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Wood rotting agaricomycetes from Uttrakhand-new to India

Lalita and I. B Prasher*

Mycology & Plant Pathology Lab, Department of Botany, Panjab University, Chandigarh 160014

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ABSTRACT

Five species of wood rotting Agaricomycetes belonging to the families Fomitopsidaceae, Polyporaceae and Xenasmataceae are being recorded from Uttarakhand (N.W. Himalayas). The species are: *Postia ceriflua, Diplomitoporus crustulinus, Fomes extensus, Polyporus varius* and *Xenasma tuslasnelloideum*. These are collected from districts/localities: Chakrata, Karanprayag, Mussoorie, Rudarprayag and Badrinath of Uttarakhand state. All these represent first time records from Himalayas/India.
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Key Words: Agaricomycetes, wood rotting fungi, Uttarakhand.

INTRODUCTION

Woody tissues are degraded by fungi, and the wood-decaying fungi fall into three categories according to their mode of attack on the wood cell walls - white-rot fungi, soft-rot fungi and brown-rot fungi (Deacon 2005). White-rot fungi are the most efficient degraders of lignocelluloses as they can degrade cellulose and hemicellulose, as well as lignin (Schmidt 2006) where as brown rot fungi (exclusively basidiomycetes) decompose hemicelluloses, cellulose and modify or cleave lignin but do not metabolise it. Wood affected by brown rot is usually dry and fragile, readily crumbles into cubes because of longitudinal and transverse cracks. There are some soft rot fungi which degrade only the cellulose and hemicelluloses. Following workers have contributed towards the floristics of wood rotting agaricomycetes from different areas of North Western Himalayas: Thind et al. (1956-1985), Rattan (1977), Dhanda (1977), Dhingra et al. (2011, 2012), Prasher et al (2011, 2012, 2012a, 2013) and Sharma (2000, 2012). However, during the fungal exploration, five species of agaricomycetous fungi are found new for Himalayas/India.

Corresponding author: chromista@yahoo.co.in

STUDY AREA

The state of Uttarakhand extends between 28°C 43'N to 31°C 27'N latitude and 77°C 34'E to 81°C 02'E altitude. The region of Uttarakhand has a total area of 53,566 km² and is covered by mountains (approximately 93%) and forests show up on about 64% of the mountains. Uttarakhand lies on the southern slope of the Himalayan range, and the climate and vegetation vary greatly with elevation, from glaciers at the highest elevations to subtropical forests at the lower elevations. The highest elevations are covered by ice and bare rock. Below them, between 3,000 and 5,000 metres (9,800 and 16,000 ft) are the western Himalayan alpine shrub and meadows. The temperate western Himalayan subalpine conifer forests grow just below the tree line. At 2,600 to 3,000 metres (8,500 ft to 9,800) elevation they transition to the temperate western Himalayan broad leaf forests, which lie in a belt from 1,500 to 2,600 metres (4,900 ft to 8,500) elevation. Below 1,500 metres (4,900 ft) elevation are present the Himalayan subtropical pine forests. Uttarakhand has a great diversity of flora and fauna. It has a recorded forest area of 34651 km^2 which constitutes 65% of the total area of the state. Uttarakhand is home to rare species of plants and animals, many of which are protected by sanctuaries and reserves. The climate is stridently distinguished in its two diverse

