Micromorphological Characters Of Seed Coat Sculpture For Some Species Of *Brassica* L. (Brassicaceae) In North Of Iraq

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**ABSTRACT**

Seed coat sculpture is a very important character for taxonomic studies. This research aimed to study seed coats between species for Brassica. The present study included seed coat morphology were studied for six species and three variety belong to the Brassica L. genus in the north of Iraq by Scanning electron microscope (SEM). The SEM photographs showed a difference in the seed coats of Brassica, a seed coat pattern in which six species and three variety belong to it reticulate in all species except two species, rugose in B.campestris and undulate – shallow undulate in B.deflexa. The present study demonstrated heterogeneous characteristics of outer epidermal cell shape between all species, Irregular cells in three species B.campestris, B.deflexa, and B.juncea, Polygonal cells just in B.oleracea var. botrytis, Polygonal-elongated cells in B.nigra. anticlinal wall isodiametric – polygonal cells in B.tournifortii and B.oleracea var. capitata, tetragonal – polygonal cells in B.rapa and tetragonal cell just in B.oleracea var. gongylode.

**Keywords:** Brassicaceae, Seed coat, seed sculpture, Scanning Electron Microscope, Brassica.

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**INTRODUCTION**

The Brassicaceae or mustard family is also considered one of the large family of flowering plants, as it is widespread all over the world except for the frozen continent as it consists of 39 tribes and about 321-500 genera of 2000-3660 species. In Iraq, it is represented by 80 genera and 90 wild species and 18 cultivated species for food and decoration purposes, spread at most in the temperate and cold regions of the north of Iraq [1]. The mustard family is distinguished by the flowers and fruits as it contains the cruciform corolla, tetradynamous stamens, and the presence of siliqua and siliqua fruits and content septum [2].

The genus *Brassica* L. is considered one of the most widespread in the world and the largest in the family of Brassicaceae. it includes 100-170 species of herbaceous annual, and perennial plants are spreads in Europe, Asia, and North Africa, while in Iraq the genus is represented by more than 18 species, the majority of its species are spread in central and northern Iraq [3]. The species of Brassica have economic significance because of their value as vegetables and oilseeds [4]. The morphological characters of fruits and seeds are used in the identification and classification of the family Brassicaceae. The seed coat sculpture has been used to solve phylogenetic and systematic problems between species and tribes [5].seed coat structure is considered to be stable characters and not affected by environmental conditions. several studies in the Brassicaceae on the seed coat and its taxonomic significance [6].studied the seed coat of *Brassica* in Iraq by using a light microscope (LM) but the studies about the seeds of the genus *Brassica* by SEM is rarely, therefore, the present study was conducted to present detailed seed coat characteristics of six *Brassica* species (*B.campestris, B.deflexa, B.juncea, B.nigra, B.rapa, and B.tournifortii*) and three tribes (*B.oleracea var. botrytis, B.oleracea var. capitata* and *B.oleracea var. gongylode*) occurring in the north of Iraq.

**MATERIALS AND METHODS**

Plant samples (seeds) were collected from a different area in the north of Iraq (Mosul, Irbil, Sulaimania, and Duhok) from April to July 2019. Plant samples were identified by Iraqi National Herbarium and other herbaria in Baghdad, Mosul University, and the identified samples were kept in the Department of Biology, College of Science, Tikrit University, Iraq. The seed was fixed in 5% glutaraldehyde buffered with 0.2 mol L⁻¹ phosphate for 5 h at room temperature. the seeds of all species for *Brassica* were dehydrated by graduated ethanol series and followed by mounting on stubs with double-sided adhesive tape. aluminum coating a few nanometers was applied using a coating machine (Q120R, H0.). examined on Quanta 400 Scanning electron microscope (SEM), made in hollands. SEM was operated at 25-30 kV with a working distance of 12 mm, high magnification was performed to capture the features of all the specimens. The surface was scanned for all species of *Brassica* [7].

