

POLLEN MORPHOLOGICAL AND FOLIAR EPIDERMAL STUDIES ON *SCILLA INDICA* (Wt.) BAKER (LILIACEAE)

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Light microscopic study reveals that in *Scilla indica* the pollen grains are large sized, boat shaped elongate, monocolpate and exine shows finely reticulate ornamentation. At the time of dehiscence all the pollen grains are in monads with binucleate condition. Foliar epidermal study of *Scilla indica* reveals that the shape of the epidermal cells are regular and rectangular with oblique cross walls. Stomata are amphistomatic and anomocytic. Guard cells are kidney shaped with chloroplast. Trichomes are totally absent. Stomatal distribution pattern is parallel to the longer axis of the lamina. The results are discussed to show the taxonomic importance.

Key Words: *Scilla indica*, Liliaceae, Light microscope, pollen morphology, monocolpate, exine, reticulate, monad, binucleate, foliar epidermis, stomata, amphistomatic, anomocytic.

Scilla indica (Wt.) Baker belongs to the tribe Scilleae of the family Liliaceae (Bentham and Hooker, 1883; Hutchinson, 1959) commonly known as Indian squill. This is a genus of about 100 species which are native of Europe, Temperate Asia and Africa. The genus is represented in India by two species namely *Scilla indica* and *Scilla hohenaekeri* (Hooker, 1894). *Scilla indica* is a handsome perennial scapigerous bulbous herb, widely grown as garden plants for its attractive foliage and flowers during March-April. It bears lanceolate leaves, usually 5-6 in number in clusters at the base of the scapose raceme.

MATERIALS AND METHODS

Plants for the present study were collected from South India. For the study of pollen morphology, pollen grains were collected just before anthesis from flowers of fresh potted plants. The collected pollen grains were fixed in 70% alcohol. In order to make pollen preparations, the acetolysis method proposed by Erdtman (1952) and modified by Nair (1960) was employed. Size measurements were obtained using light microscope and averaged for 50 randomly selected grains. In categorising pollen grains according to shape and size, the terminology used by Walker and Doyle (1975) was followed. Who classified several shape classes based on the formula E_1/E_2 . The average pollen size was calculated from a random sample of 100 grains and the mean X was calculated using the formula $X = x/n$. Here E_1 longer equatorial axis, E_2 = shorter equatorial axis.

Photomicrographs were taken for the study of pollen grains.

For detailed stomatal studies fresh mature leaves were collected from potted plants. The method adopted by Ahmad (1964) was followed, for foliar epidermal studies. Frequency of stomata was calculated for the adaxial and abaxial leaf epidermis, as the number of stomata per unit area in 10X x 20X field of microscope. The average sizes of the guard cells (including the stomatal pore) and stomatal complex (guard cell + stomatal pore + subsidiary cells) were measured with an ocular and stage micrometer using 10X x 20X magnification. The frequency of stomata and all measurements were taken from an average of ten readings. Stomatal index (S.I.) was calculated using the formula, $S.I. = S/(E+S) \times 100$.

Where, E = number of epidermal cells per unit area and S = number of stomata in the same area. The terminology of different types of stomata used here in the present study is that of Metcalfe and Chalke (1950).