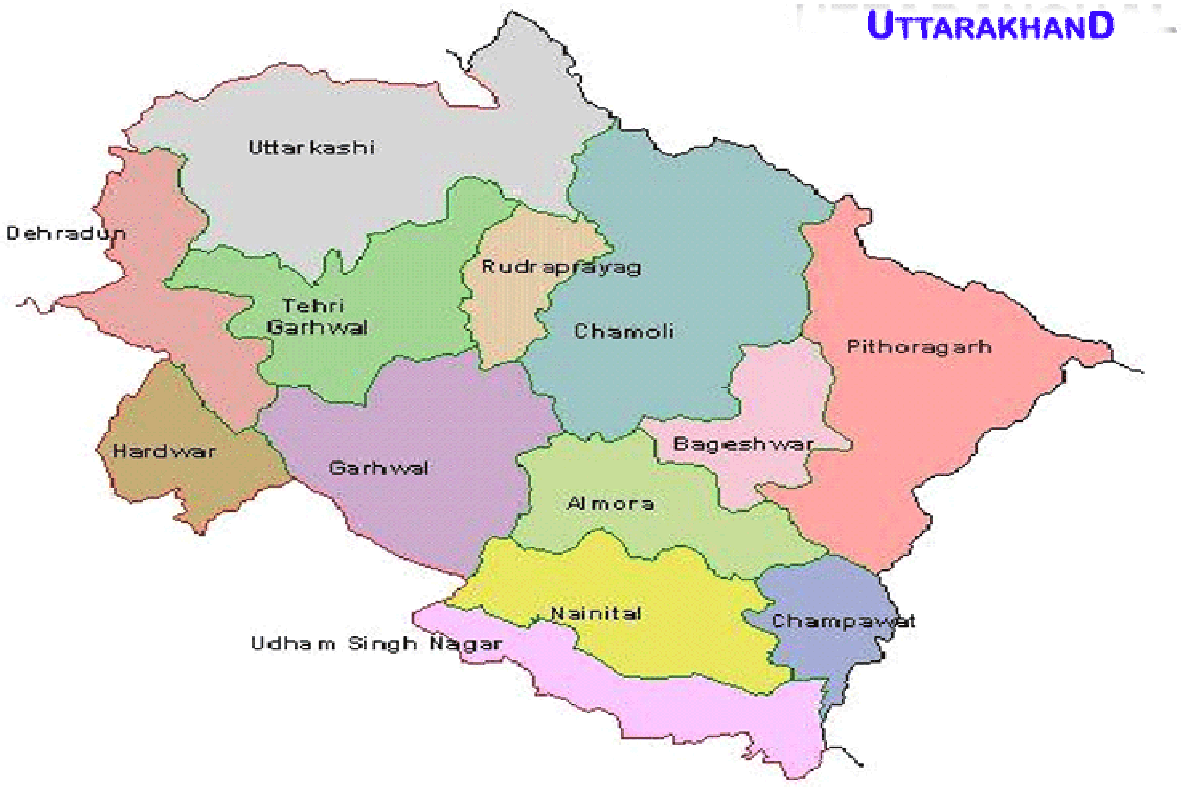

Fig. 1- Map of Uttarakhand showing localities of collection.

division: the major hilly terrain and the smaller plains. The climate however also varies within the mountains in accordance with the altitude of the place. The eastern edges of the Himalayan ranges are subject to heavy rainfall while the western division is relatively dry. The vegetation of Uttarakhand varies from tropical forests to Alpine shrubs and meadows as per climatic changes due to elevate-changes.

MATERIALS AND METHODS

All the collection cited in the text are those deposited in the PAN (Herbarium of Botany Department, Panjab University, Chandigarh, India). The collections belonging to different species were critically examined macro and microscopically for different characters. The fungi recorded in this paper are classified after Kirk *et. al.* (2008), Index Fungorum and Mycobank. Standard procedures were adopted to study the specimens after Prasher (1999).

The method of revival of the dried specimens and the different strains/reagents used are as follows: For microscopic study the section of dried fructifications were mounted in 3% KOH for measurements of various structures as basidiospores, basidia, cystidia, setae and stained with cotton blue(in lactic acid) for determining the cyanophilous reaction, melzer's reagent(for determining the amyloidity), 1% aqueous solution of congo red and Phloxine(to determine the presence or absence of clamps and for measuring the hymenial elements and hyphae), sulphobenzaldehyde (water 1.5 ml, pure sulphuric acid 5.0 ml and benzaldehyde 4.5 ml) for staining gloeocystidia after Slysh (1960).

TAXONOMIC DESCRIPTIONS

Postia ceriflua (Berk. & M.A. Curtis) Jülich, Persoonia 11(4): 423 (1982) = *Tyromyces cerifluus*(Berk. & Curt.) Murr., North Am. Flora 9: 33, 1907.

