

ON THE GENUS *RHIZOPUS* IN INDIA

Arvind Upadhyay and M.U. Charaya

Department of Botany, C.C.S. University, Meerut-250004, U.P.

Abstract: Indian fungal records recognize eighteen taxa of *Rhizopus* as species and varieties. In the light of the presently prevailing international treatment of the genus, ten taxa of *Rhizopus* need to be recognised as far as Indian records are concerned. These are:

1. *R. arrhizus* Fisch. var. *arrhizus*; 2. *R. homothallicus* Hesselt. & J.J. Ellis; 3. *R. microsporus* var. *chinensis* (Saito) Schipper & Stalpers; 4. *Microsporus* var. *microsporus* Tiegh; 5. *R. microsporus* var. *rhizopodiformis* (Cohn) Schipper & Stalpers; 6. *R. nigricans* var. *minor* Jensen; 7. *R. nigricans* var. *minutus* Chaudhuri & Sachar; 8. *R. niveus* M. Yamaz; 9. *R. sexualis* (G. Sm.) Callen; 10. *R. stolonifer* (Ehrenb.) Vuill.

Key words: Indian fungal records, *Rhizopus*.

INTRODUCTION

The genus *Rhizopus* Ehrenb. ex Corda was established by Ehrenberg (1820). Inui *et al.* (1965) recognised thirteen species groups and one variety of *Rhizopus*. However, Zheng *et al.* (2007) have recognised ten species and seven varieties *i.e.* a total of seventeen taxa in the genus. These include *Rhizopus americanus* (Hesselt. and J.J. Ellis) Zheng, Chen & Liu; *R. arrhizus* var. *arrhizus* A. Fisch.; *R. arrhizus* var. *delemer* (Wehmer & Hanzawa) J.J. Ellis; *R. arrhizus* var. *tonkinensis* (Vuill.) Zheng & Liu; *R. caespitosus* Schipper & Samson; *R. homothallicus* Hesselt. & J.J. Ellis; *R. microsporus* var. *microsporus* Tiegh.; *R. microsporus* var. *azygosporus* (Yuan & Jong) Zheng; *R. microsporus* var. *chinensis* (Saito) Schipper & Stalpers; *R. microsporus* var. *oligosporus* (Saito) Schipper & Stalpers; *R. microsporus* var. *rhizopodiformis* (Cohn) Schipper & Stalpers; *R. microsporus* var. *tuberosus* Zheng & Chen; *R. niveus* Yamazeki; *R. reflexus* Bainier; *R. schipperae* Weitzman, McGough, Rinaldi & Della-Latta; *R. sexualis* (Smith) Callen and *R. stolonifer* (Ehrenb. ex Fr.) Vuill.

As many as seventy two names of *Rhizopus* have been treated as synonyms of one or the other of the above-mentioned taxa, while some species and varieties recognised earlier are no longer considered to be affiliated with the genus. One hundred fifty five recorded taxa of *Rhizopus* have been listed in the Index fungorum (www.indexfungorum.org). Out of these, fifty eight taxa have been redesignated as *R. arrhizus* var. *arrhizus* A. Fisch., three taxa as *R. arrhizus* var. *delemer* (Wehmer & Hanzawa) J.J. Ellis, five taxa as *R. microsporus* var. *rhizopodiformis* (Cohn) Schipper & Stalpers, six taxa as *R. microsporus* var. *chinensis* (Saito) Schipper & Stalpers, two taxa as *R. microsporus* var. *oligosporus* (Saito) Schipper & Stalpers and seven taxa as *R. stolonifer* (Ehrenb. ex Fr.) Vuill. Two taxa, *R. azygosporus* Yuan & Jong and *R. microsporus* Tiegh have been redesignated as

R. microsporus var. *azygosporus* (Yuan & Jong) Zheng and *R. microsporus* var. *microsporus* Tiegh. Thus a lot of merger, rearrangement, derecognition of many species and erection of new taxa has taken effect within the genus *Rhizopus* over a period of time.

DESCRIPTION

As many as six species of *Rhizopus* were recognised by Tandon (1968) in India. One variety of *R. nigricans* Ehrenb. *i.e.* *R. nigricans* var. *minutus* Chaudhuri & Sachar was also recognised; thus, raising the total number of taxa of *Rhizopus* in India to seven. More taxa of the genus were recorded from India from time to time. The following eighteen taxa of *Rhizopus* appeared in the list of Indian fungal records provided by Bilgrami *et al.* (1991):

1. *R. arrhizus* Fischer
2. *R. artocarpus* Racib.
3. *R. cambodja* (Chrasziz) Vuill.
4. *R. chinensis* Saito.
5. *R. cohnii* Berl. & de Toni
6. *R. homothallicus* Benj.
7. *R. homothallus* Hesseltine
8. *R. macrosporus*
9. *R. microsporus*
10. *R. nigricans* Ehrenb.
11. *R. nigricans* var. *minor* Jensen.
12. *R. nigricans* var. *minutus* Chaudhuri
13. *R. niveus* Yamaz.
14. *R. nodosus* Namysl.
15. *R. oryzae* Went & Geerl.
16. *R. rhizopodiformis* (Cohn) Zopf.
17. *R. sexualis* (Smith) Callen.
18. *R. stolonifer* (Ehrenb. ex Fr.) Lind.

