

## Some new records of resupinate non-poroid fungi from Himachal Pradesh

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### ABSTRACT

Seven species of resupinate, non-poroid fungi, namely *Amethicium luteoincrustatum* Hjortstam & Ryvar den, *Lopharia mirabilis* (Berk. & Broome) Pat., *Membranomyces spurius* (Bourdot) Jülich, *Phanerochaete chrysosporium* Burds., *Radulodon acaciae* G. Kaur, Avneet P. Singh & Dhingra, *Sistotrema heteronemum* (J. Erikss.) Å. Strid and *S. resinicystidium* Hallenb. have been recorded for the first time from the state of Himachal Pradesh. Of the seven species described, *Membranomyces spurius* and *Sistotrema resinicystidium* are described for the first time from India.

**KEYWORDS:** Basidiomycota, Agaricomycetes, Himalaya, resupinate wood rotting fungi.

### INTRODUCTION

Resupinate non-poroid agaricomycetous fungi, also known as corticioid fungi, are characteristic in having resupinate to effused to pileate basidiomata with gymnocarpic, unilateral hymenium with smooth, ridged, tuberculate, toothed, warted to meruloid, hymenophore. As per Hibbett *et al.*, (2007) and Kirk *et al.*, (2008), these fungi have been placed in class *Agaricomycetes*, sub-phylum *Agaricomycotina* and phylum *Basidiomycota*. Seven species i.e. *Amethicium luteoincrustatum* Hjortstam & Ryvar den, *Lopharia mirabilis* (Berk. & Broome) Pat., *Membranomyces spurius* (Bourdot) Jülich, *Phanerochaete chrysosporium* Burds., *Radulodon acaciae* G. Kaur, Avneet P. Singh & Dhingra, *S. heteronemum* (J. Erikss.) Å. Strid and *Sistotrema resinicystidium* Hallenb. identified on the basis of macroscopic and microscopic features and comparison with literature (Eriksson and Ryvar den, 1976; Eriksson *et al.*, 1984; Boidin and Gilles, 1991; Bernicchia and Gorjón, 2010; Dhingra, 2014; Kaur *et al.*, 2014; 2016; 2017; Sharma, 2012; Kaur, 2017 and Sharma, 2017) have been described for the first time from the state of Himachal Pradesh with *Membranomyces spurius* and *Sistotrema resinicystidium* as new to India. All the specimens have been deposited at the herbarium of the Department of Botany, Punjabi University, Patiala (PUN). The color standards used are as per Methuen's Handbook of colors by (Kornerup and Wanscher, 1978).

### TAXONOMIC DESCRIPTIONS

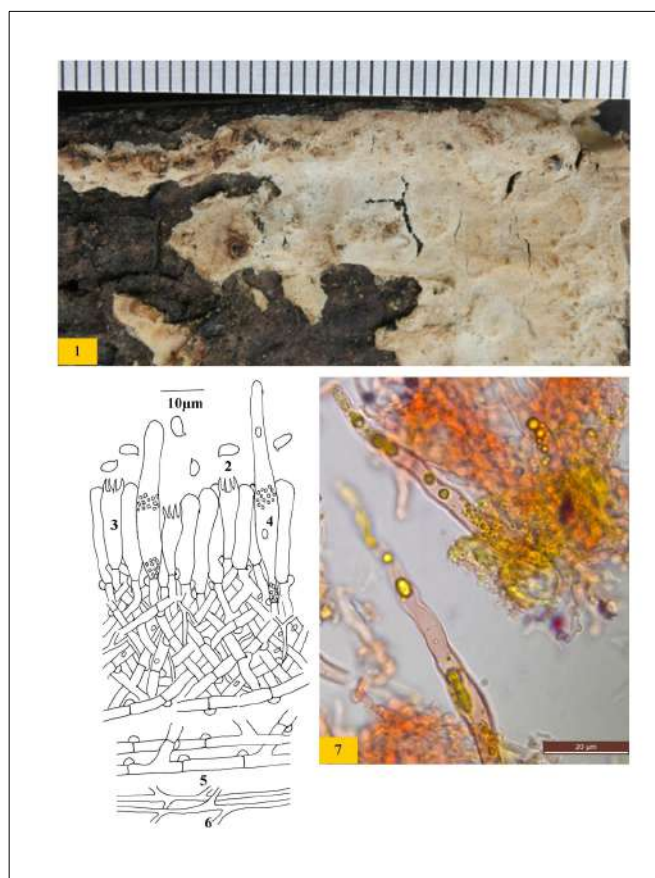
**1. *Amethicium luteoincrustatum*** Hjortstam & Ryvar den, *Mycotaxon* 25 (2): 542, 1986. **Figs. 1-7**