Fig.1 (1-3), Fig. 3 A

Fructification annual, pendent, broadly attached, soft, fleshy when fresh, hard on drying, single or close pilei unite to become imbricate. Pileus circular to semicircular or dimidiate, applanate; upper surface white when fresh, ochraceous on drying, fine tomentose to glabrous, faintly concentrically zonate, radially wrinkled on drying; margin round, smooth, white when fresh sterile below up to 2.8 mm wide.
Pore surface white when fresh, ochraceous on drying, uneven; pores small, angular to irregular on uneven surface, 3-5 per mm; dissepiments thin, even; tubes in one layer, white. Context soft, fibrous, white, homogenous, non-xanthochroic, up to 6.8 mm thick.

Hyphal system monomitic; generative hyphae hyaline, thin-walled to thick-walled to almost solid with narrow lumen, branched, septate, clamps absent, faintly cyanophilous. Dissepiments and sub hyeminum hyphae, thin-walled, branched, 2.6-4.6 µm in diameter. Context hyphae thin-walled to almost solid with narrow lumen, rarely branched, solid hyphae gelatinised with KOH. Cystidia absent. Basidia clavate, 4-spored, cyanophilous, up to 4-5.5 µm in diameter. Basidiospores hyaline, 3.5-4.6×1.2-2.0µm, thin-walled, smooth cylindric-ellipsoid to ellipsoid, non-amyloid,

Collection examined: Mussoorie, Lal Tibba-Dehradun (U.K.), on decaying *Pinus* log Lalita 37329(PAN), August 25, 2009.

Remarks: The species is characterised by annual, pendent, broadly attached , soft, fleshy white fructification; medium, angular, three to five pores per mm; white context; monomitic hyphal system with thin to thick-walled to solid, clamped generative hyphae; and hyaline, thin-walled, cylindrical-ellipsoid to ellipsoid basidiospores. It is new report for India/Himalayas.

Diplomitoporus crustulinus (Bres.) Domański, Acta Soc. Bot. Pol. 39: 192 (1970) = *Antrodia crustulina* (Bres.) Ryvarden, Norw. Jl. Bot. 20: 8(1973)

Fig.1 (4-7); Fig 3 B

Fructification annual, resupinate, fragile when fresh, hard on drying, adnate, broadly effused, smooth when fresh, deeply cracked after drying; margin white very narrow; pore surface pale yellow to sulphur yellow, yellowish brown on drying; pores angular. 3-5 per mm. Context white, soft, homogenous, non-xanthochroic, up to 2 mm thick; dissepiments concolorous, even.

Hyphal system dimitic; generative hyphae hyaline, thin-walled, septate, branched, clamped, cyanophilous, 2.0-4.1 µm in diameter; skeletal hyphae hyaline, thick-walled, aseptate, unbranched, 2.4-5.9 µm in diameter. Cystidia absent, cystidioles present. Basidia clavate, 4-spored, cyanophilous, up to 4.7 µm broad, Basidiospores hyaline, 5.8-6.8×2.6-3.2 µm, thin-walled, smooth, cyanophilous, cylindric-ellipsoid, non-amyloid.

Collection examined: Rudarprayag (U.K.), on decaying gymnospermic log, Lalita 38026(PAN), July 20, 2011.

Remarks: This species is characterised by annual, resupinate, resupinate, adnate, sulphur yellow, cracked fructification and cylindric-ellipsoid to ellipsoid basidiospores. It is a new record for the Himalayas/India.

Fomes extensus (Lév.) Cooke, Grevillea 14(no. 69): 18 (1885) = *Phellinus extensus* (Lev́.) Pat., Essai Tax. P. 97, 1900.

Fig. 1 (8-11); Fig. 3C

Fructification perennial, sessile, coriaceous when fresh, hard and woody on drying, solitary, attached by narrow lateral base; pileus sessile, applanate to conchate; upper surface brown to reddish brown, blackish near the base, fine tomentose, becoming glabrous later distinct cuticle present, concentrically zonate craked on drying; pore surface golden brown to brown, even, glancing; pores round to subangular, 6-8 per mm, 82-210 µm in diameter, dissepiments equal, 18-65 µm thick; pore mouth velutinate; tubes indistinctly stratified, golden brown in section, up to 3 mm deep in each layer. Context brown, fibrous, homogenous, xanthochroic, upper surface hard, black and white shiny crust.

