

OBSERVATIONS ON THE POLLEN MORPHOLOGY OF SOME BAUHINIAS
(LEGUMINOSAE : CAESALPINIOIDEAE) FROM INDIA

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ABSTRACT

The present investigation, aided by light and scanning electron microscopy, provides detailed pollen morphological descriptions of the 17 species of *Bauhinia* from India.

INTRODUCTION

The pollen morphology of the genus *Bauhinia* has been studied from India by Vishnu-Mittre and Sharma (1962); Nair and Sharma (1962); Schmitz (1973); Larsen (1974); Mondal and Mondal (1983). These studies were based on light microscopic observations except that of Larsen (1974) who preliminarily studied only a few species from India by scanning electron microscopy along with the detailed study on the Thai species. Furthermore, it seems that due attention has not always been given by Vishnu-Mittre and Sharma (1962); Nair and Sharma (1962) on the identity of the specimens because entirely different palynological characteristics have sometimes been attributed to the same taxon. The present investigation, aided by light and scanning electron microscopy, has therefore, been undertaken to provide detailed pollen morphological descriptions of the 17 species of *Bauhinia* from India based on authentic specimens.

MATERIALS AND METHODS

The pollen grains were obtained from herbarium specimens. Contamination was avoided by extracting them from anthers within mature buds. Samples were acetolyzed according to the method outlined by Erdtman (1952) and mounted

with glycerine jelly for light microscopic observations. The average size ($P \times E$) of the pollen grains was based on measurements of 20 acetolyzed pollen grains. All the pollen slides have been deposited in the Palynology unit-CAL.

For scanning electron microscopy unacetolyzed pollen grains, dehydrated in absolute alcohol, were mounted on double stick "Scotch-tape" adhered to metallic stubs and gold coated with an "Edward sputter-coater". Electron micrographs were taken with a "PSEM 500".

Terminology mainly followed that of Erdtman (1952), Faegri and Iversen (1964), and Praglowski and Punt (1973).

SPECIMENS EXAMINED

All specimens cited have been studied under light microscope; an asterisk indicates that the sample has also been studied with SEM.

Bauhinia acuminata L. Sur 15202 (CAL).*

B. foveolata Dalz. Ansari 122015 (BSI)*;
Talbot s.n. (BSI)*; Talbot 20 (CAL).

B. glauca (Benth.) Benth. ssp. *tenuiflora* (C. B. Clarke) Larsen & Larsen Mokim 57 (CAL); Wenger 6 (CAL)*.

B. khasiana Baker Deb 25721 (CAL)*; Kurz s.n. (CAL).

B. malabarica Roxb. Lal & Kumar 33255 (BSA); Rathakrishnan 21333 (BSA)*;
Verma 25143 (BSA).

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- Bauhinia nervosa* (Benth.) Baker Hook. f. & Thomson s.n. (CAL)*.
- B. ornata* Kurz var. *kerrii* (Gagnep.) Larsen & Larsen King's coll. s.n. (CAL)*; Watt 10329 (CAL).
- B. phoenicea* Wight & Arn. Raghavan 83120 (CAL); Sanjappa 18412 (CAL)*; Srinivasan 72316 (CAL)*.
- B. purpurea* L. Bandyopadhyay 15203 (CAL)*; Rajagopal 6174 (BSA).
- B. racemosa* Lam. Pant 43741 (BSD)*; Rau 5327 (BSD).
- B. scandens* L. King s.n. (CAL)*; Smith 495 (CAL).
- B. semla* Wund. Panigrahi 12719 (BSA); Verma 25111 (BSA)*.
- B. stipularis* Korth. Chakraborty 3231 (CAL); Dwivedi 8020 (PBL); Nair 7192 (PBL)*.
- B. tomentosa* L. Hooper s.n. (BSIS)*.
- B. vahlii* Wight & Arn. Arora 66149 (BSD)*; Bandyopadhyay 15207 (CAL); Pant 20438 (BSA).
- B. variegata* L. Bandyopadhyay 15204 (CAL)*; Bandyopadhyay 15205 (CAL); Panigrahi 15367 (BSA).
- B. wallichii* Macbr. Kanjilal 5581 (ASSAM)*; Simons s.n. (CAL).

