

Auto-taxonomy of *Brassica nigra* (L.) Koch (Brassicaceae) in Egypt

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BRASSICA L. is one of the most economically important genera within family Brassicaceae, it includes approximately 80 species worldwide. In Egypt, the genus represented by five species. Among them, *Brassica nigra* (L.) Koch, which grown as a weed in field crops as well as roadsides of Mediterranean region. The field and herbarium observations reflected the notable morphological diversity within the species populations. Accordingly, morphological and palynological studies for the different geographical populations of *Brassica nigra* were carried out to trace the species diversity and helps for identification the infra-species taxa. The taxonomic revision of the species in Egypt, was carried out on the herbarium specimens as well as fresh materials represented by 26 populations, distributed along the Nile Valley and the Nile Delta. The results revealed the presence of two varieties namely var. *bracteolata* and var. *nigra*. The fruit peak and trichomes are the differential characters delimiting the two varieties. Moreover, the results showed also presence of var. *nigra* in two different biotypes. SEM of the seed coat and pollen grains showed the presence of notable infra-specific diversity. For pollen grains, the size, apertures and exine ornamentation confirming this diversity. Photographs and taxonomic key for varieties and forms will be addressed.

Keywords: Biotypes, *Brassica*, Egyptian Flora, Forms, var. *bracteolata*, var. *nigra*, SEM, Pollen grains.

Introduction

Brassicaceae (Cruciferae) is a monophyletic group, which currently includes approximately 3709 species and 338 genera (Al-Shehbaz et al., 2006). It is one of the most agronomical important plant families, it includes vegetables, ornamental and crop species (Kasem et al., 2011). Nearly all members of this family are Mediterranean, Irano-Turanian and Saharo-Sindian zones except Antarctica region (Hedge, 1976 and Lysak & Koch, 2011). Genus Brassicaceae is one of the most agriculturally important genera of Brassicaceae family, it includes about 80 accepted species worldwide, with high morphological diversity and wide-ranging utility (Song et al., 1988 and The Plant List, 2013).

In Egypt, Brassicaceae is one of the four largest families, represented by about 103 species and 53 genera (Boulos, 1999). It showed the presence of high degree of phenotypic variations

with and within populations. Taxonomic structure of the whole family is characterized by a large number of monotypic and small genera, mostly with clearly defined taxonomic limits. Due to its great economic importance, crops of *Brassica* received the attention of taxonomists from the earliest times (Warwick, 2011). Genus *Brassica* represented in Egypt by five species, namely: *B. rapa* L., *B. tournefortii* Goauan, *B. deserti* Danin & Hedge, *B. nigra* (L.) Koch and *B. juncea* (L.) Czernj. & Coss.

Brassica nigra is an annual herbaceous plant that originated in the Middle East, its seed has long been used in central and southern Europe, North Africa and Asia for cooking oil and medicine (Tsunoda, 1980 and Vaughan, 1977). Now it is widely cultivated as a primary source of the mustard seeds used in making the condiment sauce, table mustard, and others. *Brassica nigra* is known to exhibit considerable morphological variations: It has been divided taxonomically into

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DOI: 10.21608/ejbo.2019.6375.1254

Edited by: Prof. Dr. Fawzy M. Salama, Faculty of Science, Assiut University, Assiut, Egypt.

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varieties. The morphological diversity of *B. nigra* in Egypt still unresolved issue where, Täckholm (1974) reported the occurrence of three varieties belonging to *B. nigra*, namely *v. brcteolata* (Fisch. & Mey.) Spach, *v. torulosa* Alef. and *v. turgida* Alef. Later, Boulos (1999, 2009) considered these varieties as synonyms to *B. nigra* (L.) Koch.

Although pollen morphology is useful in the separation of closely related genera within angiosperm families (Rollins, 1979 and Al-Shehbaz, 1989), most members of Brassicaceae are considered to be stenopalynous with a uniform pollen shape (Al-Shehbaz et al., 2006 and Erdtman, 1972). However, numerous studies (e.g. Erdtman, 1972; Jonsell, 1979; Rollins & Banerjee, 1979; Lahham & Al-Eisawi, 1987 and Anchev & Deneva, 1997) have demonstrated that pollen characters were useful for assessing phenetic relationships and resolving taxonomic problems within different taxa of Brassicaceae.

Seed coat ultrastructural pattern using SEM are very significant for assessing phenotypic relationships and resolving taxonomic problems (Kasem et al., 2011 and Heywood, 1971). The importance of seed coat sculpturing in discrimination and identification of Brassica was performed by numerous taxonomists (among them: Musil, 1948; Berggren, 1962; Mulligan & Bailey, 1976; Stork et al., 1980; Buth & Roshan, 1983; Fayed & El Naggar, 1988; Setia et al., 1989; Ren & Bewley, 1998; Koul et al., 2000 and Kasem et al., 2011).

However, little is known about the extent and distribution of genetic variation in *B. nigra* in Egypt. *Brassica nigra* is reported to have little morphological variation compared with the major *Brassica* crops (Prakash & Hinata, 1980).