Hyphal system dimitic; generative hyphae hyaline, thin-walled, branched, septate, clamps absent, cyanophilous, 2-3 µm in diameter, skeletal hypahe light brown to dark brown, thick-walled, aseptate, unbranched, 2-4.2 µm wide, dissepiments 3-6 µm wide in context. Setae abundant, ventricose, thick-walled, brown 26-32 × 6.2-8.5 µm, apices acute. Basidia hyaline, thin-walled, clavate, 4-spored, 6.2-9.0 × 3.5-4 µm. Basidiospores yellowish brown, thin to slightly thick-walled, smooth, sub-globose to slightly ellipsoid, 3.6-4.5 × 2.5-3.5 µm.

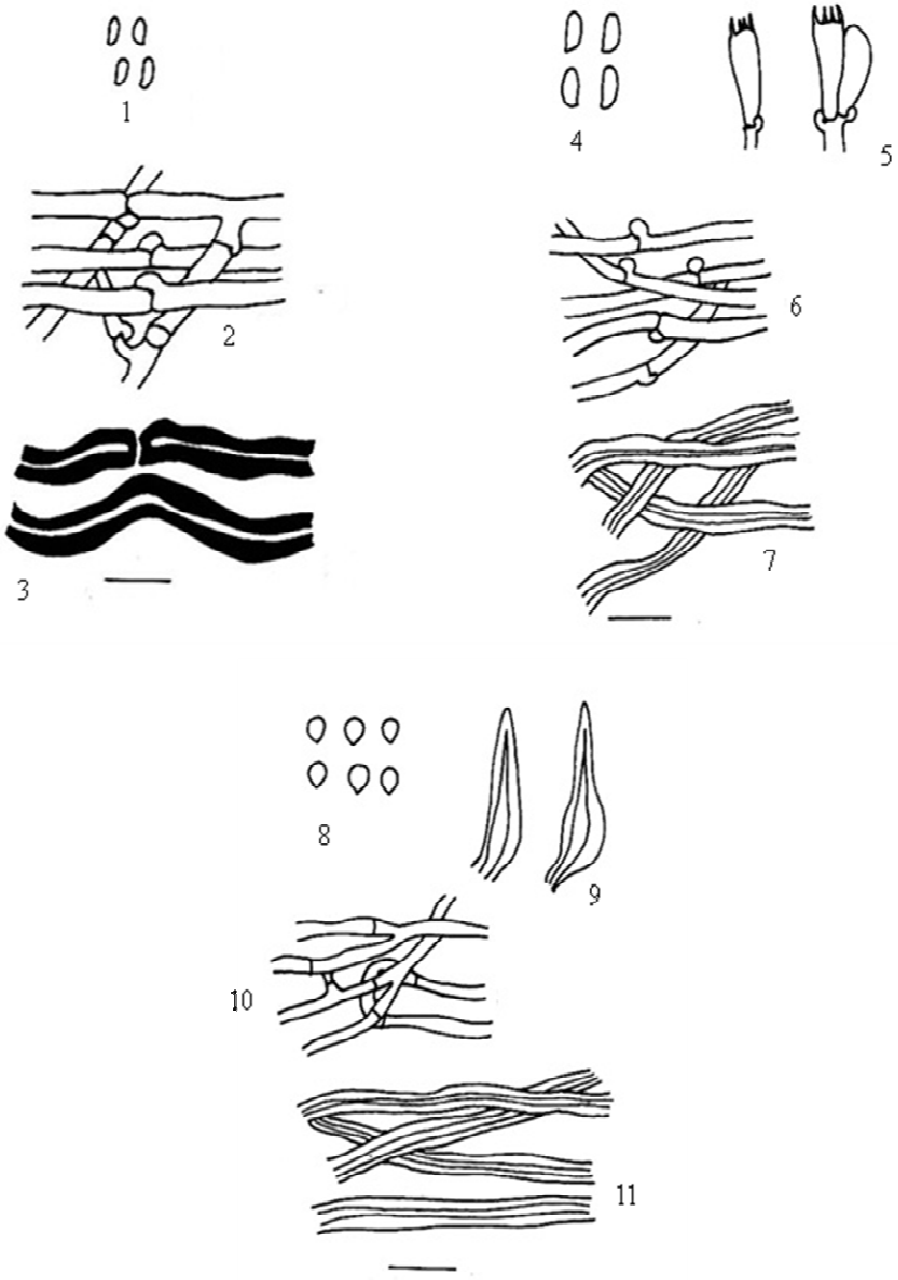