**RESULTS**

The seed coat for 6 species and three varieties for *Brassica* L. genus belonging to the family Brassicaceae are summarized in table 1 and the image by SEM is represented in Figure 1.

**Seed coat sculpature**

The studied species were examined by scanning electron microscope showed five different types of seed coat pattern in which six species and three variety belong to it: 1-Reticulate with three subtypes: a-Regular reticulate seed coat pattern in all species except three species *B.campestris, B.deflexa, B.juncea*. Show Table 1 figure 1.
b- Irregular reticulate seed coat pattern in three species *B. campestris*, *B. deflexa*, and *B. juncea*.
c- Shallow reticulate in *B. juncea* and *B.oleracea var. botrytis*.
d- Reticulate -foveate in *B. nigra* and *B.oleracea var. capitata*.
e- reticulate-ocellate in *B. rapa*, and *B.tournifortii*.
2. Rugose in *B. campestris*.
3. Undulate - shallow undulate in *B. deflexa* , these result were correspond [8,9]

**Outer epidermal cell shape**
The present study demonstrated heterogeneous characteristics of outer epidermal cell shape between all species belonging to Brassica L genus as shown below:
1. Irregular cells in three species *B. campestris*, *B. deflexa*, and *B. juncea*.
2. Polygonal cells just in *B.oleracea var. botrytis*.
3. Polygonal-elongated cells in *B. nigra*; these result were correspond [10].
4. ls antical wall isodiametric - polygonal cells in *B.tournifortii* and *B.oleracea var. capitata*.
5. Tetragonal – polygonal cells in *B. rapa* and tetragonal cell just in *B.oleracea var. gongyloides*. Show Table 1 figure 1.

**antical wall**

**antical wall shape**
This research showed a clear discrepancy in the antical wall shape as shown below:

<table>
<thead>
<tr>
<th>Species</th>
<th>Seed coat pattern</th>
<th>Outer epidermal cell shape</th>
<th>Antical wall shape</th>
<th>Antical wall texture</th>
<th>Antical wall thickness</th>
<th>Antical wall level</th>
<th>Antical wall level</th>
<th>Antical wall texture</th>
<th>Antical wall thickness</th>
<th>Antical wall level</th>
<th>Antical wall level</th>
<th>Antical wall level</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>B. campestris</em></td>
<td>Rugose</td>
<td>Irregular cells</td>
<td>Folded</td>
<td>Thick</td>
<td>Shallow</td>
<td>Striate</td>
<td>Thin</td>
<td>Concave-convex</td>
<td></td>
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<tr>
<td><em>B. deflexa</em></td>
<td>Shallow undulat e</td>
<td>Irregular cells</td>
<td>Smooth</td>
<td>Thin</td>
<td>Shallow</td>
<td>Smooth</td>
<td>Thin</td>
<td>Flat</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>B. juncea</em></td>
<td>Shallow reticulat e</td>
<td>Irregular cells</td>
<td>Straight-undulat e</td>
<td>Striate</td>
<td>Thin</td>
<td>Shallow</td>
<td>Smooth</td>
<td>Thin</td>
<td>Flat-concave</td>
<td></td>
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<tr>
<td><em>B. nigra</em></td>
<td>Reticulate -foveate</td>
<td>Polygonal-elongated cells</td>
<td>Straight-undulat e</td>
<td>Pitted</td>
<td>Thick</td>
<td>Raised</td>
<td>Reticulat e</td>
<td>Thick</td>
<td>Concave</td>
<td></td>
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<tr>
<td><em>B. rapa</em></td>
<td>Reticulate -ocellate</td>
<td>Tetragonal - polygonal cells</td>
<td>Straight-undulat e</td>
<td>Striate-warty</td>
<td>Thick</td>
<td>Raised</td>
<td>Reticulat e</td>
<td>Thick</td>
<td>Concave</td>
<td></td>
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<tr>
<td><em>B. tournifortii</em></td>
<td>Reticulate -ocellate</td>
<td>Isodiametric - polygonal cells</td>
<td>Straight</td>
<td>Smooth</td>
<td>Thick</td>
<td>Raised</td>
<td>Reticulat e</td>
<td>Thick</td>
<td>Concave</td>
<td></td>
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<tr>
<td><em>B.oleracea var. botrytis</em></td>
<td>Shallow reticulat e</td>
<td>Polygonal cells</td>
<td>Straight-undulat e</td>
<td>Striate</td>
<td>Thin</td>
<td>Shallow</td>
<td>Reticulat e</td>
<td>Thick</td>
<td>Flat-concave</td>
<td></td>
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</tr>
<tr>
<td><em>B.oleracea var. capitata</em></td>
<td>Reticulate -foveate</td>
<td>Undulat e</td>
<td>Pitted</td>
<td>Thick</td>
<td>Raised</td>
<td>Reticulat e</td>
<td>Thick</td>
<td>Concave</td>
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<tr>
<td><em>B.oleracea var.gongyloides</em></td>
<td>Shallow reticulat e</td>
<td>Tetragonal cells</td>
<td>Straight</td>
<td>Smooth</td>
<td>Thin</td>
<td>Raised</td>
<td>Smooth</td>
<td>Thin</td>
<td>Flat-concave</td>
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</tbody>
</table>

