

## POLLEN MORPHOLOGY OF EBENUS L. (LEGUMINOSAE: SUBFAMILY PAPILIONOIDEAE) IN TURKEY

N.M. PINAR, C. YURAL\* AND Z. AYTAC\*

\*Department of Biology,

Faculty of Science, Ankara University, 06100, Ankara Turkey.

### Abstract

Pollen grains of 12 species and 3 varieties of the genus *Ebenus* L., (Leguminosae: subfamily papilionoideae) have been examined using light microscopy (LM) and scanning electron microscopy (SEM). Pollen description of each taxon has been given. Pollen grains of *Ebenus* L. species examined are radially symmetrical, isopolar, tricolporate, prolate rarely perprolate. Their ornamentations are reticulate. The exine structure are similar, ektexine thicker than endexine. The pollen morphology seems to be very similar to each other.

### Introduction

*Leguminosae* in the flora of Turkey is the second largest family on the basis of species diversity after *Compositae* (Davis, 1988). The genus *Ebenus* L., has 20 species in the world of which 14 are endemic in Turkey. The genus *Ebenus* in Turkey has 14 species, 3 varieties with a total of 17 taxa where 9 taxa are Irano-Turanian and 8 taxa are East Mediterranean (Davis, 1970).

Pollen morphology of *Ebenus* has received little attention. Perveen & Qaiser (1998) studied *Ebenus stellata* Boiss., under the LM and SEM and made a comparison between other pollen morphology of Leguminosae species. They defined 10 main pollen types for the family Leguminosae viz., *Alysicarpus monilifer* 1-type, *Astragalus affghanus* type, *Colutea armata* type, *Dumasia villosa* 1-type, *Ebenus stellata* type, *Onobrychis stewartii* type, *Rhynchosia minima* 1-type, *Securigera securidaca* type, *Taverniera lappacea* type and *Vigna trilobata* type. They placed *Ebenus stellata* Boiss., in the *E. stellata* type. The present report gives a detailed account of the pollen morphology of Turkish *Ebenus* species by light and electron microscopy.

### Materials and Methods

Polliniferous material was taken from Gazi University Herbarium (GAZI) collected by Z. Aytac. For LM study, the pollen slides were prepared according to the technique of Wodehouse (1935). An Olympus B2-2 microscope was used for examination.

For SEM study, dry pollen grains were transferred to stubs and coated with gold. A Jeol 100 CXII scanning electron microscope was used. The terminology used is mainly that Faegri & Iversen (1975).

\*Department of Biology, Faculty of Science, Gazi University, Ankara, Turkey.

## Results

### Pollen descriptions

#### *Ebenus plumosa* Boiss., & Ball. var. *plumosa* (Fig. 1a-c)

Pollen grains radially symmetrical, isopolar, tricolpate, prolate; 30.4  $\mu\text{m}$  in polar diameter, 16.2  $\mu\text{m}$  in equatorial diameter. AMB subcircular, 17.1  $\mu\text{m}$  in diameter. Ornamentation reticulate; with  $\pm$  irregular pattern of muri, luminae 0.1-0.45  $\mu\text{m}$  in diameter. The diameter of luminae is narrow to colpus. Exine 1  $\mu\text{m}$  thick. Ektexine thicker than endexine. Intine 0.5  $\mu\text{m}$  thick. The colpus long, ends acute and margin even; membrane sub-psilate, operculate. Apocolpium 1.3  $\mu\text{m}$  in diameter.

#### *E. plumosa* var. *speciosa* Hub. Mor.

Pollen grains radially symmetrical, isopolar, tricolpate, prolate; 33.5  $\mu\text{m}$  in polar diameter, 18.7  $\mu\text{m}$  in equatorial diameter. AMB subcircular; 19.6  $\mu\text{m}$  in diameter.

