

A comparative analysis on pollen morphology of the genus *Brassica* L. (Brassicaceae) in Bangladesh

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Abstract

Brassica L. is one of the major agronomical valued genus with divergent oilseed crops and vegetables; belonging to the Brassicaceae family. The aim of the present analysis is to assess the pollen morphology of *Brassica* L. varieties viz. Tori-7, BARI Sarisha-6, BARI Sarisha-7, BARI Sarisha-10, BARI Sarisha-12 and BARI Sarisha-15 from Bangladesh by using light microscope. According to this analysis, the pollen grains of analyzed varieties are mostly prolate or subprolate, tricolpate, radially symmetrical with reticulate ornamented exine that furnishes an important source to get the systematic relationships of *Brassica* L.

Keywords: pollen grains, *Brassica* L., pollen morphology, light microscope

1. Introduction

The family Brassicaceae is represented by 12-15 tribes with 338 genera and 3709 species; of which 12 genera and 24 species are found in Bangladesh [33, 2]. Though it is distributed worldwide but its major distribution centers are Mediterranean, Irano-Turanian and Saharo-Sindian territories [16, 20]. Among these divergent genera, *Brassica* L. is considered as economically valued genus which covers diverse form of crops- vegetables, oilseed and condiments; a good source of vitamins, minerals, fibers, phytochemical contents, and bioactive compounds.

For being an edible oil source, *Brassica* L. categorized as 3rd in the rank followed by soybean and palm oil in the world [5]. Due to the appearance of linoleic acid (omega 3 fatty acid) and alpha linoleic acid (omega 6 fatty acid) in *Brassica* L. it is healthier for human as edible oil [23]. The oil meal of *Brassica* L. which is the by-product of oil extraction acts as a high-protein animal feed. Moreover, this genus is not only well-known as oilseed crop but also have medicinal value as anti-scurvy, diuretic and anti-inflammatory of bladder [35]. *Brassica* L. contributes a major role in human and animal nutrition as a better source of vitamins A, B₁₋₂, C, E, K and minerals i.e. calcium, iron and magnesium [34]. Generally, high-tolerance ability against heavy metals is found in some members of *Brassica* L. [8].

Pollen morphology can be considering as one of the prime inquiry guidelines to identify plant in the course of palynological investigations, evolution and environmental restoring activities [17, 21, 22, 26]. For distinct reproductive stages i.e. dispersal, pollination, fertilization and germination, the morphological characteristics of pollen are regarded as discriminatory apparatus [32]. Moreover, considered characters of pollen morphology may furnish a viewpoint to reveal the relationship among the genera and species [5, 25].

A numerous analyses of pollen morphology have been implemented to different species and taxa of Brassicaceae family in preference to Bangladesh by Erdtman *et al.* [11],

Chigurieva [7], Carter *et al.* [8], Perveen *et al.* [27], Pinar *et al.* [28], Arora and Modi [4], Keshavarzi *et al.* [18], Mutlu and Erik [24], Sharma and Singh [31] and Gabr [14]. Therefore, the current analysis has been proceeded towards detect the morphological characteristics of pollen grain of analyzed *Brassica* L. varieties from Bangladesh by light microscope which provides sufficient details to know systematic relationships of this genus.

2. Materials and Methods

2.1. Plant materials

The six BARI (Bangladesh Agricultural Research Institute) varieties of *Brassica* L. (Table 1, Figure 1) were selected to assess the present analysis due to their commercial values and easy availability in Bangladesh. At first seeds of the analyzed varieties were collected from Oilseed Research Center of BARI and then maintained in the Botanical garden of Jagannath University, Dhaka, Bangladesh.



Fig 1: Flowers of six varieties of *Brassica* L.: A. *B. rapa*. Var. Tori-7; B. *B. rapa*. var. BARI Sarisha-6; C. *B. napus* var. BARI Sarisha-7; D. *B. juncea* var. BARI Sarisha-10; E. *B. rapa*. Var. BARI Sarisha-12; F. *B. rapa*. Var. BARI Sarisha-15.

Table 1: List of analyzed six varieties of *Brassica* L. from Bangladesh.

Serial no.	Species	Varieties
1.	<i>B. rapa</i>	Tori-7
2.	<i>B. rapa</i>	BARI Sarisha-6 (Dhali)
3.	<i>B. napus</i>	BARI Sarisha-7 (BS-7)
4.	<i>B. juncea</i>	BARI Sarisha-10 (BS-10)
5.	<i>B. rapa</i>	BARI Sarisha-12 (BS-12)
6.	<i>B. rapa</i>	BARI Sarisha-15 (BS-15)

2.2. Sample preparation

Fresh unopened buds of studied *Brassica* L. varieties were collected and preserved in 20% formaldehyde. Then pollen grains were dissected from anther under light microscope without any earlier treatment. Afterwards, the prepared pollen grains were observed under Optika light microscope with 100X magnification and micrographs were taken through Euromax camera.

