

## MORPHOLOGY OF *HEVEA* POLLEN

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Light and scanning electron microscopic (SEM) studies on pollen morphology of three *Hevea* species namely, *H. brasiliensis* (Willd. ex Adr. de Juss.) Muell. Arg., *H. spruceana* Muell. Arg. and of *H. benthamiana* Muell. Arg. were carried out. The pollen grains of *Hevea* are 3-zonocolporate and there are significant differences among the species with regard to size, exine thickness and pore diameter. SEM studies offer new useful information on the taxonomy of *Hevea*.

**Key words**—*Hevea brasiliensis*, *H. benthamiana*, *H. spruceana*, Pollen grains, Zonocolporate, Pollen morphology

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### INTRODUCTION

Pollen grains of angiosperms represent a highly reduced male gametophyte with astounding morphological features embodied in their exine. Palynological studies in agricultural crops are of immense value in crop improvement and its application in breeding was stressed by several workers (Erdtman, 1952; Nair, 1961, 1970 and Khoshoo, 1979). In *Hevea*, information pertaining to morphology of pollen is very meagre (Markose and Nair, 1970). However, there are reports regarding germination studies in *Hevea* pollen (Ramaer, 1932; Dijkman, 1951; Majumder, 1964; Attanayake and Dharmaratna, 1984; Saraswathy Amma and Panikkar, 1989).

*Hevea* is monoecious with flowers arranged in panicles. The genus consists of ten species, among which *Hevea brasiliensis* alone is commercially exploited for rubber. *Hevea benthamiana* and *Hevea spruceana* are wild and are of limited or little commercial value. The present study relates to the

light microscopic and scanning electron microscopic observations of pollen from these three species, with the idea of laying down standards for using pollen morphology in the taxonomy of *Hevea*.

### MATERIALS AND METHODS

Pollen material for the present study relates to three species of *Hevea*, namely *H. brasiliensis* (Willd. ex Adr. de Juss.) Muell. Arg., *H. spruceana* Muell. Arg. and *H. benthamiana* Muell. Arg. Fully matured male flowers, just prior to anthesis, were collected and preserved in 70 per cent alcohol. The methods and terminology used for the morphological studies of pollen grains were those followed by Nair (1970). Acetolysis was done by the standard procedure (Erdtman, 1952). Pollen grains were examined and measurements of equatorial diameter, polar diameter, exine thickness and pore diameter were taken. The measurements of pollen grains were taken at a magnification of 400x by means of an ocular micrometer using a light microscope (LM).

A total of fifty pollen grains, five each from ten slides, were selected for measurement of pollen characteristics and the data were statistically analysed.

SEM studies were carried out at the National Botanical Research Institute, Lucknow. The acetolysed pollen grains were placed on a piece of adhesive tape attached to an aluminium stub and the samples were sputter coated with gold to a thickness of 200 Å. Observations were recorded with a Jeol-JSM 35C Scanning Electron Microscope and photographs were taken at 2000x and 6000x. Five samples were observed from each species.

## RESULTS AND DISCUSSION

In general, the pollen grains of *Hevea* are yellow and powdery. The pollen of all the three species studied are 3-zono-colporate. The shape varied from oblate spheroidal to prolate spheroidal. Amb is triangular with convex mesocolpium. The apertures are tenuimarginate. The exine is of uniform thickness with a clear endoexine. In a few acetolysed grains the three apertures were found united to form parasyncolpate type.

Scanning electron microscope pictures showed that the exine surface is basically areolate, the variations between the species being in the size, shape and union of areoles. The description of pollens of the three species are as follows:

### *Hevea brasiliensis* (Willd. ex Adr. de Juss.) Muell. Arg.

SEM : Grains 3-zono-colporate (Fig. 1), amb circular, colpi membrane incrustate, but bridges over the colpi membrane connecting the exine surfaces on the two sides of the colpi are seen at places.

Exine surface pilate, pila dimorphic, pila islands being large or small (Fig. 2).

Measurements(LM): Grain size 36 x 29 µm  
Exine thickness 4.21 µm  
Ora diameter 6.24 µm

### *Hevea spruceana* Muell. Arg.

SEM : Furrow island disrupted, forming furrow islands connected to the general exine surface (Fig. 3). Exine surface areolate, areoles angular and in various shapes and sizes; Columella dimorphic, the columella island occurring at two levels and in different sizes (Fig. 4).

