and *Lr*28 which is effective through all the growth stages is not due to *Lr*12.

Our observations show that for race 77-A only *Lr*12, *Lr*22*a* and *Lr*23 confer adult-plant resistance because their reaction changed from susceptible to resistant at booting stage. Lines with *Lr*14*b* and *Lr*26 were resistant when seedlings were 40 to 45 days old, while resistance of *Lr*29 was expressed in 30 to 35-day old seedlings. These three genes cannot be termed as APR genes. The detection and transfer of these three genes would be certain and easy if tests are done at late seedling stage.

Browder[2] observed that *Lr*12, *Lr*13 and *Lr*22*a* are only APR genes but rust cultures which show avirulence on seedlings of wheats with these genes have been reported from India[9]. Cultivars carrying *Lr*13 give seedling and adult-plant resistance under Australian conditions[10]. McIntosh[11] observed that lines with *Lr*26 become susceptible to some Australian leaf rust cultures as they grow but seedlings show resistant reactions. It, therefore, appears that the expression of genes at different growth stages is specific to a particular rust race/culture and classification of genes as 'seedling resistance' or 'adult-plant resistance' cannot be considered as absolute.

15 March 1986

1. McIntosh, R. A., *Proc. Sixth Inter. Wheat Genet. Symp*, Kyoto, Japan, 1983, 1197.
2. Browder, L. E., *Crop Sci.*, 1981, **13**, 203.
3. Gupta, A. K., *Third Nat. Sem. Genetics Wheat Improv.*, 1985, Simla, Abstr., p. 2.
4. Sawhney, R. N., *Third Nat. Sem. Genetics Wheat Improv.*, 1985, Simla, Abstr., p. 1.
5. Sawhney, R. N., Nayar, S. K., Singh, S. D. and Chopra, V. L., *SABRAO J.*, 1977, **9**, 13.
6. Saini, R. G. and Gupta, A. K., *Annu. Wheat Newsl.* 1979, **25**, 65.
7. Shearer, B. L. and Wilcoxon, R. D., *Tech. Bull. Agric. Expt. Stn.*, Univ. Minnesota, 1980, **323**, 6.
8. McIntosh, R. A. and Baker, E. P., *Aust. J. Biol. Sci.*, 1966, **19**, 943.
9. Gupta, A. K. and Saini, R. G., *Cereal Rusts Bull.*, 1981, **9**, 46.
10. Hawthorn, W., XIII *Int. Bot. Cong.*, 1981, Sydney, Australia Abstr., p. 274.
11. McIntosh, R. A., 1985 (*Personal communication*).

