

OCCURRENCE OF 3-ZONOCOLPATE, DIORATE POLLEN IN *AESCHYNOMENE* *ASPERA* LINN. (LEGUMINOSAE) AND THE SIGNIFICANCE OF POLLEN MORPHOLOGY IN THE TAXONOMY OF THE GENUS *AESCHYNOMENE* LINN.

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ABSTRACT

3-zonocolpate, diorate pollen grains are of rare occurrence and have been reported in the families Didymelaceae, Euphorbiaceae, Myoporaceae, Scrophulariaceae, etc. (Erdtman, 1952). The paper records for the first time the occurrence of the similar pollen grains in *Aeschynomene aspera* Linn. (Leguminosae-Papilionatae). In addition to it, two more species of *Aeschynomene*, viz., *A. indica* Linn. and *A. nyikensis* Baker have been investigated. The data reveal pollen morphological heterogeneity in the genus, and in the light of this heterogeneity the taxonomic and evolutionary significance of these species have been discussed.

INTRODUCTION

Vishnu-Mittre and Sharma (1962) described two species of genus *Aeschynomene*, viz. *aspera* and *indica* while dealing with the pollen morphology of the family Leguminosae and observed differences in their shapes and sexine patterns. In his recent studies, the present author observed a contrasting apertural difference of great significance between these two species. *Aeschynomene aspera* Linn. has been found to be 3-zonocolpate, diorate, with typical polar endings of the colpi, whereas, in *A. indica* Linn. simple 3-zonocolporate condition has been noticed. To unfold the riddle of these differences, noticed in the polliniferous materials investigated earlier and now, the pollen material of these species was collected from the different localities in India. The data, revealed by these various specimens, have corroborated the recent findings.

However, some variation in the size of the pollen grains, shape of the 'os' and very rarely in the coarseness of the sexine pattern has also been noticed.

The occurrence of 3-zonocolpate, diorate, grain in *A. aspera* Linn. is unique in Leguminosae, as a whole.

In addition to it, an African species, viz. *A. nyikensis* Baker has also been examined which is altogether different from the above mentioned species, in almost all the characters. Thus it appears that the different species grouped under *Aeschynomene* Linn. do not constitute a homogeneous assemblage.

MATERIAL AND METHOD

The polliniferous material investigated largely

comprises herbarium material collected from the Central National Herbarium, Calcutta and the herbaria of the Southern and Western Circles of the Botanical Survey of India.

Pollen preparations were made according to Erdtman's (1960) revised method of acetolysis and permanent pollen slides deposited in the Sporotheca of the Botanical Survey of India, Calcutta. The measurements are based on an average of 25 acetolysed pollen grains and detailed data have been tabulated in Table I. The percentages of variation of different pollen characters are based on 500 random pollen counts.

DESCRIPTION OF THE POLLEN GRAINS

***Aeschynomene aspera* Linn.** (Pl. I, figs. 1-11, Text figs. 1-2)

3-zonocolpate, diorate, colpus long, asyncolpate, broader in the mid and thereafter abruptly narrows at both the poles, apices acute, membrane coarsely granulate, central part of the colpus provided with two circular to slightly lalongate, tenuimarginate ora, os membrane psilate to very finely granulate, distinctly columellate, reticulate, heterobrochate, curvilinear, simplibaculate, psiloluminate, ornamentation finer towards apertures; and nexine thinner than sexine. Amb subtriangular with rounded corners, goniotreme and outline of the pollen grain undulated.

***A. indica* Linn.** (Pl. I, figs. 12-20; Text figs. 3-4)

3-zonocolporate, colpus broader in the mid, gradually tapering, apices acute, central part psilate, while rest of the area finely granulate; os very prominent, shape variable-lalongate, lalongate or circular, tenuimarginate; distinctly columellate, reti-