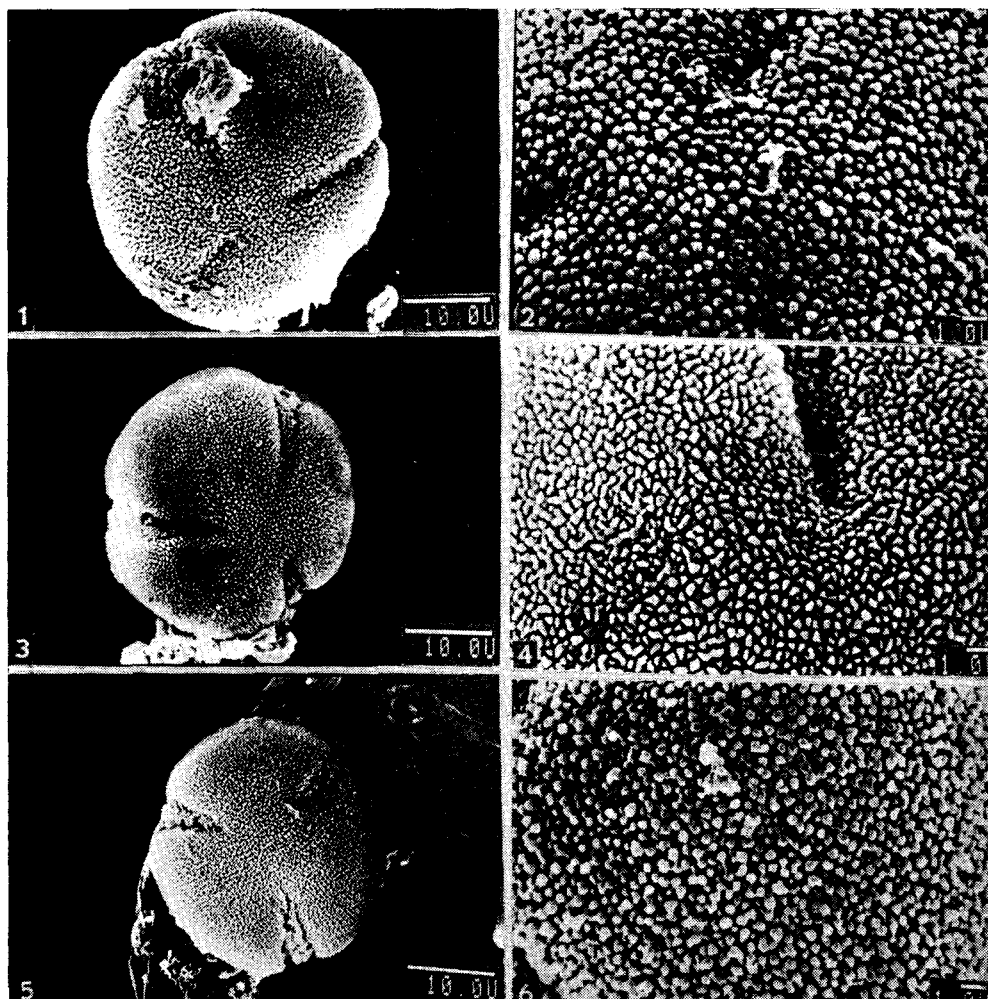
Measurements(LM): Grain size 34 x 27 µm  
Exine thickness 4.43 µm  
Ora diameter 5.03 µm

### *Hevea benthamiana* Muell. Arg.

SEM : Furrow crustate, crustate plate on colpi membrane disrupted in the sides or in the centre (Fig. 5). Exine surface retipilate, pila dimorphic, surface depressed (Fig. 6).

Measurements(LM): Grain size 29 x 22 µm  
Exine thickness 2.63 µm  
Ora diameter 3.38 µm

For comparative purposes the pollen morphological characters as seen by LM are given in Table 1. It may be seen that in *H. benthamiana* the pollen are significantly smaller (29 x 22 µm) and the exine thinner than in the other two species.



