

УДК 582.281.23(540)

© Sh. W. Khade

**RECORD OF *GLOMUS LIQUIDAMBARIS* FROM INDIA**Х А Д Е Ш. В. НАХОДКА *GLOMUS LIQUIDAMBARIS* В ИНДИИ

*Glomus liquidambaris* (Wu et Chen) Almeida et Schenck was earlier placed under the genus *Sclerocystis* where spores are arranged in a hemispherical layer forming a head and a short stalk with absence of spores at the sporocarp base. Presently the genus *Sclerocystis* is maintained with one species *S. coremioides* while rest all other species are transferred to *Glomus*. Almeida and Schenck (1990) considered *S. coremioides* unique and therefore separate from the *Glomus* clade based on following four morphological traits: 1) spore formation on separate subtending hyphae rather than from branching sporophores; 2) a well defined septum at the same position near the spore base; 3) arrangement of spores in hemispherical layer; 4) new sporocarps formed from older sporocarps to often fuse into columns.

Wu (1993) resisted this change on the basis of comparative studies of spore ontogeny and sporocarps morphology and grouped them as six species. Wu (1993) hypothesized a model of a smooth evolutionary transition between relatively unorganized, *Glomus*-like sporocarps of *S. ribiformis* and intermediate forms like *S. clavispора*, *S. liquidambaris* and *S. sinuoda* to *S. coremioides*. He concluded that *S. coremioides* was not unique. This series of transformations led Wu (1993) to reject the changes of Almeida and Schenck (1990) and revert to Gerdemann and Trappe's (1974) classification scheme. With advancement in molecular taxonomy, all the sporocarpic species of *Sclerocystis* were transferred to *Glomus* (Redecker et al., 2000).

The species *G. liquidambaris* is synonymous with *G. cunninghamia* (Hu) Almeida et Schenck based on the following characteristics: 1) sporocarp size, 2) spore shape, 3) presence of central plexus and 4) presence of paraphysis. Both these species were reported from Taiwan and named after the host viz., *Liquidambar formosana* and *Cunninghamia lanceolata* respectively since they were isolated from the rhizosphere of these plants. *Glomus liquidambaris* is also reported from Korea. The present paper reports the occurrence of *G. liquidambaris* from India.

**Material and methods**

Spores of arbuscular mycorrhizal fungi associated with plants from Mollem, Western Ghat region of Goa, India were isolated directly from rhizosphere soil samples by wet sieving and decanting method (Gerdemann, Nicolson, 1963).

Diagnostic slides containing intact and crushed sporocarps and spores of arbuscular mycorrhizal fungi were prepared in polyvinyl alcohol lactoglycerol (Koske, Tessier, 1983). Spore morphology and wall characteristics were considered for the identification of arbuscular mycorrhizal fungi and these characteristics were ascertained using compound mic-

