
Pollen Flora of the Indian Desert : Scrophulariaceae with Reference to Systematic Position of Genus *Striga*

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ABSTRACT

Scrophulariaceae are eurypalynous. 16 taxa reported from Indian Desert have been investigated. Artificial key for the identification of the taxa studied is provided. Pollen morphology of *Striga*, its parasitic mode of nutrition together with different embryological features justify its divergent nature from the other Scrophulaceous taxa.

INTRODUCTION

The great Indian desert lies between 24⁰47' and 30⁰10' latitude and 69⁰30' and 76⁰05' longitude with an area about 1,96,150, sq. kms. Physiographically it is a part of Saharo-Thar Desert. Most of the area consists of dry undulating plain of hardened sand and remaining region is largely a rolling plain of loose sand dunes. The Ganganagar, Hanumangarh, Bikaner and a part of the Churn district are being irrigated by Gang Canal, Bhakra Canal and Indira Gandhi Canal drawing water from the Punjab rivers.

The Importance of pollen morphology as an expression of the geographical distribution, genomal constitution, taxonomy and evolution of plants has been demonstrated in recent years. The Indian desert covers nearly 11 percent of the total area of India. But the information concerning the pollen morphology of Indian desert region is scanty.

Observations on the pollen morphology of plants belonging to Indian Scrophulariaceae in relation to plant taxonomy has been previously made by Varghese (1968) and Nair (1970). In the present study the pollen morphology of 16 species of Scrophulariaceae, occurring in the Indian desert is described (Table-1) and systematic position of the genus *Striga* is discussed.

MATERIALS AND METHOD

The pollen slides have been prepared by the method given by Erdtman (1952,1960). The observations are based on both acetolysed and unacetolysed pollen.

OBSERVATION

POLLEN 3-ZONOCOLPATE

Mazus pumilus (Burm.f.) Steenis (Text fig. 8)

Pollen grains 3-Zonocolpate, Oblate (24.8 x 33.6 μm , range 23.2- 26.3 x 32.5-35.6 μm in AC; 17x 26.3 μm , range 18.6-21.7 x 24.8-27,9 μm in UAC) Amb triangular. Colpus 27.9 x 1.5 μm . Exine thickness 1.5 μm , areolate. Mesocolpium 19.3 μm , apocolpium 8.6 μm .

Sopubia delphinifolia (Linn.) G. Don (Text fig. 17)

Pollen grain 3-Zonocolpate, Prolate(42 x 32 μm , range 40-45 x 30-35 μm in AC) Amb circular. Exine thickness 2 μm , Psilate, ectoexine as thck as endoexinc.

POLLEN 4-ZONOCOLPATE

Striga angustifolia (D.Don) Said. (Text fig.11)

Pollen grain 4-Zonocolpate, Prolate-spheroidal (21.5 x 21.7 μm range 20.1-23.2 x 20.1-23.2 μm in Ac; 21.3 x 17.8 μm , range 20.1 - 21.7 x 17-18.6 μm in UAC). Amb almost circular. Colpus 11.5 x 1.7 μm . Exine thickness 1.5 μm , granulate. Mesocolpium 12.4 μm .

Striga gesnerioides (Willd.)Vatke (Text fig. 10)

Pollen grain 4-Zonocolpate, Oblate-spheroidal (13.5 x 14.4 μm , range 12.4-13.9 x 12.4-15.5 μm in Ac; 16.2 x 18.2 μm range 15.5-17 x 15.5-23.2 μm in UAC). Amb circular. Exine Granulate, exine very thin. Mesocolpium 6.8 μm .

POLLEN 3-ZONOCOLPORATE

Anticharis glandulosa Asch. var. *caerulea* Blatt. et Hallb. (Text fig.4)

Pollen grain 3-Zonocolporate, Subprolate ($28 \times 22 \mu\text{m}$, range $26-30 \times 20-25 \mu\text{m}$ in AC). Amb circular, Exine thickness $1.5 \mu\text{m}$, psilate, ectoexine as thick as endoexine. Aperture diameter $1.5 \mu\text{m}$.

Anticharis senegalensis (Walp.) Bhandari (Text fig.3)

Pollen grain 3-Zonocolporate, Suboblate ($18.7 \times 23.4 \mu\text{m}$, range $15.5-20.1 \times 20.1-24.8 \mu\text{m}$ in AC). Amb fossaperturate. Colpus $18.8 \times 4.6 \mu\text{m}$. Exine thickness $1.5 \mu\text{m}$, granulate, exine bulbous at margins of colpi. Endocolpium $3.5 \mu\text{m}$, mesocolpium $11.8 \mu\text{m}$, endocolpium circular.