ON THE PERIGENOUS STOMATA IN *BACOPA MONNIERI* (L) WETTST

B. KANNABIRAN and V. RAMASSAMY*

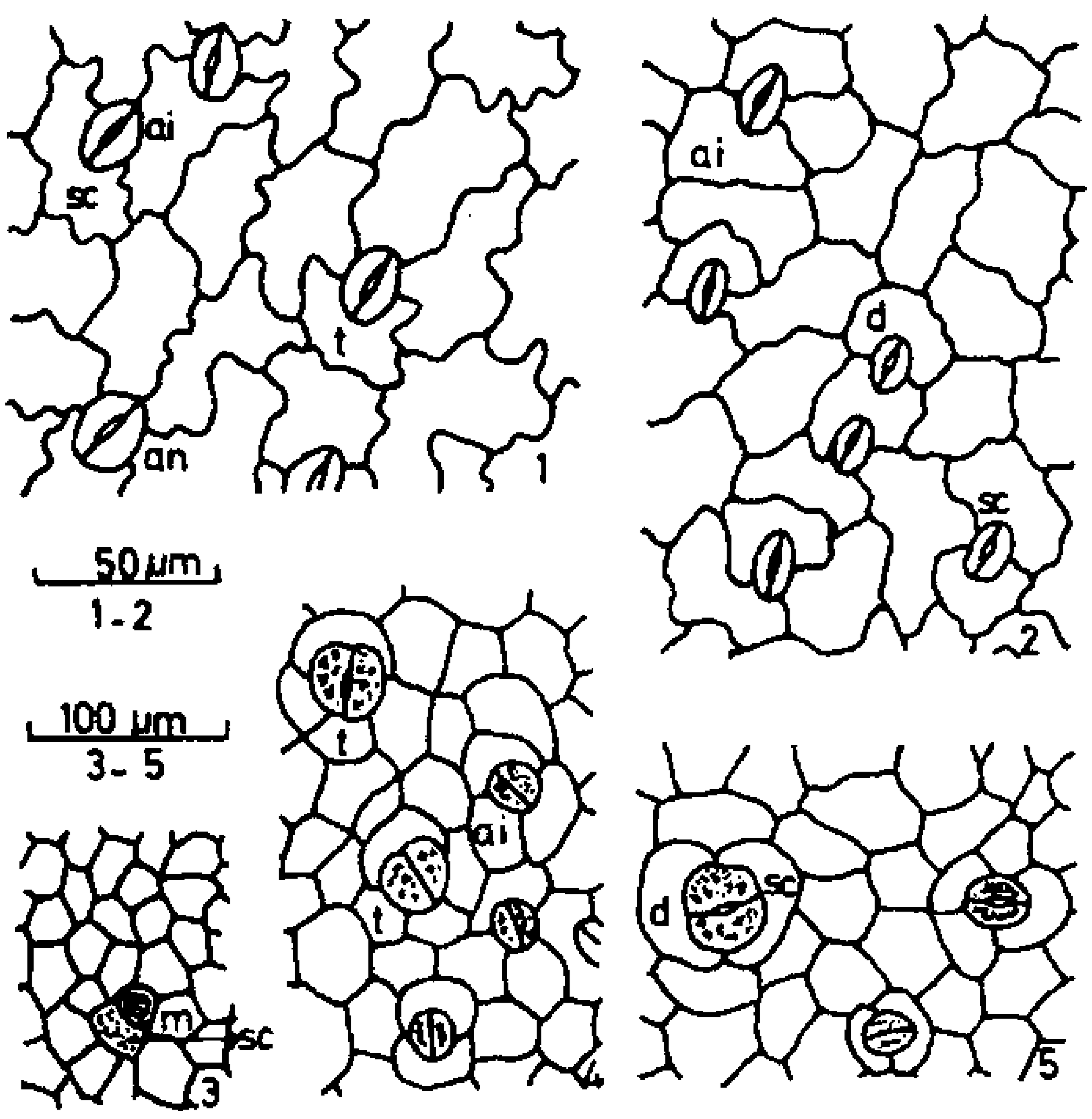
Department of Biology, Jawaharlal Institute of Postgraduate Medical Education and Research, Pondicherry 605 006, India.

* *Department of Botany, Tagore Arts College, Pondicherry 605 008, India.*

SEHGAL and Paliwal[1] were the first to report the occurrence of dia-and anisocytic stomata of perigenous origin in *Trachyspermum ammi*. However these ontogenetic stomatal types were not described by Fryns-Claessens and Van Cotthem[2]. Rajagopal and Ramayya[3] recorded anomo-and anisocytic stomata and stomata with three equal subsidiaries in *Bacopa floribunda*. The present communication deals with our observations on the foliar epidermis in the allied species, *Bacopa monnieri* which revealed interesting ontogenetic pathways of various stomatal types.

The leaves are amphistomatic, exhibiting higher stomatal frequency on the abaxial surface. The mature stomata are at slightly elevated level than the epidermis and are oriented in one direction parallel to the midrib (figures 1–2). The stomata are of four types viz tetra-, aniso-, dia- and anomocytic. The former two types are frequently seen while the other two are of rare occurrence. An interesting and persistent feature in all mature stomatal types is the occurrence of one semi-circular subsidiary cell girdling almost the three sides of the guard cells. The remaining part is flanked by one polar or 2–4 subsidiary cells mostly.

