CULTURE STUDIES IN THE GENUS *RICCIA* (MICH.) L.

I. Sporeling Germination in *Riccia billardieri* Mont. *et* N.*

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INTRODUCTION

SPORELING germination in the Marchantiales has been critically reviewed by Mehra and Kachroo (1951), who have also described the germination in *Reboulia hemispherica* (L.) Raddi, *Plagiochasma articulatum* Kash., *P. appendiculatum* L. *et* L., *Mannia* (*Grimaldia*) *indica* (St.), *Asterella blumeana* (Nees), *A. reticulata* (Kash.) Corr. Pandé *et al.*,‡ *A. mussuriensis* (Kash.) Corr. Pandé *et al.*‡ and *A. angusta* (St.) Corr. Mahabale *et* Bhate §. They observed that in the case of all of these the spore ruptures at the tri-radiate mark and the first rhizoid develops from the germ tube and gets separated from the latter by a definite septum. Nearly a year later Mehra and Kachroo (1952) described the spore germination in *Stephensoniella brevipedunculata* Kash. where they observed that the germ tube emerges through the areas between the pentagonal thickenings of the outer face of the spore while the rhizoid is a direct continuation of the germ tube and never gets separated from it by a septum.

In *Riccia* the germination of the spore has been described by Fellner (1875), Campbell (1918), Pandé (1924), Duthie and Garside (1936, 1939), Srinivasan (1940), Abeywickrama (1945) and Venkatachala (1956).

Fellner (1875) described the germination in *R. glauca* without mentioning the exact position in the spore through which the germ tube emerges. According to Campbell (1918) in *R. trichocarpa* the germ tube makes its appearance through the tri-radiate mark which appears to be characteristic of most of the Marchantiales. Pandé (1924), on the contrary, for *the first time observed* that in *R. frostii* Aust. (*R. sanguinea* Kash.) the germ tube arises opposite the tri-radiate mark, *i.e.*, through the outer face of the spore and *through a definite germ pore*. This view has been later supported by Duthie and Garside (1936) who, in a work mainly devoted to the taxonomic aspect, remarked that in all the species studied by them, *viz.*, *R. plana* Taylor, *R. cupulifera* Duthie and *R. curtisii* James, "the spore germinates from the convex outer

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‡ See Pandé *et al.* (1954).

§ See Mahabale *et* Bhate (1945).

face, a peculiarity which has been observed in a number of other South African species, and seems likely to prove constant in the genus". Subsequently Duthie and Garside (1939) observed a similar type of germination in *R. compacta* Garside and *R. rautanenii* St.

Srinivasan (1940) studied the germination stages in a monœcious species of *Riccia*, referred by him as *R. himalayensis* St.**, from sporelings growing in nature but he described fairly advanced stages. As two or more species of *Riccia* grow invariably intermingled in nature it would not be quite safe to rely on the data for a species on this method of obtaining sporelings from the soil unless confirmed by culture studies. He noted, however, that his attempts to germinate the spores in culture met with no success.

Abeywickrama (1945) described the stages of spore germination in *R. crispatula* Mitten from spores sown in water. He observed that an apical cell is established rather early contributing to the tissues of the gametophyte. The first rhizoid is produced relatively late in water cultures but occasionally even before the beginning of the formation of the germ plate.