Antirrhinum majus Linn. (Text fig. 2)

Pollen grain 3-Zonocolporate, subprolate ($25 \times 21 \mu\text{m}$ range $22-28 \times 19-24 \mu\text{m}$ in AC; $20.5 \times 18 \mu\text{m}$, range $19.5-21.5 \times 17.5-19 \mu\text{m}$ in UAC). Amb triangular. Colpus $19.5 \times 3 \mu\text{m}$. Exine thickness $1.5 \mu\text{m}$. foveolate, ectoexine as thick as endoexine. Apocolpium $6 \mu\text{m}$, mesocolpium $11 \mu\text{m}$, endocolpium $4 \times 7.5 \mu\text{m}$ and endocolpium lalongate.

Antirrhinum orontium Linn. (Text fig. 1)

Pollen grain 3-Zonocolporate, subprolate ($21.5 \times 16.5 \mu\text{m}$, range $19.5-22.5 \times 15-18 \mu\text{m}$ in AC; $21.7 \times 24.4 \mu\text{m}$, range $20.1-23.2 \times 21.7-27.9 \mu\text{m}$ in UAC). Amb triangular. Colpus $26.9 \times 2.7 \mu\text{m}$. Exine thickness $1.5 \mu\text{m}$, areolate. Apocolpium $5.8 \mu\text{m}$ and mesocolpium $8 \mu\text{m}$.

Bacopa monnieri (Linn.) Wettstein (Text fig. 5)

Pollen grain 3-Zonocolporate, Suboblate ($22.9 \times 31.6 \mu\text{m}$, range $21.7-24.8 \times 29.4-34.1 \mu\text{m}$ in AC; $21.7 \times 24.4 \mu\text{m}$, range $20.1-23.2 \times 21.7-27.9 \mu\text{m}$ in UAC). Amb triangular. Colpus $26.9 \times 2.7 \mu\text{m}$. Exine thickness $1.5 \mu\text{m}$, areolate. Apocolpium $5.8 \mu\text{m}$ and mesocolpium $8 \mu\text{m}$.

Lindenbergia muraria (Roxb.) P. Bruchl (Text fig. 7)

Pollen grain 3-Zonocolporate, Prolate-spheroidal ($8.4 \times 7.5 \mu\text{m}$, range $7.7-9.3 \times 6.2-9.3 \mu\text{m}$ in AC; $10.3 \times 9.4 \mu\text{m}$, range $7.7-12.4 \times 6.2-10.8 \mu\text{m}$ in UAC). Amb almost circular. Exine reticulate. Apocolpium $3, 4 \mu\text{m}$ and Mesocolpium $7.1 \mu\text{m}$.

Lindernia parviflora (Roxb.) Haines (Text fig. 6)

Pollen grain 3-Zonocolporate, Prolate ($15.3 \times 10.2 \mu\text{m}$, range $12.5-18.3 \times 8.6-12.4 \mu\text{m}$ in AC). Amb circular. Colpus $8.3 \times 2.4 \mu\text{m}$. Exine thickness $1.6 \mu\text{m}$, reticulate.

Russelia coccinea Wetts. (slide no. 29, Text fig. 9)

Pollen grain 3-Zonocolporate, Prolate ($20 \times 15 \mu\text{m}$ range $17-24 \times 12-18 \mu\text{m}$ in AC; $18 \times 14 \mu\text{m}$, range $16-20 \times 13-15 \mu\text{m}$ in UAC). Amb almost circular. Colpus $17 \times 2 \mu\text{m}$. Exine thickness $1.5 \mu\text{m}$. psilate. Apocolpium $3\mu\text{m}$, Mesocolpium $10\mu\text{m}$, endocolpium $4 \mu\text{m}$ and endocolpium circular.

Verbascum chinense (Linn.) Santapau (Text fig. 14 & 15)

Pollen grain 3-Zonocolporate, Prolate spheroidal ($27 \times 24 \mu\text{m}$, range $25.5-28.5 \times 21-27 \mu\text{m}$ in AC; $25.5 \times 21 \mu\text{m}$, range $24-26.5 \times 20-22 \mu\text{m}$ in UAC). Amb almost circular. Colpus $22 \times 3 \mu\text{m}$. Exine thickness $2 \mu\text{m}$, reticulate. Apocolpium $5 \mu\text{m}$, mesocolpium $15\mu\text{m}$, endocolpium $4 \mu\text{m}$ and endocolpium circular.