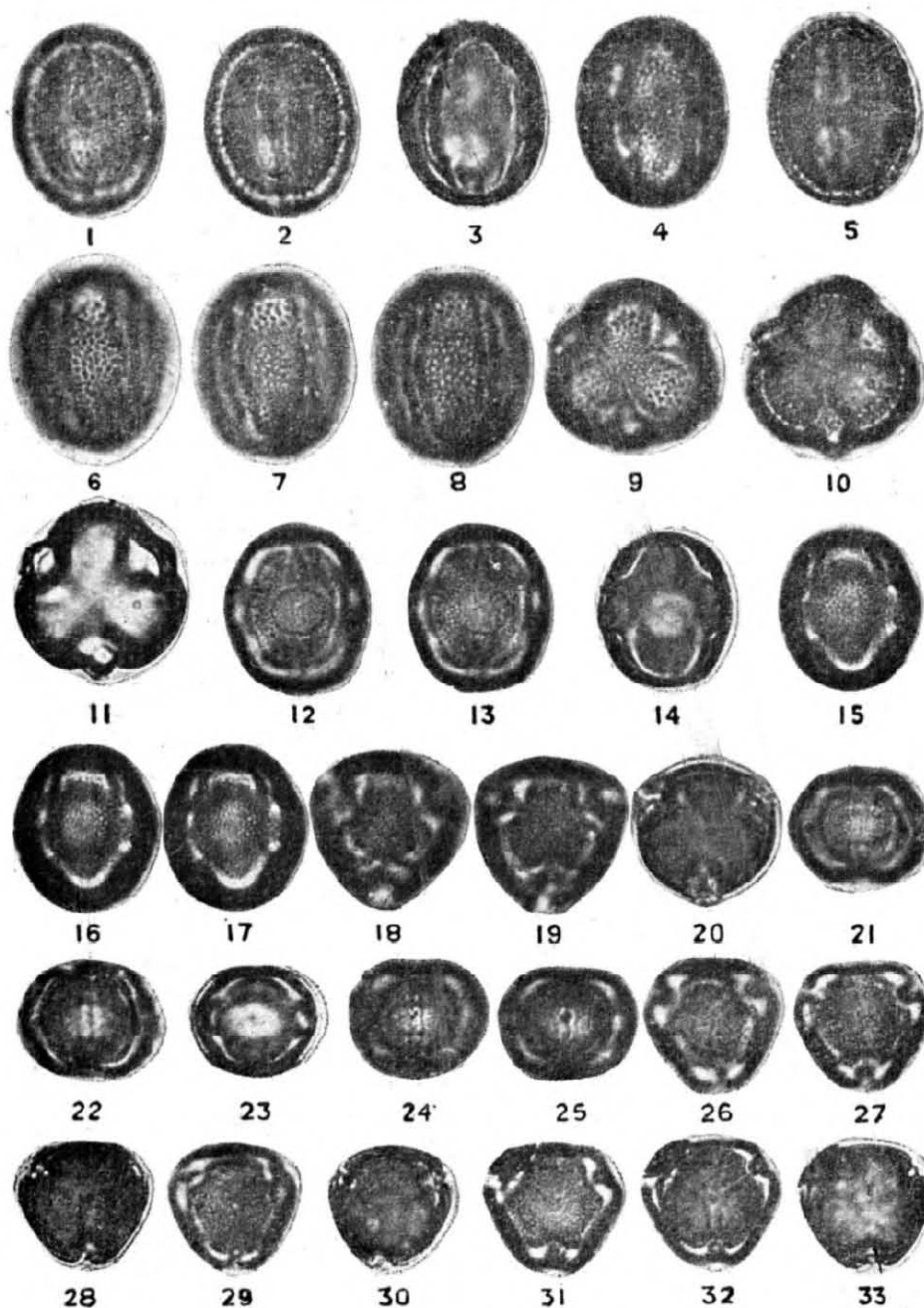
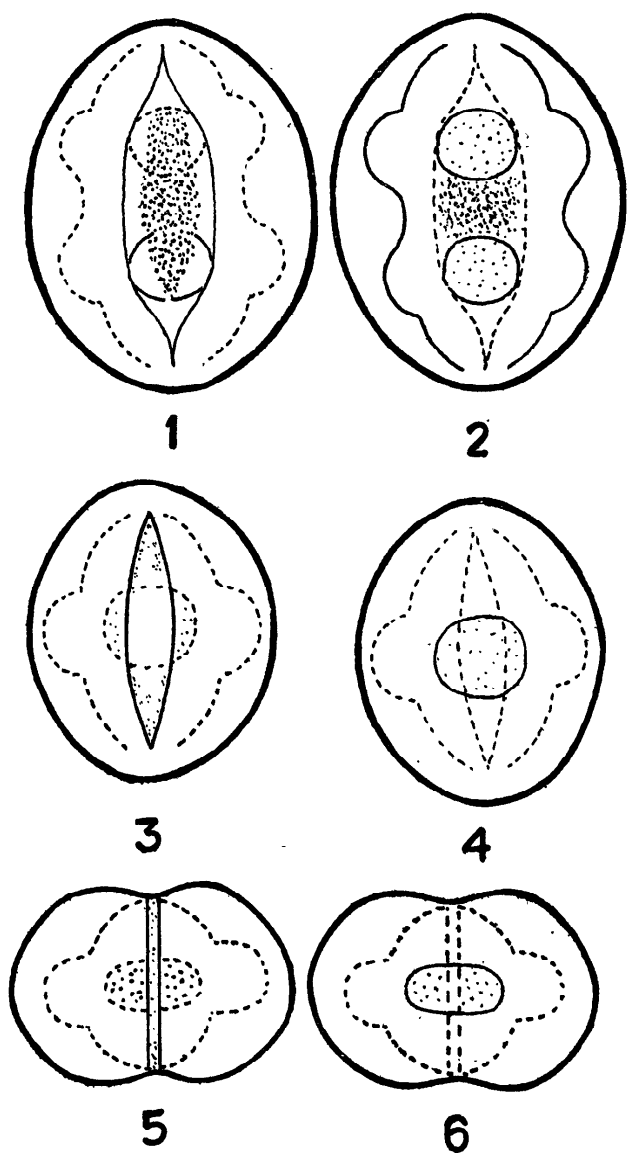


