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POLLEN FLORA OF KASTAMONU UNIVERSITY CAMPUS I: BRASSICACEAE

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ABSTRACT. Plants used in this study were collected from Kastamonu University campus and its surrounding in Turkey. Samples prepared according to Wodehouse (1935) technique, and they were examined by light microscopy to study the characteristic of pollen grains. Pollen grains of studied taxa observed as isopolar, radially symmetric with tricolpate aperture and prolate-spheroidal, subprolate and prolate pollen shape. Polar axis range between 15.30-43.53 µm while equatorial axis between 13.48-29.09 µm. *Alyssum strigosum* pollen measured as biggest pollen while *Strigosella africana* pollen is the smallest. Pollen surface ornamentation determined as reticulate. Exine thickness and intine thickness were varied between 0.4-2.3 µm, 0.1-0.9 µm, respectively. The characters like as polar axis, equatorial axis, pollen shape, pollen surface ornamentation, intine and exine thickness determined as important features for systematics of taxa.

1. INTRODUCTION

Brassicaceae is a cosmopolitan family, occurring mainly in north temperate zone particularly in Mediterranean region. The family Brassicaceae is distributed worldwide across all continents except for Antarctica. It consists of 51 tribes, about 338 genera, and 3709 species. The Brassicaceae is easily distinguished from other flowering plant families with floral and fruit morphology by the cruciform corolla, tetradynamous stamens, and a siliqua often with a septum.

Turkey is one of the richest countries in the world in terms of the number of species of the Brassicaceae. The family present 571 species, 65 subspecies, 24 varieties and 660 taxa belonging to 91 genera is approximately [1-5].

Studying various biological aspects of pollen grains has contributed to the development of multiple scientific fields. The shape of pollen grains varies both among the genera but vary rarely among the species within the same genus. Pollen morphology has provided an approach to the systematic relationships among the genera of the Brassicaceae. Pollen grains of Brassicaceae usually radially symmetrical, isopolar, sub-prolate or prolate to prolate-spheroidal, rarely oblate-

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spheroidal, tricolpate often 4-8 colpate. Sexine thinner or thicker than nexine. Tectum fine to coarse reticulate or reticulate-rugulate [6-9].

Many researchers have emphasized the importance of pollen morphology for the Brassicaceae family [10]. Pollen morphology of some taxa belong to Brassicaceae i.e.; *Asyneuma canescens* [11], *Hesperis* [12], *Isatis* [13], *Rorippa* [14], *Barbarea* [15], *Arabis* [16], *Aethionema* [17-19], *Malcolmia* [20], *Crambe* [21] and *Noccaeae aghrica* [22] distributed in Turkey were studied in detail.

The objective of this study was to examine the pollen morphology 15 species belong to Brassicaceae and to determine the contributions of pollen morphology to taxonomy of the family.

2. Material And Method

2.1. Plant specimens

Plants used in this study were collected from Kastamonu University campus and its surrounding in Turkey.

Plants species
Alliaria petiolata (M.Bieb.) Cavara & Grande
Alyssum desertorum Stapf
Alyssum strigosum Banks & Sol.
Arabis alpina L. subsp. *alpina*
Camelina rumelica Velen.
Capsella bursa-pastoris (L.) Medik.
Descurainia sophia (L.) Webb ex Prantl.
Draba verna L.
Iberis simplex DC.
Lepidium draba L.
Strigosella africana (L.) Botsch.
Microthlaspi perfoliatum (L.) F.K.Mey
Raphanus raphanistrum L.
Rapistrum rugosum (L.) All.
Thlaspi arvense L.

2.2. Pollen analysis

Pollen samples prepared according to Wodehouse [23] method and they were examined by light microscopy. For each pollen characteristic measurement taken from 20 different pollen grain [24].

Terminology was adopted from Faegri and Iversen [25], Punt et al. [26], Hesse et al. [27], Pınar et al. [12], and shape classification follows that of Erdtman [28] based on P/E ratio in Table 1.

3. Results And Discussion

3.1. *Alliaria petiolata*

Pollen shape is prolate-spheroidal with 23.07-26.30 µm polar axis and 19.07-24.61 µm equatorial axis. Exine thickness is between 0.92-2.27 µm. Intine thickness is between 0.30-0.76 µm. Colpus is long with acute ends and clear margins (Clg 15.15-21.96 µm, Clt 2.73-4.70 µm). Ornamentation is reticulate. (Figure 1 (1-4), Table 1).