Verbascum thapsus Linn. (Text fig. 12 & 13)

Pollen grain 3-Zonocolporate, Subprolate ($29 \times 22.5 \mu\text{m}$, range $25.5-31.5 \times 21-25 \mu\text{m}$ in AC; $24 \times 20 \mu\text{m}$, range $21-25.5 \times 19-22 \mu\text{m}$ in UAC). Amb almost circular. Colpus $23 \times 3 \mu\text{m}$. Exine thickness $2 \mu\text{m}$, faintly reticulate. Apocolpium $5 \mu\text{m}$, mesocolpium $13 \mu\text{m}$, endocolpium $3 \mu\text{m}$ and endocolpium circular.

Veronica agrestis Linn. (Text fig. 18)

Pollen grain 3-Zonocolporate, Subprolate ($29 \times 22.5 \mu\text{m}$, range $25.5-32 \times 21.5-25.5\mu\text{m}$ in AC; $24 \times 20.5 \mu\text{m}$, range $20-25.5 \times 20-22\mu\text{m}$ in UAC). Amb almost circular. Colpus $25 \times 3 \mu\text{m}$. Exine thickness $2.5\mu\text{m}$, faintly reticulate. Apocolpium $5 \mu\text{m}$, mesocolpium $16\mu\text{m}$, endocolpium $4 \mu\text{m}$ and endocolpium circular.

Veronica anagallis-aquatica Linn. (Text fig. 16)

Pollen grain 3-Zonocolporate, Subprolate ($36 \times 30 \mu\text{m}$, range $33-38 \times 28.5-31.5 \mu\text{m}$ in AC; $28 \times 25 \mu\text{m}$, range $25-30 \times 23-26 \mu\text{m}$ in UAC). Amb almost circular. Colpus $28 \times 3 \mu\text{m}$. Exine thickness $2 \mu\text{m}$, reticulate. Mesocolpium $17 \mu\text{m}$, endocolpium $6 \mu\text{m}$ and endocolpium circular.

DISCUSSION

On the basis of pollen apertural characters. 3-zonocolpate condition is investigated in *Mazus pumilus* and *Sopubia delphinifolia*, 4-zonocolpate in two species of *Striga* and 3-zonocolporate in 12 species of Scrophulariaceae. The taxa with 4-zonocolpate pollen are identified on the basis of pollen shape prolate-spheroidal in *Striga angustifolia* and oblate-spheroidal in *Striga gesnerioides*. The taxa with 3-zonocolporate pollen are classified on the basis of pollen shape, size, Amb, endocolpium, and exine ornamentation.

KEY TO THE SPECIES:

- | | | |
|------------------|--------------------------|--------------------------------|
| I. | Pollen 3-zonocolpate | : A |
| A ₁ . | Grain oblate | : <i>Mazys pumilus</i> |
| A ₂ . | Grain prolate | : <i>Sopubia delphinifolia</i> |
| II. | Pollen 4-zonocolpate | : B |
| B ₁ . | Grain prolate-spheroidal | : <i>Striga angustifolia</i> |
| B ₂ . | Grain oblate-spheroidal | : <i>Striga gesnerioides</i> |

III	Pollen 3-zonocolporate	: C
C ₁ .	Grain prolate	: D
D ₁ .	Exine psilate	: <i>Russelia coccinea</i>
D ₂ .	Exine reticulate	: <i>Lindernia parviflora</i>
C ₂ .	Grain prolate-spheroidal	: E
E ₁ .	Pollen size 7.5 x 8.4 μ.m	: <i>Lindenbergia muraria</i>
E ₂ .	Pollen size 27 x 24 μm	: <i>Verbascum chinense</i>
C ₃ .	Grain suboblate	: F
F ₁ .	Amb triangular	: <i>Bacopa monnieri</i>
F ₂ .	Amb fossaperturate	: <i>Anticharis senegalensis</i>
C ₄ .	Grain subprolate	: G
G ₁ .	Exine foveolate	: <i>Antirrhinum majus</i>
G ₂ .	Exine granulate	: <i>Antirrhinum orontitum</i>
G ₃ .	Exine reticulate	: H
H ₁ .	Pollen size 29 x 22.5 μm	: <i>Verbascum thapsus</i>
H ₂ .	Pollen size 36 x 30 μm	: <i>Veronica anagallis-aquatica</i>
G ₄ .	Exine faintly reticulate	: <i>Veronica agrestis</i>
G ₅ .	Exine psilate	: <i>Anticharis glandulosa</i>