OBSERVATIONS

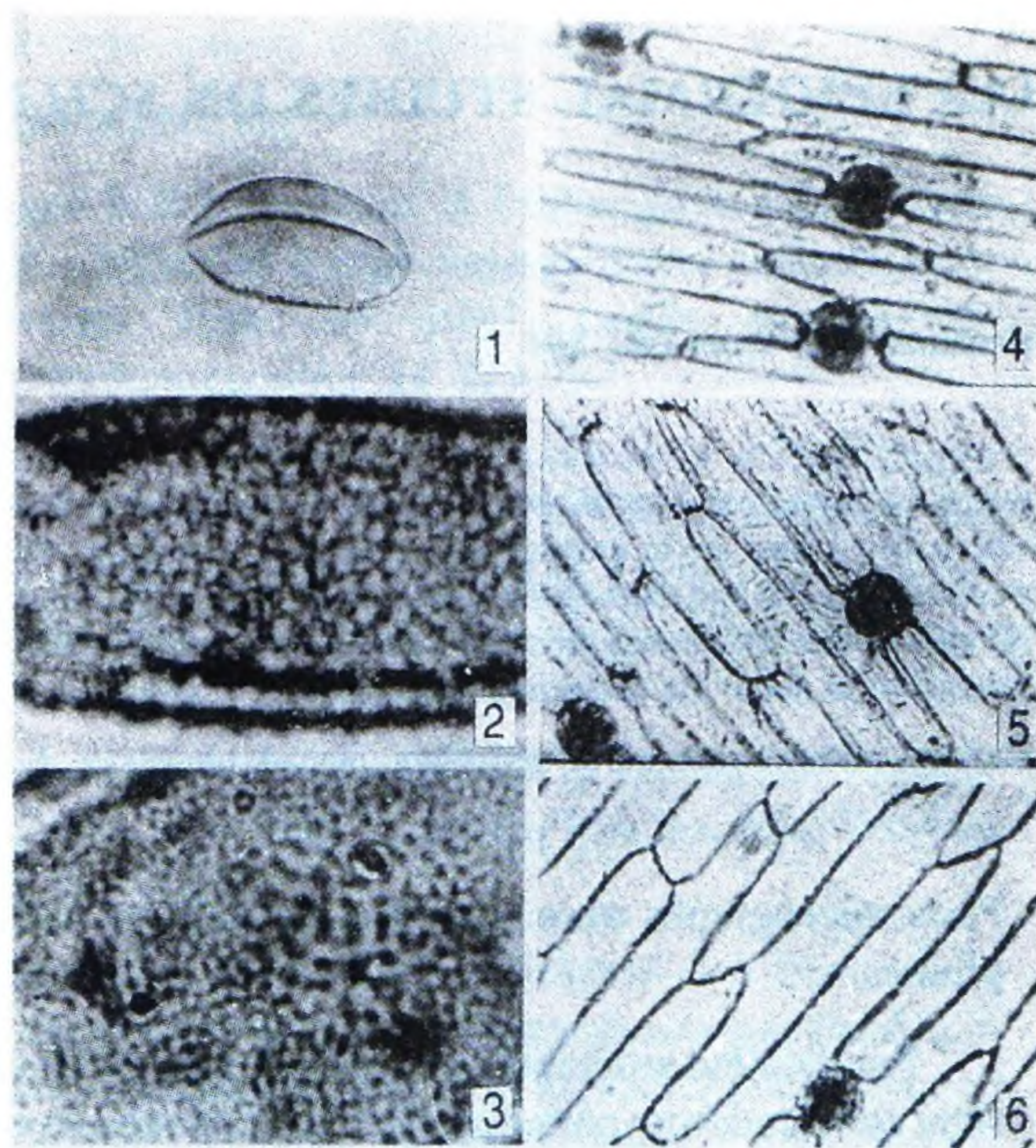
In *Scilla indica* the microspores are large sized with monocolpate aperture.

$$E_1 = (65 \mu\text{m}-80\mu\text{m}) \quad X = \mu\text{m},$$

$$E_2 = (30 \mu\text{m}) \quad X = 38.5 \mu\text{m} \text{ and}$$

$$E_1/E_2 = 9.75 \mu\text{m}.$$

The shape of pollen grain is boat shaped elongate and they are monocolpate (Fig. 1). The apertures



Figs 1-6: Pollen grain and leaf epidermis of *Scilla indica* (all figures except 2&3 X 1235). 1. General view of pollen grain. 2&3. Exine surface showing reticulate ornamentation (X 2470). 4. Arrangement of stomata on the lower epidermis. 5. Arrangement of stomata on the upper epidermis. 6. Epidermal cells showing oblique cross walls.

are elongated and occur as slits. The exine surface exhibit finely reticulate ornamentation (Figs. 2 and 3). The exine thickness is 0.5 μm .