3.2. *Alyssum desertorum*

Pollen shape is prolate with the 24.09-34.09 µm polar axis and 14.09-21.21 µm equatorial axis. Exine thickness is between 0.76-1.36 µm. Intine thickness is between 0.30-0.76 µm. Colpus is long with acute ends and clear margins (Clg 18.48-29.09 µm, Clt 1.06-3.03 µm). Ornamentation is reticulate. (Figure 1 (5-8), Table 1).

3.3. *Alyssum strigosum*

Pollen shape is prolate with 35.75-43.53 µm polar axis and 21.53-26.51 µm equatorial axis. Exine thickness is between 0.91-1.82 µm. Intine thickness is between 0.30-0.91 µm. Colpus is long with acute ends and clear margins (Clg 26.66-44.90 µm, Clt 1.36-3.74 µm). Ornamentation is reticulate. (Figure 1 (9-12), Table 1).

3.4. *Arabis alpine* subsp. *Alpine*

Pollen shape is prolate-spheroidal with 21.06-25.23 µm polar axis and 19.24-26.06 µm equatorial axis. Exine thickness is between 0.91-1.82 µm. Intine thickness is

between 0.30-0.61 µm. Colpus is long with acute ends and clear margins (Clg 15.00-21.96 µm, Clt 2.42-4.70 µm). Ornamentation is reticulate. (Figure 1(13-16), Table 1).

3.5. *Camelina rumelica*

Pollen shape is oblate-spheroidal with 21.66-25.60 µm polar axis and 20.00-25.15 µm equatorial axis. Exine thickness is between 1.06-1.67 µm. Intine thickness is between 0.15-0.45 µm. Colpus is long with acute ends and clear margins (Clg 14.84-21.06 µm, Clt 2.27-6.00 µm). Ornamentation is reticulate. (Figure 1 (17-20), Table 1).

3.6. *Capsella bursa-pastoris*

Pollen shape is subprolate with 18.48-25.30 µm polar axis and 13.48-23.63 µm equatorial axis. Exine thickness is between 0.76-1.06 µm. Intine thickness is between 0.15-0.76 µm. Colpus is long with acute ends and clear margins (Clg 15.75-18.93 µm, Clt 1.82-4.39 µm). Ornamentation is reticulate. (Figure 2 (1-4), Table 1).

3.7. *Descurainia Sophia*

Pollen shape is prolate-spheroidal with 15.30-18.88 µm polar axis and 14.09-17.57 µm equatorial axis. Exine thickness is between 0.45-1.21 µm. Intine thickness is between 0.15-0.30 µm. Colpus is long with acute ends and clear margins (Clg 10.60-12.72 µm, Clt 1.82-3.18 µm). Ornamentation is always reticulate. (Figure 2 (5-8), Table 1).

3.8. *Iberis simplex*

Pollen shape is prolate-spheroidal with 21.66-28.03 µm polar axis and 20.90-25.15 µm equatorial axis. Exine thickness is between 1.21-1.67 µm. Intine thickness is between 0.30-0.61 µm. Colpus is long with acute ends and clear margins (Clg 20.30-21.80 µm, Clt 2.12-2.88 µm). Ornamentation is always reticulate. (Figure 2 (13-16), Table 1).

3.9. *Lepidium draba*

Pollen shape is prolate-spheroidal with 18.48-23.48 µm polar axis and 17.72-21.51 µm equatorial axis. Exine thickness is between 0.91-1.67 µm. Intine thickness is

between 0.15-0.76 µm. Colpus is long with acute ends and clear margins (Clg 13.18-17.87 µm, Clt 1.36-3.18 µm). Ornamentation is reticulate. (Figure 2 (17-20), Table 1).

3.10. *Strigosella Africana*

Pollen shape is prolate-spheroidal with 16.06-18.03 µm polar axis and 15.45-18.08 µm equatorial axis. Exine thickness is between 0.45-1.06 µm. Intine thickness is between 0.15-0.76 µm. Colpus is long with acute ends and clear margins (Clg 11.06-14.24 µm, Clt 1.36-2.57 µm). Ornamentation is reticulate. (Figure 3 (1-4), Table 1).