Fig. 1. ***Postia ceriflua*** **(1-3),** 1 Basidiospores, 2 Thin-walled Generative hyphae, 3 Thick-walled Generative hyphae hyphae. ***Diplomitoporus crustulinus*** **(4-7),** 4 Basidiospores, 5 Basidia, 6 Generative hyphae, 7 Skeletal hyphae. ***Fomes extensus*** **(8-11)** 8 Basidiospores, 9 Setae, 10 Generative hyphae, 11 Skeletal hyphae (10µm)

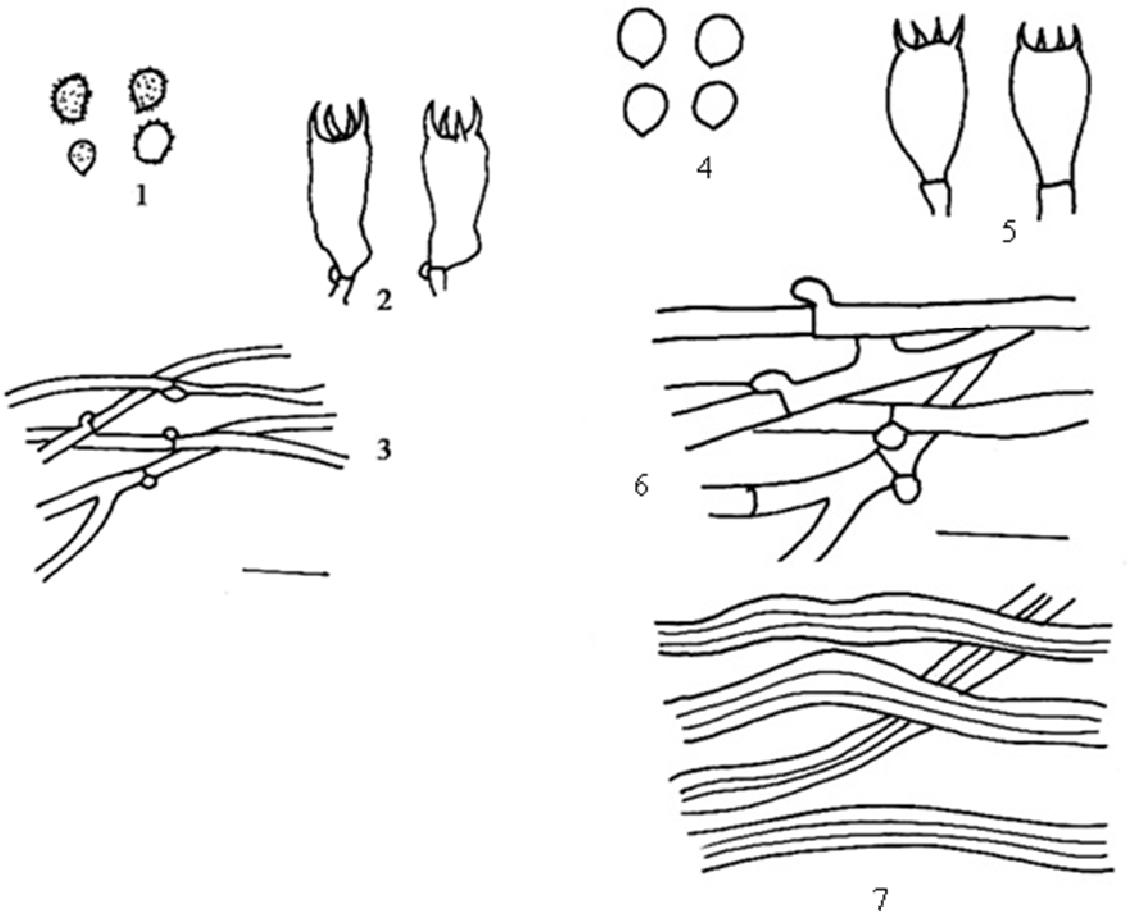

Fig. 2. ***Xenasma tulasnelloideum*** **(1-3)** 1 Basidiospores, 2 Basidia, 3 Generative hyphae (scale bar-10µm).
Polyporus varius **(4-7)** 4 Basidiospores, 5 Basidia, 6 Generative hyphae 7 Skeletal hyphae. (scale bar-10µm)

Collection examined: Karanprayag-Chamoli (U.K.), on decaying angiospermic logs, Lalita 38027(PAN), July 17, 2011.

