



Morphoanatomical Characterization of an Ectomycorrhizal Species of *Tricholoma* (*Tricholomataceae*) from Kashmir Himalaya, India

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Abstract

The present study includes the comparative study of characteristic field ectomycorrhizae between *Tricholoma aurantium* associated with *Cedrus deodara* and *Tricholoma pardinum* with *Pinus wallichiana*. The carpophores and their ectomycorrhizal morphotypes were collected under their respective host plants. These species were taxonomically identified as *Tricholoma aurantium* and *Tricholoma pardinum*. These species are unique in their characters such as *Tricholoma aurantium* is characterized by growing carpophore in ectomycorrhizal association with *Cedrus deodara*. Its pileus is yellow orange (4A8) with non-striate, involute margin. The lamellae changes from white to rusty brown, the stipe consists fluid like substance at surface with mycelium. The cystidial elements are frequently present in infected roots while rhizomorphs are not found. *Tricholoma pardinum* is characterized by tiger spotted scales covering the entire pileus, with unchanging flesh, interveined notched lamellae. It has been found in ectomycorrhizal association with *Pinus wallichiana* with frequently present rhizomorphs and absence of cystidia on mantle of root. Morpho-anatomical description of *ectomycorrhizae* and carpophores are illustrated in this paper. The *Tricholoma aurantium* associated with *Cedrus deodara* is first time morpho-anatomically described from Kashmir Himalaya while *Tricholoma pardinum* is first time recorded from India.

Keywords: Coniferous Forests; Field Ectomycorrhizae; Epigeous; Taxonomy

Introduction

The Kashmir Himalaya being located at the biogeographically pivotal position, representing a unique biospheric unit in the North-Western Himalayas Rodgers WA, et al. [1], lies between 33°20' and 34°54'N latitude and 73°55' and 75°35'E, longitudes covering an area of 15,948km² with forest area about 8,123Km². The forests of Kashmir Himalaya are dominated with conifers with dominant members as *Cedrus deodara*, *Pinus wallichiana* and *Pinus gerardiana* with pockets of *Picea smithiana*, *Abies pindrow*, *Abies spectabilis*, *Betula utilis*, *Taxus wallichiana*, and *Rhododendron anthopogan*. The best season for the

collection of ectomycorrhizal agarics starts in mid April and ends in November. The Kashmir Himalaya is a hot spot for the diversity of ectomycorrhizal agarics particularly tricholomas. *Tricholoma aurantium* and *T. pardinum* have been reported from pure coniferous forest under *Cedrus deodara* and *Pinus wallichiana*. The coniferous forests are dominant in the Kashmir province. The ectomycorrhizal hosts belong to *Pinaceae*, especially with *Cedrus deodara*, *Pinus wallichiana*, *Picea smithiana*, *Abies pindrow* and *Betulaceae*. The Kashmir Himalaya harbors a hub of diversity of agarics and their ectomycorrhizas. The present study was undertaken to document the ectomycorrhizal diversity of Kashmir forests associated with *Cedrus deodara* and *Pinus wallichiana* in the

Kashmir Himalaya, India. Watling R, et al. [2] had published a comprehensive list of 119 taxa of mushroom from Jammu and Kashmir and the list was further extended to 145 species by Beig MA, et al. (2008) [3] with the addition of 26 taxa [4] added more taxa to this list thereby extending the list to 250 from the state of Jammu and Kashmir.

Tricholoma (Fr.) Quel is an ectomycorrhizal genus that is characterized by fairly fleshy, white spored agaric which is growing in forests and distributed worldwide. They are ectomycorrhizal, associated with various species of coniferous and broad-leaved forests. These ectomycorrhizal agarics are more common under *Pinus wallichiana* and *Cedrus deodara*, thus these have been targeted for the collection. Kirk PM, et al. [5] recognized 200 species of genus *Tricholoma* world over. The recent Mycobank (<http://www.mycobank.org/>) shows 984 species of this genus. From India this genus is reported by 13 species [6,7].