Therefore, in this study we aimed to study the morphological and palynological and seed sculpture traits of different populations of *Brassica nigra* representing its geographic range in Egypt to provide detailed information about the species diversity and for identification of the infra-species taxa (species auto-taxonomy).

Materials and Methods

Morphological data of *Brassica nigra* were achieved by examination of fresh specimens belonging to 26 populations collected from

different geographical regions during flowering and fruiting seasons. Localities of the sampled populations are given in Table 1 and mapped in Fig. 1. However, the floras mentioned that the species traced in Mediterranean region (Boulos 2009), the last specimens deposited in Cairo University Herbarium dated back to 1964 and no specimens were traced in the field trips.

Fresh samples were collected and directly fixed in FAA fixative (50ml ethyl alcohol, 10ml formaldehyde, 5ml glacial acetic acid, and 35ml distilled water) and voucher samples were dried and deposited in herbaria of both of Assiut (ASTU) and Minya Universities.

All the distribution localities were studied for morphological diversity using different morphological criteria of stem, leaves, inflorescence and fruit characters (Table 2). Stem, leaves and fruits were examined and photographed by Olympus SZ61 stereomicroscope provided with a digital Olympus camera SC100.

Sample preparation for SEM

For pollen SEM study, representative population from each variety and biotype was chosen. Fresh anthers were collected from floral buds and photographed by Scanning Electron Microscope (SEM) using Joel 1200 EXIISEMat 20KV. Measurements of size, polar axis, equatorial axis and colpus length and width were recorded in Table 3.

For seed sculpture, representative clean, full ripened seeds were selected in triplicate and fixed on aluminium stub using double stick adhesive and then coated and photographed using Joel 1200 EX II SEM at 20KV. The terminology of Punt et al. (1994) and Koul et al. (2000) are used for describing the pollen morphological characters as well as seed coat sculpturing, respectively.

Results

Species morphology

Brassica nigra (L.) Koch, is annual herb 0.4–1.5 (2)m, glabrous to sparingly hispid with stiff hairs. Stem erect branched from upper and lower parts. The radicle leaves lyrate- pinnatisect (in different forms), up to 75cm long, petiolate serrate–double serrate margin. Cauline leaves ovate with 18–20×2.0–2.5cm and serrate margin. Inflorescence richly branched. Flowers, with yellow, claw-shaped

petals and 6 stamens (tetradynamous). Fruit siliqua up to 40mm length, its peak ranges from 1/4 to 1/2 of the fruit length. Seeds numerous, globose, dark brown, 0.2mm in diameter.

Infra-specific diversity

Based on macromorphological traits

The present study carried out on 26 *Brassica nigra* populations in addition to the herbarium specimens deposited in Cairo, Assiut and Minya herbaria. 50 morphological traits are used to reveal the infra specific diversity in the studied populations grouped these populations under two varieties.

The radical leaves showed clear variations in size (up to 75cm in var. *nigra* and up to 50cm in var. *bracteolata*) as shown in Table 2. The leaf at the species level is lyrate, with pinnatisect lobes (Fig. 2). Terminal lobe in var. *bracteolata* is broad ovate with clear basal collar lobes not-reached

to the midrib (Fig. 2 C), where this basal collar lobes reach to the midrib in var. *nigra* (Fig. 2 A and B). Moreover, var. *nigra* showed triangular terminal lobe in form 1 and elliptical in form 2, the both forms provided with irregular serrate-dentate margin, while var. *bracteolata* showed clear dentate margin.

The siliqua fruit ranges from up to 35mm in var. *nigra* to up to 40mm in var. *bracteolata* (Table 2). The later also distinguished by its longer fruit peak which extended to half of the fruit length.

The taxonomic study of the studied *Brassica nigra* populations using 50 morphological characters outlined in Table 2 showed the presence of high degree of phenotypic variations among the studied 26 populations and revealed the presences of distinct three infraspecific taxa namely var. *bracteolata*, var. *nigra* form 1 and var. *nigra* form 2.

TABLE 1. The phyto-geographical locations of the studied *Brassica nigra* populations.