The foliar epidermal studies revealed that the shape of the epidermal cells of the lower and upper epidermis are regular and rectangular with oblique cross walls (Fig. 6). Cuticle is present on the upper epidermis. Stomata are present on both surfaces of the leaves (Figs. 4 and 5). Stomatal distribution pattern is parallel to the longer axis of the lamina and is restricted between the two adjacent veins. The vein surfaces are devoid of stomata. Stomata are aperiogenous (anomocytic) without subsidiary cells. Arrangement of the epidermal cells gives the appearance of a chain link having stomata at the joints (Fig. 5). The guard cells are kidney shaped with chloroplast granules (Fig. 5). Hairs are absent on both upper and lower epidermis. Frequency of stomata/microscopic field on the lower epidermis was 4.9 and upper epidermis was 2.7. Average size of the guard cells in the lower epidermis was 71.5 μm x 62.5 μm and upper epidermis was 59 μm x 56 μm . Average size of the stomatal complex was 806 μm x 94 μm in lower

epidermis and 611.5 μm x 127 μm on the upper epidermis. Stomatal index of lower epidermis was 11.64 and upper epidermis was 7.12.

DISCUSSION

The major pollen morphological characters of taxonomic and phylogenetic importance relate to aperture, exine ornamentation, exine strata, pollen-unit, polarity, symmetry, grain shape and size (Walker and Doyle, 1975). In *Scilla indica* pollen grains are 1-colpate and distally located. According to Walker and Doyle (1975) pollen grains of Monocotyledons are basically monosulcate group like that of primitive Ranalian family (Magnoliidae) and they represent a major monophyletic group within the Angiosperms. Among the apertural morphoforms, pollen grains with more than one aperture is the most primitive and the monolete form is derived from them. So monolete, 1-colpate aperture forms are advanced. In the present study, the fundamental pattern of exine ornamentation is reticulate. The most striking ornamentation form in monocots is the reticulate type. In a typical Liliaceous pollen, the reticulum is formed of large meshes and in yet others the meshes are small (Nair, 1970). Size and shape of pollen grains are highly unfixed characters, and are of less phylogenetic value (Saad, 1972). In *Scilla indica* only large sized grains are present, and their size ranges from 65 μm to 80 μm . Regarding the evolution of pollen grain size, the primitive Angiosperm pollen falls between 50-99 μm (Walker, 1971). Based on shape, Nair and Chaturvedi (1978) observed the occurrence of boat shaped elongate forms as regular feature in monocolpate pollen grains. It has been found to be of taxonomic and phylogenetic significance. The elongate forms are more primitive in the line of monocolpate taxa of Angiosperms (Nair, 1988). From comparative and fossil evidences, both Magnoliidae and Monocotyledons retain the essentially Gymnospermous boat-shaped monosulcate type. Which is believed to be the basic to Angiosperms as a whole (Walker and Doyle, 1975). The palynological data observed in the *Scilla indica* showed that, remarkable homogeneity and primitiveness exists with regard to Liliaceae in almost all the pollen features like pollen aperture, exine ornamentation and pollen size and shape.

Foliar epidermal characters are often relayed upon to establish systematic relations. They provide char-

acters of diagnostic importance. There are no reports on the stomatal studies of *Scilla indica* so far. The present study shows that, the shape of the epidermal cells are rectangular regular, but with oblique cross walls and trichomes are absent. The nature of cell wall of this genus is straight walled. Some workers have suggested that, the straight walled epidermal cells are common in xeromorphic plants (Stace, 1965; Gbile, 1986). Though cell shape of the epidermis may vary among species of a genus, it is generally constant within a species. In *Scilla indica* the arrangement of the epidermal cells are like a chain-link having stomata at the joints. This is typical for the family Liliaceae (Meidner and Mansfield, 1968). In Monocotyledons leaves have parallel venation, the stomatal orientation is parallel to the longer axis of the lamina. In *Scilla indica* the stomata is found to be aperiogenous (anomocytic) characterised by the absence of subsidiary cells. According to Tomlinson (1974), this type of simple stomata represents the unspecialised and ancestral condition for Monocotyledons. But Stebbins and Kush (1961) have suggested that, the stomata with many subsidiary cells are the most primitive. And other types with minimum number of subsidiary cells, are derived ones independently by the reduction of subsidiary cells. From a phylogenetic point of view, species with stomata of homogeneous type can be considered as end members of phylum. Most of the species reported under Liliaceae, have only anomocytic stomata. Therefore, anomocytic type may be considered as the highly evolved in the family. Distribution, size and frequency of stomata have been reported to be specific for a species (Miller, 1938) and hence these characters are potential tools in taxonomy and phylogeny (Ahmad, 1979; Rajagopal, 1979).

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