MORPHOLOGY OF THE SPORES AND THE PROTHALLI OF *TECTARIA AMPLIFOLIA* (V.A.V.R.) CHRISTENSEN

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The spores of *Tectaria amplifolia* germinated in the cultures after a period of 15 days' rest. The spores then become green and show the earliest stages of division. Bipolar germination is initiated by the swelling of the spores inside the sporangium, a rupture along the leasure puts forth the germ tube preceded by a rhizoid. At two to three cell stage the wedge-shaped apical cell is formed. This cuts off cells on the two sides and thus the broadening of the thallus is effected. After about four weeks of germination the apical notch is formed and the midrib formation is initiated. Unicellular marginal hairs develop and superficial branched and unbranched multicellular hairs are formed all over, when the cultures are six weeks old. Sex organs develop on the ventral side of the mature thallus below the notch and surrounded by the rhizoids. Fertilization takes place four to five months after germination of spores and in subdued light. The juvenile leaves of the sporophyte are small, entire, dichotomously veined and often lobed. Adult leaves are pinnately compound and reticulately veined.

INTRODUCTION

The genus *Tectaria* Cav. has received considerable attention; recently Nayar and Kaur (1964) have studied the spore germination, development of the gametophyte and the formation of the juvenile sporophyte of six species—*T. fuscipes*, *T. macrodonta*, *T. polymorpha*, *T. semibipinnata*, *T. simonsii* and *T. variolosa*. The present paper records the observations of spores and gametophyte development of another species of *Tectaria*—*T. amplifolia*—whose mature sporophyte has already been studied in detail by Rao and Khare (1964).

MATERIAL AND METHODS

Fertile fronds were taken from the potted plants in the departmental garden. Spores were inoculated for culture studies in 4″ diameter Petri dishes. Allen and Arnon (1955) medium, supported by sterilized sand, was found satisfactory for the cultures. Spores germinated within a month and the germlings showed prominent phototactic response. Light intensity of 4,500 ft. candles was provided from daylight fluorescent tubes, fitted on the upper side of a culture cabinet at about 18″ distance. Cultures were maintained

at room temperature ranging between 20–40° C in summer and 14–25° C in winter; they showed very little or negligible growth during the summer months. The morphology of the spores is based on the acetolyzed preparations, mounted in glycerine jelly (Erdtman 1952).

Observations

Spores:

Spores of *T. amplifolia* (Figs. 1, 2) are monolete bilateral and planoconvex, measuring 33 $\mu \times 42$ $\mu \times 30$ μ ($P \times E_1 \times E_2$) in size, having a thin faintly granulate and hyaline exine and the perine thrown into irregular folds (Fig. 3).

