TABLE II

Percentage of the total radioactivity recovered in the grain and stem at harvest

Leaf No.	Grain		Stem	
	1975	1976	1975	1976
Flag leaf	97·2	96·1	2·8	3·9
2nd leaf	97·4	95·8	2·6	4·2
3rd leaf	96·6	97·3	3·4	2·7
4th leaf	96·5	96·8	3·5	3·2
5th leaf	91·5	94·6	8·5	5·4
6th leaf	88·7	86·5	12·3	13·5

Authors wish to thank the Director, IARI, New Delhi, for facilities and ICAR, New Delhi, for the grant of a senior fellowship to the senior author.

October 1, 1980.

1. Lupton, F. G. H., *Ann. Appl. Biol.*, 1966, **57**, 355.
2. Quinlan, J. D. and Sagar, G. R., *Weed Res.*, 1962, **2**, 264.
3. Singh, S. P. and Rao, D. V. M., *Indian J. Pl. Physiol.*, 1978, **21**, 287.
4. Stoy, V., *Physiol. Plant.* 1963, **16**, 851.
5. Thorne, G. N., *The Growth of Cereals and Grasses*, Ed. Milthrope, F. L., Ivins, J. D., 1965, p. 88.
6. Wardlaw, I. F., *Aust. J. Biol. Sci.*, 1965, **18**, 269.

SCANNING ELECTRON MICROSCOPIC ANALYSIS OF POLLEN IN TRISTYLOUS *EICHHORNIA CRASSIPES* (MART.) SOLMS. (PONTEDERIACEAE)

BIR BAHADUR, S. BANGARU LAXMI AND R. SRIKANTH

Department of Botany, Kakatiya University
Warangal 506 009, India

TRISTYLY is a genetic polymorphism in which a species exist in three flower forms in natural populations. Each flower form is characterised by a style length and two tiers of stamens. Thus, the long styled form is associated with mid and short stamens; the mid-styled form with long and short stamens and the short-styled form with long and mid stamens. Darwin[1] studied tristyly in *Pontederia* species (Pontederiaceae). Various aspects of tristyly in *Eichhornia crassipes* have been studied by Barrett[2]; Reddy and Bahadur[3] and Bangaru Laxmi[4].

Although pollen size morphism is known in several tristylous species Darwin[1], Dulberger[5], Hyde and Adams[6] and Coz Compos[7] appear to be the earliest to observe the differences in the exine pattern in the three types of pollen grains in tristylous species of Lythraceae. This report presents observations on pollen exine morphism in relation to tristyly as seen in SEM in *E. crassipes*.

For the SEM study, pollen grains of short, mid and long stamens of short- mid- and long-styled flowers of *E. crassipes* (Mart.) Solms. were collected separately and acetolysed following the method of Erdtman[8]. Acetolysed pollen grains were stored in absolute ethanol. The pollen grains were coated with silver under vacuum and scanned on a Cambridge Stereo-scan Microscope (Model S_4-10, Cambridge Scientific Instruments Limited, England), housed at Indian Institute of Technology, New Delhi.

In Fig. 1 the stereo-structures of pollen grains of long, mid and short stamens of *E. crassipes* are shown. The pollen grains are clearly trimorphic not only in size but also in their exine pattern. The details are described below.

