-38 x 5.7-13µm, cylindrical, clavate or lageniform, thin-walled, hyaline. Clamp connections rarely present in the stipe context hyphae.

Chemical reaction– Basidiospores do not loose colour when treated with concentrated H_2SO_4.

Collections examined– Punjab: Patiala (251 m): Nainakut, growing in groups on mixed cattle dung, Amandeep Kaur, PUN 4076, June 16, 2008; Patiala (251 m): Bhunerheri, growing in groups on mixed cattle dung, Amandeep Kaur, PUN 4346, June 16, 2008; Hoshiarpur (295 m): Kot Fatuhi, growing solitary on mixed cattle dung among grassy litter, Narinderjit Kaur, PUN 4341, August 18, 2011.

Distribution and ecology– *Panaeolus tropicalis* is dung inhabiting agaric reported from Hawaii, Central Africa and Cambodia by Stamets (1996). The Indian collections were found in groups or rarely solitary growing on mixed cattle dung.

Remarks– The gross morphology of the presently examined specimen indicates it to be *Panaeolus*

cyanescens (Berk. & Broome) Sacc., but on critical examination based on microscopic details, given by Stamets (1996), it has been identified as *P. trpicalis* Ola'h, G. M. In the present collection the basidia are only bi sporic as in *P. trpicalis* Ola'h, G. M. and not bi to tetra sporic as in *P.cyanescens* (Berk. & Broome) Sacc., even the spore size is much smaller i.e. 8.95-10.74 × 7.16-8.05 µm in PUN 4341, in comparison to *P. cyanescens* (Berk. & Broome) Sacc. in which the minimum spore length is 10 µm and minimum spore breadth is 8 µm. Thus, this species is identified as *P. trpicalis* and is a new fungus record for India.

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