OBSERVATIONS

Bauhinia acuminata (Pl. 1, fig. 1)

Pollen grains spheroidal, 95-129 (112) μm in diameter, inaperturate, semitectate; amb circular. Exine 2 μm thick. Sexine as thick or slightly thicker than nexine, reticulate with scattered supracteal processes. Reticulum heterobrochate, simplibaculate. Muri <1 μm wide. Lumina rounded to angular, <1-3 μm in maximum diameter. Processes more or less rounded, 4-6 μm in diameter.

The description of the grains given by Nair and Sharma (1962) probably belongs to *B. tomentosa*. They described them as faintly aperturate (3-4-zonicolpate) with about 7 μm thick exine and punctate-retipilate ornamentation.

B. foveolata (Pl. 1, figs. 2-3)

Pollen grains oblate spheroidal, 22-26 \times 24-28 (24 \times 26) μm , 3-porate, tectate; amb circular. Pori circular to lolongate, 3-6 \times 3-5 μm , indistinct at margins. Exine 2 μm thick. Sexine thicker than nexine. Tectum finely rugulate with minute puncta and numerous supracteal spinules <1-1.5 μm high. Bacula thin.

B. glauca* ssp. *tenuiflora (Pl. 1, fig. 4)

Pollen grains oblate spheroidal to spheroidal, 30-37 \times 32-38 (33 \times 35) μm , 3-colporate, semitectate; amb circular to roundedly triangular. Colpi 8-10 μm wide, tapering and confluent at ends. Colpus membrane, crustate with processes of the same type as those of exine. Ora circular, 3-4 μm in diameter. Exine 2-3 μm thick. Sexine as thick as nexine or slightly thinner, consisting of closely placed somewhat verrucate to clavate processes supported by bacula. Processes rounded to angular in outline, <1-3 μm in maximum diameter, subequal in height.

B. khasiana (Pl. 1, figs. 5-6)

Pollen grains prolate spheroidal to subprolate, rarely prolate, 34-50 \times 31-37 (41 \times 35) μm , 3-colporate, semitectate; amb trilobate; apocolpia 6-12 μm . Colpi 28-40 \times 8-12 μm , acute at ends. Colpus membrane crustate with verrucate to gemmate processes; processes rounded to irregular in outline, <1-2 μm in maximum diameter. Ora circular, 2.5-3 μm in diameter. Exine 2-3 μm thick. Sexine as thick as nexine or slightly thicker. Tectum punctate to foveolato-reticulate. Tectal holes and depressions circular, angular or slightly elongated, <1-2 μm in maximum diameter. Bacula thin.

B. malabarica

Pollen grains oblate spheroidal to spheroidal, 22-31 \times 24-32 (26 \times 27) μm , 3-porate, tectate; amb circular. Pori circular to lolongate, 2-5 \times 2-4