Ornamentation reticulate; with  $\pm$  irregular pattern of muri, luminae 0.1-0.35  $\mu\text{m}$  in diameter. The diameter of luminae is narrow to colpus. Exine 1  $\mu\text{m}$  thick. Ektexine thicker than endexine. Intine 0.5  $\mu\text{m}$  thick. The colpus long, ends acute and margin even; membrane sub-psilate, operculate. Apocolpium 1.3  $\mu\text{m}$  in diameter.

#### *E. macrophylla* Jaub & Spach (Fig. 2a)

Pollen grains radially symmetrical, isopolar, tricolpate, prolate; 28.3  $\mu\text{m}$  in polar diameter, 16.8  $\mu\text{m}$  in equatorial diameter. AMB subcircular; 17.2  $\mu\text{m}$  in diameter. Ornamentation reticulate; with  $\pm$  irregular pattern of muri, luminae 0.1-0.3  $\mu\text{m}$  in length. The diameter of lumen is narrow to colpus. Exine 1  $\mu\text{m}$  thick. Ektexine thicker than endexine. Intine 0.5  $\mu\text{m}$  thick. The colpus long, ends acute and margin even; membrane sub-psilate, operculate. Apocolpium 3.8  $\mu\text{m}$  in diameter.

#### *E. barbigera* Boiss (Fig. 1d-f)

Pollen grains radially symmetrical, isopolar, tricolpate, prolate; 24.6  $\mu\text{m}$  in polar length, 17.3  $\mu\text{m}$  in equatorial diameter. AMB subcircular; 17.5  $\mu\text{m}$  in diameter. Ornamentation reticulate; with  $\pm$  irregular pattern of muri, luminae 0.1-0.3  $\mu\text{m}$  in diameter. The diameter of luminae is narrow to colpus. Exine 1  $\mu\text{m}$  thick. Ektexine thicker than endexine. Intine 0.5  $\mu\text{m}$  thick. The colpus long, ends acute and margin even; membrane sub-psilate, operculate. Apocolpium 1.7  $\mu\text{m}$  in diameter.

#### *E. reesei* Hub-Mor. var. *reesei* (Fig. 1i-k)

Pollen grains radially symmetrical, isopolar, tricolpate, prolate; 36.5  $\mu\text{m}$  in polar length, 16.3  $\mu\text{m}$  in equatorial diameter. AMB subcircular; 17.2  $\mu\text{m}$  in diameter. Ornamentation reticulate; with  $\pm$  irregular pattern of muri, luminae 0.03-0.25  $\mu\text{m}$  in diameter. The diameter of luminae is narrow to colpus. Exine 1  $\mu\text{m}$  thick. Ektexine thicker than endexine. Intine 0.5  $\mu\text{m}$  thick. The colpus long, ends acute and margin even; membrane sub-psilate, operculate. Apocolpium 2.8  $\mu\text{m}$  in diameter.

#### *E. reesei* Hub-Mor. var. *minor*

Pollen grains radially symmetrical, isopolar, tricolpate, prolate; 27.9  $\mu\text{m}$  in polar diameter, 18  $\mu\text{m}$  in equatorial diameter. AMB subcircular; 18.5  $\mu\text{m}$  in diameter. Ornamentation reticulate; with  $\pm$  irregular pattern of muri, luminae 0.1-0.4  $\mu\text{m}$  in diameter. The diameter of luminae is narrow to colpus. Exine 1  $\mu\text{m}$  thick. Ektexine thicker than endexine. Intine 0.5  $\mu\text{m}$  thick. The colpus long, ends acute and margin even; membrane sub-psilate, operculate. Apocolpium 3.5  $\mu\text{m}$  in diameter.