3.11. *Microthlaspi perfoliatum*

Pollen shape is prolate-spheroidal with the 18.63-21.66 µm polar axis and 18.33-20.30 µm equatorial axis. Exine thickness is between 0.76-1.67 µm. Intine thickness is between 0.15-0.61 µm. Colpus is long with acute ends and clear margins (Clg 13.63-15.90 µm, Clt 1.51-5.61 µm). Ornamentation is reticulate. (Figure 3 (5-8), Table 1).

3.12. *Raphanus raphanistrum*

Pollen shape is prolate-spheroidal with the 25.60-32.27 µm polar axis and 23.78-29.09 µm equatorial axis. Exine thickness is between 1.21-1.82 µm. Intine thickness is between 0.15-0.45 µm. Colpus is long with acute ends and clear margins (Clg 20.75-28.03 µm, Clt 2.27-4.70 µm). Ornamentation is reticulate. (Figure 3 (9-12), Table 1).

3.13. *Rapistrum rugosum*

Pollen shape is prolate-spheroidal with 23.18-29.84 µm polar axis and 21.36-28.18 µm equatorial axis. Exine thickness is between 1.06-1.97 µm. Intine thickness is between 0.15-0.61 µm. Colpus is long with acute ends and clear margins (Clg 18.18-22.42 µm, Clt 1.97-3.64 µm).Ornamentation is reticulate. (Figure 3 (13-16), Table 1).

3.14. *Thlaspi arvense*

Pollen shape is prolate-spheroidal with 18.78-24.24 µm polar axis and 18.63-22.57 µm equatorial axis. Exine thickness is between 0.91-1.67 µm. Intine thickness is between 0.15-0.76 µm. Colpus is long with acute ends and clear margins (Clg 15.45-19.24 µm, Clt 1.36-3.03 µm). Ornamentation is reticulate. (Figure 3 (17-20), Table 1).

3.15. *Draba verna*

Pollen shape is prolate-spheroidal with 23.48-30.30 µm polar axis and 21.06-26.96 µm equatorial axis. Exine thickness is between 1.21-1.97 µm. Intine thickness is between 0.15-0.76 µm. Colpus is long with acute ends and clear margins (Clg 17,57-25,15 µm, Clt 1.97-2.27 µm). Ornamentation is reticulate. (Figure 2 (9-12), Table 1).

Pollen grains of studied taxa observed as isopolar, radially symmetric with tricolpate aperture and prolate-spheroidal, subprolate and prolate pollen shape. Polar axis range between 15.30-43.53 µm while equatorial axis between 13.48-29.09 µm. *Alyssum strigosum* pollen measured as biggest pollen while *Strigosella africana* pollen is the smallest. Pollen surface ornamentation determined as reticulate. Exine thickness and intine thickness were varied between 0.4-2.3 µm, 0.1-0.9 µm, respectively.