St. No.	Localities	GPS coordinates		Associated field
		N	E	
11	Dirout – Assuit	27° 34' 3.348"	30° 48' 7.085"	Alfalfa
12	South to Qousia – Assuit	27° 27' 21.438"	30° 49' 24.584"	Wheat
13	Bani Zeid , Qousia – Assuit	27° 24' 22.361"	30° 52' 10.707"	Alfalfa
14	Bani Rafea , Manflout – Assuit	27° 21' 32.429"	30° 54' 59.543"	Alfalfa
15	Abo teeg – Assuit	27° 9' 25.341"	31° 12' 40.289"	Alfalfa
16	5 Km to Assuit	27° 4' 20.880"	31° 15' 10.959"	Alfalfa
17	El Mouteaa – Sohag	27° 2' 35.92"	31° 17' 45.25"	Alfalfa
18	Sedfa – Sohag	27° 0' 19.712"	31° 20' 26.911"	Cabbage
19	Tma – Sohag	26° 53' 41.863"	31° 26' 33.989"	Wheat
20	Shatora – Sohag	26° 49' 11.029"	31° 30' 9.114"	Alfalfa
21	Tehta – Sohag	26° 46' 32.078"	31° 31' 3.658"	Wheat
22	Banawit – Sohag	26° 44' 8.908"	31° 33' 7.876"	Wheat
23	El Maragha – Sohag	26° 41' 4.925"	31° 36' 44.159"	Wheat
1	5 Km to Samalot - Minya	28° 17' 35.856"	30° 42' 55.315"	Alfalfa
2	Samalot – Minya	28° 19' 40.130"	30° 42' 9.552"	Alfalfa
3	Matai – Minya	28° 23' 58.125"	30° 46' 14.230"	Lentil
4	El Gharabawi – Minya	28° 30' 57.945"	30° 47' 31.618"	Alfalfa
5	Dahrout – Minya	28° 36' 14.588"	30° 48' 46.146"	Alfalfa
6	Maghagha – Minya	28° 37' 38.189"	30° 49' 8.758"	Alfalfa
7	El Howslia – Minya	28° 1' 48.513"	30° 48' 1.002"	Wheat
8	Abo Qorkas – Minya	27° 52' 3.226"	30° 48' 0.528"	Wheat
9	Malawy – Minya	27° 46' 55.051"	30° 50' 28.675"	Wheat
10	Dermawas – Minya	27° 37' 12.988"	30° 50' 40.104"	Wheat
24	Beni Suef	29° 04' 22.45"	31° 05' 27.33	Wheat
25	El Giza	30° 18' 33.14	31° 10' 91.44	Wheat
26	Ashmoon – al-Minufiyah	30° 12' 39"	30° 57' 23"	Wheat

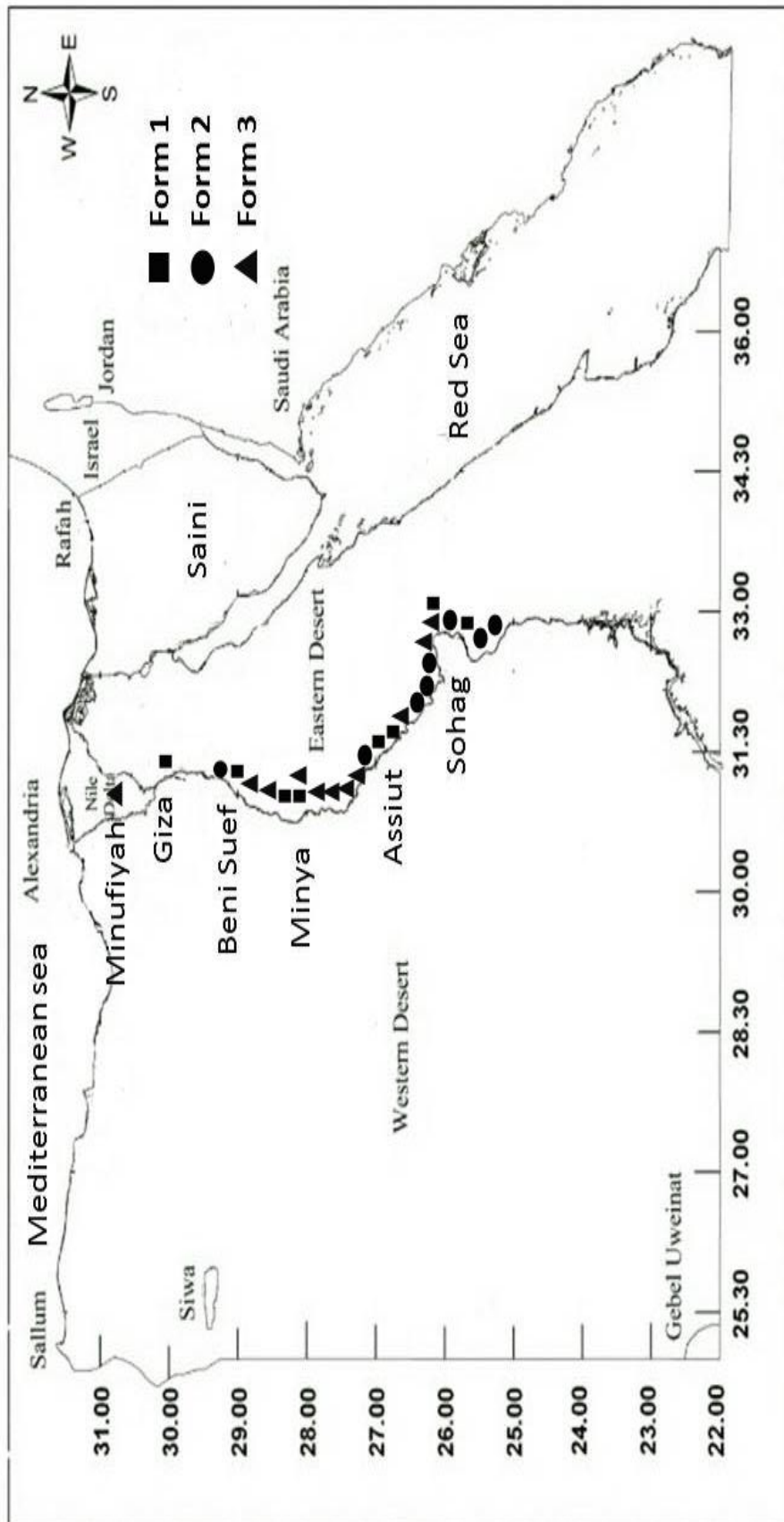


Fig. 1. Distribution map of *Brassica nigra* in Egypt.