**Basidiomata** resupinate, adnate, effused, up to 220 µm thick in section; hymenial surface smooth, orange white to orange grey to pale orange when collected, not changing much on drying; margin thinning, paler concolorous, or indeterminate.

**Hyphal system** dimitic. Generative hyphae septate, clamped, up to 2.8 µm wide, thin-walled; basal hyphae parallel to the substrate, less branched; subhymenial hyphae vertical, more branched. Microbinding hyphae without clamps, branched, up to 1.4 µm wide, thin-walled. **Cystidia** fusiform to subcylindrical with obtuse tip, 38-53 × 5.2-5.7 µm, thick-walled, basally strongly incrustated with yellowish resinous

matter, with basal clamp. **Basidia** clavate, 13-18 × 4-4.7 µm, four sterigmate, with basal clamp; sterigmata up to 4.7 µm long. **Basidiospores** ellipsoid, 2.8-5.2 × 1.4-2.3 µm, thin-walled, smooth, inamyloid, acyanophilous.

**Collections examined** - Himachal Pradesh: Sirmaur, Nahan, Ambwala, on the trunk of *Ficus religiosa*, Ramandeep and Dhingra 8816 (PUN), August 23, 2015; about 2 km from Ambwala towards Nahan, on the trunk and sticks of *Ficus*



**Figs. 1-7** *Amethicium luteoincrustatum* 1. Basidiome showing hymenial surface 2. Basidiospores 3. Basidia 4. Cystidia 5. Generative hyphae 6. Microbinding hyphae 7. Photomicrograph showing cystidia.

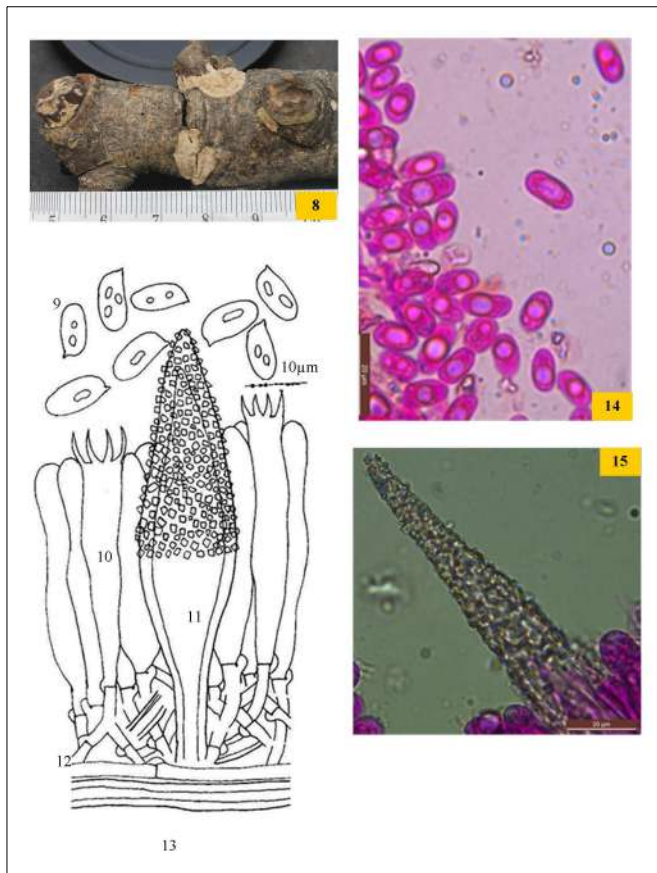
*religiosa*, Ramandeep and Avneet 8817 (PUN), August 23, 2015; Paonta Sahib, Rajban, near cement factory, on the trunk of *Mallotus philippensis*, Ramandeep 8819 (PUN), October 7, 2016; near La Devi Mandir, on the trunk of *Shorea robusta*, Ramandeep 8818 (PUN), October 7, 2016; Renuka Ji, near water shed development office, on the trunk of *Mallotus philippensis*, Ramandeep 8821 (PUN), October 8, 2016; Renuka Ji Mandir, on the trunk of *Ficus religiosa*, Ramandeep 8820 (PUN), October 8, 2016; Renuka Ji Mini Zoo, on the trunk of *Bauhinia variegata*, Ramandeep 8822 (PUN), October 8, 2016.