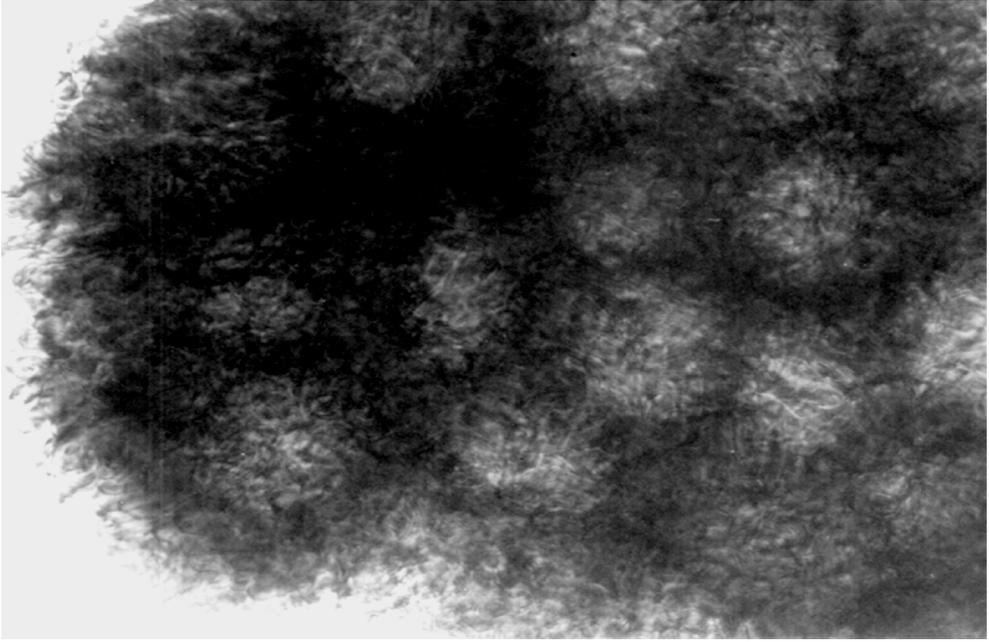


Fig. 1. A portion of sporocarp of *Glomus liquidambaris* with radially formed spores enclosed within the protruding paraphysal hyphae (400 $\times$ ).

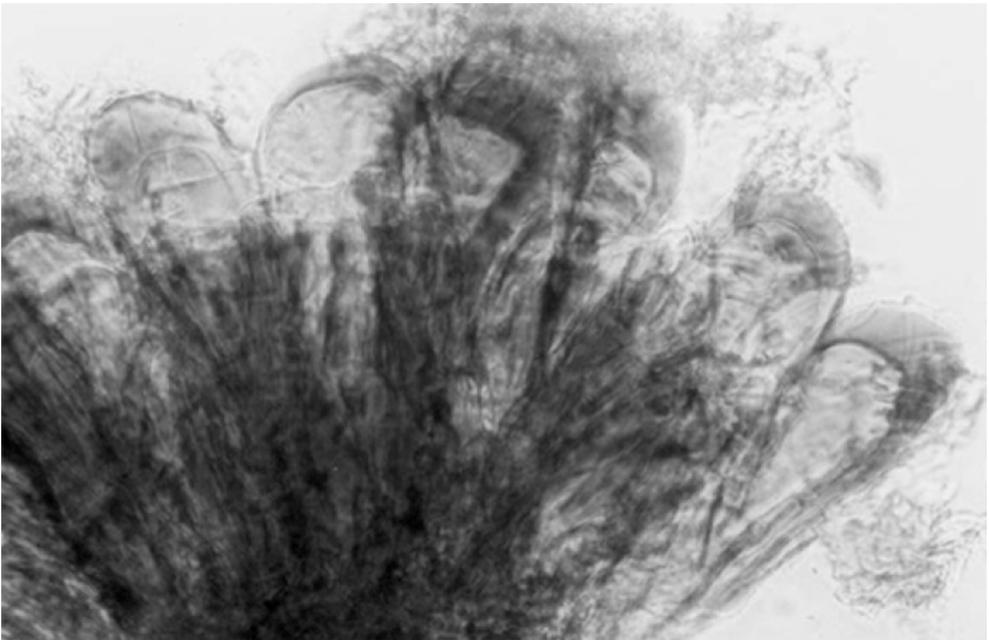


Fig. 2. Radiating spores of *Glomus liquidambaris* with thickened apex interspersed with paraphysis forming a sheath over them (400 $\times$ ).