SYSTEMATIC POSITION OF STRIGA:

Although a close relationship of Scrophulariaceae to Orobanchaceae has been long recognised (Glisic, 1929), Maheshwari (1963) cites this affinity as one of the noteworthy examples for the value of embryology to taxonomy. Tiagi (1956, 1967) investigated *Striga euphrasioides* and *S. orobancheoides* and observed that the mode of development of the endosperm in these Scrophulariaceae is essentially like that in Orobanchaceae. In addition, *Striga* differ from Scrophulariaceae and resembles Orobanchaceae in : extent of curvature in the female gametophyte, form of micropylar and chalzal haustoria., ongrad type of embryogeny and structure of seed (Johri, 1984).

Tiagi (1963) concluded that Orobanchaceae are derived from the subfamily Rhinanthoideae of Scrophulariaceae and Maheshwari accordingly regarded the matter as settled. This position is supported by the work of Nagendran et al. (1980b) on *Striga densiflora*. They showed that there is consistency and uniformity in development of female gametophyte and endosperm among the species of *Striga*. Teriokhin (1980) finds similarities in the major embryological features within Orobanchaceae, support the conclusion of the Tiagi (1963) and Maheshwari (1963).

Pollen morphologically the species of *Striga* investigated, i.e. *S. angustifolia*, *S. gesnerioides* and *S. hermonthica* (Erdtman 1952) are essentially different from Scrophulariaceae and Orobanchaceae. In *Striga* pollen are 4-zonocolpate, in Scrophulariaceae 3-zonocolporate and in Orobanchaceae 3-zonocolpate.

So pollen morphology of *Striga*, its parasitic mode of nutrition together with different embryological features mentioned above, justify its divergent nature from other Scrophulaceous taxa.

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Table – 1

TAXA	APERTURE	SHAPE	Amb	Size (AC) (μm)	E.T. (μm)	E.O.
<i>Majus pumilus</i>	3- zonocolpate	Oblate	Triangular	24.8×33.6	1.5	Areolate
<i>Sopubia delphinifolia</i>	3- zonocolpate	Prolate	Circular	42×32	2	Psilate
<i>Striga angustifolia</i>	4- zonocolpate	Prolate- spheroidal	Circular	21.5×21.7	1.5	Granulate
<i>Striga gesnerioides</i>	4- zonocolpate	Olbate- spheroidal	Circular	13.5×14.4	---	Granulate
<i>Anticharis glandulosa</i>	3- zonocolpate	Subprolate	Circular	28×22	1.5	Psilate
<i>Anticharis senegalensis</i>	3- zonocolpate	Subprolate	Fossaperture	18.7×23.4	1.5	Granulate
<i>Antirrhinum majus</i>	3- zonocolpate	Subprolate	Triangular	25×21	1.5	Foveolate
<i>Antirrhinum orontium</i>	3- zonocolpate	Subprolate	Circular	21.5×16.5	---	Granulate
<i>Bacopa monnieri</i>	3- zonocolpate	Subprolate	Triangular	22.9×31.6	1.5	Areolate
<i>Lindenbergia muraria</i>	3- zonocolpate	Prolate- spheroidal	Circular	8.4×7.5	---	Reticulate
<i>Lindernia parviflora</i>	3- zonocolpate	Prolate	Circular	15.3×10.2	1.6	Reticulate
<i>Russelia coccinea</i>	3- zonocolpate	Prolate	Circular	20×15	1.5	Psilate
<i>Verbascum chinense</i>	3- zonocolpate	Prolate- spheroidal	Circular	27×24	2.0	Reticulate
<i>Verbascum thapsus</i>	3- zonocolpate	spheroidal	Circular	29×22.5	2.0	Reticulate
<i>Veronica agrestis</i>	3- zonocolpate	spheroidal	Circular	29×22.5	2.5	Faintly Reticulate
<i>Veronica angallis-aquatica</i>	3- zonocolpate	spheroidal	Circular	36×30	2.0	Reticulate

Test Fig. : 1 *Antirrhinum orontium* Equatorial view (1500X)