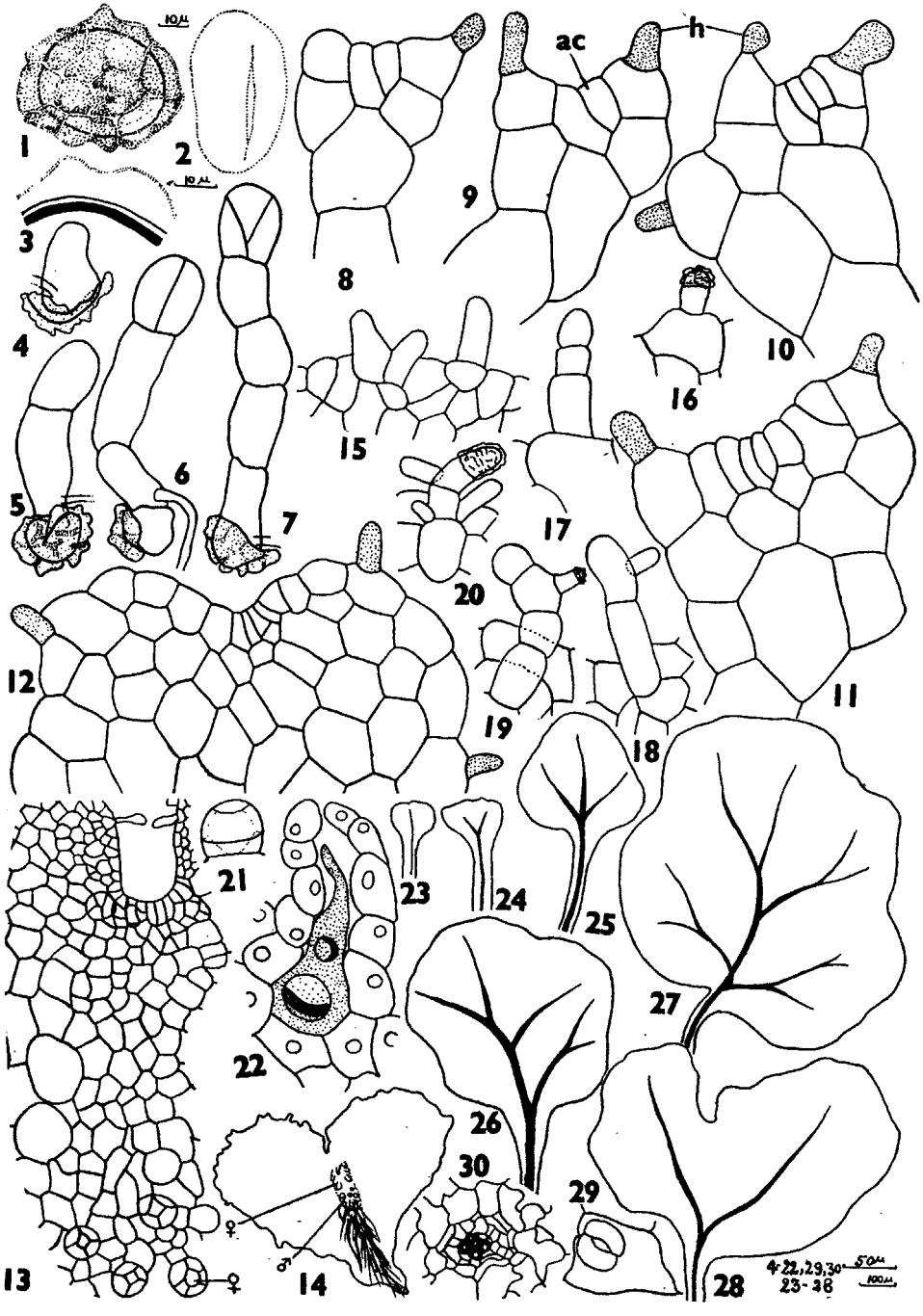
Development of the prothallus:

Bipolar germination of spores (Atkinson and Stokey 1964) was observed after three to five weeks of inoculation. Spores show a pronounced swelling before germination, the exine ruptures along the leasure and the germ filament emerges out, preceded by the first rhizoid. The exine of the spore remains attached to the basal end of the germ filament for quite some time (Figs. 4–7). Usually the germ filament is 3-4 cells long, often 6–8 cells by transverse divisions. The cells of the filaments are short barrel-shaped and contain numerous discoid chloroplasts. Formation of the meristematic cell plate (cf. Atkinson and Stokey 1964) is initiated by a vertical longitudinal division of the terminal cell in a filament of about 3-4 cells long (Fig. 6). In the next stage a second wall oblique to the first cuts off an apical cell by a septum oblique to the median wall (Fig. 7). The other daughter cells of the terminal cell may develop into an apical unicellular club-shaped hair (Figs. 8–10). A condition where the terminal cell ends in a hair has also been observed as has been reported by Nayar and Kaur (1964) for the above-mentioned species of *Tectaria*. The apical cell soon starts cutting off daughter cells on either side alternately so that the thallus becomes spatulate (Fig. 11). Hairs are produced by the marginal cells (Figs. 11, 12). By this time the growing thallus becomes somewhat triangular and the apical notch formation starts with the apical cell situated at the base of the notch (Fig. 12). The prothallus elongates and becomes ovate-cordate in shape (Fig. 14), in approximately two to three months from the time of germination.