**antical wall texture**
The current study clarified the texture of the antical wall and it was in the following forms:
1. Smooth in *B. deflexa*, *B. tournifortii*, and *B.oleracea var. gongyloides*.
2. Striate in *B. juncea* and *B.oleracea var. botrytis*.
4. Pitted in *B. nigra* and *B.oleracea var. capitata*.
5. Folded in *B. campestris*.

**antical wall thickness**
The present study showed the thickness of the antical wall and it was in the following in two forms:
1. Thick antical wall in *B. campestris*, *B. nigra*, *B. rapa*, and *B.tournifortii* and *B.oleracea var. capitata*.
2. Thin antical wall in *B. deflexa*, *B. juncea*, *B.oleracea var. botrytis*, and *B.oleracea var. gongyloides*.
Table 1. seed coat micromorphology in some species of genus *Brassica* L.
anticlinal wall Level
This research showed two levels of the anticlinal wall as shallow in all species except in species B.nigra, B.rapa, B.tournifortii, Boleraceae var. capitata, and Boleraceae var. gongyloides were raised as table 1 figure 1.

periclinal wall
periclinal wall thickness
The research showed periclinal wall thickness as thick in all species except B.campestris, B.deflexa, B.juncea, and Boleraceae var. gongyloides show thin of the periclinal wall, as Table 1 figure 1.

periclinal wall level
This study showed periclinal wall level in species of genus Brassica in three types: 1.straite in B.campestris. 2.smooth in B.deflexa, B.juncea, and Boleraceae var. gongyloides. 3.retilcuar in B.nigra, B.rapa, and B.tournifortii, Boleraceae var. botrytis and Boleraceae var. capitata, as Table 1 figure 1.

DISCUSSION
The genus Brassica contains species very similar in more morphological characters [11], and it is difficult to identify them except using the fruits and seeds. In the present study showed clear differences between species belonging to genus Brassica L. by used seed coat pattern and outer epidermal cell shape. This study used important characters for differentiation between all species for identification by use (SEM), several studies in the Brassicaceae on the seed coat and its taxonomic significance [12], studied the seed coat of Brassica in Iraq by using a light microscope (LM) but the studies about the seeds of the genus Brassica by SEM are rarely [13].

The seed coat sculpture has been used to solve phylogenetic and systematic problems between species and tribes [14] seed coat structure is considered to be stable characters[15] and not affected by environmental conditions [16] because the periods of flowering and fruiting very limit [17], [18].

Conclusion
The seed coat sculpture is a very important character that can be used for identification and differentiates between all species and varieties belong to the Brassica genus, most seed coat were reticulate, undulate and rugose, anticlinal and periclinal wall characters are very
important characters that can be used for differences between species.

REFERENCES