On the basis of morphotyping, 5800 fungal species belonging to 184 genera form ectomycorrhizal associations. As per Alexander I, et al. [8], 7000-10000 fungal species form ectomycorrhizal association worldwide. Recently Rinaldi AC, et al. [9] documented 343 genera including 11,950 species, of which 252 genera belong to *Basidiomycota*, 84 to *Ascomycota* and 5 to *Zygomycota* that form ectomycorrhizal association. The members of *Betulaceae*, *Pinaceae*, *Fagaceae*, *Salicaceae* and *Dipterocarpaceae* families form ectomycorrhizal association with fungal species Buscot F, et al. [10] described mycorrhizae formation of *Tricholoma sulfureum* and *T. vaccinum* with spruce. *Tricholoma aurantium* is widely distributed in North America Kuo M, et al. [11]; Niazi AR, et al. [12] described putative ectomycorrhizae of *T. aurantium* with *Pinus wallichiana* and *Abies pindrow* from Pakistan Comandini O, et al. [13] described mycorrhizae of *T. aurantium* with *Abies alba* in Italy. About 5400 species of fungi form ectomycorrhizal associations with members of families *Betulaceae*, *Fagaceae*, *Pinaceae* and *Myrtaceae*. The morphological and anatomical characterization of ectomycorrhizae and identification of fungal partner are pre-requirement for recognizing mycorrhizal diversity in an forest ecosystem. In the present paper, ectomycorrhizae of *Tricholoma aurantium* with *Cedrus deodara* and *T. pardinum* associated with *Pinus wallichiana* are documented in detail.

Materials and Methods

Study Area

The Kashmir Himalaya was taken as investigation area. The present collections were examined from Kulgam at an altitude of 2130m with coordinates 33° 31.554' N -075° 26.9'E and village Langate of district Kupwara at an altitude of 1791m during summer season. The agarics were collected,

examined and identified in the laboratory.

Methodology for Systematics

The classification, terminology and generic concepts as given in the "Dictionary of Fungi" by Kirk PM, et al. [5] will be followed. The macroscopic & microscopic details will be worked out as per methodology given by Atri et al.. The characters pertaining to the gross morphology like, shape, colour, size of the pileus, stipe, lamellae, presence or absence of annulus and volval types, etc will be noted. The macroscopic features of the collected material will be documented on the "Field Key to Mushroom Collector". The colour terminology of Kornerup A, et al. [14] will be used. A small portion of the collection will be preserved in a liquid preservative Hawksworth DL, et al. [15]. The major portion of the same collection was hot dried as per the standard protocol. The dried material will be packed in the cellophane sheets along with few crystals of 1,4 paradichlorobenzene or naphthalene balls. The microscopic details will be studied by cutting free hand sections of the wet preserved material. In case of dried material it is revived in 10% KOH solution. The sections will be stained with 1% Cotton Blue. Camera Lucida drawings of the sections will be done. The observations for basidia, cystidia, epicutis, hymenophoral trama, root sections, etc. will be made with the help of Camera Lucida at accurate magnification. The research work will consist of systematics including the description and illustrations of the families with its genera, section, subsections, species and varieties. A full synonymy and author citations will be quoted for each species and collection data of all specimens will be mentioned. All the collections have been deposited in the Herbarium of the Department of Botany, Punjabi University, and Patiala under (PUN) for further references.

Methodology for ECM preservation and Morpho-Anatomical Studies

The fruiting bodies of putative ectomycorrhizal agarics growing under *Cedrus deodara* and *Pinus wallichiana* have been collected. The ECM roots just beneath the fruit bodies growing on the fine feeder roots of host plant have been accessed. The ECM roots were preserved in FAA (Formalin acetic acid alcohol) for morpho anatomical studies. Morpho anatomical details of ectomycorrhizal roots were worked out as per methodology given by Agerer and Rambold, et al. (2004-2007).

Results

Key to the Investigated Taxa of Genus *Tricholoma*

- Carpophores growing in scattered condition in a pure coniferous forest under *Cedrus deodara* on humus soil;

Pileus yellow orange (4A8); Odour farinaceous; Lamellae changes to rusty brown; Rhizomorphs not observed. Cystidia present on outer mantle of root.. ***Tricholoma aurantium***.

- Carpophores growing in groups in ECM association with *Pinus wallichiana* in coniferous forest; Pileus reddish grey (9B2) with pinkish to violet shade; Odor mild; Lamellae unchanging; Rhizomorphs frequently present; Cystidia not found on outer mantle of root.. ***Tricholoma pardinum***.