Protodermal cells are small, thin- and straight-walled and 4–6-sided (figure 3). Some of them put forth a straight or slightly curved wall always towards one pole so as to produce two unequal cells. Of these, the larger one becomes semi-circular enclosing the stoma on almost three sides (figures 1–2). The smaller lenticular or trapezoidal cell is the meristemoid characterized by denser cytoplasm and prominent nucleus (figure 3). Soon it enlarges and intrudes into the protodermal cell on the polar sides (figures 4–5). When there are many neighbouring cells occupying the position of one polar cell they are pushed away by the enlarged meristemoid (figures 4–5). Now the meristemoid is oval or spherical and divides perpendicular to the plane of previous division producing two guard cells with abundant chloroplasts. Meanwhile, protodermal cells expand and assume different shapes with deep sinuous anticlinal walls in mature leaves (figures 1–2). Thus it may be difficult, if not impossible, to recognize these subsidiaries at once. However, the



Figures. 1–5. Leaf epidermis of *Bacopa monnieri*. **1, 2.** Mature epidermis. **1.** Abaxial. **2.** Adaxial. **3–5.** Developmental stages of various stomatal types. (*ai*, anisocytic; *an*, anomocytic; *d*, diacytic; *m*, meristemoid; *sc*, subsidiary cell; *t*, tetracytic stoma).

position, size and shape of these cells help us to distinguish them from the other epidermal cells. Since these stomata are directly derived from the meristemoids their development conforms to the perigenous type[1,2].

It is interesting to observe that all these four stomatal types result from the same type of meristemoid depending upon how the protodermal cell cuts off the meristemoid. Frequently the new wall of the protodermal cell interesects the mother wall beyond two lateral walls or on either side of one of the walls of adjacent cell present on the polar side (figure 3). In the former case the meristemoid is flanked by two polar and two lateral cells. In the latter case the meristemoid is encircled by two lateral cells besides one polar cell mostly. Rarely the two intersecting points of this new wall are within two lateral walls of the polar neighbouring cell (figures 4–5). Here the meristemoid is completely enclosed by two polar cells whose common walls lie at right angles to the long axis of guard cells. Sometimes these intersecting points are beyond two adjacent cells resulting in anomocytic stomata with at least five encircling cells.

Of the stomatal types described above, anomocytic ones were recorded earlier under the name 'aperigenous type'[2]. Dia- and anisocytic stomata of perigenous origin were reported in *Trachyspermum ammi*[1]. The present study brings out for the first time the occurrence of tetra-perigenous stomata in *B. monnieri*. Secondly it establishes the possibility that stomatal diversity may also be due to the difference in the nature of intersection of the wall of the protodermal cell cutting off the meristemoid. Further work is in progress to ascertain whether these ontogenetic types of stomata characterize the family, Scrophulariaceae.

The authors thank Prof. H. Y. Mohan Ram, University of Delhi for his encouragement. One of them (VR) is grateful to the Principal, Tagore Arts College, Pondicherry, for permission to carry out the work.

7 November 1985; Revised 24 March 1986

1. Sehgal, C. B. and Paliwal, G. S., *Curr. Sci.*, 1970, **39**, 19.
2. Fryns-Claessens, E. and Van Cotthem, W., *Bot. Rev.*, 1973, **39**, 71.
3. Rajagopal, T. and Ramayya, N., *Curr. Sci.*, 1970, **39**, 201.

DISTRIBUTION OF SONIFIC MUSCLES IN SOME SCIAENID FISHES AND ITS SEX-RELATED SEASONAL VARIATIONS IN *KATHALA AXILLARIS* [CUVIER]

A. PASSOUPATHY* and R. NATARAJAN
Centre of Advanced Study in Marine Biology, Parangipettai 608 502, India.
** Present Address: Dr S. R. K. Government Arts College, Yanam*

THE capacity for sound production in fishes has been well documented[1–7]. In sciaenids, sound production involves vibrations of sonific muscles of the swimbladder[1]. The sonific muscles, compressed, broad and located laterally near the body wall (ventrolateral to the viscera and swimbladder), are either present in both the sexes or in males only[8,9]. But variations in sonific muscles related to sex, stage of sexual maturity and season, have not been examined in Indian sciaenids. In the present communication the distribution of sonific muscles in various sciaenids, along with their seasonal and sex related variations, in *Kathala axillaris*, is described.