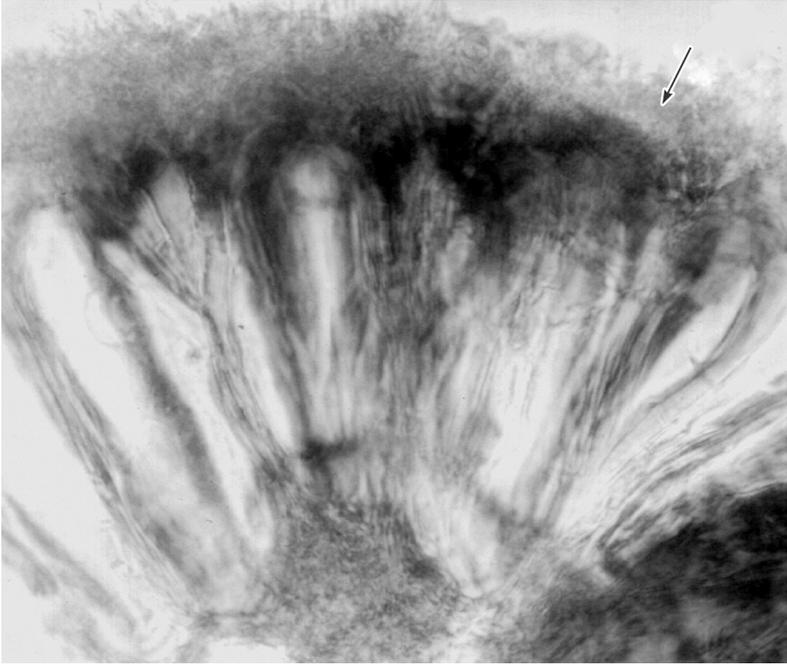


Fig. 3. A portion of *Glomus liquidambaris* sporocarp showing spores above which paraphysal hypha fuses forming tufts (pseudoperidium) (400×).  
 Note: the arrow showing pseudoperidium.

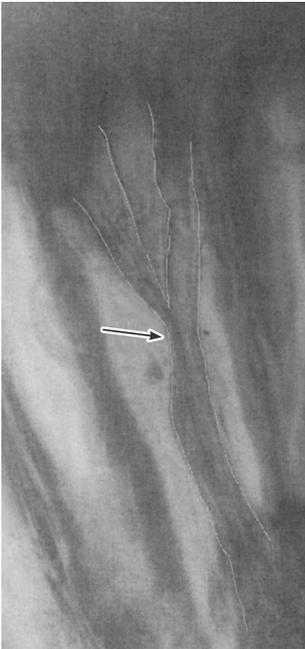


Fig. 4. A mature single paraphysal hypha (see arrow) of *Glomus liquidambaris* with terminal chlamydo-spore like structure (1000×).

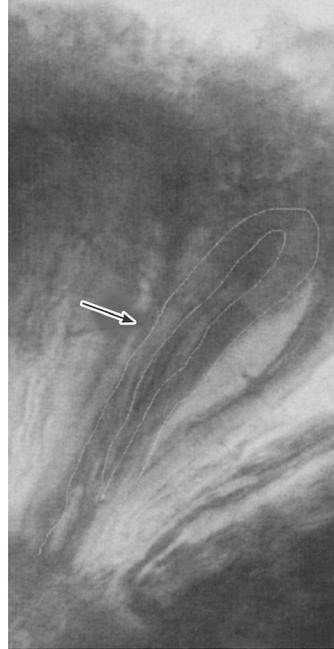


Fig. 5. A immature single paraphysal hypha (see arrow) of *Glomus liquidambaris* forming a terminal chlamydo-spore like structure (1000×).

Note: in figs 4 and 5, the paraphysal hypha is attached to the central plexus at the base.

roscope, Leica WILD MP 3 and Nikon E 800. Arbuscular mycorrhizal fungi were identified to species level using bibliographies provided by Schenck and Perez (1990), Almeida and Schenck (1990) and Wu (1993).

## Results and discussion

*Glomus liquidambaris* (Wu et Chen) Almeida et Schenck [= *G. cunninghamia* (Hu) Almeida et Schenck].

**Sporocarpis:** globose to subglobose,  $300\text{--}600 \times 370\text{--}680$  mkm, brown to dark brown (Fig.1), consisting of chlamydospores formed radially within the paraphysis like structures (Fig. 1, 2).

**Chlamydospore:** ellipsoid to obovoid  $70\text{--}150 \times 40\text{--}65$  mkm diam., yellowish brown to reddish brown (Fig. 2, 3), sometimes with septum at the base and mostly with a small pore opening into the subtending hyphae. Chlamydospore walls brown to reddish brown,  $7\text{--}25$  mkm thick at the apices,  $6\text{--}10$  mkm thick at the base and  $2\text{--}5$  mkm thick at the sides (Fig. 2). Subtending hyphae  $4\text{--}12$  mkm diam.

**Peridium:** The peridium composed of chlamydospore like structure (Fig. 4, 5) which were formed terminally on hyphae arising from the central plexus at the base of the sporocarpic chlamydospores. These hyphae repeatedly branched dichotomously resulting in tufts of hyphae (Fig. 3) referred to as paraphysis like structure (Wu, Chen, 1986).