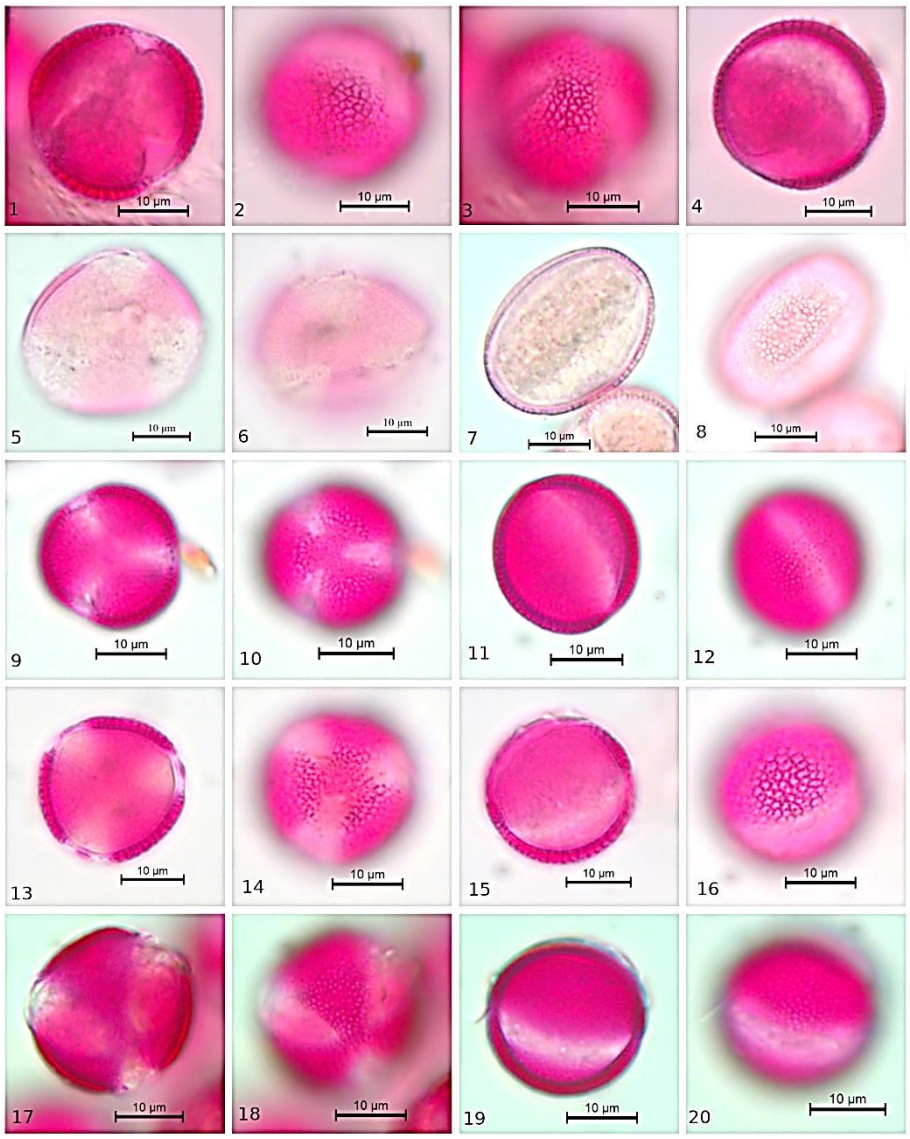

FIGURE 1. Pollen microphotograph of taxa of Brassicaceae, 1-4: *Alliaria petiolate*, 5-8: *Alyssum desertorum,* 9-12: *Alyssum strigosum,* 13-16: *Arabis alpina* subsp. *alpine*, 17-20: *Camelina rumelica.*