TABLE 2. Morphological features of the studied *Brassica nigra* taxa.

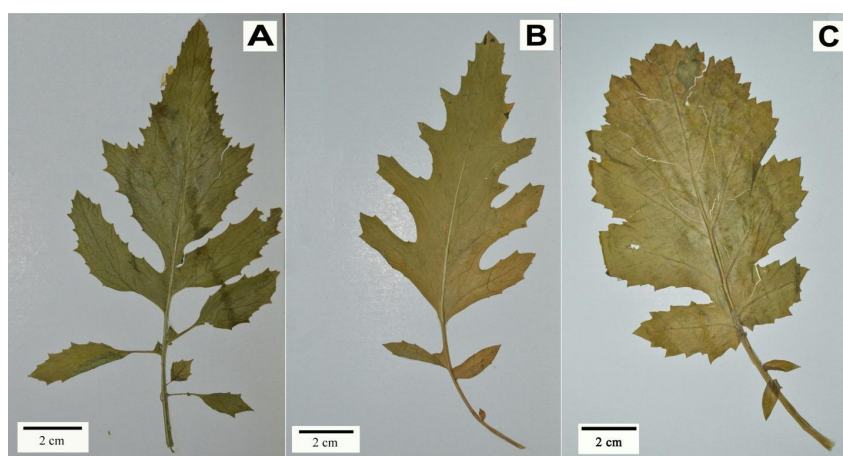
Characters	var. <i>nigra</i> form 1	var. <i>nigra</i> form 2	var. <i>bracteolata</i>
Basal (radical) leaf:			
1-Hairs	Hairy all over	Midrib only	Glabrous
2-Shape	Pinnatisect	Pinnatisect	Pinnatisect
3-Margin	Irregularly serrate-dentate	Irregularly serrate-dentate	Irregularly dentate
4-Petiole	Petiolate	Petiolate	Petiolate
5-Length	Up to 75cm	Up to 30cm	Up to 50cm
6-Shape	Oblong ovate	Oblong ovate	Oblong ovate
7-Stomata	Kidney shape stomata	Kidney shape stomata	Kidney shape stomata
8-Apex	Acute	Acute	Obtuse
9-Segmentation	3–7 lobes	2–5 lobes	2–6 lobes
10-Width of the upper lobe	1.5–5cm	2–5cm	1.5–4cm
Upper (cauline) Leaf:			
11-Margin	Serrate denticulate	Denticulate	Denticulate
12-Petiole	Petiolate	Petiolate	Petiolate
13-Segmentation	1–4 lobes	1–2 lobes	1–3 lobes
14-Upper lobe: L × Wcm	Up to 2.5×20	Up to 1.5×15	Up to 2×18
15-Shape	Ovate	Ovate	Ovate
16-Apex	Acute	Acute	Acute
Flower:			
Sepals:			
17-(L×W)mm	4-7×0.5-1.5	5-6×1-1.5	4-6×0.5-1.5
18-Shape	Linear	Linear	Linear
19-Surface	Glabrous	Glabrous	Glabrous
20-No. of main veins	3	3	3
21-Apex	Obtuse	Obtuse	Acute
22-Margin	Entire	Entire	Entire
Petals: (divided into claw and blade)			
23-(L×W)mm	9-14×3-5.5 L of claw 3-5 L of blade 6-9	9-12×4-6 L of claw 3-5 L of blade 6-9	9-11×4-6 L of claw 3-5 L of blade 5-7
24-Shape of claw	Filiform	Filiform	Filiform
25-Surface	Glabrous	Glabrous	Glabrous
26-No. of main veins	5-7	5-9	5-9
27-Apex	Obtuse	Obtuse	Obtuse
28-Margin	Entire	Entire	Entire
Stamens: 6 (2+4)			
Filaments:			
29-L×Wmm	5-7×0.3-0.5	4-7×0.3-0.5	5-7×0.2-0.5
30-Shape	Linear	Linear	Linear
31-Surface	Glabrous	Glabrous	Glabrous
Anthers:			
32-L×Wmm	1.5-3×0.5-1	1.5-3×0.5-1	1.5-2×0.5
33-Shape	Oblong	Oblong	Oblong
34-Base of attachment	Normal	Normal	Normal
35-Apex	Obtuse	Obtuse	Obtuse
36- Stigma	Capitate bi-lobed	Capitate bi-lobed	Capitate bi-lobed

TABLE 2. Cont.