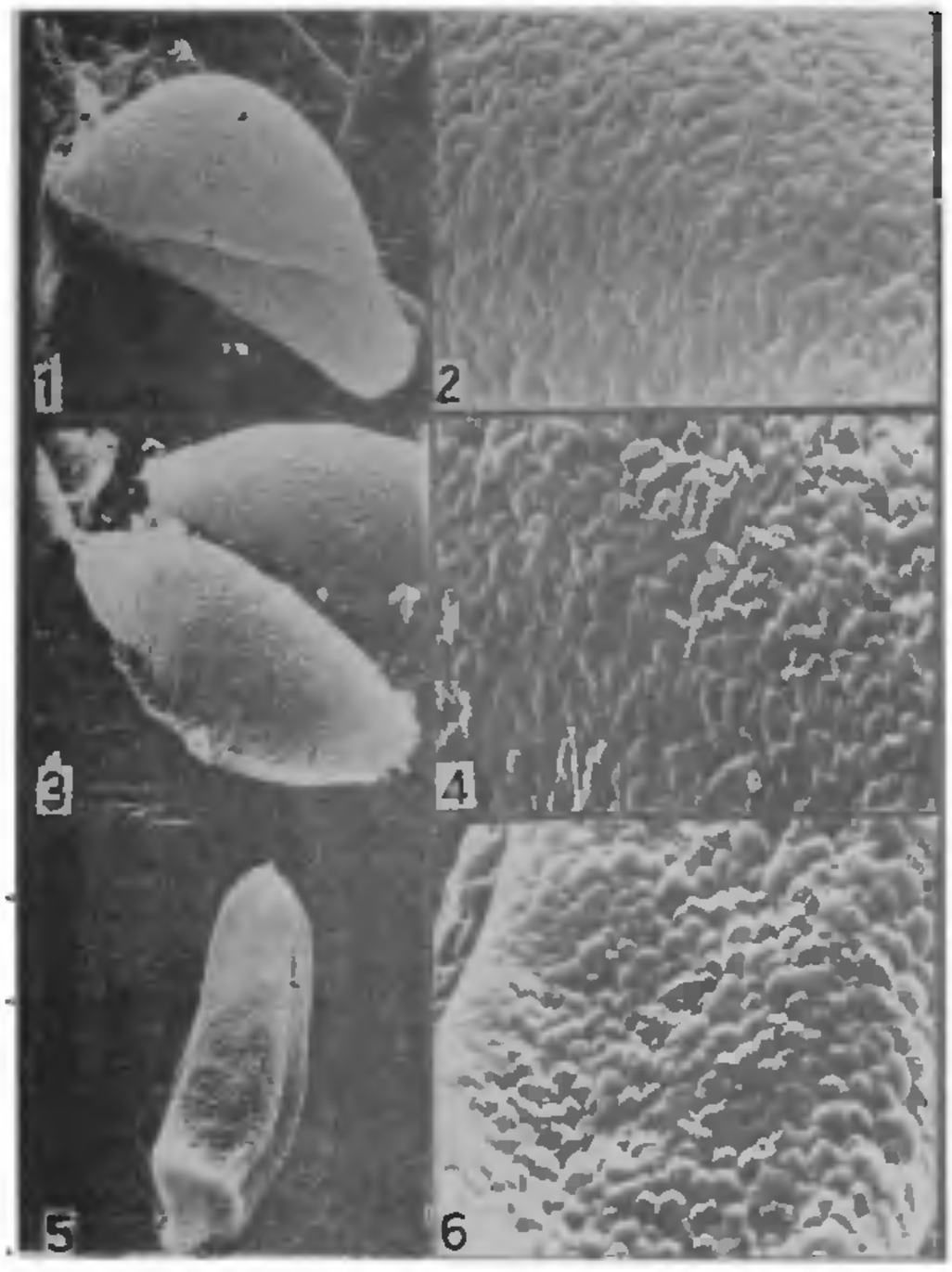
Pollen grains produced in the long stamens of short- and mid-styled forms are large (86·8 × 29·3 μm), sausage shaped, 2 sulcate. Exine shows irregular mound like areas, stretched all over the pollen surface, exine psilate (Figs. 1–2).

Pollen grains produced in the mid stamens of long- and short-styled forms are medium sized (85·8 × 33·0 μm), lens-shaped, 2 sulcate. Exine shows prominent irregular pointed processes of various sizes, some processes are blunt (Figs. 3–4).

Pollen grains produced in the short stamens of long- and mid-styled forms are small (78·0 × 29·6 μm), crescents-haped, 2 sulcate. Exine shows prominent irregular verrucae of various sizes, coarsely verrucate, dense, coalescing at the base (Figs. 5 and 6).

It may be pointed out that Rao and Rao[9] and Raj and Saxena[10] have studied exine morphology of *E. crassipes* under the light microscope but make no comment on tristyly. They have described the exine as either smooth or faintly reticulate and the pollen grains as 1 or 2 sulcate.