2.3. Data analysis

For each studied sample, at least 10 number of pollen grains were considered for the measurements of pollen grains and done by using Image Focus 4 English software. The terminology of Erdtman^[12] and Abdel Khalik *et al.*^[1] was assumed to describe the morphology of pollen. Lastly, PAST: Paleontological Statistics Software^[15] (version 4.03) was used to construct dendrogram among the studied six varieties of *Brassica* L.

3. Results and Discussion

Pollen morphological characteristics viz. pollen size, shape, thickness and ornamentation of exine are considered as a functional implement to identify plant. In this conducting analysis, the pollen morphology of six analyzed *Brassica* L. was acquired by light microscope and summarized in the Table 2 and Figure 2.

In this conducting analysis, the range of polar axis (P) and equatorial axis (E) were from 13.08 μm to 33.90 μm and 10.93 μm to 29.47 μm in the studied varieties, respectively. The pollen grain of *Brassica napus* var. BARI Sarisha-7 with 13.08 μm polar axis and 10.93 μm equatorial axis were considered as smallest pollen whereas having 33.90 μm polar axis and 29.47 μm equatorial axis the pollen of *B. juncea* var. BARI Sarisha-10 was the biggest pollen in size. The ration of polar axis and equatorial axis was used as a parameter to identify the shape of the pollen grains according to Erdtman^[1]. Based on this P/E ratio, the pollen of three varieties of *B. rapa* i.e. Tori-7 (1.16), BS-6 (1.17), BS-12 (1.15) and *B. juncea* var. BS-10 (1.22) were sub-prolate as a consequence *B. napus* var. BS-7 (1.03) and *B. rapa* var. BS-15 (1.37) were prolate-spheroidal and prolate in shape. In case of exine thickness, the highest value was found in *B. rapa* var. BS-15 (2.02 μm) and *B. napus* var. BS-7 showed the lowest value (0.76 μm). Regarding the exine thickness, all the analyzed varieties were reticulate in exine ornamentation expect BS-15. Hence, the pollen grains of analyzed six *Brassica* L. varieties were radial symmetrical with tricolpate (Table 2, Figure 2).

Depending on the values of polar axis (P) and equatorial axis (E) of analyzed *Brassica* L. varieties a bidirectional scatter plot was established^[1]; where the values of P and E were placed on 'X-axis' and 'Y-axis', consequently (Figure 3). Regarding this P versus E graph, the pollen grains of

three varieties of *B. rapa* viz. Tori-7, BS-6, BS-12 and *B. juncea* var. BS-10 were sub-prolate in shape whereas *B. napus* var. BS-7 was prolate-spheroidal as all these values were positioned closely the 45°-line. Due to the faraway appearance of *B. rapa* var. BS-15 considering 45°-line position, it was prolate in shape.

A dendrogram was established among analyzed six *Brassica* L. varieties regarding the three morphological characteristics i.e. polar axis (p), equatorial axis (x) and exine thickness (Figure 4). At first all the six varieties of *Brassica* L. formed two clusters in which the first cluster consists of *B. napus* var. BS-7 and *B. juncea* var. BS-10 as they both showed relatively small sized pollen grains. Then the second cluster was sub-divided where *B. rapa* var. BS-12 was situated slight distantly from closely correlated varieties of *B. rapa* i.e. BS-15, BS-6 and Tori-7 as a reason the pollen grains of BS-12 was comparatively big in size than the remaining varieties of *B. rapa* (BS-15, BS-6 and Tori-7).

According to the conducted analysis, the pollen grains of *Brassica* L. could be grouped into three types considering the shape of pollen such as prolate-spheroidal, subprolate and prolate^[3, 13, 19, 30] with tricolpate and finely reticulate ornamented exine^[10, 29] but BARI Sarisha-15 showed coarsely reticulate exine ornamentation.