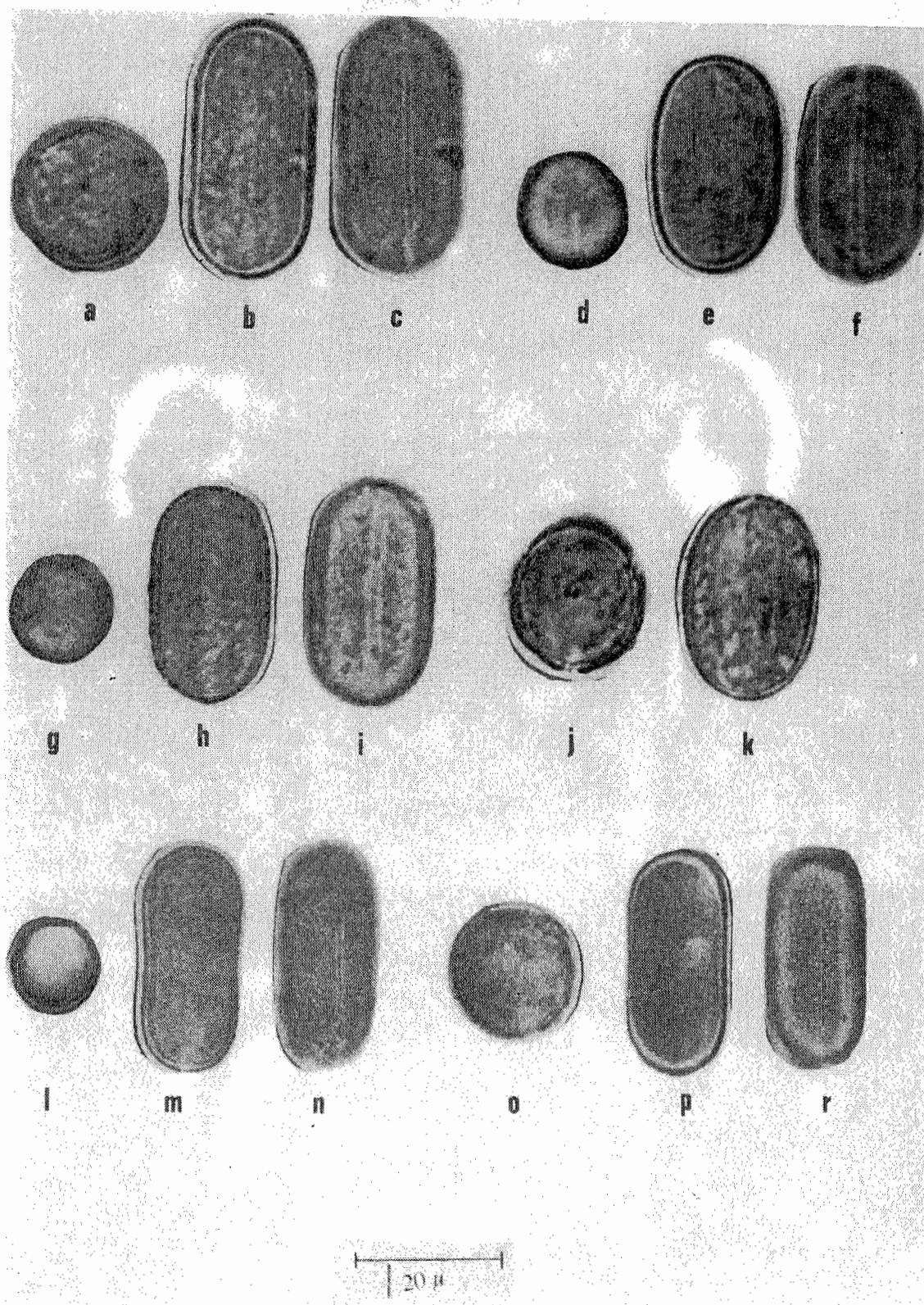


Fig. 1. Micrographs of pollen grains of *Ebenus* L., under light microscope X 1000. a, d, g, j, l, o. Optical equatorial view. b, e, h, k, m, p, optical meridional view. c, f, i, k, n, r. Optical meridional view showing aperture in profile. (a-c) *E. plumosa* var. *plumosa* (d-f) *E. barbigeria* (g-i) *E. bourgaei* (j-k) *E. cappadocica* (l-n) *E. boissieri* (o-r) *E. laguroides* var. *cilica*.