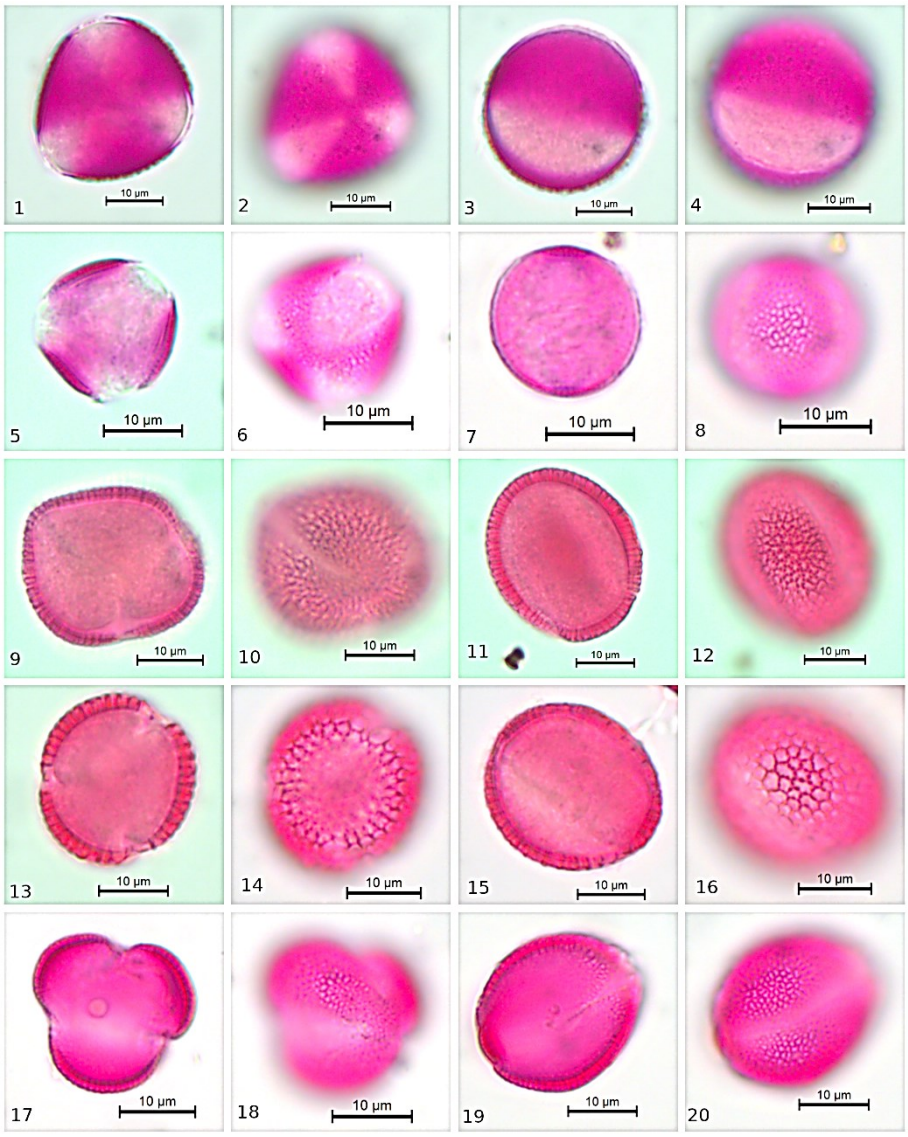

FIGURE 2. Pollen microphotograph of taxa of Brassicaceae, 1-4: *Capsella bursa-pastoris*, 5-8: *Descurainia sophia,* 9-12: *Draba verna,* 13-16: *Iberis simplex,* 17-20: *Lepidium draba*

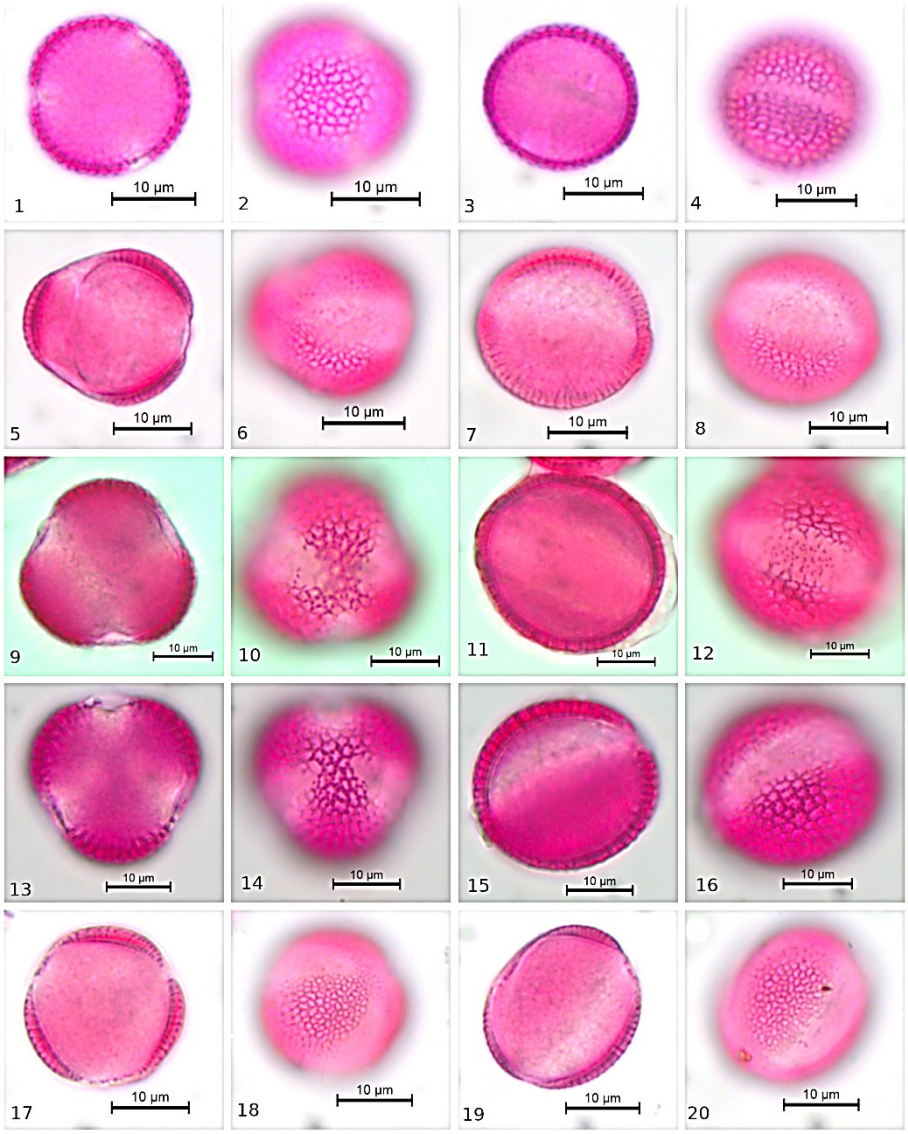

FIGURE 3. Pollen microphotograph of taxa of Brassicaceae, 1-4: *Strigosella africana*, 5-8: *Microthlaspi perfoliatum,* 9-12: *Raphanus raphanistrum,* 13-16: *Rapistrum rugosum,* 17-20: *Thlaspi arvense.*