Plate I (Figs. 1-33) : Figs. 1-11 : *Aeschynomene aspera* Linn.: 1-4. Equatorial view, showing apertures under different foci. 5. Equatorial view, optical section. 6-8. Exine pattern under different foci. 9-11. Polar view under different foci. Figs. 12-20 : *A. indica* Linn.: 12-14. Equatorial view, showing apertures under different foci. 15-17. Exine pattern under different foci. 18-20. Polar view under different foci. Figs. 21-33 : *A. nyikensis* Baker.: 21-25. Equatorial view under different foci. 26-28. Polar view under different foci showing syncolpate condition. 29-30. Polar view showing asyncolpate condition. 31-33. Polar view showing parasyncolpate condition. (All figures enlarged to $\times 1000$)

culate, homo-heterobrochate, simplibaculate, psiloluminate, ornamentation finer towards apertures; and nexine thinner than sexine. Amb subtriangular, goniotreme and outline of the pollen grain undulated.



Text figs. 1-6: 1-2. *Aeschynomene aspera* Linn., showing apertures under two foci. 3-4. *A. indica* Linn., showing apertures under two foci. 5-6. *A. nyikensis* Baker., showing apertures under two foci. (Magnification $\times 1500$)

***Aeschynomene nyikensis* Baker** (Pl. I, figs. 21-33;

Text figs. 5-6)

3-zonocolpate, mostly syncolpate, rarely asyncolpate or parasyncolpate, apices acute when it is asyncolpate. The colpi characters are very fluctuating-

syncolpate, parasyncolpate or asyncolpate condition may be present at both the poles or one of the poles in the same sporomorph, finely ornamented; os lalongate, lateral ends rounded, tenuimarginate, distinctly columellate, reticulate, homo-heterobrochate, simplibaculate, psiloluminate; and nexine thinner than sexine. Amb subtriangular, goniotreme and outline of the pollen grain undulated.

DISCUSSION

In India genus *Aeschynomene* Linn. is represented by two species, viz. *A. aspera* Linn. and *A. indica* Linn. Both the hydric species are commercially exploited and the pith is used as cork substitute for floats, helmet, insect boxes, etc. and for stropping knives and razors. It is also used for making toys and temporary decorations of idols. Taxonomically, genus *Aeschynomene* Linn. has been treated under various generic synonyms (Rudd, 1959-61). Similarly, both the species have been described under various specific names in genus *Hedysarum* (Tourn.) L. and *Aeschynomene* Linn. However, in recent years both the species have been distinctly established and there is no confusion as regards their taxonomic position. The palynological data, presented here, provides additional, authentic and easily determinable characters for the specific delimitations. The colpi in *Aeschynomene aspera* Linn. pollen grains are provided with two distinct ora, whereas, in *A. indica* Linn. the number of os in each colpus is strictly one. Besides this basic apertural differentiation, both these species differ in size of pollen grain, size of aperture, shape of the pollen grain, polar field indices and size class (Table I).