*G. liquidambaris* mostly exhibited subglobose sporocarps of larger size i. e. in the category of  $6000\text{--}7000$  mkm<sup>2</sup> (Wu, 1993). *G. liquidambaris* is similar to *G. clavispota* and *G. taiwanensis* due to thickened apex of the spore and the hyphal branches arising from the base of the spore and being attached to the central plexus. *G. liquidambaris* however differs from the two species due to presence of paraphysis. The species resembles *G. coremioides* and *G. sinuosum* in appearance due to presence of peridium enclosing the spores but differs from these species due to presence of paraphysis like structure which protrude out of the spore layer and forms pseudoperidium. The peridium of *G. liquidambaris* is primitive as compared to *G. coremioides* and *G. sinuosum* since it formed out of tightly packed thick walled club shaped cells. While in the *G. coremioides* and *G. sinuosum*, the peridium consists of interwoven hyphae (Wu, 1993). *G. liquidambaris* besides being distributed in China and Korea (Eom et al., 1992), is also reported from tropical India.

## Conclusion

*Glomus liquidambaris* is characterized by the presence of paraphysis which is like peridium enclosing the chlamydospores and is reported for the first time in India. The species was isolated in March 2001 from the rhizosphere of plants growing in Western Ghat region of Goa, India. The species is rare in occurrence.

## REFERENCES

- Almeida R. T., Schenck N. C. A revision of the genus *Sclerocystis* (Glomaceae, Glomales) // *Mycologia*. 1990. Vol. 82. P. 703—714.
- Eom A. H., Lee S. K., Lee S. S. Five sporocarpic species of *Glomus* found in Korea // *Korean Mycol.* 1992. Vol. 20. P. 85—94.
- Gerdemann J. W., Nicolson T. H. Spores of mycorrhizal *Endogone* species extracted from soil wet sieving and decanting // *Trans. Brit. Mycol. Soc.* 1963. Vol. 46. P. 235—244.
- Gerdemann J. W., Trappe J. M. The *Endogonaceae* in the Pacific Northwest // *Mycologia Memor.* 1974. Vol. 5. P. 1—76.
- Koske R. E., Tessier B. A. A convenient permanent slide mounting medium // *Mycol. Soc. Amer. Newsletter*. 1983. Vol. 34. P. 59.

Redecker D., Morton J. B., Bruns T. D. Molecular phylogeny of the arbuscular mycorrhizal fungi *Glomus sinuosum* and *Sclerocystis coremioides* // *Mycologia*. 2000. Vol. 92. P. 282—285.

Schenck N. C., Perez Y. Manual for identification of VA Mycorrhizal fungi / Eds N. C. Schenck, Y. Perez. Gainesville: INVAM University of Florida, USA. 1990. 241 p.

Wu C. C., Chen Z. C. The Endogonaceae of Taiwan: I. A preliminary investigation on Endogonaceae of bamboo vegetation at Chi-Tou areas, central Taiwan // *Taiwania*. 1986. Vol. 31. P. 65—88.

Wu C. Glomales of Taiwan: III. A comparative study of spore ontogeny in *Sclerocystis* (Glomaceae, Glomales) // *Mycotaxon*. 1993. Vol. 47. P. 25—39.

Goa University, Taleigao Plateau  
sharda\_khade@yahoo.com

Received 5 XII 2008

## Р Е З Ю М Е

*Glomus liquidambaris* (Wu et Chen) Almeida et Schenck, известный из Тайваня, Китая и Кореи, впервые обнаружен в районе Восточный Гхат (Гоа, Индия). Этот гриб спорулирует летом и лучше всего может быть изолирован во время муссона. Вид характеризуется наличием парафиз и спор с утолщенным апексом, что документировано на фотографиях. Термин «парафизальная гифа» предлагается впервые в литературе по таксономии.

Ключевые слова: *Glomus liquidambaris*, Индия, парафизы, парафизальные гифы.

## S U M M A R Y

*Glomus liquidambaris* (Wu et Chen) Almeida et Schenck known in Taiwan, China and Korea is recorded for the first time from Western Ghat region, Goa, India. This species sporulates in summer and can be mostly isolated at the onset of monsoon. This species is characterized by the presence of paraphysis and spores with thickened apex which is documented photographically. The term *paraphysal hypha* is introduced for the first time in taxonomic literature.

Key words: *Glomus liquidambaris*, India, paraphysis, paraphysal hypha.