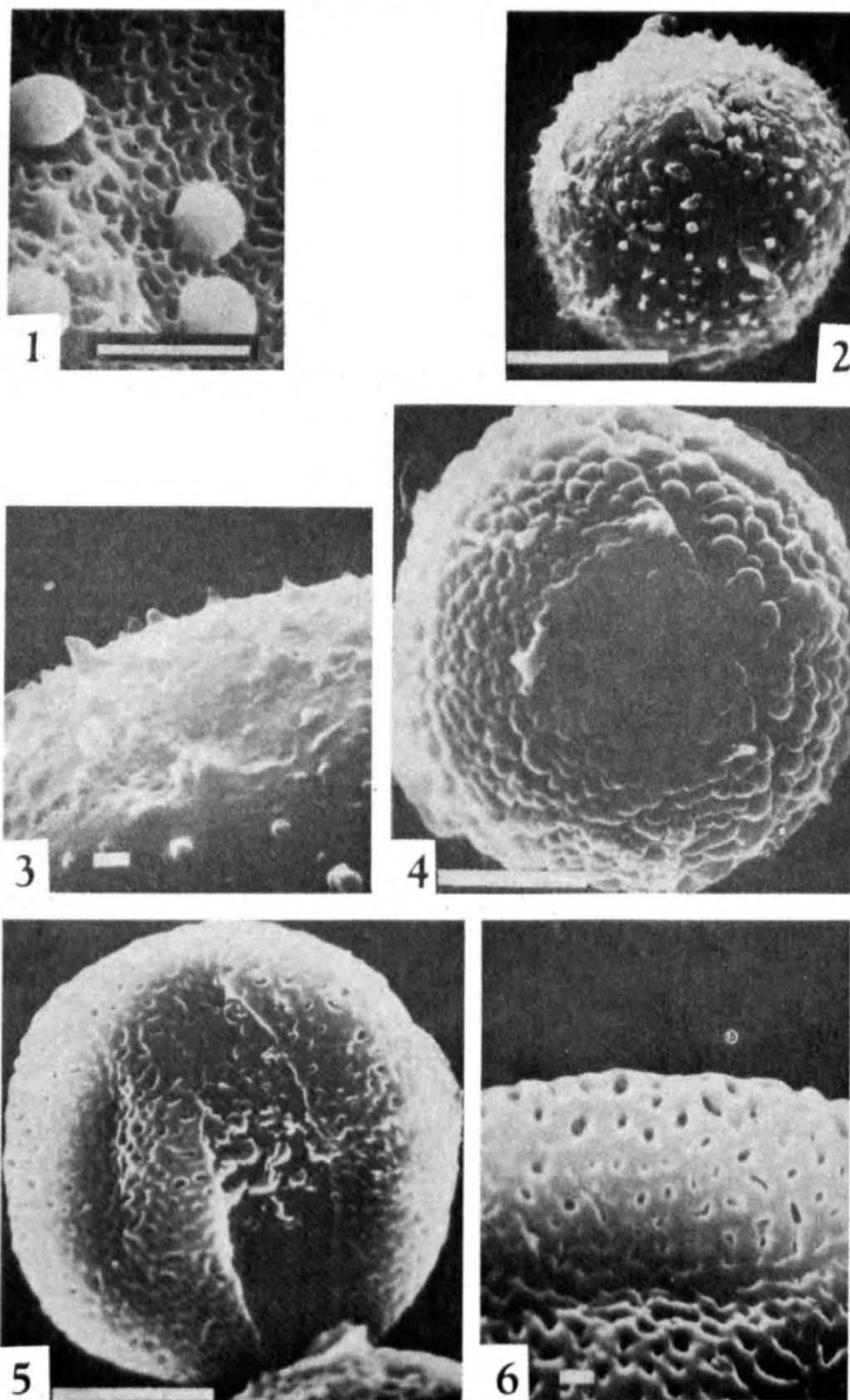


Plate 1. Figs. 1-6: 1. *Bauhinia acuminata* Detail of surface ornamentation (marker line = 10 μ m) 2-3 *B. foveolata* : 2. A pollen grain (marker line = 10 μ m), 3 Detail of surface ornamentation (marker line = 1 μ m). 4 *B. glauca* ssp. *tenuiflora* : A pollen grain (marker line = 10 μ m). 5-6. *B. khasiana* 5 A pollen grain (marker line = 10 μ m); 6. Detail of surface ornamentation (marker line = 1 μ m).

μm , indistinct at margins. Exine $2\ \mu\text{m}$ thick. Sexine thicker than nexine. Tectum finely rugulate with minute puncta and numerous supracteal spinules $<1-1.5\ \mu\text{m}$ high. Bacula thin.

Vishnu-Mittre and Sharma (1962) referred this species to their *Bauhinia malabarica* type : grains 3-zoniporate, baculate, in- tegillate. Sometimes 2-3 bacula fuse together. Nexine thinner than sexine. Nair and Sharma (1962) described the grains as spinulate with a faint OL-pattern on the interspinular area.

Bauhinia nervosa (Pl. 2, fig. 7)

Pollen grains subprolate to prolate, $54-72 \times 43-50$ (65×45) μm , 3-colporate, tectate ; amb circular to trilobate ; apocolpia $8-10\ \mu\text{m}$. Colpi $40-60 \times 3-6\ \mu\text{m}$, rounded at ends. Colpus membrane granulate. Ora lolongate, $3-7 \times 2-5\ \mu\text{m}$. Exine $2-3\ \mu\text{m}$ thick. Sexine as thick as nexine or slightly thicker. Tectum rugulate with minute puncta. Bacula thin.