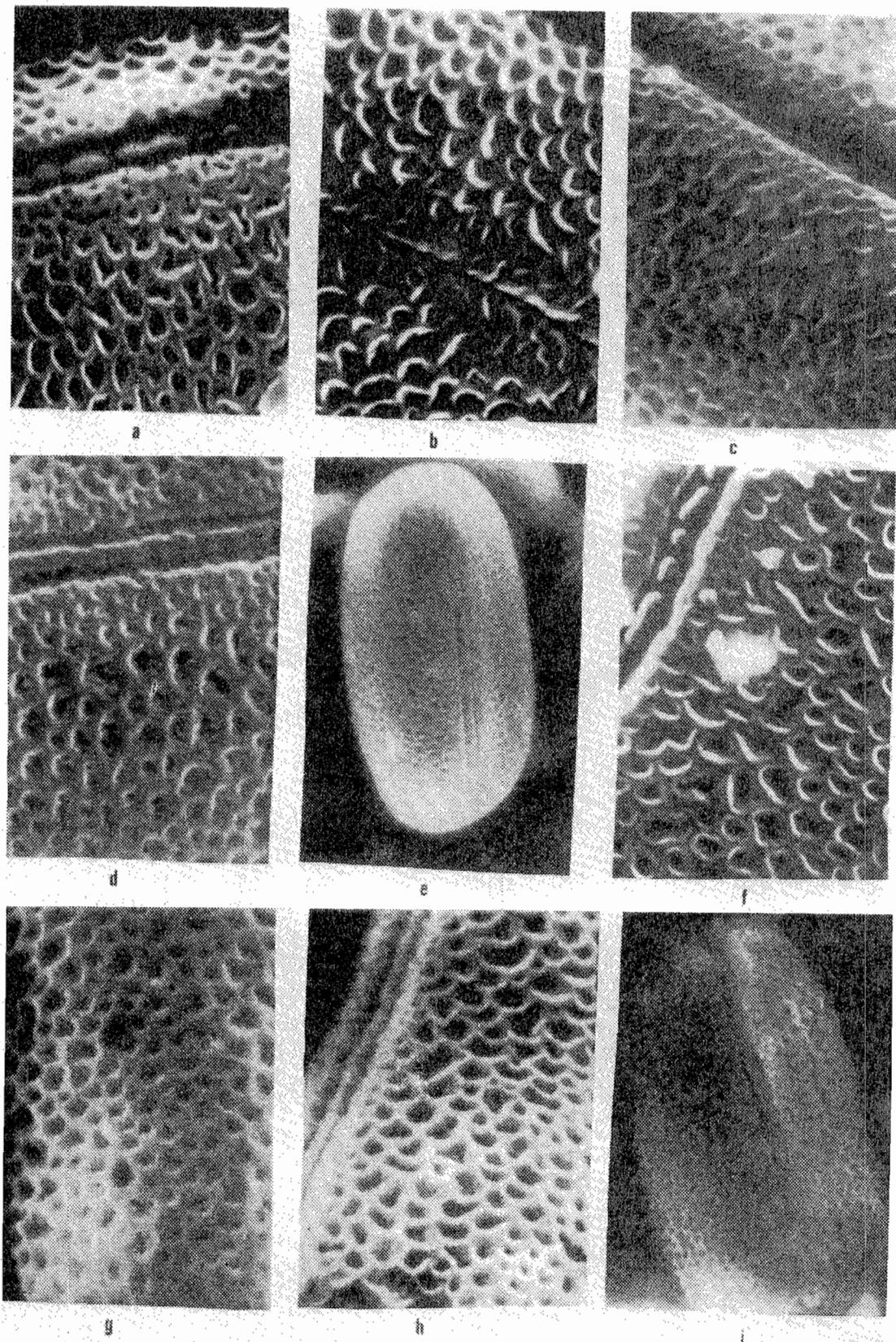


Fig. 2. Scanning electron micrographs of pollen grains. a. *E. macrophylla*: exine pattern, SEM x 10.000; b. *E. bourgaei*: exine pattern, SEM x 10.000; c. *E. cappadocicaria*: exine pattern, SEM x 10.000; d. *E. boissieri*: exine pattern, SEM x 10.000; e. *E. boissieri*: equatorial view, SEM x 3.000; f. *E. hirsuta*: exine pattern, SEM x 10.000; g. *E. laguroides* var. *laguroides*: exine pattern, SEM x 8.000; h. *E. laguroides* var. *cilicia*: exine pattern, SEM x 10.000; i. *E. pisidica*: equatorial view, SEM x 3.000

***E. haussneckthii* Bornm. eq Hub.-Mor.**

Pollen grains radially symmetrical, isopolar, tricolpate, prolate; 29.1  $\mu\text{m}$  in polar diameter, 17.7  $\mu\text{m}$  in equatorial diameter. AMB subcircular, 18.4  $\mu\text{m}$ . Ornamentation reticulate; with  $\pm$  irregular pattern of muri, luminae 0.05-0.25  $\mu\text{m}$  in diameter. The diameter of luminae is narrow to colpus. Exine 1  $\mu\text{m}$  thick. Ektexine thicker than endexine. Intine 0.5  $\mu\text{m}$  thick. The colpus long, ends acute and margin even; membrane sub-psilate, operculate. Apocolpium 3.1  $\mu\text{m}$  in diameter.

***E. degrassa* Boiss & Bal**

Pollen grains radially symmetrical, isopolar, tricolpate, prolate; 27.8  $\mu\text{m}$  in polar length, 17.2  $\mu\text{m}$  in equatorial diameter. AMB subcircular; 18.7  $\mu\text{m}$ . Ornamentation reticulate; with  $\pm$  irregular pattern of muri, luminae 0.1-0.5  $\mu\text{m}$  in