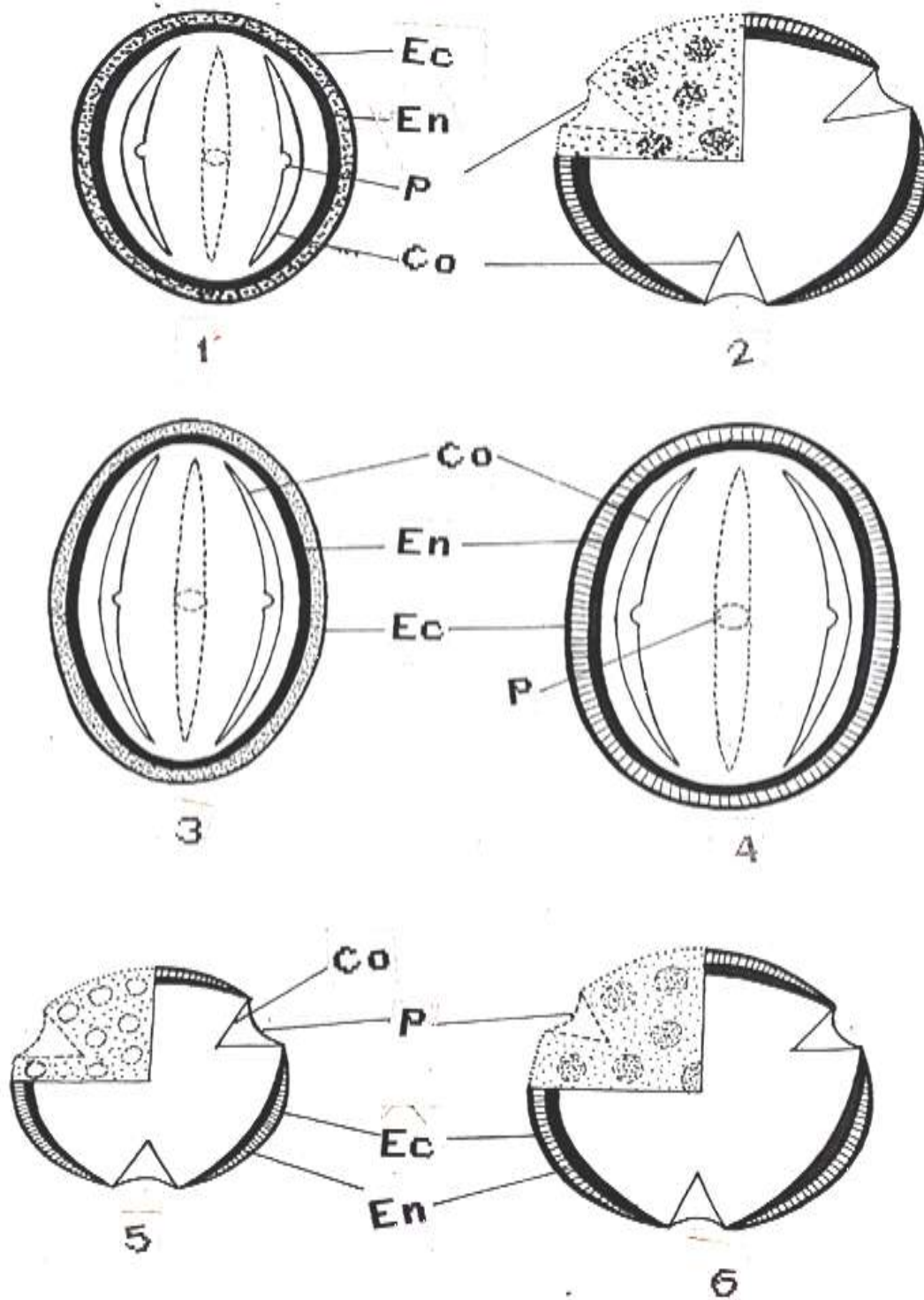
Test Fig. : 2 *Antirrhinum majus* Polar view (1500X)

Text Fig. : 3 *Anticharis senegalensis* Equatorial view (1500X)

Text Fig. : 4 *Anticharis glandulosa* Equatorial view (1500 X)

Text Fig. : 5 *Bacopa monnieri* Polar view (600 X)

Text Fig. : 6 *Lindernia parviflora* Polar view (1500 X)



Test Fig. : 7 *Lindenbergia muraria* Equatorial view (1500X)