Characters	var. <i>nigra</i> form 1	var. <i>nigra</i> form 2	var. <i>bracteolata</i>
<u>Pedicle:</u>			
37-Length	Up to 10mm	Up to 7mm	Up to 15mm
<u>Flower bract:</u>			
38-Hairs	Hairy	Glabrous	Glabrous
39-Venation	Pinnate reticulate	Pinnate reticulate	Pinnate reticulate
40-Margin	Dentate	Dentate	Almost entire
41-Apex	Acute	Acute	Acute
42-Shape	Ovate	Ovate	Obovate
43-Length	Up to 3.5cm	Up to 3cm	Up to 3cm
<u>Fruit:</u>			
44-Length of the whole fruit	Up to 35mm	Up to 35mm	Up to 40mm
45-Length of the fruiting part	Up to 20mm	Up to 22mm	Up to 35mm
46-Length of peak	Up to 15mm	Up to 15mm	Up to 12mm
47-Ratio (Fp/Flp)	10–25	27-50	(7:1) – (4:1)
48-Number of seeds/ fruit	6-12	8-12	8-20
49-Surface	Glabrous	Glabrous	Glabrous
50-Shape of receptacle	Flat	Flat	Flat

TABLE 3. Pollen features of the studied *B.nigra* taxa, (): mean value.

Characters	var. <i>nigra</i>		var. <i>bracteolata</i>
	Form 1	Form 2	
Pollen Shape	Oblate	Suboblate	Oblate
Pollen aperture	Tricolpate	Tricolpate	Tricolpate
Pollen sculpture	Reticulate	Reticulate	Reticulate
Endexine sculpture	Sparsely-warty	Densely warty	Smooth
Muri-wall	Warty	Sparsely warty	warty
Muri-pattern	Regular-heterobronchate	Regular-heterobronchate	irregular-heterobronchate
Polar Axis (P) μ m	20.50–21.0 (20.75)	25.50–26.20 (25.85)	19.20–20.0 (19.60)
Equatorial Axis (E) μ m	40.50–41.50 (41.0)	30.90–31.70 (31.30)	29.20–30.70 (29.95)
P/E (μ m)	0.506	0.825	0.654
Colpus length (L)	35.70	21.40	26.35

Fig. 2. Radical leaves diversity in *Brassica nigra*, A: var. *nigra* form 1 , B: var. *nigra* form 2 and C: var. *bracteolata* .

The taxonomic differentiation was based on the 50 morphological characters including features of basal leaves, cauline leaves, inflorescence as well as fruit characters, seeds and flower structure (Table 2), claimed the following differential key:

Key

- 1 -Leaves glabrous, fruit peak up to 1/4 fruit length var. *bracteolata*
- Leaves hairy, fruit peak up to 1/2 fruit length(2)

- 2 -Basal leaves up to 30 cm, hairs on all over the surface var. *nigra* form 1
- Basalleaves up to 75cm, hairs found only on mid ribs of leaf lower surface..... var. *nigra* form 2

Based on micromorphological traits using SEM

Stem

Scanning of the stem epidermal system in the studied *B. nigra* represented in Fig. 3. This figure reflecting a clear striate epidermal sculpture in var. *nigra* (Fig. 3 A and B) and incontinuous ridges in var. *bracteolata* (Fig. 3 C), the later also characterized by high density of verrucate cuticular deposits of varying –size, where it appears uniform and sparse in var. *nigra* as outlined in Fig. 3 A.

Leaf

The scanning of the leaf upper surface outlined in Fig. 4, confirming the distinctive differential micromorphological characters. Among them the presence of abundant stomata on the same level in

epidermal cells in var. *nigra* form 1 (Fig. 4 A) and it appeared on raised ridges in var. *nigra* form 2 (Fig. 4 B). On the other hand, stomata in case of var. *bracteolata* appeared sparse and in lower level than epidermal cells. Moreover, var. *bracteolata*, this variety characterized by abundant verrucate–shaped cuticular deposits, which appeared sparse in var. *nigra* (Fig. 4 C).

Seed coat

The micromorphological features of the seed coat of the studied *B. nigra* populations as seen by SEM showed common reticulate seed coat pattern (Fig. 5). Notable infra-specific variations noticed in the periclinal wall; as it appears elevated wavy and folded in var. *nigra* form 1, elevated and straight in form 2, while it is grooved in var. *bracteolata* (Figs. 5 A, B & C). The anticlinal surface is straight with faint papillae in form 1, straight, striate in form 2 and papillate in var. *bracteolata* (Fig. 5 A, B & C).

Pollen grains

The SEM of the studied *Brassica* taxa showed that the pollen grains are radially symmetric, isopolar, with oblate-suboblate shapes. Apertures are tricolpate with syncolpi in both form 1 and 2 while in var. *bracteolata* the pollens have narrow apocolpi. Evine surface is widely reticulate in forms 1 and 2, while it is narrowly reticulate in var. *bracteolate* (Fig. 6 A, B & C). The measurements and descriptions based on 30 pollen samples are summarized in Table 3.