diameter. The diameter of luminae is narrow to colpus. Exine 1  $\mu\text{m}$  thick. Ektexine thicker than endexine. Intine 0.5  $\mu\text{m}$  thick. The colpus long, ends acute and margin even; membrane sub-psilate, operculate. Apocolpium 2.3  $\mu\text{m}$  in diameter.

***E. bourgaei* Boiss. (Fig. 1g-i, 2b)**

Pollen grains radially symmetrical, isopolar, tricolpate, prolate; 28.8  $\mu\text{m}$  in polar length, 16.8  $\mu\text{m}$  in equatorial diameter. AMB subcircular; 18.7  $\mu\text{m}$ . Ornamentation reticulate; with  $\pm$  irregular pattern of muri, luminae 0.15-0.45  $\mu\text{m}$  in diameter. The diameter of luminae is narrow to colpus. Exine 1  $\mu\text{m}$  thick. Ektexine thicker than endexine. Intine 0.5  $\mu\text{m}$  thick. The colpus long, ends acute and margin even; membrane sub-psilate, operculate. Apocolpium 3.6  $\mu\text{m}$  in diameter.

***E. cappadocica* Hauss. & Siehe (Fig. 1j-k, 2c)**

Pollen grains radially symmetrical, isopolar, tricolpate, prolate; 25.2  $\mu\text{m}$  in polar length, 17.8  $\mu\text{m}$  in equatorial diameter. AMB subcircular; 19  $\mu\text{m}$ . Ornamentation reticulate; with  $\pm$  irregular pattern of muri, luminae 0.05-0.25  $\mu\text{m}$  in diameter. The diameter of luminae is narrow to colpus. Exine 1  $\mu\text{m}$  thick. Ektexine thicker than endexine. Intine 0.5  $\mu\text{m}$  thick. The colpus long, ends acute and margin even; membrane sub-psilate, operculate. Apocolpium 2.3  $\mu\text{m}$  in diameter.