***Tricholoma aurantium* (Schaeff.) Ricken, Die Blätterpilze 1: 332 (1915)**

[Mycobank No. 356852; Legitimate] Figures 1&2
Carpophores 4.5-11.0cm in height Pileus 2.8-7cm broad, convex to flattened depressed; surface brownish (6D7) towards margin, yellow orange (4A8) in center, irregular, splitting at maturity, non-straite, sticky when young; involute, areolate, dry, brown colour appressed fibrillose scales cover entire pileus surface; cuticle half peeling; flesh offwhite, unchanging, upto 0.8cm thick; odour farinaceous. Lamellae adnexed, subdistant, unequal, not in series, moderately broad (upto 0.3cm broad), yellowish white (3A2), changing; changes to rusty brown, tinges of yellow colour on gill edges, white fragments on gill surface, lamellulae present; forking absent; gill edges smooth, fragile. Spore print not found. Stipe excentric, 4.0-7.0 cm long and upto 1.2cm broad near apex, 1.5cm at middle, and 1.0cm broad at base, tapering at both ends and broad in the middle; brownish orange (6C8), brownish (7D7) colour appressed fibrillose scales on surface except at apex; surface areolate and flaring, base offwhite in color, fluid like substance at surface, basal mycelium white to off-white.

Basidiospores 3.7-6.0×3.0-4.5µm (Q=1.23), subglobose, single walled, smooth; inamyloid; apiculate, apiculus 0.5-0.7µm long. Basidia 16.0-25.0×4.5-6.0µm, clavate, tetrasterigmate, granular, basal clamps absent; sterigmata 3.0-4.5 µm long; acute type. Cheilocystidia 22.0–29.0 × 4.5–6.5 µm, clavate, clavate to cylindrical having inflated apices. Pleurocystidia absent. Gill edge heteromorphous. Hymenophoral trama regular. Pileus surface hyphal, gelatinized (ixocutis) made up of horizontally placed 0.9-18.0 µm, interwoven, broad septate hypha. Pileus context hyphal made up of sub-horizontally placed interwoven, 0.9-19.0µm broad septate hyphae interspersed with cellular cells. Stipe cuticle hyphal, made up of longitudinally placed loosely interwoven 6.0-16.0 µm broad septate hyphae. Context hyphal made up of parallelly running, tightly woven, 9.0-16.0µm broad septate hyphae. Clamp connections absent throughout.

Collection Examined: Jammu and Kashmir: Kupwara, village

Langate (1791 m) 34°22'42 N– 74°18'32E, growing in scattered condition in a pure coniferous forest in ECM association with *Cedrus deodara* on humus soil during summer season, Hilal Ahmad Rather, PUN (10778), June 19th, 2017.

Distribution and Ecology: *Tricholoma aurantium* growing scattered or gregariously and in clusters in mycorrhizal symbiosis with conifers, quite extensively dispersed in northern and montane North America includes the Rocky mountains and the Appalachians Kuo M, et al. [11]. This species is widely distributed in North America Kuo M, et al. [11]. The ectomycorrhizal characterization of *T. aurantium* has been documented with *Pinus wallichiana* and *Abies pindrow* from Pakistan Niazi AR, et al. [12]. This species also form ectomycorrhizal association with silver fir (*Abies alba*) in Italy Comandini O, et al. [13]. From India, it has been reported from Kashmir Abraham, et al. 1993. The presently worked out collection have been found growing in scattered condition in a pure coniferous forest under *Cedrus deodara* on humicolous soil during summer season at an altitude of (1791m).

Edibility: The mushroom should be considered to be toxic Boa E, et al. [16].

Description of putative Ectomycorrhizae: *Tricholoma aurantium* (Schaeff.) Ricken, Die Blätterpilze with *Cedrus deodara* (Roxb. ex D. Don.) G. Don.

Morphological characters: Mycorrhizal system dichotomously branched to irregularly pinnate with 0-1 order of ramification, upto 13.0-20mm long; main axes 3.0-5.0mm in diam. Unramified ends sinuous to constricted between older and young parts and tapering to enlarged at tip, 0.5-0.9mm in length and 0.1-0.3mm in diam; tips rounded to slightly pointed. Surface of unramified ends not smooth, loosely hairy and covered with soil particles, younger mycorrhizae grayish brown to redish gray and older dark gray to deep black, mycorrhizae color changes to redish brown on bruising or injury, no latex or any other fluid exuded when injured; mantle not transparent, cortical cells not visible; mantle hydrophobicity absent, root tip rounded, straight to tapering, mostly swollen, dark brown to deep black, mantle dots present, reddish brown, carbonisation absent. Emanating hyphae present, not specifically distributed, cystidia present. Rhizomorphs not observed. Sclerotia not found.