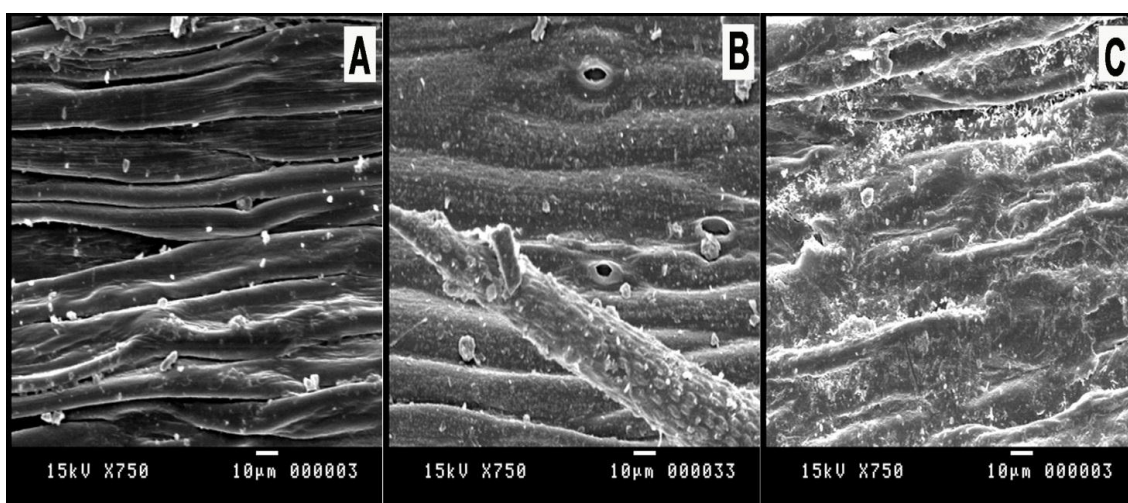


Fig. 3. Stem sculpture in *Brassica nigra*; A, B: var. *nigra* (A: form 1 and B: form 2) and C: var. *bracteolata*.

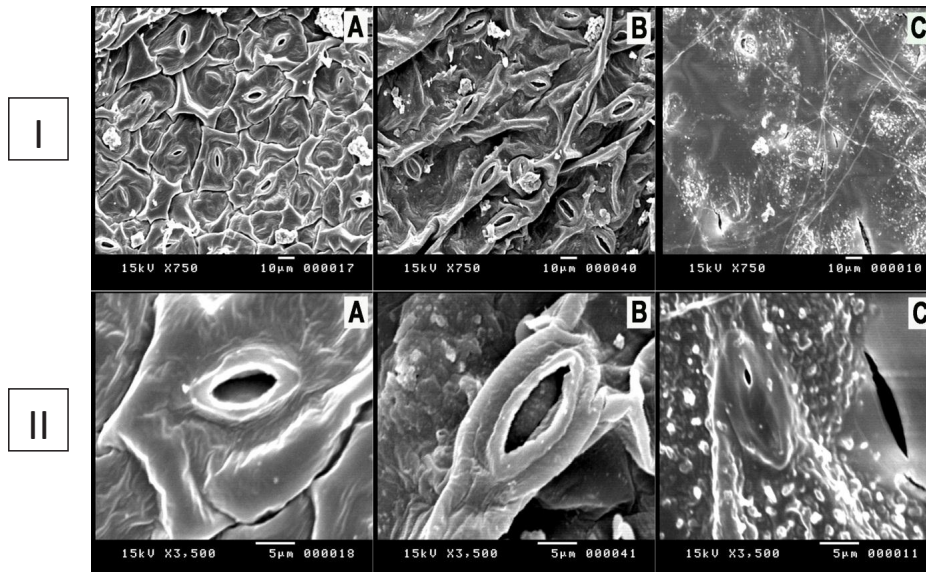


Fig. 4. Leaf surface sculpture of *B. nigra* using SEM; I- Stomata pattern, II- Magnified part. A and B: var. *nigra* with notable stomata and sparse cuticular deposits (A: form 1 and B: form 2) and C: var. *bracteolata*, with sparse stomata and dense cuticular deposits.