Remarks: This species is characterised by perennial, broadly attached, woody hard fructifications with persistent, reddish brown tomentum; smaller pores; ventricose setae and yellowish brown, thick-walled basidiospores. It is a new specific record for Himalayas.

Polyporus varius (Pers.)Fr., Syst. Myco. 1: 352, 1821.

Fig. 2 (4-7); Fig. 3 D

Fructification annual, substipitate, reflexed, spathulate, corky; upper surface glabrous, chocolate with deep brown venations, closely zonate near the margin, depressed, glabrous; margin reddish brown, lobed or toothed, thin. Stipe lateral or eccentric. Context chocolate, corky; hymenial surface brown. Pore surface cream to light brown, darken on drying; pores subglobose to angular, 2-4 per mm, dissepiments thin, pore tubes brown.

Hyphal system dimitic; generative hyphae hyaline, thin-walled, branched, septate, clamps present, 1.6-3µm wide; binding hyphae thick-walled with narrow lumen, branched, aseptate, cyanophilous, tapering branched, 2.2-4.3µm wide. Basidia clavate, 4-sterigmate, 13-15×5-6µm. Basidiospores cylindric, smooth, hyaline, 7.4-12×3.2-4.2 µm hyphae hyaline to pale coloured, thick-walled with lumen almost obliterated, rarely branched, aseptate, 2.2-6 µm in diameter.