Figs. 1-6. Scanning electron micrographs of *Hevea* pollen; surface view showing exine ornamentation. (2, 4 & 6) Figs. 1 & 2. *Hevea brasiliensis*; 3 & 4. *H. spruceana*; 5 & 6. *H. benthamiana*

The scanning electron microscopic studies particularly have given an insight into the fine structure of the exine surface. At the same time, the studies also provide a new parameter for taxonomic differentiation of the species. The exine surface is pilate in *H. brasiliensis* and *H. spruceana* and retipilate in *H. benthamiana*. In *H. spruceana* ornamentation is regulate and striate, and the occurrence of furrow bridges connecting

the islands with the main surface is interesting as it evidently reinforces the delicate colpi membrane. Between *H. brasiliensis* and *H. spruceana* the pila islands are more or less circular in the former and clearly angular in the latter.

The new parameters recorded here may be useful in studies of comparative morphology, identification of species and in taxono-

mic and phylogenetic studies of not only *Hevea*, but also of other plants even at sub specific and clonal levels (Nair and Kapoor, 1974).

Table 1. Morphological characters of pollen

| Species                | Polar diameter<br>$\mu\text{m}$ | Equatorial diameter<br>$\mu\text{m}$ | Exine thickness<br>$\mu\text{m}$ | Oral diameter<br>$\mu\text{m}$ |
|------------------------|---------------------------------|--------------------------------------|----------------------------------|--------------------------------|
| SE                     | 0.56                            | 0.27                                 | 0.10                             | 0.11                           |
| CD                     | 1.63                            | 0.78                                 | 0.29                             | 0.32                           |
| <i>H. brasiliensis</i> | 36.20<br>(33-38)                | 28.64<br>(26-33)                     | 4.21                             | 6.24                           |
| <i>H. spruceana</i>    | 34.03<br>(32-36)                | 26.60<br>(25-29)                     | 4.43                             | 5.03                           |
| <i>H. benthamiana</i>  | 28.55<br>(25-31)                | 22.28<br>(20-26)                     | 2.63                             | 3.38                           |
| G. Mean                | 32.93                           | 25.84                                | 3.75                             | 4.88                           |

(Figures in parenthesis indicate the range)

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## REFERENCES

- Attanayake, D.P.S.T.G. & Dharmaratna, S.C. (1984). Preliminary observation on flowering, pollen germination and fruit set in *Hevea* species. *Journal of Rubber Research Institute of Sri Lanka*, **62**: 41-46.
- Dijkman, M. J. (1951). *Hevea* : Thirty years of research in the Far East. University of Miami Press, Florida. pp. 178-180.
- Erdtman, G. (1952). Pollen morphology and plant taxonomy. Angiosperms Waltham Mass, U.S.A. pp. 43-45.
- Khoshoo, T. N. (1979). Palynology in relation to genetics and plant breeding. In: *Glimpses in Plant Research*, 4: 20-26 (Ed. P. K. K. Nair), NBRI, Vikas Publishing House, Kanpur.
- Majumder, S. K. (1964). Studies on the germination of pollen of *Hevea brasiliensis* in vivo on artificial media. *Journal of the Rubber Research Institute of Malaya*, **18**: 185-193.
- Markose, V. C. & Nair, V.K.B. (1970). Studies on the pollen of *Hevea*. *Rubber Board Bulletin*, **11**: 24-28.
- Nair, P. K. K. (1961). Pollen grains of Indian Plants 1. *Bulletin of the National Botanic Garden*, **53**, Lucknow.
- Nair, P.K.K. (1970). Levels of evolution of families of crop plants with reference to the morphological evolution of pollen grains. *Botanique*, **I**, 7-13.
- Nair, P.K.K. & Kapoor, S.K. (1974). Pollen morphology of Indian vegetable crops. In: *Glimpses in Plant Research*, 2: 106-201. (Ed. P.K.K. Nair), NBRI, Vikas Publishing House, Kanpur.
- Ramaer, H. (1932). Germination of *Hevea* pollen. *Archives of Rubber Cultivation*, **16**: 328.
- Saraswathy Amma, C. K. & Panikkar, A.O.N. (1989). Anthesis and pollen germination in *Hevea brasiliensis*. *Turrialba* (in press).