The apical cell becomes narrow and is ultimately replaced by a multicellular meristematic cell plate (Fig. 13). After about three months the thallus becomes typically cordate and develops superficial hairs also. Soon the midrib starts differentiating on the ventral side below the apical notch region.

Mature prothallus:

The mature prothallus of *T. amplifolia* (Fig. 14) is 1 cm broad, dark green in colour and cordate like those of other Polypodiaceae (Nayar and Kaur 1964;


10μ
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13
28
4·22,29,30 50μ
23-38 100μ

FIGS. 1–30.

Atkinson and Stokey 1964). It is usually broader than long, with a spindle-shaped short midrib, and two large semicircular wings sometimes overlapping near the notch. The apical meristem is here composed of six to eight long slender elongated cells arranged in a row (Fig. 12). Nayar and Kaur (1964) have recorded more than eight cells forming the apical meristem in many species of *Tectaria*. Rhizoids borne ventrally are thin, long, almost hyaline and soft in texture. Marginal hairs are club-shaped, have distantly distributed chloroplasts and an extra-cellular cap-like waxy secretion adhering round the apex (Fig. 16). Often two hairs may develop from the same cell (Fig. 15). Multicellular superficial hairs, simple or branched, are numerous on the ventral surface (Figs. 17–20) as reported by Stokey (1960), Atkinson and Stokey (1964) and Nayar (1961, 1962), sometimes on the penultimate cell itself as in *T. variolosa* (Nayar and Kaur 1964).

Sex organs:

The sex organs occur on the young prothalli which grow crowded together. Soon after the formation of cordate apex the antheridia develop. The antheridia of *T. amplifolia* resemble those of other advanced Leptosporangiate ferns (Davie 1951; Nayar 1961, 1962); they are small with a saucer-shaped basal cell (Fig. 21).

The archegonia occur on the lower side in the midrib region. They have a five cells long neck usually curved away from the apical meristem. The venter is not clear (Fig. 22).

Regeneration in fern prothalli is known to occur in prolonged cultivation (Kyn 1872; Goebel 1877; Campbell 1892; Mottier 1927). Some older prothalli were kept growing during the summer months. They did not develop much due to unfavourable conditions of temperature and moisture but regenerated profusely after the onset of the monsoon and the return of favourable conditions. The young prothalli are formed on the vegetative apical portions of the older prothalli which turn brown with disintegration of the chloroplasts. The regenerated prothalli in their turn bear sex organs and younger prothalli.

Juvenile sporophyte:

The young sporophytes appear about 4-5 months after germination of spores. A regular photoperiod was provided by fluorescent tubes for eight hours every day, the cultures were flooded with tap water and the extra light

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FIGS. 1–30 (*ac*, apical cell; *h*, hair). 1, polar view of the spore; 2, equatorial view of the spore; 3, exine pattern; 4–7, germination of the spore and the germ filament; 8–12, apical portion of the thallus showing apical cell and marginal hairs; 13, apical notch; 14, mature prothallus; 15, 16, marginal hairs; 17–20, superficial hairs; 21, antheridium; 22, L.S. of archegonium; 23–28, stages in the development of the juvenile leaf; 29, stomata; 30, stalk of the juvenile sporophyte.

cut off for 4-5 days to promote fertilization, when the first sporophyte leaf appeared. The leaf has a lobed apex and is more or less spatulate resembling that of *T. simonsii* (Nayar and Kaur 1964). Stomata (Fig. 29) are found on the lower surface, even on the first juvenile leaf. The vascular supply is initially made up of a single vein (Fig. 23) which later divides into two (Fig. 24) and still later into three (Fig. 25). The second or third leaf (Figs. 26, 27) has a definite midrib and smooth margins as in *T. variolosa* and *T. polymorpha* (Nayar and Kaur 1964). It may also show a cordate base and may even bifurcate initiating the formation of the pinnately compound condition, each lobe having a definite midvein. The mature leaf shows reticulate venation (Nayar and Kaur 1964). A protostele (Fig. 30) with 4–6 tracheids constitutes the vascular supply of the juvenile sporophyte.

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