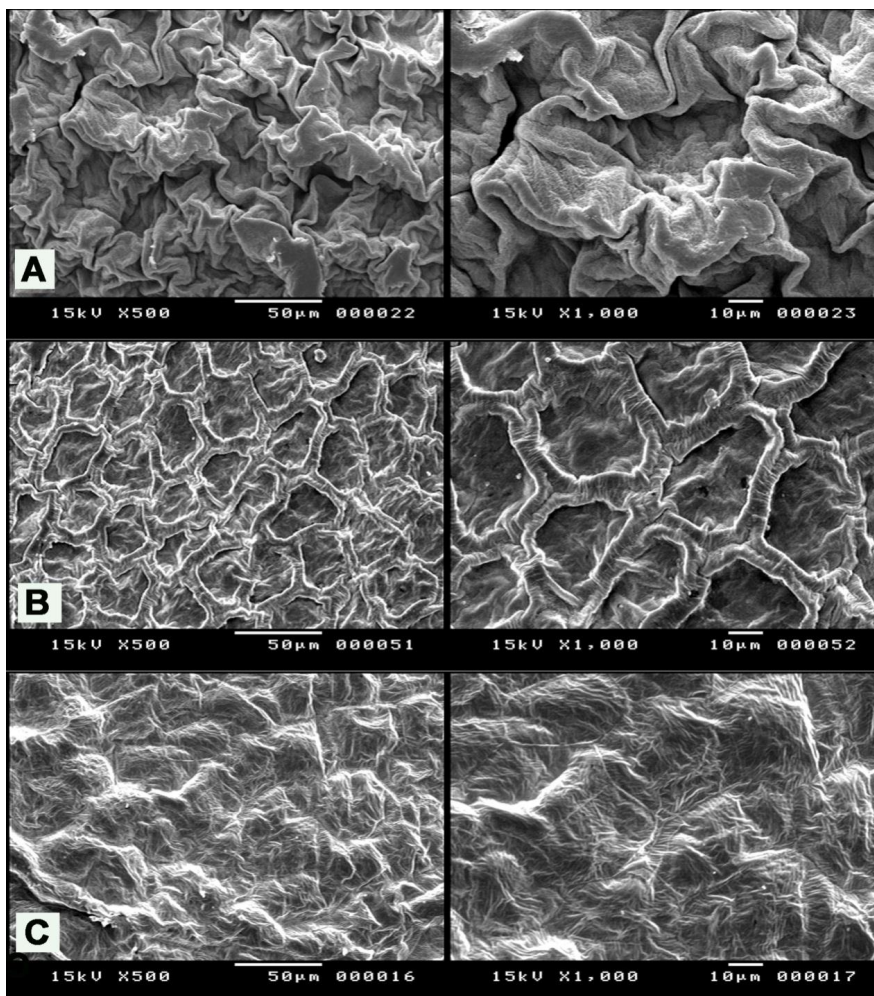


Fig. 5. Seed coat sculpture of *B. nigra* A & B: var. *nigra* (A: form 1, with elevated wavy-folded periclinal walls & B: form 2, with elevated-straight periclinal walls) and C: var. *bracteolata*, with grooved periclinal walls.

Size: The pollen grain diameter of the studied *B. nigra* taxa ranges from 29.95–41µm (Table 3), var. *bracteolata* is the smallest (P×E: 19.6 × 29.95), as showed in Table 3 and Fig. 6 C.

Shape: The pollen according to P/E ratio (Table 3), distinguished two types oblate shape (P/E: 0.5-0.75) in var. *bracteolata* and var. *nigra* form 1. While form 2 is suboblate (P/E: 0.76–0.88).

Pollen apertures: Tricolpate pollen in *B. nigra* with shortest colpus (21.40µm) in var. *nigra* form 2 and the largest (35.70µm) in var. *nigra* form 1, while var. *bracteolata* was intermediate in colpus length (Fig. 6).

Exine sculpture: It is reticular, with regular heterobronchate muri-pattern in var. *nigra* (Fig. 6 A & B), to irregular heterobronchate in var. *bracteolata* (Fig. 6 C). While, the endexine sculpture appeared warty in var. *nigra* and being smooth in var. *bracteolata* (Fig. 6).

Discussion

The taxonomic identity of the *B. nigra* (L.) Koch at the infraspecific level was subjected to debates long time ago since 1966 (Zohary & Feinbrun-Dothan, 1966), who classified *B. nigra* (L.) Koch into two varieties var. *bracteolata* (Fisch. & Mey.) Spach ex cross. and var. *nigra*, based mainly on the presence of epidermal trichomes and the length of

fruit peak.

In flora of Egypt, Täckholm (1974) mentioned the presence of *B. nigra* in three varieties namely var. *bracteolata* (Fisch. & Mey.) Spach ex Cross., var. *torulosa* (Pers.) Alef. and var. *turgida*(Pers.) Alef. Later, all these infra-specific taxa were grouped as synonyms for *B. nigra* species by Bolous (1999 and 2009). Worldwide, the “Plant list” and the “IUCN Red List” (Korpelainen et al., 2011), also grouped all the infra-specific taxa as synonyms to the species.

In Egypt, the earlier works were at the flora and not in taxonomic levels, and no detailed taxonomic study was carried out at the infra-specific level, in addition to the notable morphological diversity observed during field trips and herbarium specimens, which enhance authors to carry the species auto-taxonomy. The study based on 50 macro-morphological characters (Table 2), revealed the presence of two distinctive varieties, var. *bracteolata* with glabrous plant surface and fruit peak not exceeding the quarter of the fruit length and var. *nigra* with trichomes and fruit peak extended to half of the whole fruit, in addition to the rest of the 50 characters outlined in Table 2 and Fig. 2, which outlined the notable variation in the terminal lobe of the basal leaf between the two varieties. This achieved classification is supported by the earlier grouping by Zohary & Feinbrun-Dothan (1966).