Anatomical characters in cross section: Mantle thickness 56.6–65.5µm, differentiated into outer mantle layer and inner mantle layer. Outer mantle layer 20.9.–35.7µm thick, almost plectenchymatous, with patches of rounded cells

representing type F Agerer and Rambold, et al. (2004-2007); giving rise to prominent emanating hyphae and cystidia, tightly arranged, ampullate, not gelatinous; hyphal cells 2.0–4.5µm thick in outer mantle layer, smooth, no contents present inside, septate, thick walled (0.7µm), not constricted at septa, septa clamps absent; septa as thick as hyphal wall. Inner mantle layer 28–46µm, pseudoparenchymatous representing type K Agerer and Rambold, et al. (2004-2007); hyphal cells hyaline, thin walled, variable in shape measuring 4.5–13.5µm, tangentially and 3–5µm radially. Emanating hyphae 3.0–6.0µm in diam; longitudinally placed, woven, septate with normal ends, slightly swellings, thick walled upto (0.8 µm), ramified, not constricted, clamps absent throughout. Cystidia 14.9–26.8 × 3.7–6.0µm, arising from outer mantle, the most distinct and often frequent with type 1(Agerer and Rambold, et al. (2004-2007), unramified, clavate to fusiform representing type F Agerer and Rambold, et al. (2004-2007), agranulated, smooth, thick walled upto (0.2µm), septate to aseptate without clamps. Rhizomorphal hyphae not observed.

Longitudinal section: Mantle thickness 56.6–65.5µm, differentiated into outer mantle layer and inner mantle layer. Outer mantle layer 20.9–35.7µm thick, almost plectenchymatous with patches of rounded cells representing type F Agerer and Rambold, et al. (2004-2007), giving rise to emanating hyphae and cystidia, hyphal cells 2–5µm in diam., smooth, no contents inside as no contents present in case of sporophores hyphal cells. Inner mantle layer 28–46µm, pseudoparenchymatous possessing angular to rounded cells representing type K Agerer and Rambold, et al. (2004-2007), hyphal cells thick, hyaline, variable having rounded, angular, elliptic to oval in shape measuring 4.5–13.5µm tangentially and 3–5µm radially. Labyrinthine Hartig net hyphae protruding towards endodermis around cortical cells, measuring 19–38.7µm tangentially and 13.5–31.2µm radially, rounded, oval to elliptic in shape. Epidermal cells measuring 3–6µm tangentially and 3–5µm radially, angular to elliptic in shape. Tannin cells in 1-2 rows, measuring 17.9–47.7µm tangentially and 3–6µm radially, oval, elliptic to cylindrical in shape and oriented parallarly. Root tip mantle upto 75µm thick, different from rest of the mantle, plectenchymatous with prominent emanating hyphae and cystidia representing type D Agerer and Rambold, et al. (2004-2007).

Colour reaction with different reagents: FeSO₄ (no reaction); Ethanol (70%): brownish orange, KOH (10%): brownish green; Melzer's reagent: brownish gray, Cotton blue: bluish green, Acetic acid: (no reaction).

Remarks: All the morphological and internal details of the present worked out taxa are similar to the description given for *Tricholoma aurantium* (Schaeff.) by Kuo M, et

al. [11]. Putative ectomycorrhizae of *T. aurantium* are reported as new record from Kashmir Himalaya, India. The ectomycorrhizae *T. aurantium* have already been described Niazi AR, et al. [12] with *Abies pindrow* from Pakistan. The putative ECM of this species have been described by (Uhl, 1988) with *Picea* sp. Reshi ZA, et al. [17] also collected this species under *Cedrus deodara* from Kashmir Himalaya but did not described field ectomycorrhizae and morphological and anatomical characterization of ECM of *Tricholoma aurantium* with *Cedrus deodara* in detail. Presently, the ectomycorrhizae of this species have been illustrated morphologically and anatomically in detail. The ECM of *Tricholoma aurantium* are reported as a new record from Kashmir Himalaya. Here *C. deodara* is reported as a new host for this species.