From the description, it is clear that the tristyly in *E. crassipes* is also expressed in the exine morphism of pollen in the stamens of various heights. It is interesting to note that although stigma and pollen heteromorphism in a number of distylous species has been studied, there is no comparable study on any tristylous species so far. The present observations on SEM of exine, however, is comparable to that in *Biophytum intermedium* studied by Bahadur *et al.*[11] Thus, the pollen morphism not only in size but exine appears to be related to the morphism in the stigmatic papillae and the chemical differences associated with



FIGS. 1–6. Figs. 1, 3 and 5. SE micrographs of pollen grains from long, mid and short stamens of *Eichhornia crassipes* (× 3,670). Sulcus can be seen in Fig. 5. Figs. 2, 4 and 6. A portion of the sporoderm of the pollen from long, mid and short stamens (× 9,170).

the cellulose, pectin and lipids present in the stigmatic papillae (unpublished). Ganguly *et al.*[12] have studied the role of steroids and amino acids in the pollen grains and pistils of *E. crassipes*, but the flower forms and pollen type they studied, however, is not indicated. In view of the complex tristyly, it would be desirable to investigate the chemical constituents of pollen and stigma of the three flower forms for a better elucidation of the pollen acceptance and rejection phenomenon in this species.

It is interesting to point out that only the pollen from the long stamens of mid-styled form of *E. crassipes* gave I/KI positive test while those of mid and short stamens are I/KI negative. Similar observations have been made in *Lythrum junceum* Dulberger[5]. In *Lythrum salicaria*, however, Schoch-Bodmer[13] found large starch grains in the pollen grains of long stamens; variable amount of starch in the pollen grains of mid stamen, and the pollen grains from the short stamens to be devoid of starch but to contain fats. The significance of this variation is not properly understood, but according to Darwin[1] the large pollen grains with more starch are adapted to grow on long style of long-styled plants in a distylous species. Dulberger[14, 15] has made a fine study of intramorph structural differences between the stigmatic papillae and pollen grains in the Plumbaginaceae and has also discussed the S-gene action and the significance of characters in the heterostylous plants that control pollen size heteromorphism and related characters. In view of the large flower size and weedy nature, the biochemical basis of incompatibility in *E. crassipes* needs investigation.

The authors are grateful to Mr. V. K. Lall, In-charge, SEM Laboratory, Indian Institute of Technology, New Delhi, for his skilled assistance, and to Dr. S. C. H. Barrett, University of Toronto, Canada, for supplying the short-styled form of *Eichhornia* investigated. (SBL) and (RSK) are grateful to CSIR and UGC, respectively for the award of Junior Research Fellowships.

October 8, 1980.

1. Darwin, C., *The Different Forms of Flowers on Plants of the Same Species*, John Murray, London, 1892.
2. Barrett, S. C. H., *Biotropica*, 1977, **9**, 230.
3. Reddy, N. P. and Bahadur, B., *J. Indian Bot. Soc.*, 1977, **56**, 299.
4. Bangaru Laxmi, S., "Some aspects of tristyly in *Eichhornia crassipes* (Mart.) Solms.," M.Sc. Dissertation, Kakatiya University, Warangal, 1979.
5. Dulberger, R., *New Phytol.*, 1970, **69**, 751.
6. Hyde, H. A. and Adams, K. F., *An Atlas of Air Borne Pollen Grains*, Macmillan, London, 1958.
7. Coz Compos, D., *Pollen et Spores*, 1964, **6**, 303.
8. Erdtman, G., *Pollen Morphology and Plant Taxonomy of Angiosperms*, Stokholm and Walthum, Mass., USA, 1952.
9. Rao, T. S. and Rao, R. R., *Pollen et Spores*, 1961, **3**, 45.
10. Raj, B. and Saxena, M. R., *Ibid.*, 1966, **8**, 49.
11. Bahadur, B., Rao, P. H. and Srikanth, R., *Curr. Sci.*, 1981 (in press).
12. Ganguly, P. C., Chanda, S., Barua, A. K. and Choudhary, M. K., *Grana*, 1977, **16**, 41.
13. Schoch-Bodmer, M., *J. Genet.*, 1940, **40**, 393.
14. Dulberger, R., *Proc. R. Soc. London*, 1975, **188**, 257.
15. —, *Heredity*, 1975, **35**, 407.