**Remarks** - This species is characteristic in having a dimitic hyphal system and fusiform to subcylindrical cystidia with yellowish resinous incrustations at the base. Earlier it was reported by Kaur *et al.*, (2017) from Punjab. Presently it is being described for the first time from Himachal Pradesh.

**2. *Lopharia mirabilis*** (Berk. & Broome) Pat., *Bulletin de la Société Mycologique de France* **11**: 14, 1895.

- *Radulum mirabile* Berk. & Broome, *Botanical Journal of the Linnean Society* **14**: 61, 1875. **Figs. 8-15**

**Basidiome** resupinate, adnate, effused, somewhat reflexed at the margins, up to 950  $\mu\text{m}$  thick in section; hymenial



**Figs. 8-15** *Lopharia mirabilis* 8. Basidiome showing hymenial surface 9. Basidiospores 10. Basidia 11. Cystidia 12. Generative hyphae 13. Skeletal hyphae 14-15. Photomicrographs showing basidiospores and cystidia.

surface concentrically ribbed, tuberculate to odontoid, yellowish white to orange grey to greyish orange to brownish orange to greyish red when fresh, not changing much on drying; abhymenial surface tomentose, orangish grey; margin thinning, somewhat reflexed in mature basidiome and on drying, fibrillose (under lens), paler than the colour of the hymenial surface, or indeterminate. **Hyphal system** dimitic. Generative hyphae up to 4.1  $\mu\text{m}$  wide, septate, clamped, thin-walled; basal hyphae, parallel to the substrate, less branched; subhymenial hyphae vertical, more branched. Skeletal hyphae up to 4.6  $\mu\text{m}$  wide, non-septate, generally unbranched, thickwalled, extend vertically as skeletocystidia in the subhymenium/hymenium. **Skeletocystidia** arising from skeletoid hyphae, of variable length, up to 22  $\mu\text{m}$  wide, terminal part subfusiform to fusiform, sinuous, thick-walled, encrusted. **Basidia** 40–86  $\times$  8–9.3  $\mu\text{m}$ , narrowly clavate to clavate, sinuous, four sterigmate, with basal clamp; sterigmata up to 8.1  $\mu\text{m}$  long. **Basidiospores** 9–12.7  $\times$  5–6.9  $\mu\text{m}$ , cylindrical to ellipsoid to broadly ellipsoid, smooth, with oily contents, inamyloid, acyanophilous.

**Collection examined**– Himachal Pradesh: Sirmaur, Paonta Sahib, on angiospermous log, Ramandeep 10640 (PUN), September 3, 2017.

**Remarks**- This species is characteristic in having concentrically ribbed, tuberculate to odontoid basidiome, thick-walled, heavily encrusted skeletocystidia and cylindrical to ellipsoid to broadly ellipsoid basidiospores. From India, it was earlier reported by Kaur (2017) from Chandigarh. Presently it is being described for the first time from Himachal Pradesh.