***E. boissieri* Barbey (Fig. 1l-n, 2e)**

Pollen grains radially symmetrical, isopolar, tricolpate, prolate; 35.8  $\mu\text{m}$  in polar length, 17.7  $\mu\text{m}$  in equatorial diameter. AMB subcircular; 16.8  $\mu\text{m}$ . Ornamentation reticulate; with  $\pm$  irregular pattern of muri, luminae 0.1-0.35  $\mu\text{m}$  in diameter. The diameter of luminae is narrow to colpus. Exine 1  $\mu\text{m}$  thick. Ektexine thicker than endexine. Intine 0.5  $\mu\text{m}$  thick. The colpus long, ends acute and margin even; membrane sub-psilate, operculate. Apocolpium 3.9  $\mu\text{m}$  in diameter.

***E. hirsuta* Jaub. & Spach (Fig. 2f)**

Pollen grains radially symmetrical, isopolar, tricolpate, prolate; 30.3  $\mu\text{m}$  in polar length, 17.7  $\mu\text{m}$  in equatorial diameter. AMB subcircular; 18.3  $\mu\text{m}$ . Ornamentation reticulate; with  $\pm$  irregular pattern of muri, luminae 0.1-0.45  $\mu\text{m}$  in diameter. The diameter of luminae is narrow to colpus. Exine 1  $\mu\text{m}$  thick. Ektexine thicker than endexine. Intine 0.5  $\mu\text{m}$  thick. The colpus long, ends acute and margin even; membrane sub-psilate, operculate. Apocolpium 0.66  $\mu\text{m}$  in diameter.

### *E. laguroides* Boiss. var. (Fig. 2g)

Pollen grains radially symmetrical, isopolar, tricolpate, prolate; 31.8  $\mu\text{m}$  in polar length, 18.8  $\mu\text{m}$  in equatorial diameter. AMB subcircular; 18.3  $\mu\text{m}$ . Ornamentation reticulate; with  $\pm$  irregular pattern of muri, luminae 0.05-0.4  $\mu\text{m}$  in diameter. The diameter of luminae is narrow to colpus. Exine 1  $\mu\text{m}$  thick. Ektexine thicker than endexine. Intine 0.5  $\mu\text{m}$  thick. The colpus long, ends acute and margin even; membrane sub-psilate, operculate. Apocolpium 0.9  $\mu\text{m}$  in diameter.

### *E. laguroides* (Boiss.) Bornm. var. *cilicica* (Fig. 1o-r, 2h)

Pollen grains radially symmetrical, isopolar, tricolpate, prolate; 28.8  $\mu\text{m}$  in polar length, 16.7  $\mu\text{m}$  in equatorial diameter. AMB subcircular; 17.4  $\mu\text{m}$ . Ornamentation reticulate; with  $\pm$  irregular pattern of muri, luminae 0.05-0.2  $\mu\text{m}$  in diameter. The diameter of luminae is narrow to colpus. Exine 1  $\mu\text{m}$  thick. Ektexine thicker than endexine. Intine 0.5  $\mu\text{m}$  thick. The colpus long, ends acute and margin even; membrane sub-psilate, operculate. Apocolpium 3.8  $\mu\text{m}$  in diameter.

### *E. pisidica* Hub-Mor. (Fig. 2i)

Pollen grains radially symmetrical, isopolar, tricolpate, prolate; 32.1  $\mu\text{m}$  in polar length, 18.8  $\mu\text{m}$  in equatorial diameter. AMB subcircular; 19.2  $\mu\text{m}$ . Ornamentation reticulate; with  $\pm$  irregular pattern of muri, luminae 0.1-0.4  $\mu\text{m}$  in diameter. The diameter of luminae is narrow to colpus. Exine 1  $\mu\text{m}$  thick. Ektexine thicker than endexine. Intine 0.5  $\mu\text{m}$  thick. The colpus long, ends acute and margin even; membrane sub-psilate, operculate. Apocolpium 3.2  $\mu\text{m}$  in diameter.