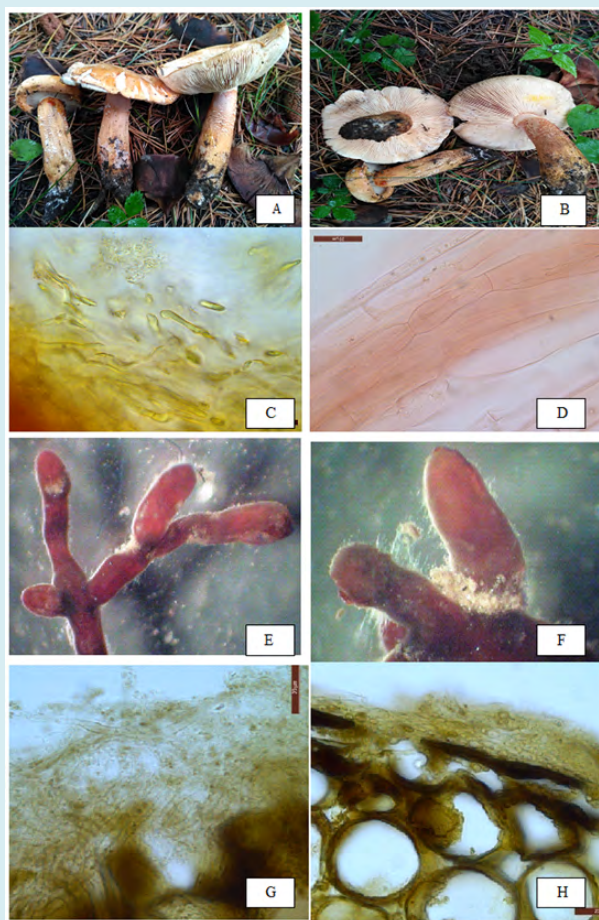


Figure 1: *Tricholoma aurantium*: (A) Carpophores in groups. (B) Underview of cap with adnexed to notched lamellae. (C) Pileus cuticle and ixocutis. (D) Stipe cuticle hyphae closely septate. (E) Dichotomously branched ectomycorrhizal system. (F) Emanating hyphae proximally positioned. (G) Plectenchymatous mantle type 'F'. (H) Hartig net (hn) between cortex cells of root and parallarly oriented layers of tannin cells.