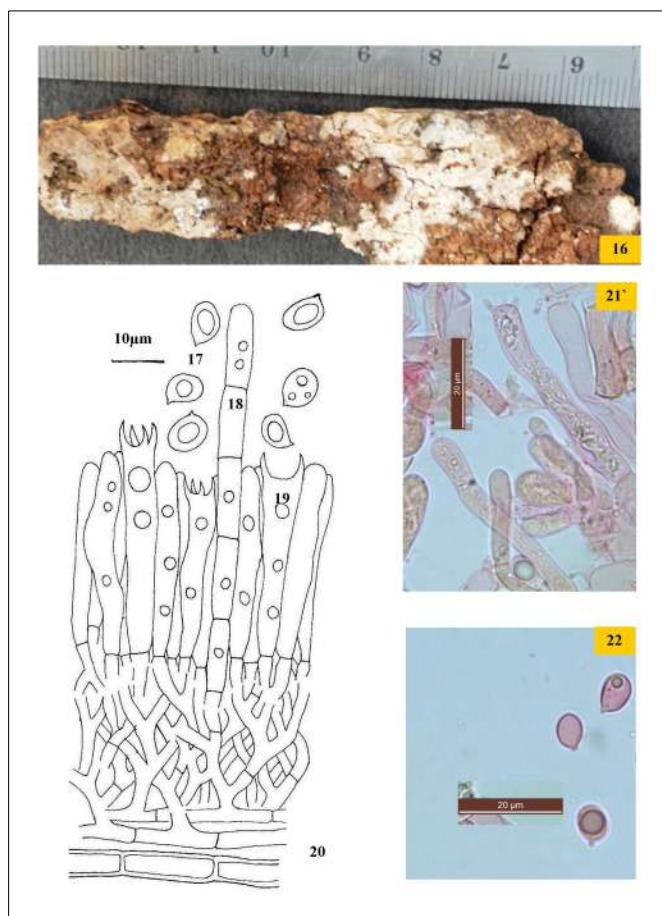
**3. *Membranomyces spurius*** (Bourdot) Jülich, *Persoonia* **8** (3): 292, 1975.

- *Corticium spurium* Bourdot, *Revue scient. Bourbon. Cent. Fr.*: 15, 1922. **Figs. 16-22**

**Basidiome** resupinate, effused, adnate, up to 310  $\mu\text{m}$  thick in section; hymenial surface smooth to tuberculate, greyish white to orange white when collected, cracked, greyish orange on drying; margin thinning, pruinose, paler concolorous. **Hyphal system** monomitic. Generative hyphae simple-septate; basal hyphae up to 10  $\mu\text{m}$  wide, thick-walled; sub-hymenial hyphae up to 3.5  $\mu\text{m}$  wide, thin-walled. **Cystidia** hyphoid, with several septa, 42–80  $\times$  4.8–5.2  $\mu\text{m}$ , thin-walled, with oily contents. **Basidia** subcylindrical, 30–40  $\times$  5.2–8  $\mu\text{m}$ , two - four sterigmate, with basal clamp; sterigmata up to 4.7  $\mu\text{m}$  long. **Basidiospores** broadly ellipsoid, 6–8  $\times$  4.7–7.1  $\mu\text{m}$ , smooth, guttulate, inamyloid, acyanophilous.

**Collection examined** - Himachal Pradesh: Sirmaur, Rajgarh, on stump of *Quercus leucotrichophora*, Ramandeep and Avneet 8824 (PUN), September 12, 2016.

**Remarks**- It is a new record for India and characteristic in having hyphoid, simple-septate cystidia with oily contents. Earlier, it was reported from Austria, Germany, Russia, Italy, France, Belgium, United Kingdom, Turkey, Sweden,



**Figs. 16-22 *Membranomyces spurius*** 16. Basidiome showing hymenial surface 17. Basidiospores 18. Cystidia 19. Basidia 20. Generative hyphae 21-22. Photomicrographs showing basidia, cystidia and basidiospores.

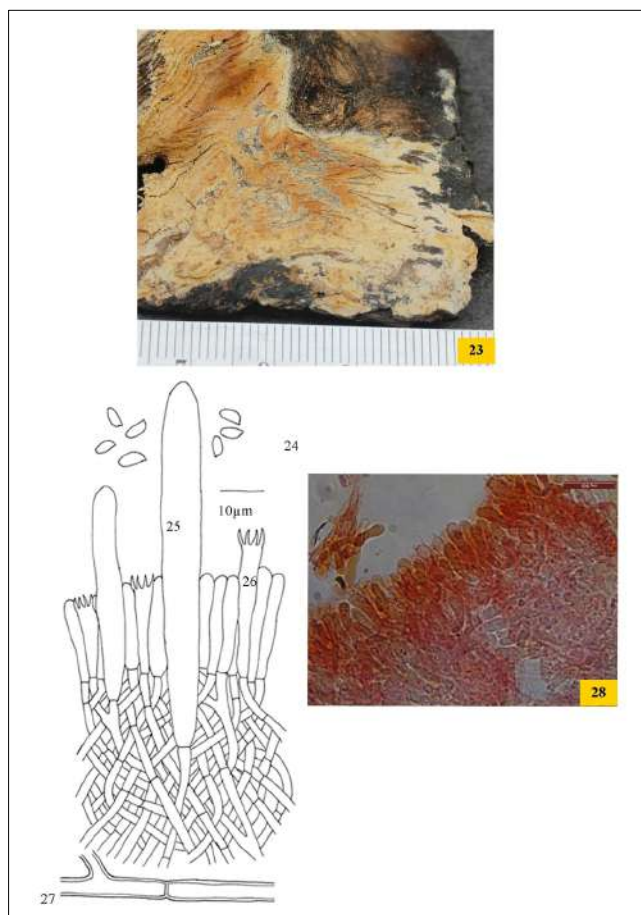
Denmark, Norway, Switzerland, Finland, and the Caucasus (Jülich, 1975; Mycobank, 2019).