Aeschynomene nyikensis Baker, an African tropical species, produces suboblate, 3-syncolporate, asyncolporate or parasyncolporate pollen grains having strictly lalongate ora. These characters distinguish this species from the above mentioned species. The contrasting difference within the few species of this genus is suggestive of further investigation of various species under it. The most interesting pollen morphological feature, amongst these species and the family Leguminosae as a whole, is the occurrence of very rare type of aperture (3-colpate-diorate) in *A. aspera* Linn. Pollen grains with $\pm$ similar type of apertures have been described by Erdtman (1952) in *Didymeles madagascarensis* (Didymelaceae), *Breynia* and *Breyniopsis* (Euphorbiaceae), *Myoporum laetum* (Myoporaceae), *Capraria biflora* (Scrophulariaceae), etc.

TABLE I : Showing the morphological characters of the pollen grains

Names of the species	Type	Aperture				Shape	Size of pollen grain(μ)		Exine		Polar	field
		Colpus size (μ)		Pore size (μ)			P	E	Pattern	Thickness (μ)	Index	Size Glass
		l	b	l	b							
<i>Aeschynomene aspera</i> Linn. Sengupta 305; 24-Parganas.	3-zono- colpate, diorate	23.6 22.5-25.0	7.5 6.2-8.8	5.6 5.0-6.0	5.6 5.0-6.0	Sub- prolate	26.8 25.0-28.2	23.2 22.5-24	ret.	1.5 1.2-2.0	1 : 8	Very small
<i>A. aspera</i> Linn. Subramanyam 4348; Kallandari, S. India.	"	18.7 17.5-20.0	5.5 4.5-6.2	6.4 6.0-8.0	6.4 6.0-7.5	"	23.4 21.2-25.2	20.4 20-21.2	"	1.6 1.2-2.0	1 : 6	Small
<i>A. indica</i> Linn. CAL 17619.	3-zono- colporate	16.5 15.0-18.0	3.8 3.5-4.5	6.7 6.5-7.0	7.0 6.2-7.5	Prolate spher.	19.5 18.5-21.2	17.7 16.2-18.2	"	1.5 1.2-1.8	1 : 3.6	Medium
<i>A. indica</i> Linn. Rao 9768; Assam.	"	15.6 15.0-16.2	4.4 3.8-5.0	6.8 6.2-7.5	6.1 5.5-6.5	"	17.9 17.5-18.7	16.4 16.2-17.5	"	1.2 1.1-1.4	1 : 3.6	"
<i>A. indica</i> Linn. Wadhwa & Vohra 445; Kashmir.	"	15.6 15.0-16.2	3.3 2.5-4.5	6.6 5.5-8.0	5.4 5.0-6.2	Sub- prolate	20.2 18.7-21.2	15.6 15.0-16.2	"	1.5 1.2-1.8	1 : 3.1	"
<i>A. indica</i> Linn. Sebastine 1185; Coimbatore Dist.	"	15.6 15.0-17.5	3.0 2.5-3.5	6.3 6.2-6.5	6.3 6.2-6.5	"	18.7 17.5-20.0	15.0 13.5-16.2	"	1.3 1.2-1.7	1 : 3.4	"
<i>A. indica</i> Linn. Gamble 117526; Madras.	"	17.4 16.2-18.7	3.5 3.2-4.0	6.9 6.2-7.5	8.3 7.5-10.0	"	21.4 20.0-23.7	18.6 17.5-20.0	"	1.2 —	1 : 4	"
<i>A. indica</i> Linn. Rolla 102850; Western Circle.	"	15.3 15.0-16.2	3.3 3.2-3.5	6.4 5.5-7.0	6.0 5.5-6.5	"	18.5 17.5-20.0	15.4 13.8-17.0	"	1.2 —	1 : 3.3	"
<i>A. nyikensis</i> Baker CAL 117639; Africa.	" (asyn., syn. or parasyn.)	11.0 10.5-12.0	2.5 2.0-3.0	5.4 5.0-6.0	8.6 8.2-10	Sub- oblate	15.1 14.5-16.2	17.7 17.5-18.0	"	1.2 —	1 : 8	Very small

Abbreviations : asyn. asyncolpate; b. breadth; CAL. Central National Herbarium, Calcutta; E. equatorial axis; l. length; P. polar axis; parasyn. parasyncolpate; ret. reticulate; spher. spheroidal; syn. syncolpate.