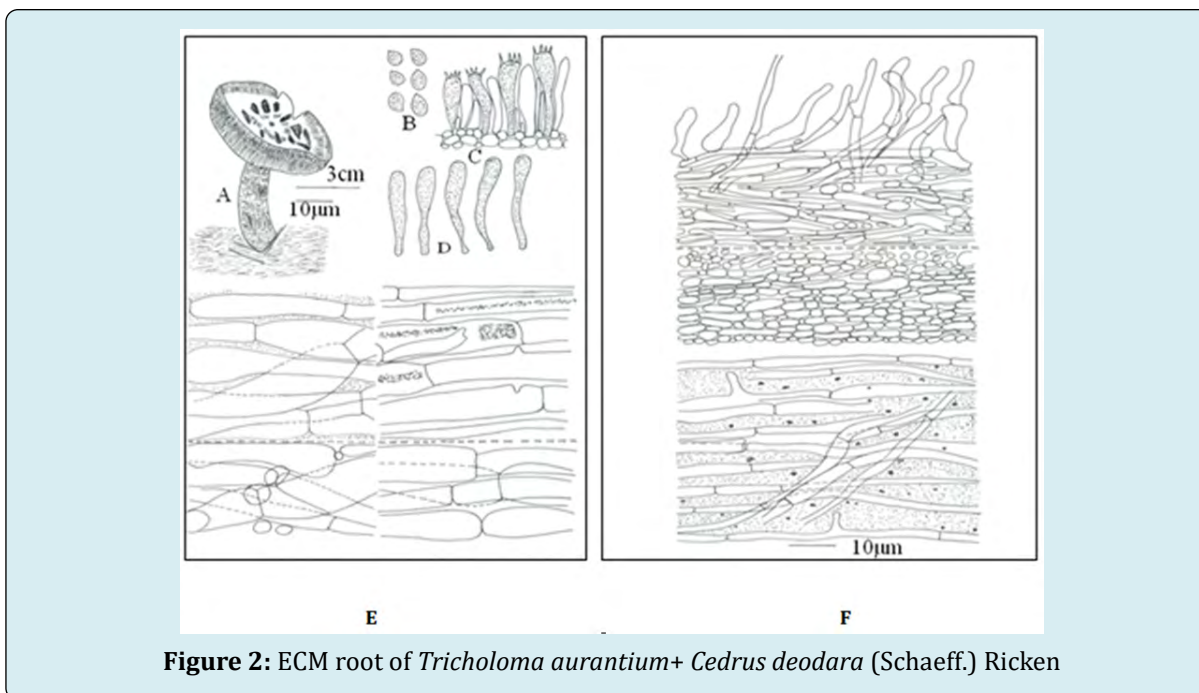


Figure 2: ECM root of *Tricholoma aurantium*+ *Cedrus deodara* (Schaeff.) Ricken

Tricholoma pardinum (Pers.) Quél., *Mém. de la Soci. d'Émul. de Montb.* 5: 339, 1873.

[Mycobank No.356853; Legitimate] Figures 3 & 4

Synonymy: =*Agaricus myomyces* var. *pardinus* Pers., *Syn. meth. fungor.*: 346, 1801. =*Tricholoma pardalotum* Herink & Kotl., *Ceská Mykologie* 21 (1): 5, 1967.

Carpophores 3.0-4.5cm in height. Pileus 2.0-3.0cm broad, convex, incurved margin when young; umbo absent; surface reddish grey (9B2) with pinkish to violet shade; scaly, scales, appressed fibrillose, tiger spotted, cover the entire pileus, reddish brown (9E4); velvety; dry; margin regular; cuticle half peeling; flesh up to 0.1cm thick, white, unchanging; odor and taste mild. Pileal veil appendiculate. Lamellae up to 0.4 cm broad, adnexed to notched, distant, and unequal, interveined, white (2A1) with pinkish tinge, not grey spotted, furcate, unchanging; lamellulae present. Gill edges smooth, fimbriate to wavy near margin. Stipe excentric, 3.0-3.5cm long, up to 1.0cm broad in middle, up to 0.3cm broad near base; clavate, slightly tapering downward; surface white (15A1), unchanging; scaly, scales fibrillose, off white; solid; exannulate.

Basidiospores 5.81-8.3×4.15-5.81µm, Q=1.4, ellipsoidal, granular, double walled, thick, non-guttulate, inamyloid; apiculate, apiculus up to 0.83µm long, eccentric. Basidia 25.0-36.52×5.0- 8.3µm, clavate, granular, thick walled, bi to tetrasterigmate, commonly tetrasterigmate; sterigmata 2.49- 3.32µm long, hyaline. Pleurocystidia and cheilocystidia absent. Hymenophoral trama regular. Gill edge sterile.

Pileus cuticle cellular, ixocutis, made up of hyaline, spherical cells intermixed with septate, hyaline hyphae, giving rise to the regular turf of 8.3–13.28µm broad, closely septate, hyaline, encrustated hyphae; context hyphal, made up of 9.96–18.26µm broad, septate, gelatinized, irregularly placed, hyaline, inflated hyphae intermixed with broad, hyaline spherical cells. Stipe cuticle hyphal, made up of 3.2–6.4µm broad, septate, granular, longitudinally placed hyphae; context hyphal made up of 3.2–9.6µm broad, hyaline, longitudinally placed hyphae. Clamp connections absent.

Collection Examined: Kulgam, Banimulla (2130m), 33° 31.554' N-075°00.269E, growing in groups in ECM association with *Pinus wallichiana* in coniferous forest, 18th May, 2013, Nazir Ahmad Malik, PUN 9079.

Edibility: It is a poisonous species (Alder, 1960).

Distribution and Ecology: Zeitlmayr L, et al. [18] found *Tricholoma pardinum* in ectomycorrhizal (ECM) association with fir, beech and conifers during summer and autumn in South Europe while Lamaison JL, et al. [19] have found this species growing solitary or in groups or fairy rings from France, Belgium Germany and North America. In India, presently this species have been found growing in groups in putative ECM association with *Pinus wallichiana* during starting summer in coniferous forest of Jammu and Kashmir at an altitude of 2130m.