**4. *Phanerochaete chrysosporium*** Burds., *Mycotaxon* 1 (2): 124, 1974. **Figs. 23-28**

**Basidiome** resupinate, adnate, effused, up to 325  $\mu\text{m}$  thick in section; hymenial surface smooth, orange white to orange grey to brownish orange when collected, not changing much on drying; margin thinning, fibrillose, paler to concolorous, or indeterminate. **Hyphal system** monomitic. Generative hyphae simple-septate, up to 4.8  $\mu\text{m}$  wide, thin-walled; basal hyphae parallel to the substrate, thick-walled, less branched. **Cystidia** cylindrical with obtuse tip, 51-101  $\times$  5.2-9.2  $\mu\text{m}$ , thin- to slightly thick-walled, without basal clamp. **Basidia** clavate, 17-35  $\times$  4-6.2  $\mu\text{m}$ , four sterigmate; sterigmata up to 4.7  $\mu\text{m}$  long. **Basidiospores** ellipsoid, 5.2-9.2  $\times$  2.4-4.3  $\mu\text{m}$ , thin-walled, smooth, inamyloid, acyanophilous.

**Collection examined** - Himachal Pradesh: Sirmaur, Nahan, Ambwala, on the trunk of *Ficus religiosa*, Ramandeep and Dhingra 10641 (PUN), August 23, 2015.

**Remarks**- This species is characteristic in having large, cylindrical, thin- to slightly thick-walled cystidia. From India, it was earlier documented by Kaur *et al.*, (2016) from Punjab.



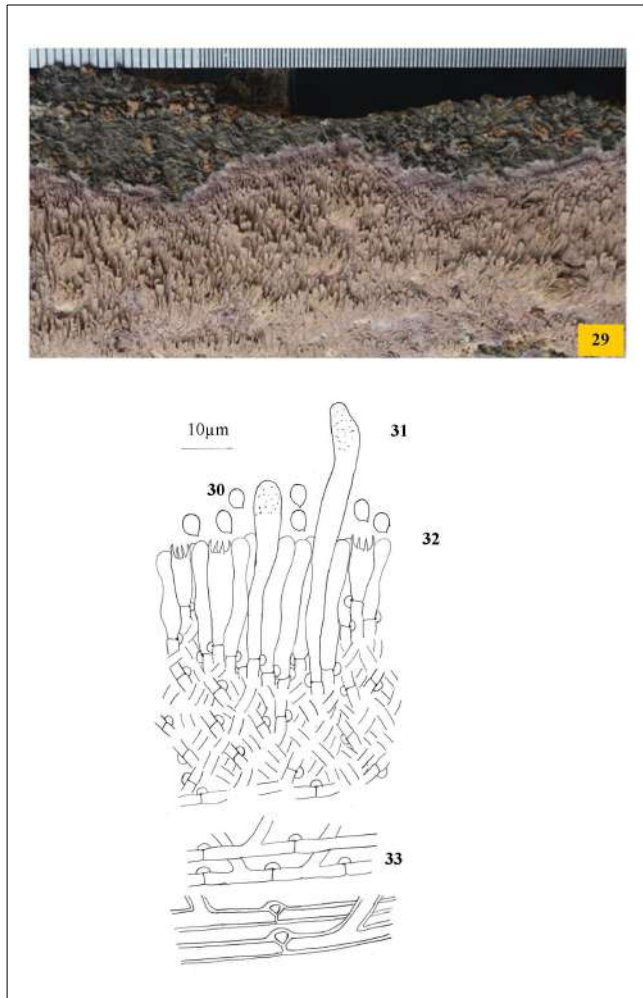
**Figs. 23-28 *Phanerochaete chrysosporium*** 23. Basidiome showing hymenial surface 24. Basidiospores 25. Cystidia 26. Basidia 27. Generative hyphae 28. Photomicrograph showing hymenium.