No new taxon in the genus was listed by Jamaluddin *et al.* (2004). A look at the above-mentioned list of eighteen

taxa of *Rhizopus* reveals that delimitation of taxa within the genus is not as per current international treatment of the genus; and hence, needs to be updated. Unfortunately, a number of merged, derecognised or otherwise invalid taxa are being continued to be recorded as species or varieties of *Rhizopus*.

The above-cited eighteen taxa now need to be replaced by ten taxa in view of the following taxonomic rearrangements as per international opinion prevailing presently:

- a) Four taxa i.e. *R. arrhizus* Fischer.; *R. cambodja* (Chrasziz) Vuill.; *R. nodosus* Namyslowski and *R. oryzae* Went & Geerlings are now treated as *R. arrhizus* var. *arrhizus* A. Fisch.
- b) *R. microsporus* Tiegh is now referred to as *R. microsporus* var. *microsporus* Tiegh.
- c) Two taxa i.e. *R. cohnii* Berl. & De Toni as also *R. rhizopodiformis* (Cohn) Zopf. are now considered as a single taxon namely *R. microsporus* var. *rhizopodiformis* (Cohn) Schipper & Stalpers.
- d) *R. artocarp*i Racib. and *R. nigricans* Ehrenb. have been merged with *R. stolonifer* (Ehrenb.) Vuill.

However, the taxa *R. homothallicus* Hesselt. & J.J. Ellis, *R. nigricans* var. *minor* Jensen., *R. nigricans* var. *minutus* Chaudhuri, *R. niveus* Yamaz. and *R. sexualis* (Smith) Collen are retained as such.

Thus, attuning of the taxa of *Rhizopus* in India with current trends would mean the recognition of ten taxa of the genus in India. These are listed below. The taxa which were recognised earlier but are now represented by one or the other of these ten taxa are mentioned in brackets.

1. *R. arrhizus* Fisch. var. *arrhizus* [(i) : *R. arrhizus* Fisch.; (ii) : *R. cambodja* (Chrasziz) Vuill.; (iii) : *R. nodosus* Namysl.; (iv) : *R. oryzae* Went & Geerl.]
2. *R. homothallicus* Hesselt. & J.J. Ellis [(i) : *R. homothallicus* var. *homothallicus* Hesselt. & J.J. Ellis; (ii) : *R. homothallicus* var. *indicus* B.S. Mehrotra]
3. *R. microsporus* var. *chinensis* (Saito) Schipper & Stalpers [*R. chinensis* Saito]

4. *R. microsporus* var. *microsporus* Tiegh. [*R. microsporus* Tiegh.]
5. *R. microsporus* var. *rhizopodiformis* (Cohn) Schipper & Stalpers [(i) : *R. cohnii* Berl & De Toni; (ii) : *R. rhizopodiformis* (Cohn) Zopf]
6. *R. nigricans* var. *minor* Jensen
7. *R. nigricans* var. *minutus* Chaudhuri & Sachar
8. *R. niveus* M. Yamaz.
9. *R. sexualis* (G. Sm.) Callen
10. *R. stolonifer* (Ehrenb.) Vuill. [(i) : *R. artocarp*i Racib.; (ii) : *R. nigricans* Ehrenb.]

The lists of Indian fungal records of the genus *Rhizopus* need to be revised in the light of above-discussed taxonomic revisions.

REFERENCES

- Bilgrami, K.S.; Jamaluddin, S. and Rizvi, M.A.** (1991). *Fungi of India. List and References*. Today and Tomorrow's Printers & Publishers. India.
- Ehrenberg, C.G.** (1820). *Nova Acta Academiae Caesareae Leopoldino-Carolinae Germanicae Naturae Curiosorum* 10 : 198.
- Inui, T.; Takeda, Y. and Iizuka, H.** (1965). Taxonomical studies on the genus *Rhizopus*. *J. Gen. appl. microbiol.* 11 : 121
- Jamaluddin, Goswami, M.G. and Ojha, B.M.** (2004). *Fungi of India 1989-2001*. Scientific Publishers. India.
- Tandon, R.N.** (1968). *Mucorales of India*. Indian Council of Agricultural Research. India.
- Zheng, R.Y.; Chen, G.Q.; Huang, H. and X.Y. Liu** (2007). A monograph of *Rhizopus*. *Sydowia* 59: 273-372.