TABLE 1. Pollen morphological features of studied Brassicaceae taxa (value in µm).

Species	Polar axis (P)			Equatorial axis (E)			P/E	Colpus length (Clg)			Colpus width (Clt)			Shape	Exine thickness	Intine	Surface
	min	mean	max	min	mea	max	mean	min	mean	max	min	mean	max				
Alliaria petiolata	23.1	24.7	26.3	19.1	21.8	24.6	1.13	15.1	18.5	21.9	2.73	3.71	4.70	Prolate-spheroidal	1.59	0.53	Reticulate
Alyssum desertorum	24.0	29.0	34.0	14.0	17.6	21.2	1.64	18.5	23.8	29.1	1.06	2.04	3.03	Prolate	1.06	0.35	Reticulate
Alyssum strigosum	35.7	39.6	43.5	21.5	24.0	26.5	1.65	26.7	35.8	44.9	1.36	2.55	3.74	Prolate	1.36	0.60	Reticulate
Arabis alpine subsp.	21.1	23.1	25.2	19.2	22.6	26.1	1.02	15.0	18.4	21.9	2.42	3.56	4.70	Prolate-spheroidal	1.36	0.45	Reticulate
Camelina rumelica	21.7	23.6	25.6	20.0	22.5	25.1	1.04	14.8	17.9	21.1	2.27	4.13	6.00	Oblate-spheroidal	1.36	0.30	Reticulate
Capsella bursa-pastoris	18.5	21.9	25.3	13.5	18.5	23.6	1.18	15.7	17.3	18.9	1.82	3.10	4.39	subprolate	0.90	0.45	Reticulate
Descurainia sophia	15.3	17.1	18.9	14.1	15.8	17.6	1.08	10.6	11.6	12.7	1.82	2.50	3.18	Prolate-spheroidal	0.83	0.22	Reticulate
Iberis simplex	21.7	24.8	28.0	20.9	23.0	25.1	1.07	20.3	21.0	21.8	2.12	2.50	2.88	Prolate-spheroidal	1.34	0.45	Reticulate
Lepidium draba	18.5	21.0	23.5	17.7	19.6	21.5	1.07	13.2	15.5	17.9	1.36	2.27	3.18	Prolate-spheroidal	1.28	0.45	Reticulate
Strigosella africana	16.0	17.0	18.0	15.4	16.7	18.0	1.01	11.1	12.6	14.2	1.36	1.96	2.57	Prolate-spheroidal	0.75	0.45	Reticulate
Microthlaspi perfoliatum	18.6	20.1	21.7	18.3	19.3	20.3	1.04	13.6	14.7	15.9	1.51	3.56	5.61	Prolate-spheroidal	1.21	0.37	Reticulate
Raphanus raphanistrum	25.6	28.9	32.3	23.8	26.4	29.1	1.09	20.7	24.3	28.0	2.27	3.48	4.70	Prolate-spheroidal	1.51	0.30	Reticulate
Rapistrum rugosum	23.2	26.5	29.9	21.4	24.8	28.2	1.06	18.2	20.3	22.4	1.97	2.80	3.64	Prolate-spheroidal	1.51	0.37	Reticulate
Thlaspi arvense	18.8	21.5	24.2	18.6	20.6	22.6	1.04	15.4	17.3	19.2	1.36	2.19	3.03	Prolate-spheroidal	1.28	0.45	Reticulate
Draba verna	23.5	26.90	30.3	21.1	24.0	26.9	1.12	17,2	21.1	25,1	1.97	2.12	2.27	Prolate-spheroidal	1.59	0.45	Reticulate

The characters like as polar axis, equatorial axis, pollen shape, pollen surface ornamentation, intine and exine thickness determined as important features for systematics of taxa.

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