Presently it is being described for the first time from Himachal Pradesh.

**5. *Radulodon acaciae*** G. Kaur, Avneet P. Singh & Dhingra, *Mycotaxon* 127: 111, 2014. **Figs. 29-33**

**Basidiomata** resupinate, adnate, effused, up to 950  $\mu\text{m}$  thick in section; hymenial surface hydroid with dense spines; up to 4 mm long, cylindrical, tapering to aggregated, flattened; brownish orange to brownish red to violet brown when collected, dark grayish on drying; margin wavy, very thin and grayish in young basidiomata, thinning, paler to concolorous, or even indeterminate on maturity. **Hyphal system** monomitic. Generative hyphae branched, septate, clamped, up to 2.8  $\mu\text{m}$  wide; basal hyphae intertwined and parallel to the substrate, up to 4.2  $\mu\text{m}$  wide; tramal hyphae more or less parallel and thick-walled; subhymenial hyphae compactly arranged and thin-walled. **Cystidia** clavate, 36-53  $\times$  5.7-5.8  $\mu\text{m}$ , thin- to thick-walled, with resinous encrustation at the tip. **Basidia** clavate, 10-19  $\times$  4.2-5.2  $\mu\text{m}$ , four sterigmate, with basal clamp; sterigmata up to 2.8  $\mu\text{m}$  long. **Basidiospores** broadly ellipsoid to subglobose, 4.2-4.7  $\times$  2.8-3.3  $\mu\text{m}$ , thin-walled, smooth, inamyloid, acyanophilous.

**Collections examined**- Himachal Pradesh: Sirmaur, Paonta Sahib, near Gurudwara Paonta Sahib, on the trunk of *Delonix*



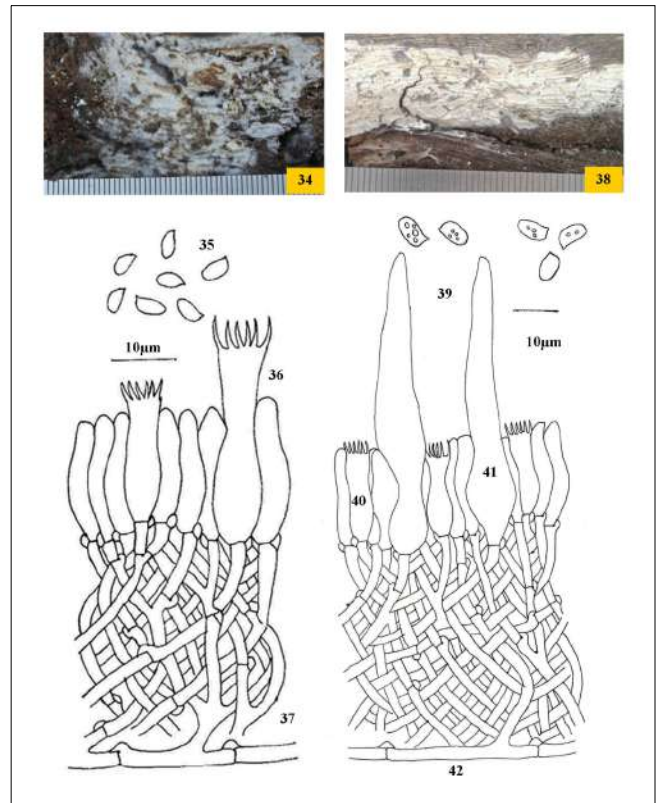
**Figs. 29-33** *Radulodon acaciae* 29. Basidiomata showing hymenial surface 30. Basidiospores 31. Cystidia 32. Basidia 33. Generative hyphae.

*regia*, Ramandeep 8826 (PUN), October 3, 2015; on the way from bus stand to Gurudwara sahib, on the trunk of *Delonix regia*, Ramandeep, 8823 (PUN), October 7, 2016.