Schmitz (1973) studied this species and published light microscopic photographs.

B. ornata var. **kerrii** (Pl. 2, fig. 8)

Pollen grains subprolate to prolate, $54-68 \times 35-52$ (61×45) μm , 3-colporate, semitectate; amb circular to trilobate; apocolpia $11-19\ \mu\text{m}$. Colpi $37-50 \times 5-13\ \mu\text{m}$, rounded at ends. Colpus membrane crustate with verrucate to gemmate processes; processes rounded to irregular in outline, $<1-2\ \mu\text{m}$ in maximum diameter. Ora lolongate to circular, $5-10 \times 4-7\ \mu\text{m}$. Exine $2-2.5\ \mu\text{m}$ thick. Sexine as thick as nexine or slightly thicker. Tectum punctate to foveolato-reticulate. Tectal holes and depressions circular, angular or slightly elongated, $<1-1.5\ \mu\text{m}$ in maximum diameter. Supracteal processes rarely present, rod-like, broadened at base, $c. 3\ \mu\text{m}$ in length. Bacula thin.

Larsen (1974) referred this taxon to her *Integrifolia* type characterized by foveolate to foveolato-reticulate pollen grains.

B. phoenicea (Pl. 2, fig. 9)

Pollen grains in tetrahedral tetrads, $70-126$ (92) μm in diameter. Individual grains 3-colporate,

tectate. Colpi $3-4\ \mu\text{m}$ wide, confluent at distal ends. Colpus membrane granulate. Exine $3-4\ \mu\text{m}$ thick. Sexine as thick as nexine. Tectum punctate. Bacula thin.

Schmitz (1973) described the grains as "réticulée ou fovéolée". Larsen (1974) referred to the *Pottsii* type characterized by pollen grains in tetrads.

B. purpurea (Pl. 2, fig. 10)

Pollen grains subprolate to prolate, $68-94 \times 46-81$ (74×54) μm , 3-colporoidate or 3-colporate, semitectate; amb roundedly triangular; apocolpia $10-27\ \mu\text{m}$. Colpi $58-72 \times 5-11\ \mu\text{m}$, tapering at ends. Colpus membrane provided with gemmae-like processes; processes rounded in outline, $1-3\ \mu\text{m}$ in diameter. Ora (in colporate grains) lolongate, $11-16 \times 5-11\ \mu\text{m}$. Exine $2.5-3\ \mu\text{m}$ thick, thinner towards the margin of the colpi. Sexine thicker than nexine, striato-reticulate. Reticulum heterobrochate, finer towards the colpi, simplibaculate. Ridges $<1-1\ \mu\text{m}$ wide. Lumina rounded to angular, $<1\ \mu\text{m}$ in maximum diameter.

The exine ornamentation was variously interpreted as striate (Vishnu-Mittre and Sharma, 1962), reticulate (Nair and Sharma, 1962) or striato-reticulate (Mondal and Mondal, 1983). The striations were described to be formed of free and fused pila (Vishnu-Mittre and Sharma, 1962; Mondal and Mondal, 1983) because the ridges appear to be broken up into pieces under low magnifications. Nair and Sharma (1962) also mentioned of some "tuberculate elevations" on the exine surface and published palynograms showing their developmental stages but no such elevations have been observed during this study. Larsen (1974) described the exine ornamentation as striate to striato-reticulate. It was also pointed out that *B. triandra* studied by Vishnu-Mittre and Sharma (1962) is only a synonym of this species.

B. racemosa

Pollen grains prolate spheroidal, $20-28 \times 19-24$ (24×22) μm , 3-colporoidate, semitectate; amb trilobate; apocolpia $5-6\ \mu\text{m}$. Colpi $16-22 \times 2-3\ \mu\text{m}$, tapering at ends. Colpus membrane almost smooth. Exine $1.5-2\ \mu\text{m}$ thick. Sexine as thick as nexine or