It is interesting to note that the basic pollen morphological characters, i.e. number and nature of apertures and the exine pattern in *Aeschynomene aspera* Linn., collected from two widely separated localities, 24 Parganas (West Bengal) and Kallandari (South India), do not show any dissimilarity. However, the size of the pollen grains, colpi and pores show considerable differences. Pollen grains of West Bengal specimen (*Sengupta* 305) are larger in size (average $26.8 \times 23.3 \mu$; range $25.0-28.2 \times 22.5-24.0 \mu$), whereas, that of South Indian specimen (*Subramanyam* 4348) are comparatively small (average $23.4 \times 20.4 \mu$; range $21.2-25.2 \times 20-21.2 \mu$). The polar field in the former specimen is very small, while in the latter one it is small (Table I).

Similarly, various specimens of *Aeschynomene indica* Linn., collected from different localities, do not show appreciable difference and the measure-

ments are found to be overlapping amongst themselves. However, the pollen grains from Madras specimen (*Gamble* 11509) have the largest size (average $21.4 \times 18.6 \mu$; range $20-23.7 \times 17.5-20.0 \mu$). The shape of the pollen grain from Assam (*Rao* 9768) and (CAL 17619) is prolate spheroidal, whereas, the rest of the specimens have subprolate grains. The exine pattern, in almost all the specimens, is distinctly reticulate, except that of Kashmir specimen (*Wadhwa & Vohra* 445), where it varies from faintly reticulate to distinctly reticulate.

Further, *A. indica* Linn. specimens from Assam (*Rao* 9768) and Kashmir (*Wadhwa & Vohra* 445) possess lolongate ora; from Coimbatore (*Sebastine* 1185) and Poona (*Rolla* 102850) they are $\pm$ circular, whereas, in other specimen (Madras; *Gamble* 11509) it is lalongate.

The variation in the morphological characters, observed here, does not show any effect of plant

distribution on the pollen morphology. Because no definite set of variation is restricted to the pollen of a particular locality or zone.

Pollen grains of *Aeschynomene nyikensis* Baker show a great deal of variation in apertural character. Percentages, based on 500 random pollen grains, show that 9.3% grains are asyncolpate, 82.6% syncolpate and 8.1% parasyncolpate. Further, within the syncolpate grains, syncolpate condition at both the poles is present in 77.41% grains, while in the rest of the 22.59% grains it is present at one of the poles. As a whole, syncolpate grains outnumber other types.

Eurypalyny and evolutionary significance: Eurypalyny or the occurrence of different types of pollen grains within family, genus, or species is indicative of unnatural assemblages, whereas, stenopalyny is indicative of natural assemblage. The apertural differences in the species of *Aeschynomene* Linn., studied here, are so wide that it is rather difficult to justify their inclusion in the same genus. However, this investigation is based on a very limited number of species and the phenomenon of eurypalyny within the genus cannot be ruled out.

In recent years, as reviewed earlier (Sharma, 1967), an attempt has been made by various workers to elucidate the evolutionary significance of various pollen morphological characters. Based on these various schools of thought, it appears that aperturally genus *Aeschynomene* Linn., having colporate grain, is quite advanced.

The occurrence of syncolpate, asyncolpate or parasyncolpate condition in *A. nyikensis* Baker, with many variations within the single specimen,

is an interesting phenomenon. It appears that apertural evolution is still in progression, probably heading towards parasyncolpate or spiraperturate condition—another advanced stage.

Pollen grains with spiraperturate, alternate pores and colpi and diorate apertures have been considered to be most advanced, as they appeared late in the geological history (Vishnu-Mittre, 1964). The occurrence of 3-colpate, diorate condition in the pollen grains of *Aeschynomene aspera* Linn., a member of Leguminosae-Papilionatae, may be considered most advanced amongst the Leguminosae.

ACKNOWLEDGEMENTS

The author records his gratitude to the authorities of the Botanical Survey of India, for providing valuable polliniferous material and research facilities. He is also indebted to Dr. Vishnu-Mittre, Head of the Quaternary Palaeobotany, Birbal Sahni Institute of Palaeobotany, Lucknow for going through the manuscript.

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