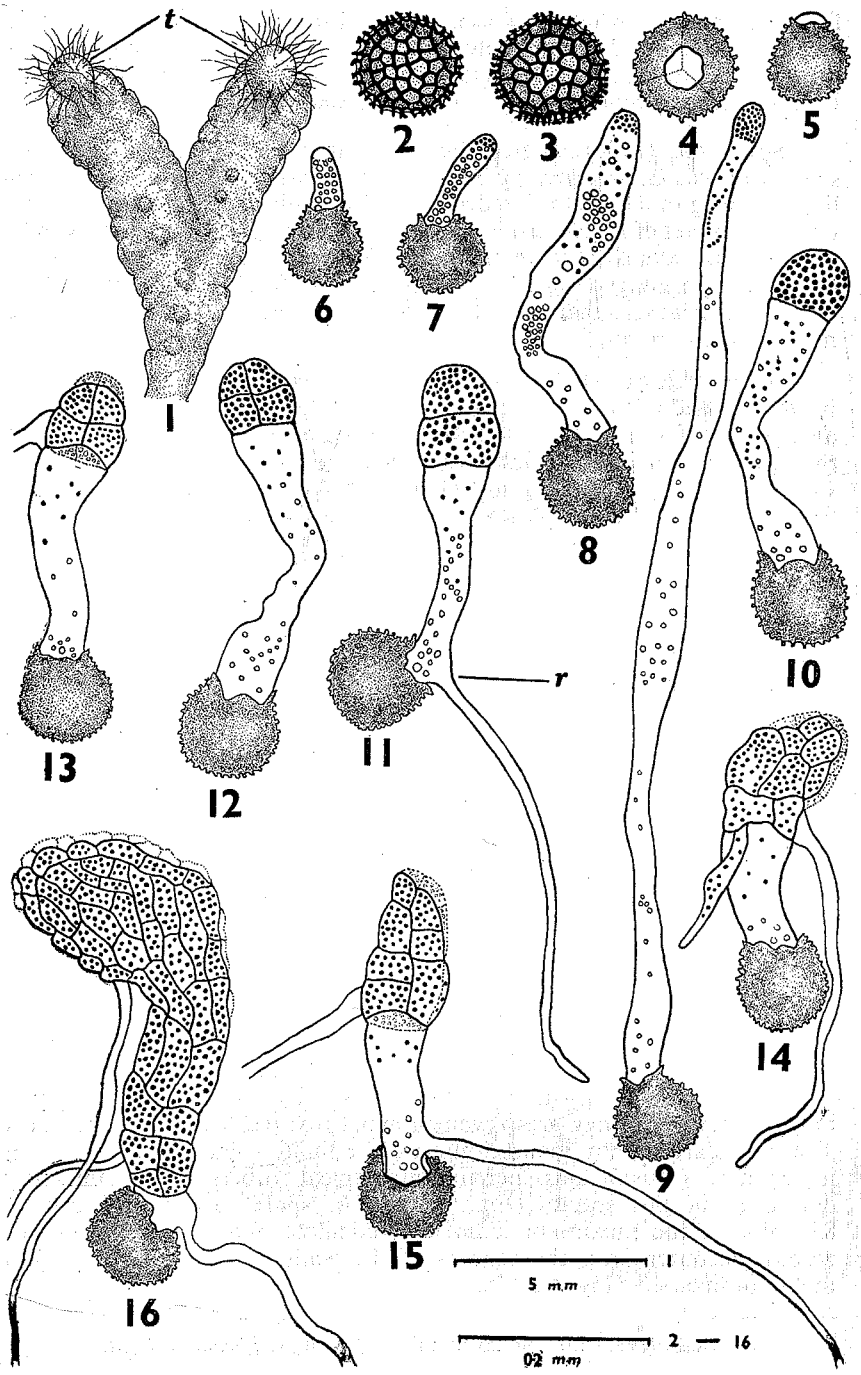
Venkatachala (1956) has figured a single stage of spore germination in *R. discolor* L. *et* L.

In view of the fact that a great deal of confusion persists with respect to the taxonomic limits of several species of *Riccia* growing in India, Dr. S. K. Pandé suggested to the author a detailed investigation of the genus covering all the aspects, *viz.*, taxonomy, cytology and variations in culture to obtain elaborate data to settle the taxonomy of the various species finally. A paper, dealing mainly with critical taxonomic details of *R. discolor*, *R. billardieri* and *R. gangetica* has already been published (Udar, 1957). The present paper deals with the germination of spore of *R. billardieri* and is a part of the culture studies now in progress.