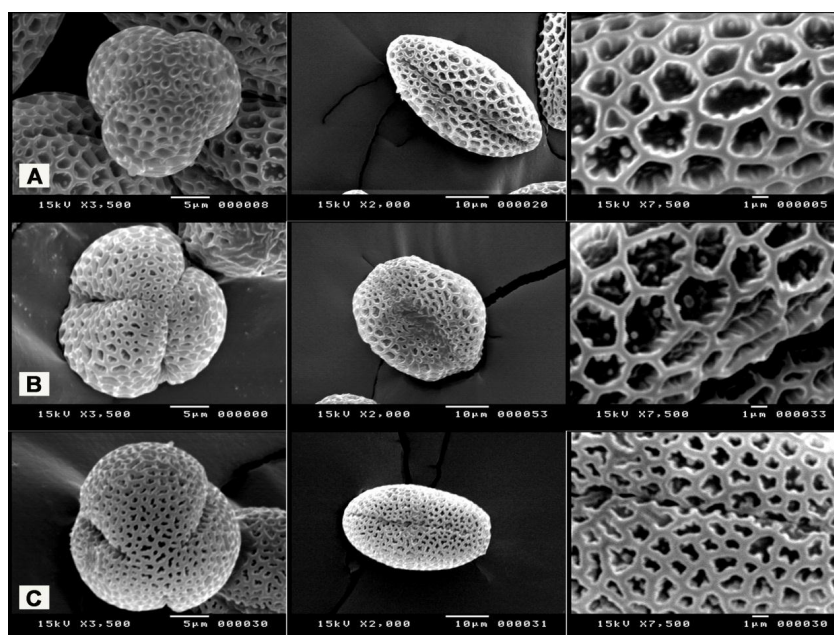


Fig. 6. Pollen grains with reticulate-heterobronchate sculpture of the studied *B. nigra* (A & B: var. *nigra* with wide, regular muri-pattern and C: var. *bracteolata*, with narrow irregular muri-pattern).

The identified varieties (var. *nigra* and var. *bracteolata*) showing no distinctive geographical distribution (Fig. 1 and Table 1) for each variety, both are co-distributed sometimes in mixed populations along the cultivated area in Nile Delta and Nile valley, this is an evidence for the absence of the environmental influence in the varieties distribution within the Egyptian borders.

The retrieved micromorphological traits using SEM on stem (Fig. 3) and leaf (Fig. 4) showed distinctive differences between the studies 26 *B. nigra* populations, confirming grouping of them into two varieties. However, this grouping is not supported earlier by Boulos (1999 and 2009) and Korpelainen et al. (2011), works in which these varieties treated as synonyms to *B. nigra*.

The data retrieved from seed coat (Fig. 4), confirming our grouping of *B. nigra* into two varieties, and the observed variations supported the potential use of seed coat pattern as a parameter for grouping to variety level. The underspecific variations in seed coat was supported by Song et al. (1988), Delseny et al. (1990), Prakash & Hinata (1980) and Koul et al. (2000), who reported a wide range of morphotypes in diploid Brassicaceae species, in which, *Brassica nigra* among them.

The pollen grains of *B. nigra* possess reticulate, tricolpate type (Fig. 6), this reported by Abdel Khalek et al. (2002). The observed pattern regular heterobronchate in var. *nigra* and irregular heterobronchate in var. *bracteolata*, also the warty endexine in var. *nigra* compared to the smooth one in var. *bracteolata* (Table 3 and Fig. 6). These variations can give a phylogenetic point of view that *B. nigra* is more primitive than *B. bracteolata*. This phylogenetic opinion can be supported by the syncolpate aperture in the former versus the noticeable apocolpi in the later. The seed coat characters and the macromorphological characters of both stem and leaves confirming the presence of two distinct varieties for *B. nigra* in Egypt. The high taxonomic significance of pollen morphology at the infra-specific level was confirmed earlier by Amer & Abdo (2014).

Conclusion

Finally, we conclude that the autotaxonomy of *B. nigra* in Egypt based on the macro- and micro-morphological characters confirming the presence of two distinctive varieties var. *nigra* and var.

bracteolata with a trend in phylogeny within them and these two varieties should adopted taxonomically.

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(Received 25/11/2018;
accepted 26/2 /2019)

التصنيف الذاتي للمستردة السودان (الفصيلة الصليبية) في مصر

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جنس المستردة هو أحد أهم الأجناس الاقتصادية في الفصيلة الصليبية، ويحتوي علي ما يقرب من 80 نوع علي مستوى العالم. والمستردة السودان هو أحد هذه الأنواع وينمو برياً في حقول المحاصيل والطرق في منطقة المتوسط. وقد أثبتت الملاحظات الحقلية والمعشبية لتجمعات المستردة السودان تنوع ملحوظ في الشكل الظاهري. ومن هنا كان لزاماً إجراء دراسة تشمل الشكل الظاهري وحبوب اللقاح لتجمعات المختلفة بالمناطق الجغرافية المختلفة لهذا النوع للتعرف علي الوضع التصنيفي للوحدات تحت هذا النوع.

وقد شملت الدراسة العينات المعشبية و 26 تجمع للنبات موزعة علي طول وادي النيل والدلتا. وأثبتت الدراسة وجود صنفان الأول بركتيولاتا والثاني نجرا. وقد ميزهما صفات الثمرة والشعيرات. كما أوضحت المراجعة وجود صنف النجرا في نوعين بيولوجيين (بيوتيب).

كما أثبت المسح السطحي لقصرة البذرة بالميكروسكوب الماسح الإلكتروني (SEM) وكذلك حبوب اللقاح أن نوع المستردة السودان يحتوي علي وحدات تصنيفية واضحة تحت النوع وظهر هذا جلياً من خلال حجم وشكل وفتحات الأنبات لحبوب اللقاح. وخلصت هذه الدراسة إلى وضع مفتاح تصنيفي للتمييز بين الأصناف والأشكال البيولوجية لهذا النوع (المستردة السودان).