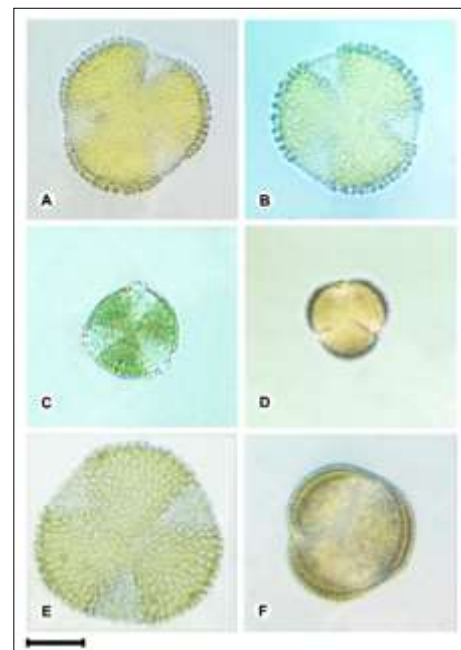


Fig 2: Pollen morphology of six varieties of *Brassica* L. by light microscope: A. *B. rapa*. Var. Tori-7; B. *B. rapa*. var. BARI Sarisha-6; C. *B. napus* var. BARI Sarisha-7; D. *B. juncea* var. BARI Sarisha-10; E. *B. rapa*. Var. BARI Sarisha-12; F. *B. rapa*. Var. BARI Sarisha-15; Bar= 10 μm .

Table 2: Pollen morphological character of analyzed six varieties of *Brassica* L.

Serial no.	Varieties	Polar axis (µm)	Equatorial axis (µm)	P/E	Exine thickness	Shape	Symmetry	Aperatures	Exine ornamentation
1.	Tori-7	28.68±1.27	23.91±0.19	1.16	1.64±0.14	Sub-prolate	Radial	Tricolpate	Reticulate
2.	BARI Sarisha-6	28.46±0.94	24.39±0.85	1.17	1.60±0.11	Sub-prolate	Radial	Tricolpate	Reticulate
3.	BARI Sarisha-7	16.17±0.67	15.75±0.41	1.03	0.76±0.09	Prolate-spheroidal	Radial	Tricolpate	Reticulate
4.	BARI Sarisha-10	13.08±0.52	10.93±0.48	1.22	1.23±0.15	Sub-prolate	Radial	Tricolpate	Reticulate
5.	BARI Sarisha-12	33.90±1.33	29.47±1.12	1.15	1.20±0.21	Sub-prolate	Radial	Tricolpate	Reticulate
6.	BARI Sarisha-15	26.62±1.06	19.30±0.87	1.37	2.02±0.23	Prolate	Radial	Tricolpate	Coarsely reticulate

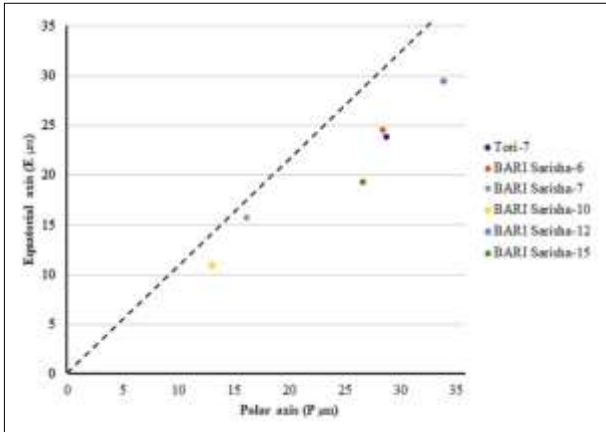


Fig 3: Polar axis (P) versus Equatorial axis (E) parameter of six studied varieties of *Brassica* L.

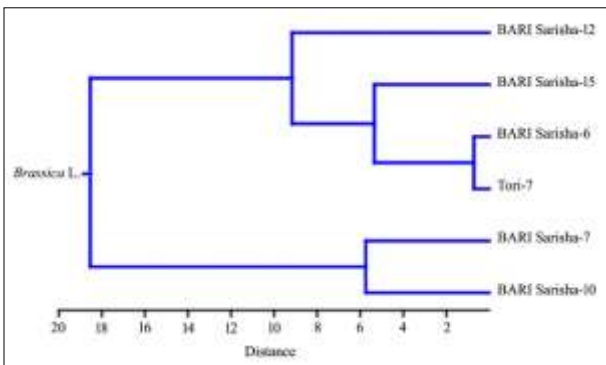


Fig 4: Dendrogram representing the interrelations among six analyzed varieties of *Brassica* L. based on three morphological characteristics of pollen: a) Polar axis, b) Equatorial axis, c) Exine thickness.

4. Conclusion

The observations coming from these six varieties of *Brassica* L. pointed out the presence of slight differences among their pollen morphology. On the whole, the present analysis emphasizes important details in terms of pollen morphology that can be regarded as a salient point to taxonomic grouping in addition to disclose the systematic relationship of *Brassica* L. in Bangladesh.

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6. References

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