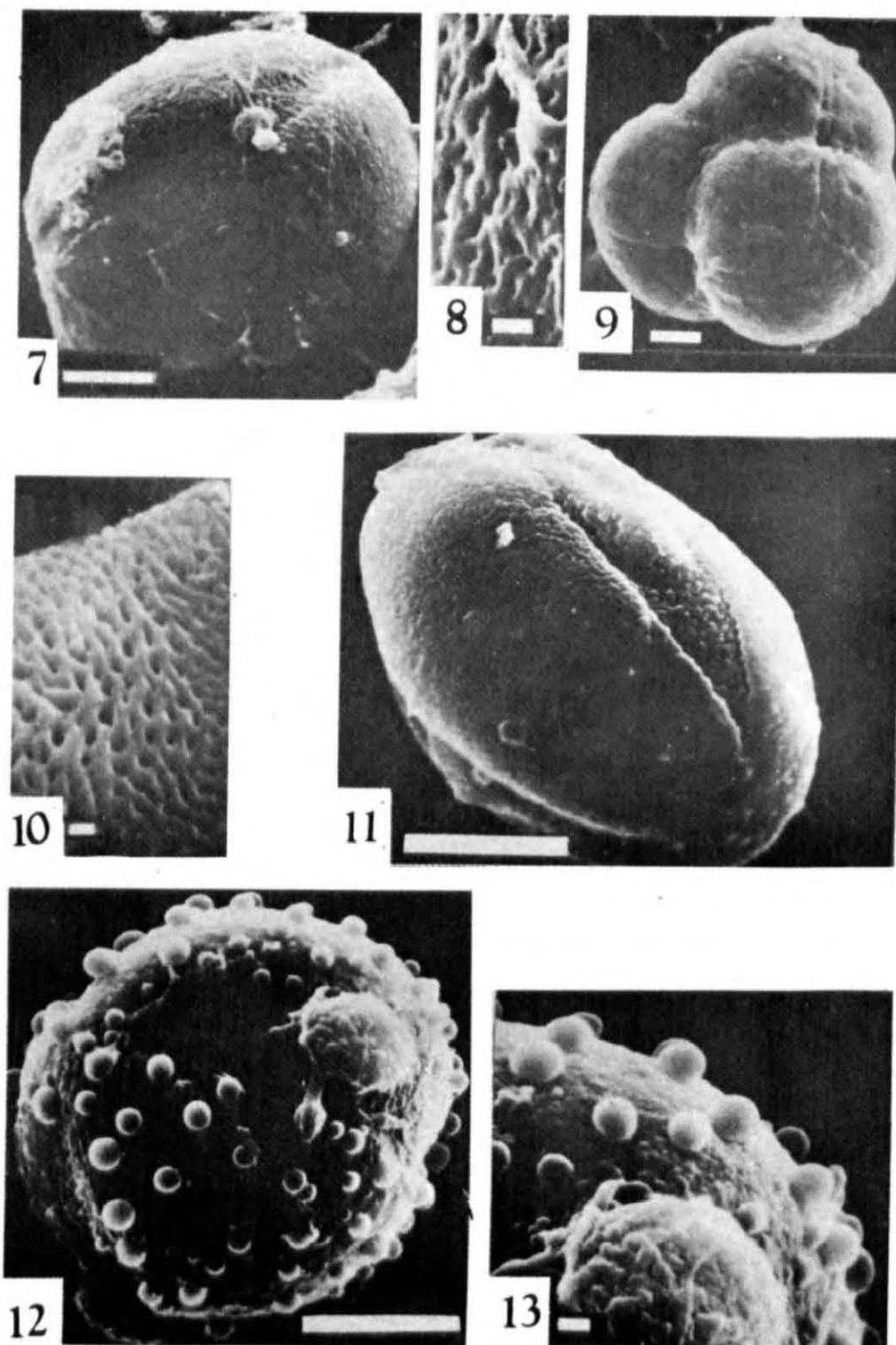


Plate 2. Figs. 7-13: 7. *Bauhinia nervosa* : A pollen grain (marker line = 10 μ m) 8. *B. ornata* var. *kerrii* Detail of surface ornamentation (marker line = 1 μ m). 9. *B. phoenicea* : Pollen grains in tetrad (marker line = 10 μ m). 10. *B. purpurea*: Detail of surface ornamentation (marker line = 1 μ m); 11. *B. scandens* A pollen grain (marker line = 10 μ m); 12-13. *B. semla* : 12. A pollen grain (marker line = 10 μ m); 13. A portion of aperture and detail of surface ornamentation (marker line = 1 μ m).

thicker, reticulate. Reticulum heterobrochate, finer towards the colpi, simplibaculate. Muri $<0.5-1\ \mu\text{m}$ wide. Lumina angular to elongate, $<1-1.5\ \mu\text{m}$ in maximum diameter.