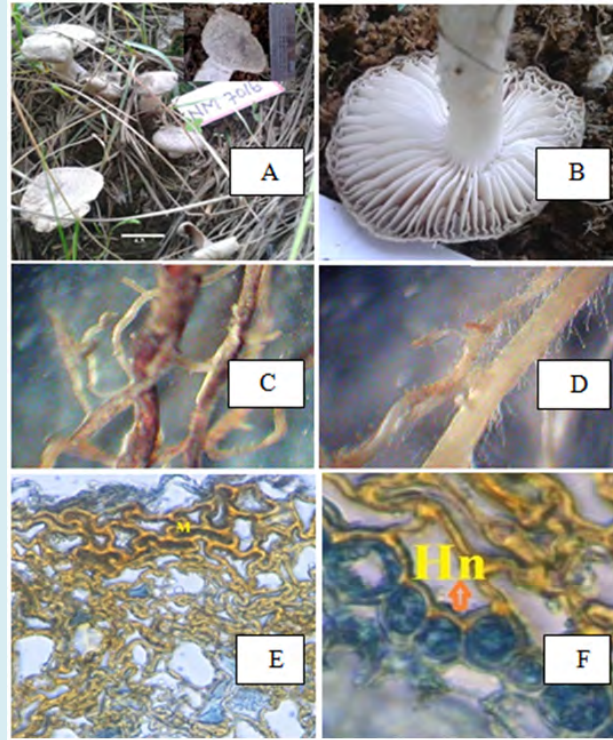


Figure 3: *Tricholoma pardinum*: (A) Carpophores in groups. (B) Under view of cap with adnexed to notched lamellae. ECM (*Tricholoma pardinum* + *Pinus wallichiana*): (C) Dichotomously branched ecto- mycorrhizal system. (D) Ectomycorrhizae with cottony appearance. (E) T.S. of mantle with Type 'H'. (F) Hartig net (Hn) between cortex cells of root.

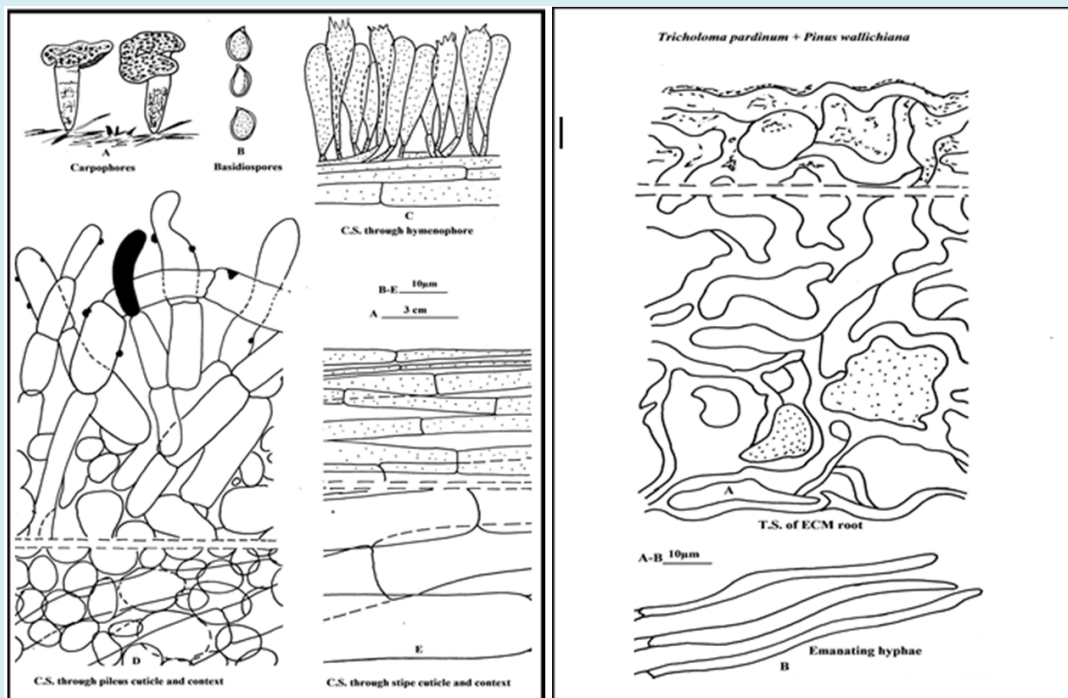


Figure 4: *Tricholoma pardinum* (Pers.) Quél ECM root of *Tricholoma pardinum* + *Pinus wallichiana*