**Remarks-** This species is characteristic in having hydroid hymenophore with dense spines and clavate cystidia with resinous encrustations at the tip. Kaur *et al.*, (2014) published it on the basis of material collected from Chandigarh (India). Sharma (2017) described it from Jammu and Kashmir. This is the first report of *R. acaciae* from Himachal Pradesh.

**6. *Sistotrema heteronemum*** (J. Erikss.) Å. Strid, *Wahlenbergia* **1**: 76, 1975. - *Botryobasidium heteronemum* J. Erikss., *Svensk bot. Tidskr.* **52** (1): 13, 1958. **Figs. 34-37**

**Basidiome** resupinate, effused, loosely adnate, up to 100 µm thick in section; hymenial surface smooth to graninoid, grayish white to yellowish white when collected, pale yellow to pale orange on drying; margin thinning, pruinose, paler concolorous, to indeterminate. **Hyphal** system monomitic. Generative hyphae septate, clamped; basal hyphae up to 8.5 µm wide, parallel to the substrate, light brown, less branched, thin- to somewhat thick-walled, with or without oily contents;



**Figs. 34-37** *Sistotrema heteronemum* 34. Basidiome showing hymenial surface 35. Basidiospores 36. Basidia 37. Generative hyphae. **38-42** *Sistotrema resinicytidium* 38. Basidiome showing hymenial surface 39. Basidiospores 40. Basidia 41. Cystidia 42. Generative hyphae.

subhymenial hyphae up to 4.0 µm wide, vertical, thin-walled, more branched. **Cystidia** none. **Basidia** urniform to suburniform, 20-23 × 5.4-6.3 µm, six to eight sterigmate, with basal clamp; sterigmata up to 2.5 µm long. **Basidiospores** narrowly ellipsoid to ellipsoid, 3.4-4.8 × 1.9-2.4 µm, smooth, thin-walled, inamyloid, cyanophilous.

**Collection examined** - Himachal Pradesh: Sirmaur, Rajgarh, Batyuri, on stump of *Quercus leucotrichophora*, Ramandeep and Avneet 10642 (PUN), September 12, 2016.

**Remarks:** *S. heteronemum* is typical in having light brown basal hyphae, six to eight sterigmate basidia and narrowly ellipsoid to ellipsoid basidiospores. It is being described for the first time from Himachal Pradesh. Earlier it was documented from India by Samita (2014) from Uttarakhand and Sharma (2017) from Jammu and Kashmir.

**7. *Sistotrema resinicytidium*** Hallenb., New taxa of *Corticaceae* from N. Iran (*Basidiomycetes*). *Mycotaxon* **11** (2): 466 1980. **Figs. 38-42**

**Basidiomata** resupinate, effused, adnate, up to 230 µm thick in section; hymenial surface smooth to tuberculate to more or less graninoid, white to cream when collected, not changing much on drying; margin indeterminate. **Hyphal system** monomitic. Generative hyphae with clamps, thin-walled; basal hyphae intertwined and parallel to the substrate, up to 4.1 µm wide, thin- to slightly thick-walled, less branched;

subhymenial hyphae up to 3.3 µm wide, thin-walled, highly branched. **Cystidia** sinuous to moniliform, 52-70 × 9.4-11.75 µm, thin-walled, with dark brown contents. **Basidia** narrowly urniform, 19-22 × 5.6-6.6 µm, six to eight sterigmate, with basal clamp; sterigmata up to 4.3 µm long. **Basidiospores** ellipsoid to broadly ellipsoid, 4.7-5.1 × 3.3-4.7 µm, smooth, thin-walled, inamyloid, acyanophilous.

**Collections examined-** Himachal Pradesh: Sirmaur, Paonta Sahib, Rajban, on the sticks of *Shorea robusta*, Ramandeep, 10643 (PUN), September 4, 2017; Paonta Sahib, Rajban, on the sticks of *Shorea robusta*, Ramandeep, 10644 (PUN), September 4, 2017.

**Remarks:** *S. resinicystidium* can be differentiated from *S. heteronemum* in having sinuous to moniliform cystidia. It is being described for the first time from India. Earlier it was reported from Germany, Belgium, Denmark, Sweden, Italy, Norway, Finland, Spain, and Caucasus (Hallenberg, 1980; Mycobank, 2019).

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