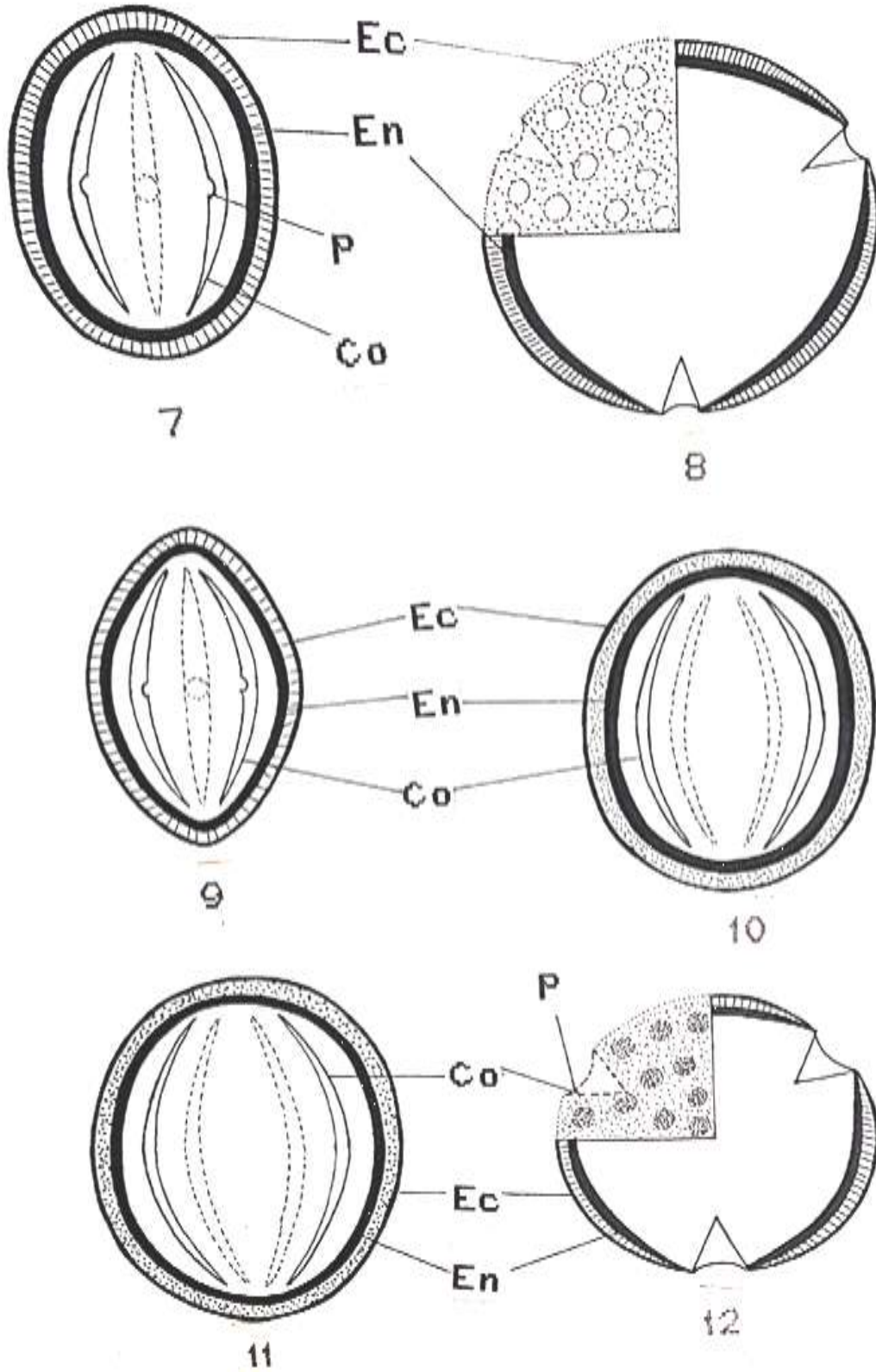
Test Fig. : 8 *Majus pumilus* Polar view (1500X)

Text Fig. : 9 *Russelia coccinea* Equatorial view (1500X)

Text Fig. : 10 *Striga gesnerioides* Equatorial view (1500 X)

Text Fig. : 11 *Striga angustifolia* Euatorial view (600 X)

Text Fig. : 12 *Verbascum Thapsus* Polar view (1500 X)



Test Fig. : 13 *Verbascum Thapsus* Equatorial view (1500X)

Test Fig. : 14 *Verbascum Chinense* Equatorial view (1500X)

Text Fig. : 15 *Verbascum Chinense* Polar view (1500X)

Text Fig. : 16 *Veronica anagallis-aquatica* Equatorial view (1500 X)

Text Fig. : 17 *Sopubia delphiniifolia* Polar view (1500 X)

Text Fig. : 18 *Veronica agrestis* Equatorial view (1500 X)