Material and Methods

R. billardieri, a common monsoon species growing in several parts of the country, had long been overlooked and confused with *R. discolor* although it had been reported from India more than half a century back by Schiffner (1900). Both Schiffner (1900) and Stephani (1900) note that this species does not form rosettes though the plants, growing locally, quite often form perfect rosettes. The species is xerophytic but occasionally it may grow even on moist isolated bricks and on walls. The plants are strictly monœcious and the thalli robust and deep green in colour. Conspicuous perennating apical tubers are abundantly developed in this species (Fig. 1, *t*). The spores are reddish-brown, 85–135 μ in the maximum diameter, reticulate, with 5–8 reticulations across the outer face, the corners of the walls of reticulations project out prominently (Figs. 2, 3).

** See Udar (1957) for the taxonomic status of *R. himalayensis* St.



FIGS. 1–16

FIGS. 1–16. 1. Thallus showing apical tubers, *t.* (ventral view). 2. Spore. 3. Enlarged spore after absorbing moisture. 4. Spore showing a prominent germ pore opposite the tri-radiate mark. 5. Emergence of the germ tube. 6-9. Elongation of the germ tube. 10. Separation of the first cell of the germ plate. 11–15. Further stages of the germlings. *r.*, the first rhizoid arising from the germ tube. 16. An advanced germling.

The mature spores of *R. billardieri* were collected from the compound of the local Isabella Thoburn College and the historic Lucknow Residency where it grows luxuriantly. The spores were germinated (*a*) in sterile tap water, on (*b*) 2% Bacto-agar and (*c*) sterilised soil collected from the home locality of the plant. In some cases complete sporophytes, ruptured to expose the spores, were sown. The cultures were made in large glass Petri-dishes covered with glass plates and exposed to diffused light through the north glass window panes of the laboratory. Best result was obtained in (*c*) whereas in (*b*) the spores did not germinate.

OBSERVATIONS

Apparently spores in *Riccia billardieri* do not require any rest period as fresh collections from the plants of the current year sown on October 5, 1956 germinated in about 6–9 days. In ruptured sporophytes a mass of spores germinated *in situ* showing practically all the stages.

The first sign of germination in the spore is a marked increase in its size (Fig. 3). Subsequently it becomes more or less transparent. This is followed by the appearance of a prominent pore opposite the tri-radiate mark (Fig. 4) as described for *R. forstii* by Pandé (1924). The endospore comes out through this pore in the form of a colourless papilla (Fig. 5) which soon becomes laden with dense contents (Fig. 6). Later a large number of chloroplasts make their appearance (Fig. 7). The germ tube subsequently elongates (Fig. 8). In spores grown in water (Fig. 9) the germ tube elongates considerably but in spores growing on soil, however, it may occasionally remain extremely small (Fig. 16). Due to the inrush of cytoplasm and chloroplasts the apex of the germ tube bulges out conspicuously and shows a deep green colour (Figs. 9, 10). A transverse septum, near the terminal part, delimits the first cell destined to form the germ plate (Fig. 10). Later on this cell divides transversely into two (Fig. 11), each dividing vertically to produce a 4-celled plate (Fig. 12). An older stage showing an 8-celled germ plate is represented in Fig. 13. Subsequently a 2-sided apical cell is established (Figs. 14–16) which cuts off segments adding to the tissues of the gametophyte.

The first rhizoid develops, when the germ plate is 2-celled (Fig. 11, *r*), as a continuation of the germ tube, and is not separated from the latter by a septum (Figs. 11, 15, 16), resembling in this respect *Stephensoniella brevipedunculata* (Mehra and Kachroo, 1952). In *R. trichocarpa*, Campbell (1918) definitely states that the first rhizoid which arises from the germ tube is separated by a septum as in many other Marchantiales. The young rhizoids show granular contents and often even chloroplasts but the latter disappears later.

SUMMARY

1. In culture the spore of *Riccia billardieri* does not require any rest period and germinates in 6–9 days.

2. Preceding germination the spore enlarges in size and becomes transparent. The germ tube emerges through a prominent pore opposite the tri-radiate mark.

3. The germ tube elongates considerably in spore cultures in water but is much shorter in those grown on soil.

4. An apical call is established in the early stages of the germling contributing to the tissues of the gametophyte.

5. The first rhizoid is a continuation of the germ tube and is not separated by a septum.

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* Not seen in original.