Description of Putative Ectomycorrhizal root system of *Pinus wallichiana* with *Tricholoma pardinum* (Pers.) Quél

Morphological characters: Ectomycorrhizal system hydrophobic, dichotomously branched up to 3.0mm long, ectomycorrhizae small to large in numbers, clusters, coralloid; main axis 2.0mm diameter; Unramified ends 1.0-1.5mm diameter, bent, sineous with pointed tips, reddish brown with silvery appearance, glabrous, mantle transparency opaque; cortex cells are not visible; appearance dense cottony. It does not consist debris of soil particles. Emanating hyphae present. Rhizomorphs frequently present. Sclerotia absent.

Anatomical characters: Mantle is plectenchymatous, Type 'H'. Mantle 155.42–204.5µm thick, non-gelatinized, Pseudoplectenchymatous net of coarse and irregularly shaped hyphae at an angle of 120°. Hartig net extending deep up to many layers of cortex. Cystidia not seen. Emanating hyphae, 3.2–4.8µm broad, septate, narrow, thick walled, rarely present.

Chemical reactions: Potassium hydroxide: The mantle becomes a dull brown.

Melzer's Reagent: There is a little reactivity with Melzer's Reagent.

Sulfovanillin: ECM becomes reddish-brown with sulfovanillin expect the oldest roots.

Remarks: All the morphological and internal details of the present worked out collection are similar to the description given for *Tricholoma pardinum* (Pers.) Quél. By Bas et al. (1999); Arora (1986). This collection is characterized by reddish grey (9B2) with pinkish to violet shade cap having reddish brown (9E4) tiger spotted scales covering the entire pileus, white unchanging flesh, notched lamellae, interveined and are not spotted grey. Although present specimen shows variation in the basidiospore size which is 7-9.5(10)×5-6.5(7) µm in the literature while it is 5.81- 8.3 × 4.15-5.81µm in presently examined specimen but its all other characters matches and fits well with the *T. pardinum* as given by Bas et al. (1999); Arora (1986) in their description. It has also been founded from southwestern Turkey Solak MH, et al. [20], China Deng H, et al. [21] and Japan Miyauchi S, et al. [22]. This species is first time recorded from India.

Discussion

Carpophores and their ECM root surveys carried out during the present study resulted in identification of *Tricholoma aurantium* associated with *Cedrus deodara* and *Tricholoma pardinum* with *Pinus wallichiana*. Previously, the putative ECM of *Tricholoma aurantium* have been described by Uhl M, et al. [23] with *Picea* species. Hence *Cedrus deodara* is reported as a new host for this species. Itoo ZA, et al. [17] collected this species under *Cedrus deodara* from Kashmir Himalaya but they did not described

field ectomycorrhizae and morphological and anatomical characterization of ECM of *Tricholoma aurantium* with *Cedrus deodara* in detail. There is no an earlier record of *Tricholoma pardinum* from India, hence it constitutes a new addition to the tricholomas of India. Earlier, Zeitlmayr L, et al. [18] reported *Tricholoma pardinum* in ECM association with fir and beech but presently it has been found in having putative ECM association with *Pinus wallichiana*. Abraham and Kaul (1985) listed 175 taxa of agarics from the Kashmir of which 53 were found to form ectomycorrhizal associations with tree species. Watling and Abraham (1992) reported 77 ECM taxa from Kashmir forests. Beig MA, et al. [3] reported 24 ectomycorrhizal species during describing mycorrhizal biodiversity of Kashmir Himalayas. Pande (2004) described 98 ectomycorrhizal species from western Himalaya out of which 55 species were found in ectomycorrhizal association with *Pinus wallichiana* and *Cedrus deodara*.

Conclusion

The present study disclosed that coniferous forests of Kashmir Himalaya, constitutes several ectomycorrhizal agaric taxa. The diverse forests of Kashmir Himalaya need to be intensively surveyed for agaric taxa springing during different seasons. The present study stresses the need for the vast and specialized exploration of these forests which could clearly lead to the detection of many new and unnoticed ectomycorrhizal agaric taxa from this diverse region.

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