Nair and Sharma (1962) described the grains as 3-zonicolporate with faint endocolpium.

Bauhinia scandens (Pl. 2, fig. 11)

Pollen grains subprolate, $28-33 \times 22-26$ (31×24) μm , 3-colporate, tectate; amb trilobate; apocolpia $6-8\ \mu\text{m}$. Colpi $24-28 \times 3-6\ \mu\text{m}$, tapering at ends. Colpus membrane finely granulate. Ora circular to lolongate, $3-6 \times 2-4\ \mu\text{m}$. Exine $1.5-2\ \mu\text{m}$ thick. Sexine as thick as nexine or slightly thicker. Tectum rugulate with minute puncta. Bacula thin.

Schmitz (1973) described the grains as "lisse a' densément scabre". Larsen (1974) described the grains as rugulose.

B. semla (Pl. 2, figs. 12-13)

Pollen grains spheroidal to prolate spheroidal, $27-34 \times 25-32$ (30×28) μm , 3-colporate, tectate; amb trilobate; apocolpia $6-7\ \mu\text{m}$. Colpi $22-29 \times 3-6\ \mu\text{m}$, acute at ends. Colpus membrane finely rugulate with minute puncta. Ora circular to lolongate, $2-5 \times 2-5\ \mu\text{m}$. Exine $2-2.5\ \mu\text{m}$ thick. Sexine as thick as nexine or slightly thicker. Tectum finely rugulate with minute puncta and scattered supratectal processes. Processes rounded, $<1-2\ \mu\text{m}$ in diameter. Bacula distinct.

Vishnu-Mittre and Sharma (1962) referred this species to their *Bauhinia retusa* type : grains 3-zoniporate, verrucose, bacula very distinct and verrucae of different sizes. But presently, the 3-porate condition of the grains could not be corroborated. The narrow colpi might, however, be difficult to see under a light microscope. Nair and Sharma (1962) also described the grains as verrucate with depression in the centre of verrucae at their distal surface. But in course of this study no such depression could be located.

B. stipularis

Pollen grains prolate spheroidal to subprolate, rarely prolate, $45-61 \times 41-50$ (52×45) μm , 3-colporate, tectate; amb circular; apocolpia $7-12\ \mu\text{m}$.

Colpi $38-54 \times 5-12\ \mu\text{m}$, tapering at ends. Colpus membrane crustate with verrucate to gemmate processes; processes rounded to angular in outline, $<1-3\ \mu\text{m}$ in maximum diameter. Ora circular, $5-8\ \mu\text{m}$ in diameter, rarely lolongate, $8 \times 5\ \mu\text{m}$. Exine $2-3\ \mu\text{m}$ thick. Sexine as thick as nexine. Tectum finely rugulate with minute puncta. Bacula thin.

B. tomentosa (Pl. 3, fig. 14)

Pollen grains oblate spheroidal to spheroidal, $80-100 \times 80-100$ (85×90) μm , (4-) 5-colpate, semitectate; amb circular; apocolpia $40-48\ \mu\text{m}$. Colpi $36-50 \times 5-8\ \mu\text{m}$. Colpus membrane crustate with processes of the same type as those of exine but much smaller in size. Exine $6-7\ \mu\text{m}$ thick. Sexine much thicker than nexine, consisting of closely placed clavae. Clavae angular to rounded in outline, $1-5\ \mu\text{m}$ in diameter at apex.

Vishnu-Mittre and Sharma (1962) described the grains as inaperturate with verrucose ornamentation. Sometimes free bacula were also noticed. But from the published light microscopic photograph (Pl. IV, fig. 43) it appears that they based their observations on specimen of *B. acuminata* wrongly identified as *B. tomentosa*. Nair and Sharma (1962) described the grains as punctate-retipilate. Mondal and Mondal (1983) described them as 3 (-4)-colpate with verrucose ornamentation. The colpus membrane was noted to be smooth.