## Discussion

Pollen grains of *Ebenus* L. species examined are radially symmetrical, isopolar and tricolpate. The shape is commonly prolate or less commonly to perprolate. Only *E. boissieri* has a perprolate pollen shape and by this peculiarity, it can be easily separated from other species. Colpal membrane sub-psilate. The ektexine is thicker than endexine. A reticulate tectum type is common (Table 1). The delimitation of this genus on the basis of pollen characters is difficult.

This study has revealed that the species of *Ebenus* should be placed in the *Ebenus stellata* type of Parveen & Qaiser (1998) on the basis of their colpate, with prolate pollen shape. *Ebenus* species are also similar to *Onobrychis stewartii*-type (tricolpate grains with a reticulate tectum). *O. stewartii*-type is recognized by its preprolate P/E ratio from *Ebenus*. Only *E. boissieri* has preprolate pollen shape. *E. boissieri* should therefore be placed in the *O. stewartii* type.

The *Ebenus* genus has colpate peculiarity according to Guinet & Ferguson (1989) where in the Leguminosae family phylogenetic diagram it is shown as advanced character. All the taxa of the genus *Ebenus* which were examined appear to be very similar.

Table 1. Summary of pollen morphology of *Ebenus* L. the values are in  $\mu\text{m}$ .

Taksonlar Name of taxa	Equatorial diameter	Polar diameter	Pollen shape	L*	T**	Exine	Intine	Ornamentation	Lumen diameter
<i>E. plumosa</i> var. <i>plumosa</i>	16.2	30.4	Prolate	17.1	2.9	1	0.5	reticulate	0.23
<i>E. plumosa</i> var. <i>speciosa</i>	18.7	33.5	Prolate	19.6	1.3	1	0.5	reticulate	0.28
<i>E. macrophylla</i>	16.8	28.3	Prolate	17.2	3.8	1	0.5	reticulate	0.2
<i>E. burbigeru</i>	17.3	24.6	Prolate	17.5	1.7	1	0.5	reticulate	0.2
<i>E. reesei</i> var. <i>reesei</i>	16.3	26.5	Prolate	17.2	2.8	1	0.5	reticulate	0.13
<i>E. reesei</i> var. <i>minor</i>	18	27.9	Prolate	18.5	3.5	1	0.5	reticulate	0.25
<i>E. hausknechii</i>	17.7	29.1	Prolate	18.4	3.1	1	0.5	reticulate	0.15
<i>E. depressa</i>	17.2	27.8	Prolate	18.7	2.3	1	0.5	reticulate	0.3
<i>E. bourgaei</i>	16.8	28.8	Prolate	16.5	3.6	1	0.5	reticulate	0.29
<i>E. cappadocica</i>	17.8	25.2	Prolate	19	2.3	1	0.5	reticulate	0.15
<i>E. boissieri</i>	15.7	35.8	Preprolate	16.8	3.9	1	0.5	reticulate	0.28
<i>E. hirsuta</i>	17.7	30.3	Prolate	18.3	0.66	1	0.5	reticulate	0.23
<i>E. laguroides</i> var. <i>laguroides</i>	18.8	31.8	Prolate	18.3	3.47	1	0.5	reticulate	0.23
<i>E. laguroides</i> var. <i>ciliata</i>	16.7	32.6	Prolate	17.4	3.7	1	0.5	reticulate	0.20
<i>E. psicidica</i>	18.8	32.1	Prolate	19.2	3.2	1	0.5	reticulate	0.25

\*L = AMB diameter

\*\* = Apocolpium diameter

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