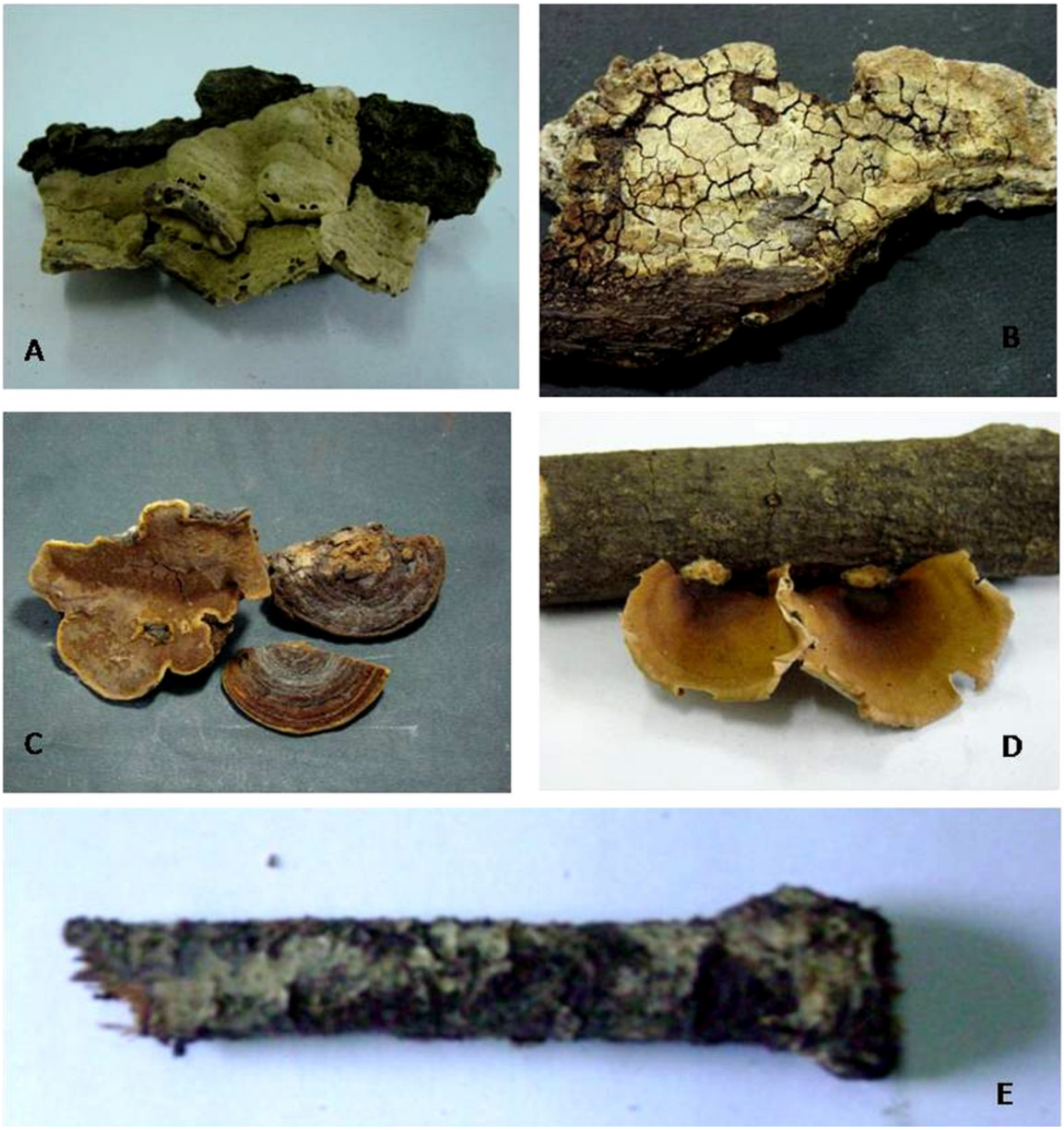

Fig. 3. A) ***Postia ceriflua,*****B)** ***Diplomitoporus crustulinus,*** **C)** ***Fomes extensus,*** **D)** ***Polyporus varius*****, E)** ***Xenasma tuslasnelloideum***

Collection examined: Karanprayag-Chamoli (U.K.), on decaying angiospermic twigs Lalita 38035, July 17, 2011.

Remarks: *Polyporus varius* is close to *P.picipes* from which it differs in the thicker pileus and context, the pale bay or tan colouration rather tan dark bay or chestnut and the more pronounced hyphal pegs. It is a new specific repord for Himalayas.

Xenasma tulasnelloideum (Höhn. & Litsch.) Donk, Fungus, Wageningen 27: 26 (1957) =*Xenasmatella tulasnelloidea* (Hoehn. & Litsch.) Oberw., Syd. Ann. Mycol. 19 p.34, 1965.

Fig. 2 (1-3), Fig. 3 E
Fructification resupinate, adnate, effused, very thin, waxy gelatinous; hymenial surface smooth, light grey to grey; margin not distinctly marked.
Hyphal system monomitic; generative hyphae 1.2-2.1 µm wide, branched, septate, clamped, thin-walled, often gelatinized and difficult to observe. Cystidia absent. Basidia 11.8-19.9 × 5.6-7.6 µm, subclavate to cylindrical, pleurobasidiate, 4- sterigmate, with basal clamp. Basidiospores 4.4-7 × 3.4-4.4 µm, broadly ellipsoid or ovoid or subglobose, thin-walled, prominently warted, non-amyloid, acyanophilous.

Collection examined: Karanprayag- Chamoli (U.K.), on decaying angiospermic twigs Lalita 38046, July 17, 2011.

Remarks: This species is characterized by thin, waxy gelatinous fructification, clamped generative hyphae, subclavate to cylindrical, 4-spored, pleurobasidia and broadly ellipsoid to ovate or subglobose, prominently warted, non-amyloid basidiospores. It was first described by Hoehnel and Litzschauer (1908) from Germany as *Corticium tulanelloideum*. Oberwinkler (1965) transferred it to *Xenasmatella*. The collection resembles the description of *Xenasmatella tulasnelloidea* as given by Oberwinkler (1965), Cunningham (1963) and Christiansen (1960) in almost all the characters. Now it is transferred into *Xenasma* (www.Indexfungorum.org). It is new specific record for North Western Himalayas.

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