B. vahlii (Pl. 3, fig. 15)

Pollen grains subprolate, $45-60 \times 36-49$ (53×43) μm , 3-colporate, semitectate; amb circular; apocolpia $10-19\ \mu\text{m}$. Colpi $30-44 \times 5-11\ \mu\text{m}$, rounded at ends. Colpus membrane crustate with verrucate to gemmate processes; processes rounded to irregular in outline, $<1-2.5\ \mu\text{m}$ in maximum diameter. Ora circular to lolongate, $4-8 \times 3-5\ \mu\text{m}$. Exine $2-2.5\ \mu\text{m}$ thick. Sexine as thick as nexine or slightly thicker. Tectum punctate to foveolato-reticulate. Tectal holes and depressions circular, angular or slightly elongated, $<1-1.5\ \mu\text{m}$ in maximum diameter. Bacula thin.

Vishnu-Mittre and Sharma (1962) referred this species to their *Crotalaria vestita* type : grains

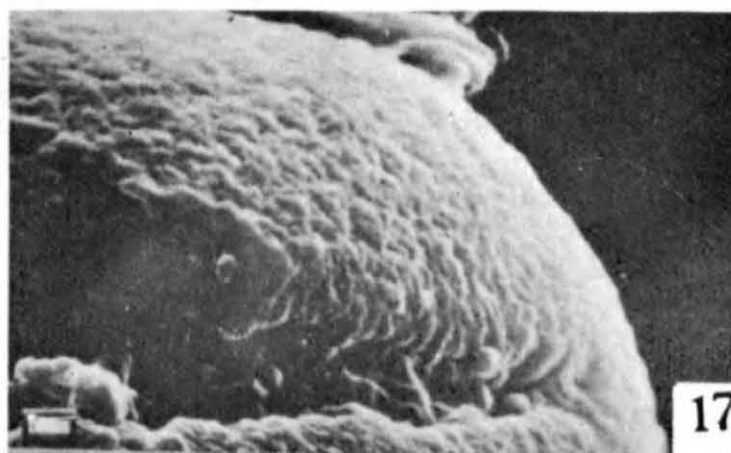
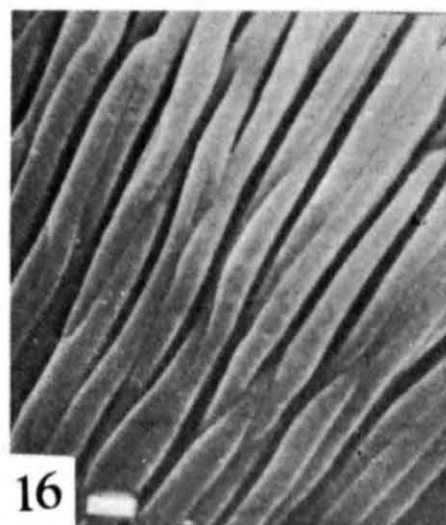
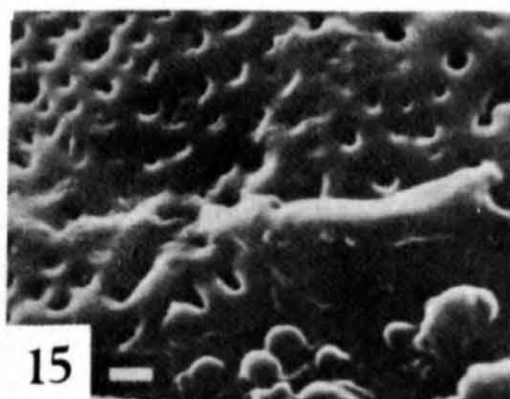
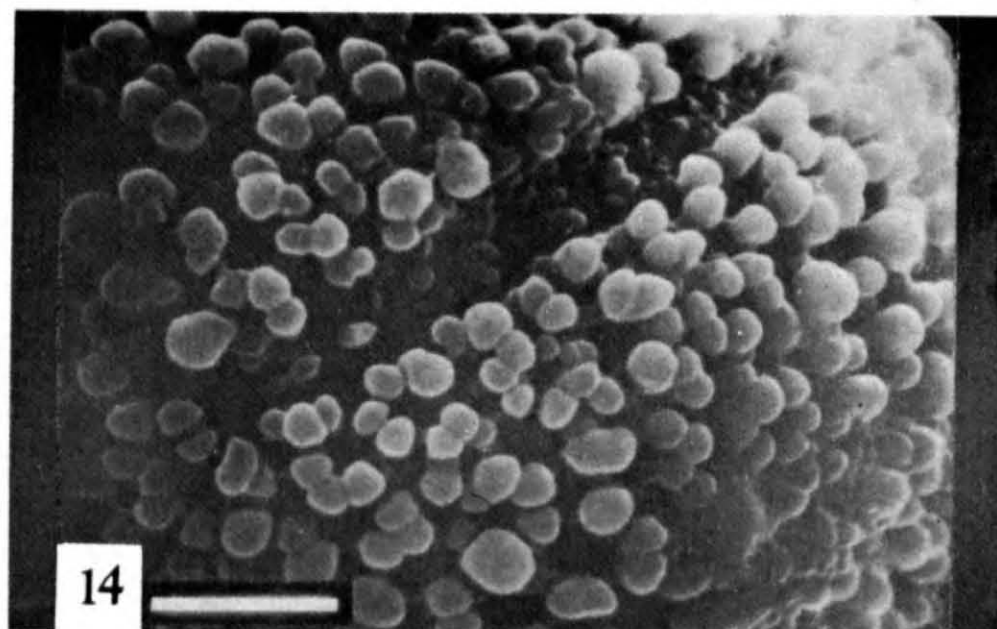


Plate 3. Figs. 14-17: 14. *Bauhinia tomentosa* : Detail of aperture and surface ornamentation (marker line = 10 μ m); 15. *B. vahlii* : Detail of a portion of aperture and surface ornamentation (marker line = 1 μ m); 16. *B. variegata* : Detail of surface ornamentation (marker line = 1 μ m); 17. *B. wallichii* : Detail of a portion of aperture and surface ornamentation (marker line = 1 μ m).

3-zonicolporate, reticulate, lumina devoid of any ornamentation. Nair and Sharma (1962) described the grains as reticulate, infrategillate. Larsen (1974) referred to her *Integrifolia* type characterized by foveolate to foveolato-reticulate pollen grains.

Bauhinia variegata (Pl. 3, fig. 16)

Pollen grains oblate spheroidal to subprotate, $34-51 \times 34-40$ (43×36) μm , 3-colporoidate or 3-colporate, tectate; amb roundedly triangular; apocolpia $5-8 \mu\text{m}$. Colpi $26-44 \times 3-8 \mu\text{m}$, tapering at ends. Colpus membrane granulate. Ora (in colporate grains) circular, $4-5 \mu\text{m}$ in diameter or lalongate with irregular margins, $5-12 \times 11-14 \mu\text{m}$. Exine $2-3 \mu\text{m}$ thick, thinner towards the colpi. Sexine as thick as nexine or thicker, closely to appressedly suprastrate with minute puncta within the grooves. Lirae $<1-1 \mu\text{m}$ wide, finer towards the colpi. Bacula distinct.

The exine ornamentation was always interpreted as striate (Vishnu-Mittre and Sharma, 1962; Nair and Sharma, 1962; Mondal and Mondal, 1983) but in two of these publications (Vishnu-Mittre and Sharma, 1962; Mondal and Mondal, 1983) the striations were described to be formed of free and fused pila because the lirae appear to be broken up into pieces under low magnifications.

B. wallichii (Pl. 3, fig. 17)

Pollen grains prolate, $39-48 \times 29-35$ (44×32) μm , 3-colporate, tectate; amb trilobate; apocolpia $7-10 \mu\text{m}$. Colpi $33-38 \times 1-3 \mu\text{m}$, acute at ends, slightly invaginated. Colpus membrane coarsely rugulate with a few granules. Ora lalongate to circular, $2-5 \times 2-4 \mu\text{m}$. Exine $2-3 \mu\text{m}$ thick. Sexine as thick as nexine or slightly thicker.

Tectum rugulate with minute puncta. Bacula distinct.

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